



A M C S
ACTIVITIES
NEWSLETTER
Number 25 May 2002

A M C S

A C T I V I T I E S

N E W S L E T T E R

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AMCS

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The AMCS Activities Newsletter is published by the Association for Mexican Cave Studies, a Project of the National Speleological Society. The AMCS is an informal, nonprofit group dedicated to the exploration, study, and conservation of the caves of Mexico.

The Activities Newsletter seeks articles and news items on all significant exploration and research activities in the caves of Mexico. The editor may be contacted at the address below or at editor@amcs-pubs.org. Text and graphics may be submitted on paper, or consult the editor for acceptable formats for electronic submission. Exceptional color photographs for the covers are also sought. They need not pertain to articles in the issue, but the original slide or negative must be available for professional scanning.

This issue was edited by Bill Mixon, with help from Maureen Cavanaugh, Ramón Espinasa, Sergio Sanchez-Armass, and Jack "Solo" White.

All previous issues of the Activities Newsletter are available, as are various other publications on the caves of Mexico. Contact sales@amcs-pubs.org, see www.amcs-pubs.org, or write the address below.

ASSOCIATION FOR
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Front cover

Humberto Delgado
among the giant selenite
crystals in the mine at
Naica, Chihuahua.
Photo by Carlos Lazcano.

Back cover

Diving gear inside the
Infiernillo entrance to
Sistema Purificación.
Photo by Bill Stone.



CONTENTS

4	authors' addresses
5	Mexico News
18	long and deep caves lists
20	deep pits list
21	Cerro Rabón 1995–2000 <i>Karlin Meyers</i>
34	Tabasco 2001 <i>Bob Stucklen</i> with a contribution by <i>Jim Pisarowicz</i>
40	The Exploration of Sistema Ox Bel Ha <i>Bil Phillips</i>
47	Where Does the Sewage Go? <i>Patricia Beddows</i>
53	2001 InnerSpace Odyssey Expedition <i>Bev Shade and Bill Stone</i> with contributions by <i>Jason Mallinson and Rick Stanton</i>
72	Cueva de los Cristales <i>Carlos Lazcano Sahagún</i>
78	A New Map of Sac Actun, Quintana Roo <i>Bil Phillips</i>
81	Searching for Caves near El Cielo, Tamaulipas <i>Gerald Moni</i>
95	Recent Field Investigations of Blind <i>Astyanax</i> <i>Jean Krejca</i>
101	The Long Crawl <i>Terri Treacy</i>
104	The Black Hole of Coahuila <i>Peter Sprouse</i>
106	Mixtlancingo: The River of the Underworld <i>Ramón Espinasa-Pereña</i>
114	Grutas de los Ríos San Jeronimo and Chontalcuatlan <i>Chris Lloyd</i>
119	Accident Report: Resumidero La Joya, Guerrero <i>Ramón Espinasa-Pereña</i>
122	Zacatón Update <i>Marcus Gary</i>
124	Cave-Rescue Courses in Mexico <i>Antonio Aguirre Álvarez</i> with a contribution by <i>John Pint</i>
126	The Yucatan Deep Speleological Dive Team <i>Andreas Matthes</i>
130	Some Quintana Roo Diving Adventures <i>Fred Devos and Christophe Le Maillot</i>
135	Proyecto Espeleológico Sierra Oxmolón <i>Jerry Fant</i>
146	Filo de Caballo, Guerrero <i>Ramón Espinasa-Pereña</i>

AUTHORS IN THIS ISSUE

Antonio Aguirre Álvarez
Leon García 735-2
Barrio de San Miguelito
San Luis Potosí, San Luis Potosí 78330
Mexico

Patricia Beddows
Carbonate Processes and Palaeo-
environments Group
University of Bristol
Bristol BS8 1SS
United Kingdom
Patricia.Beddows@bristol.ac.uk

Fred Devos
PO Box 14
Puerto Aventuras, Quintana Roo 77750
Mexico
fred@aqualexploration.com

Ramón Espinasa Pereña
Ingenieros No 29
Col. Escandón
Mexico, D. F. 11800
Mexico
ramone@tonatiuh.igeofcu.unam.mx

Jerry Fant
21 Gold Rush Circle
Wimberly, Texas 78676
jerryfant@worldnet.att.net

Marcus Gary
300 West Mockingbird Lane
Austin, Texas 78745
marcusgary@mail.utexas.edu

Jean Krejca
4806 Savorey Lane
Austin, Texas 78744
creature@mail.utexas.edu

Christophe Le Maillot
PO Box 14
Puerto Aventuras, Quintana Roo 77750
Mexico
chris@DIR-Mexico.com

Chris Lloyd
Teotihuacan 1661
Pinar de la Calma
Zapopan, Jalisco 54080
Mexico
cjllloyd@igu.net.mx

Andreas Matthes
PO Box 397
Playa Del Carmen, Quintana Roo 77710
Mexico
matt@mayatechdiving.co

Karlin Meyers
Neusatzweg 13
Binningen CH-4102
Switzerland
karlin@speleo.ch

Gerald Moni
2330 Rader Ridge Road
Antioch, Tennessee 37013
moni7597@aol.com

Bil Phillips
Speleotech
PO Box 153
Tulúm, Quintana Roo 77780
Mexico

John Pint
johnpint@sps.net.sa

Jim Pizarowicz
343 North 9 Street
Custer, South Dakota 57730
pizarowi@gwtc.net

David Roemer
Carlsbad Caverns National Park
3225 National Parks Highway
Carlsbad, New Mexico 88220
Dave_Roemer@nps.gov

Carlos Lazcano Sahagún
Virginia 2202
Jardines del Santaurio
Chihuahua, Chihuahua 31280
Mexico
carloslazcano@hotmail.com

Bev Shade
8427 Old Lockhart Road
Muldoon, Texas 78949
shad0017@tc.umn.edu

Peter Sprouse
PO Box 8424
Austin, Texas 78713
psprouse@texas.net

Bill Stone
18912 Glendower Road
Gaithersburg, Maryland 20879
william.stone@nist.gov

Bob Stucklen
3349 Chestnut Avenue
Loveland, Colorado 80538
stucklen@att.net

Terri Treacy
2993 Dutch Ridge Road
Carbondale, Illinois 62901
territreacy@yahoo.com

MEXICO NEWS

Compiled by Bill Mixon

CHIHUAHUA

At the end of 2000, the government of the city of Chihuahua opened to the public the famous **Cueva de Nombre de Dios**, close to the city at the edge of the neighborhood with the same name. The cave was well known in the city and frequently visited by small groups. During the development of the cave, it was explored and surveyed. It is almost 2 kilometers long and is 95 meters deep. Now there are two show caves in the state. Five years ago, **Cueva de Coyame**, about 140 kilometers from Chihuahua on the highway to Ojinaga, was opened. There are plans to open **Cueva del Diablo**, near Parral in the southern end of the state. *Source:* Carlos Lazcano.

During the period 1995–2001, Carlos Lazcano made numerous trips to the northern part of the Sierra Tarahumara, mainly to the Madera area. He systematically explored canyons such as those of the Río Chico and the Huapoca, deeper than the Grand Canyon of Arizona, and he located more than a hundred caves with adobe structures from the thousand-year-old, extinct Paquimé culture. Results of the investigations may be published as an AMCS Bulletin. *Source:* Carlos Lazcano.

In August 2000, Carlos Lazcano, Claude Chabert, and Nicky Boullier explored **El Hundido**, a wide drain for a large valley near the mining community of La Perla, about one hundred kilometers from Camargo

on the highway to Ojinaga. The entrance is a little above the actual drain. The collapse that gives the cave its name leads to a wide, descending gallery about 100 meters long, with some stalactites. The floor is mostly breakdown that requires careful movement. Near the end, there's a bat roost full of guano, and at the end there's a large, mud-covered collapse. Between the blocks, they found a pit 5.7 meters deep that passes into a bed of white gypsum, making it very pretty. Below is a short walk to a crawlway about 10 meters long that leads to 20 or 30 meters more of mud-floored passage to a sump. Other caves in the area include **Cueva del Macho**, around 60 meters long, **Cueva de las Indias**, and **Cueva del Puerto**, which has a narrow entrance with a lot of air movement. *Source:* Carlos Lazcano.

COAHUILA

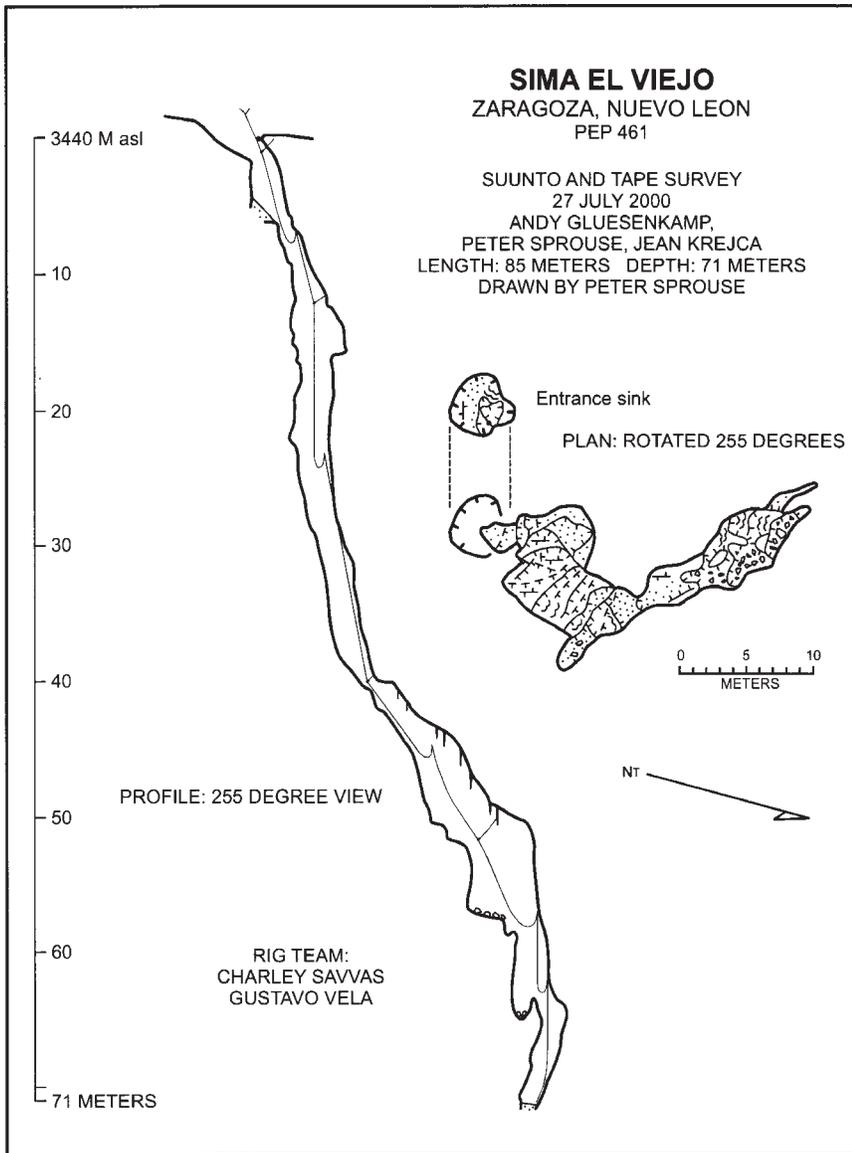
On June 17, 2001, nineteen cavers from Austin and San Antonio, Texas, surveyed **El Abra** to 1764 meters, making it the longest in Coahuila. This cave is located on a large ranch in the Sierra del Burro, in the floor of a large canyon. This was the third survey trip to the cave. The hole in the canyon floor drops into a stream, which was a rushing river that came halfway up the log ladder because of a recent rain. By the next day, the level had dropped, and five survey teams entered the cave. One found an upstream sump after only 50 meters. The rest went downstream to continue mapping in the maze area, where exploration had ended in April. The maze was

fun, and it is complicated enough that you never take the same route through it twice. Every loop had knee-deep flowing water, and one caver had his pack float away while he was reading the instruments. Another team recovered it several hundred meters downstream.

After completing the maze, all five teams leapfrogged down the canyon passage, where the stream tumbled down several short waterfalls. At the point where we stopped, the cave continues, but there is a low airspace that will be better done in drier times. *Source:* Peter Sprouse.

During Thanksgiving weekend 2001, a return was made to **Sótano de Amezcua**. The cave was pushed on two fronts, upstream and downstream. Two dives downstream pushed through approximately 150 meters of underwater passage. Upstream, beyond previously explored sumps 1 and 2 and the 200 meters of boot-sucking mud between them, survey continued through virgin sump 3 to roughly 800 meters of walking borehole. A blind catfish that had been marked in June 1998 was recaptured between sumps 3 and 4. Other recapture data were obtained at the sumps in the main room, and a dozen new fish were marked. Isopods were collected for genetic studies. While the divers were pushing the cave, other cavers found and mapped three other pits in the area. *Source:* Jean Krejca in *Texas Caver*, December 2001.

The Italian cavers of the La Venta Associazione Culturale Esplorazioni



to another sump. A high, overflow passage was found that led to a chamber with two pit leads. Rigging the one with the sound of water at the bottom, we rejoined the stream and followed it past a near-sump to a large passage where a bigger stream came in. The combined waters enter a final sump filled with very active cave-adapted fish (*Rhamdia?*). The incoming stream was followed up to a sump, but lack of time prevented proper investigation of other leads, including the other pit in the overflow passage, which takes some air. Total survey so far is 471 meters. *Source:* Ramón Espinasa.

Mexpeleo 2002 will be held December 26 to 30 in Acahuizotla, Guerrero. It is sponsored by the AMCS and the Sociedad Mexicana de Exploraciones Subterráneas. See site smes_web.tripod.com/mexpeleo2000.html.

MORELOS

According to a Reuters dispatch of June 14, 2001, farmers in Chimalcatlan found large bones while digging in **Cueva Encantada** above the village. They were trying to channel water from a spring as a water source for the village. INAH officials believe the bones are mammoth bones, because a similar find was made in the area twenty years ago.

NUEVO LEÓN

Pozo de Montemayor was explored to a depth of nearly 500 meters in the years around 1990, but the foldout map printed here has not been previously published. Articles on the exploration of Montemayor appear in *AMCS Activities Newsletter* 18, by Bill Steele, and 19, by Joe Ivy.

Five cavers did a surface traverse of Cañón de Infierno, from 1700 meters elevation above Zaragoza, Nuevo León, to 474 meters at Los Angeles, Tamaulipas. They were looking for cave entrances in the upper part of the canyon that might be the resurgence for the **Sistema Cretácico** and other caves in the Cretaceous Park area. During their

Geografiche, the same group that explored caves in and near the Río La Venta canyon in Chiapas (see "Mexico News," *AMCS Activities Newsletter* 23 and the review of their book on the area in number 24), has been exploring in the vicinity of Cuatro Ciénegas. In November 1998 and May 1999 they located and partially explored many caves in the valley and surrounding mountains, with 5 kilometers of passage seen. The project continues, with a narrative on their web site of an expedition in October and November 2001. *Source:* www.laventa.it/en/4C-index.html.

GUERRERO

In the area of Acahuizotla, where Mexpeleo 2002 will be held in late December, a new stream sink, known as **El Garbanzal**, has been explored by cavers of the Sociedad Mexicana Exploraciones Subterráneas. The actual sink produced only 218 meters of survey, with only one lead left, but farther down the valley another doline was checked and found to contain a pit that went straight down to water. Upstream, the water came from a narrow crevice heading toward El Garbanzal. Downstream, the river immediately entered a sump that turned out to be short and easy to pass. On the other side, a sporting passage led

eight days in the canyon, they found four caves, some inaccessible from the canyon floor. One had a 20-meter-diameter entrance and sloped downward for 110 meters to a sump. A high-water mark is obvious at the entrance, and the cave might be the resurgence. *Source:* Jonathan Wilson in *Death Coral Caver* 11, 2001.

Eleven cavers from the United States and Mexico prospected for caves around Cerro el Viejo in July 2000. They found a number of small pits around La Escondida and looked for leads in **Cueva de Más Cable** and **Pozo del Primero de Septiembre**. (The map of Más Cable appears in "Mexico News" in *AMCS Activities Newsletter* 22.) During an ascent of 3500-meter Cerro el Viejo, they discovered 71-meter-deep **Sima el Viejo**. At the end of the trip they looked at a large open-air pit near Pablillo. *Source:* Gustavo Vela Turcott in *Death Coral Caver* 11, 2001.

OAXACA

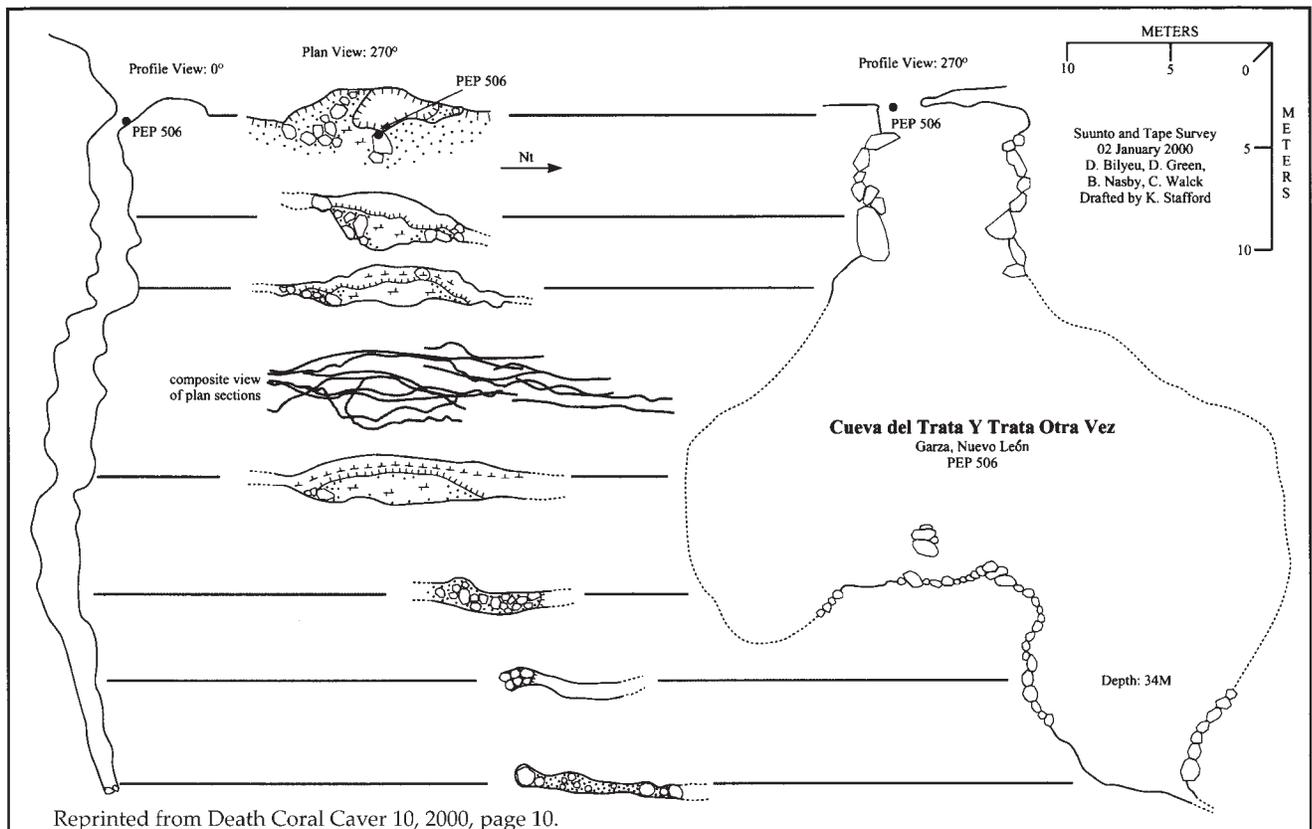
A group of thirteen American cavers, mainly from Colorado, visited the Cerro Rabón in February 2001. The main goal was to explore the largely unexplored southern part of the plateau, dubbed Terra Incognita. From base camp in San Martín Caballero, a remote jungle camp was established in Terra Incognita, where **Cueva de Arañas Negras** was explored and surveyed. Many short, blind pits were found at the northern edge of the area. North from base camp, **Nita Cein**, an 80-meter pit, was found. *Source:* Todd Warren in *NSS News*, April 2002.

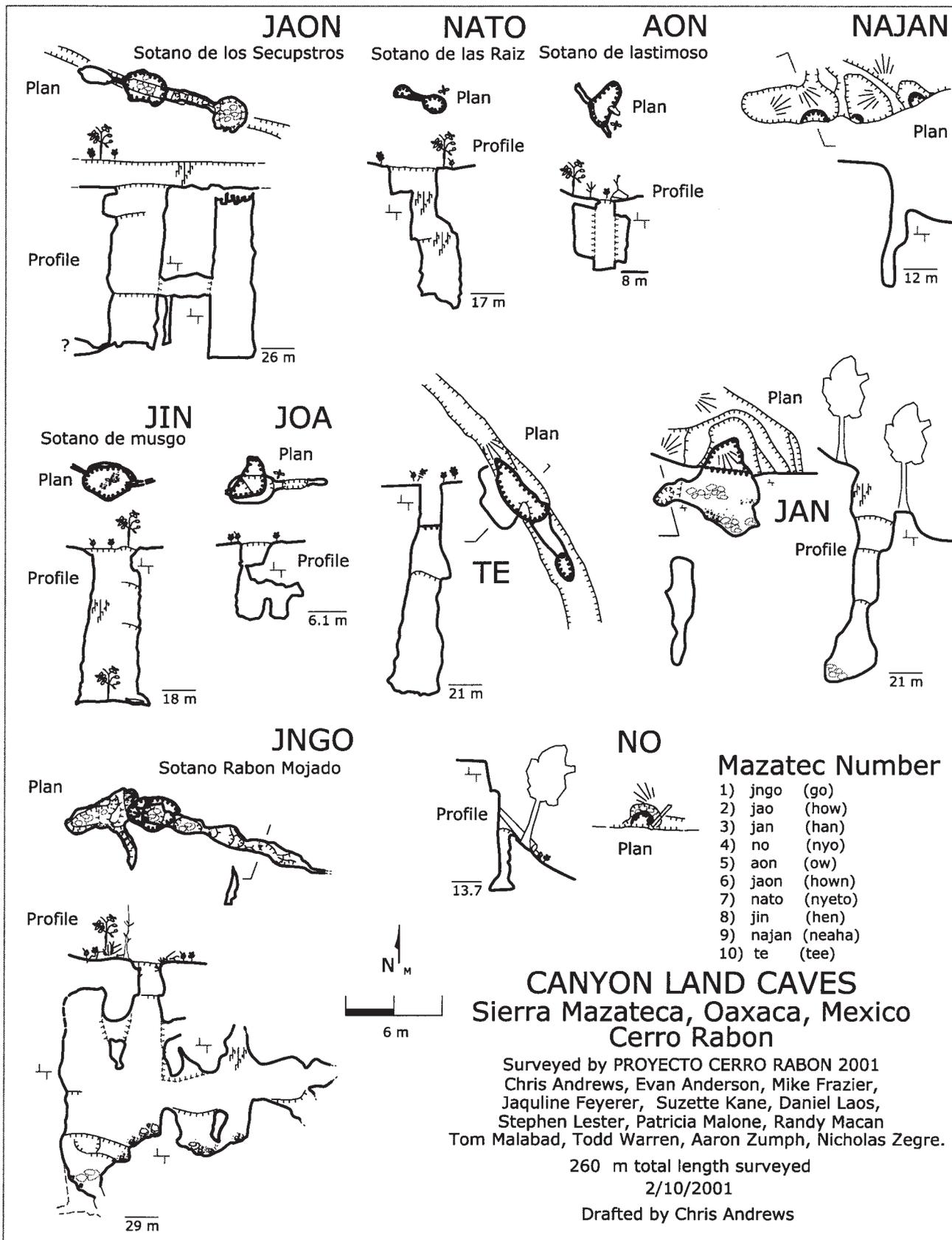
Five cavers from Colorado returned to the Cerro Rabón in February 2002. During very rainy weather, they worked out of Ayautla, since politics were very bad at San Martín Caballero, the usual caver base. Among the caves surveyed were **Ha Goothu**, where a small stream disappears into a boulder pile with a lot of air, and **Ha Amigos**, a large cave with drops of 25,

31, 21, 10, and 41 meters to another drop, about 18 meters, that was not descended because they were out of rope. *Source:* Mike Frazier.

Beyond the Deep: The Deadly Descent in the World's Most Treacherous Cave, by Bill Stone and Barbara am Ende, with, as they say, Monte Paulsen, is scheduled to be published in July 2002 by AOL Time Warner. It is the story of the 1994 San Agustín expedition during which Bill and Barb explored kilometers of new cave beyond the sump at the previous bottom of **Sótano de San Agustín**, Sistema Huautla. It will be interesting to compare this with the article on the expedition by the same two authors that appeared in *AMCS Activities Newsletter* 21.

The **Cueva y Nacimiento Agua Fría de Mazatlán**, the foldout map of which appears here, was explored in 1995 and 1997. See the Río Tuerto Expedition report in *AMCS Activities Newsletter* 22 and, briefly, "Mexico News" in number 23.





CUEVA Y NACIMIENTO AGUA FRÍA DE MAZATLÁN

MUNICIPIO DE MAZATLÁN VILLA DE FLORES

DISTRITO DE TEOTITLÁN FLORES MAGÓN

OAXACA, MÉXICO

EQUIPO DE EXPLORACIÓN
 BARBARA AM ENDE, KIM COCHRANE, BART HOGAN, JASON MALLINSON, BRIAN RENNEX,
 JASON RICHARDS, BEV SHADE, NOEL SLOAN, RICK STANTON, BILL STONE

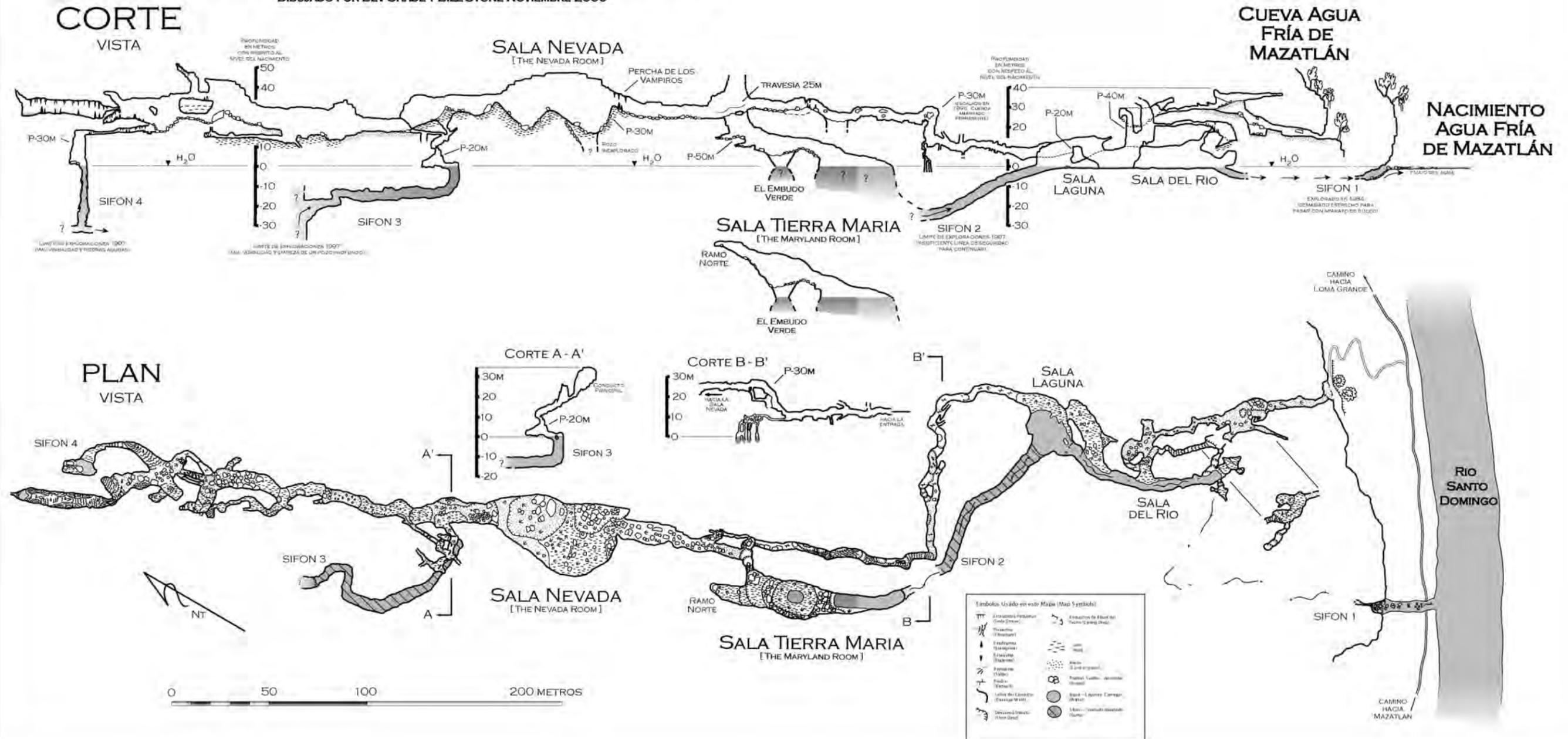
LARGO 1468 METROS, PROFUNDIDAD 70 METROS
 EXPLORACIONES CONDUCTOS MAYO 1995 Y ENERO 1997
 POR EL PROYECTO HUAUTLA Y EL EQUIPO ESTADOUNIDENSE DE EXPLORACIÓN DE CUEVAS PROFUNDAS
 DIBUJADO POR BEV SHADE Y BILL STONE NOVIEMBRE 2000

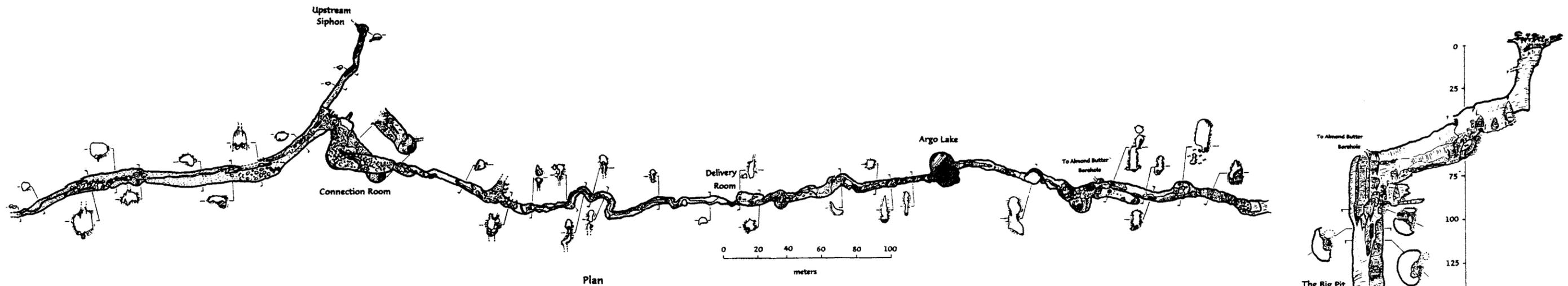
INFORMACION SOBRE LA CUEVA Y EL MAPA:

A ESTA FECHA HAY CUATRO CONDUCTOS INUNDADOS (CONOCIDOS COMO "SIFONES") QUE HAN SIDO EXPLORADOS ADENTRO LA CUEVA AGUA FRÍA DE MAZATLÁN. ESTOS CONDUCTOS LLEVAN EL RIO SUBTERRANEO AL NACIMIENTO. PENSAMOS QUE TODOS SON CONECTADOS PARA FORMAR UN SOLO RIO. PERO, DEBIDO A LOS LIMITES DEL APARATO DE BUCEO, LOS PARTES MOSTRADO EN ESTE MAPA NO REPRESENTAN LOS LIMITES DE LA CUEVA Y SE PRESUME QUE LA CUEVA SIGUE AL NORTE POR MEDIO DEL SIFON 4. TODOS LOS CONDUCTOS EN COLOR AZUL SON FORMADOS BAJO EL AGUA. PARA EXPLORARLOS USAMOS DOS TANQUES DE AIRE COMPRIMIDO, CONTENIENDO 3,000 LITROS DE AIRE EN CADA UNO. PODEMOS EXPLORAR BAJO EL AGUA PARA MAS O MENOS UNA HORA CON ESTE APARATO. EN EL MAPA HAY NOTICIAS CON CADA SIFON EXPLICANDO EL RAZON PORQUE NO PUDIMOS EXTENDER LOS LIMITES DE EXPLORACION EN EL AÑO 1997. TODOS LOS CONDUCTOS QUE CONTIENEN UN SIMBOLO "???" SON INEXPLORADOS Y LA POSIBILIDAD EXISTE QUE LA EXPLORACION PUEDIERA SER CONTINUADA EN ESTOS LUGARES.

ARRIBA DE LOS CONDUCTOS INUNDADOS ES UN LABERINTO EXTENSIVO QUE ESTA SECA Y LLENO DE AIRE. LA TEMPERATURA ES 22 C. PERO, NO ES POSIBLE ALCANZAR EL LIMITE ADENTRO LA CUEVA SIN LUZ Y SIN CUERDA PARA AMARRAR LOS VARIOS POZOS VERTICALES. LOS LUGARES QUE REQUIEREN CUERDA PARA BAJAR Y ASCENDER SON MARCADOS COMO, POR EJEMPLO "P-30M". ESTE INDICA QUE UN PEDAZO DE CUERDA (DE 11MM DIAMETRO Y HECHO DE NYLON) DE 30 METROS DE LARGO ES NECESARIO PARA NEGOCIAR EL OBSTACULO.

AGRADECIMIENTO: QUEREMOS EXPRESAR NUESTRO AGRADECIMIENTO A LA PRESIDENCIA DEL MUNICIPIO DE MAZATLÁN VILLA DE FLORES PARA SU AYUDA EN CONDUCCION ESTAS EXPLORACIONES DURANTE LOS AÑOS 1995 Y 1997. TAMBIEN, QUEREMOS EXPRESAR NUESTRO AGRADECIMIENTO A LA GENTE DEL PUEBLO Y A LA AGENCIA DE LOMA GRANDE POR SU AYUDA EN LLEVAR EL EQUIPO DE EXPLORACION AL CAMPAMENTO BASE.





Pozo de Montemayor

Nuevo Leon, Mexico

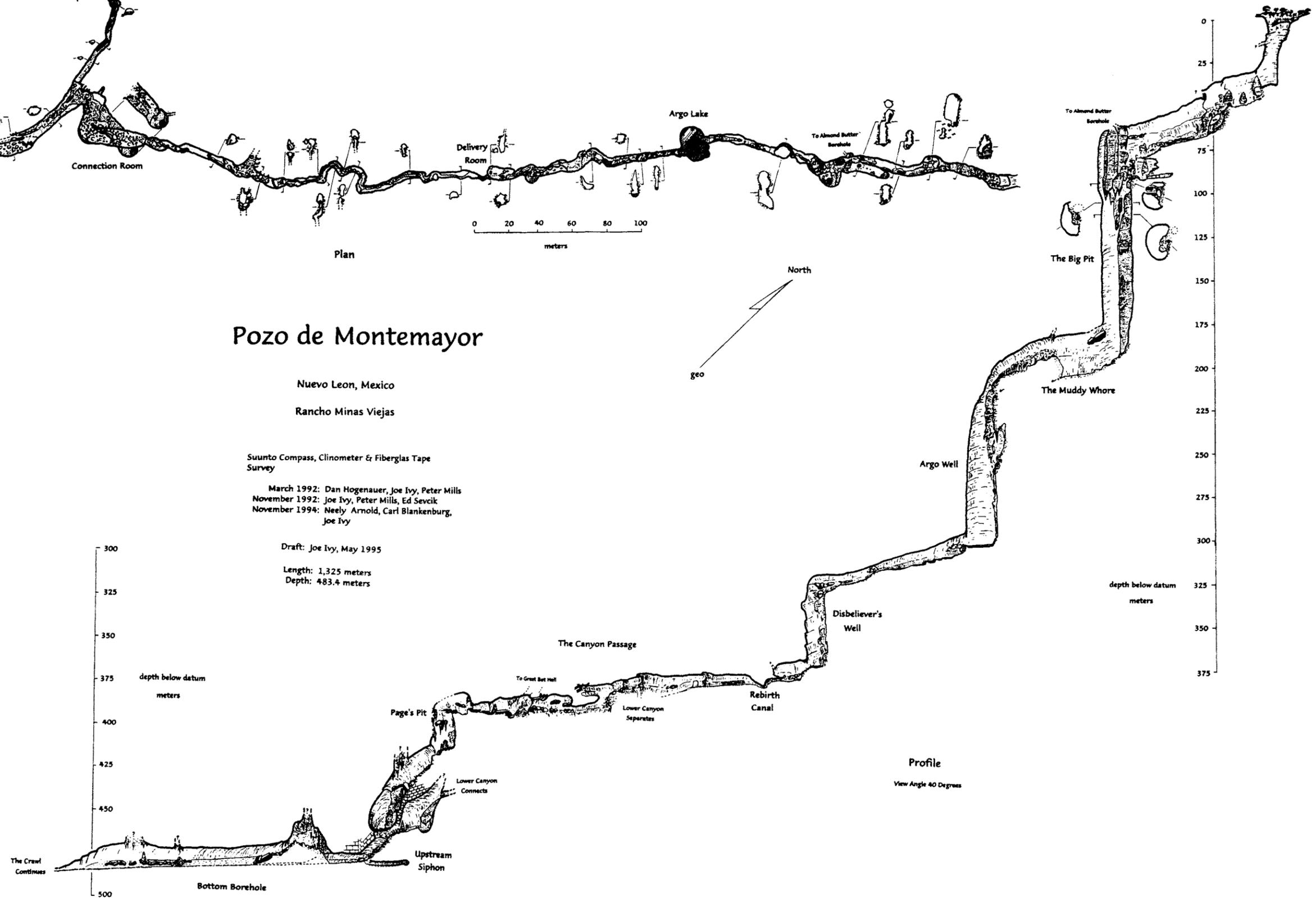
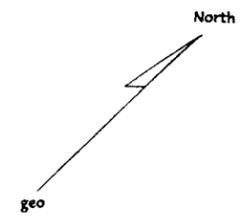
Rancho Minas Viejas

Suunto Compass, Clinometer & Fiberglas Tape Survey

March 1992: Dan Hogenauer, Joe Ivy, Peter Mills
 November 1992: Joe Ivy, Peter Mills, Ed Sevcik
 November 1994: Neely Arnold, Carl Blankenburg, Joe Ivy

Draft: Joe Ivy, May 1995

Length: 1,325 meters
 Depth: 483.4 meters



PUEBLA

The British cavers who have been exploring caves in the Cuetzalan area have created a web site with expedition reports, maps, and other information. See www.vale.org.uk/caves/cuetzalan.

In April 2002, a joint Sociedad Mexicana Exploraciones Subterráneas-Société Québécoise de Spéléologie expedition to the Sierra Negra succeeded in establishing a connection between **Sistema de Niebla** (TP4-13) and **Sistema Ehécatl-**

Xalltégoxtli. (The connection between Ehécatl and Xalltégoxtli is described in an article in *AMCS Activities Newsletter 24*.) The combination, taking the name **Sistema Tepepa** of the TP4-13 part, is over 24 kilometers in total length and at least 880 meters deep, according to field calculations. There are two independent routes, each over 10 kilometers long and 800 meters deep. The connection was established at the upper parts of both systems by a mixed team from both groups, although it was mostly due to the work of the québécois cavers

on previous expeditions. The potential for adding more length and depth is great, and we hope to continue this joint effort. *Source*: Ramón Espinasa and Marc Tremblay.

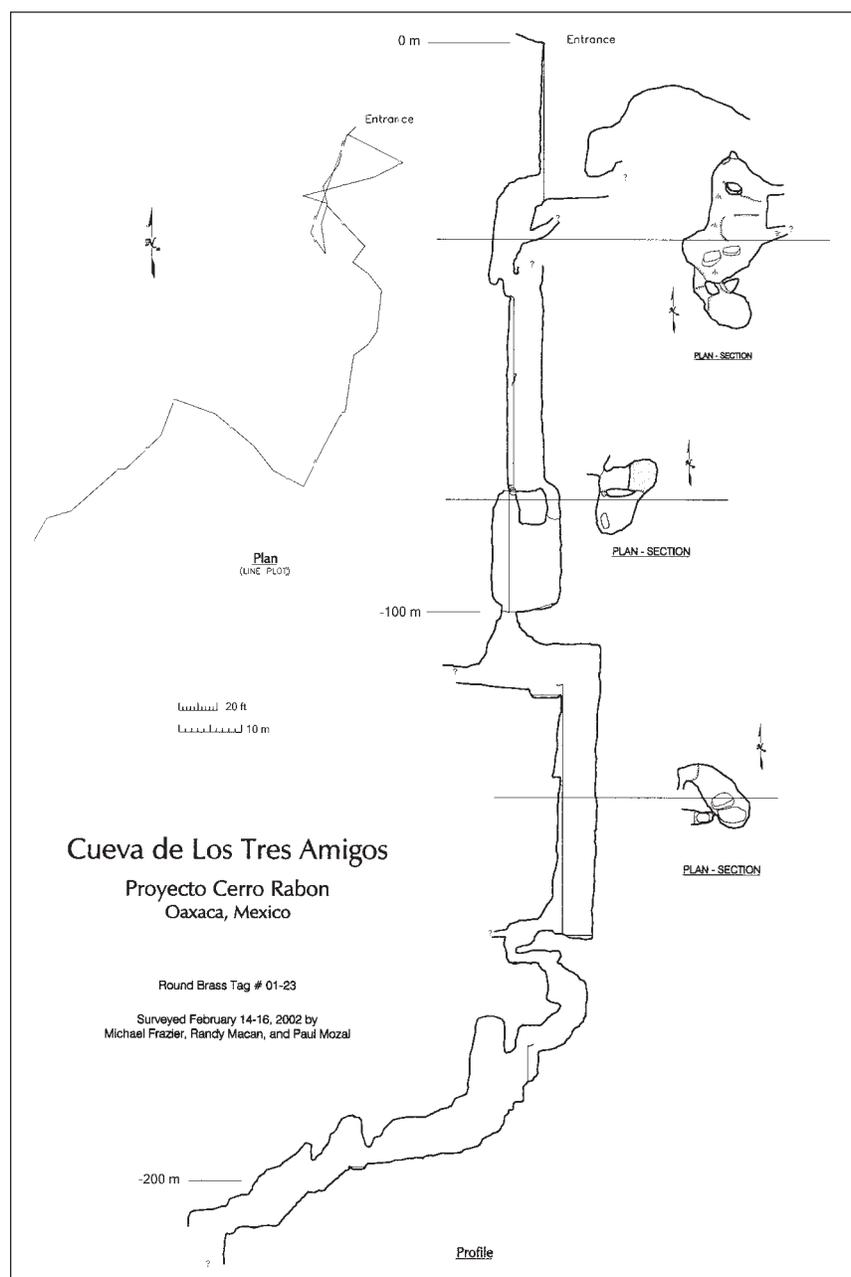
QUINTANA ROO

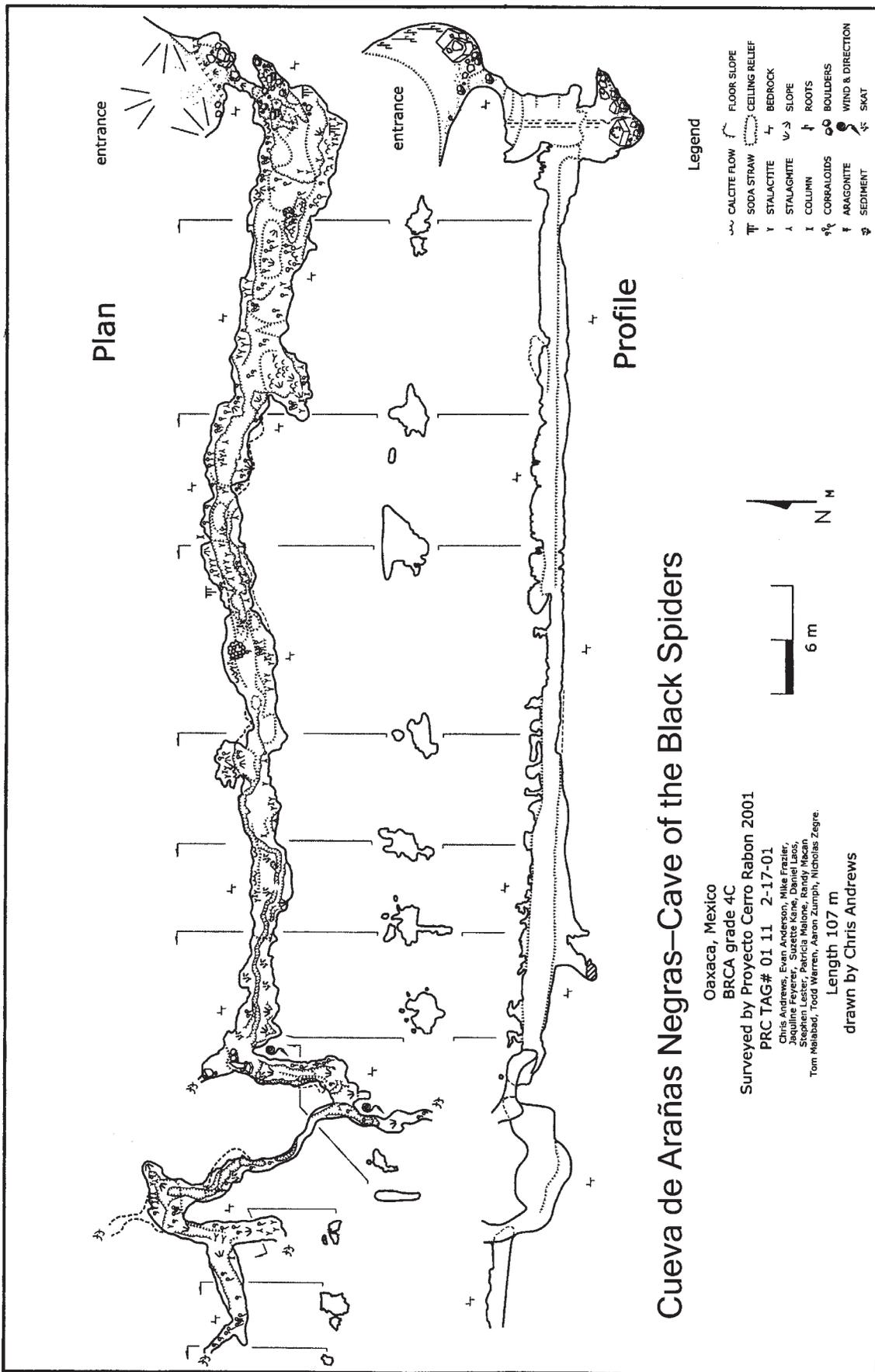
Cenote Angelina is located a few kilometers south of Tulúm. A dense hydrogen-sulfide layer occurs at the halocline at -30 meters. A tree-limb-covered debris cone barely pierces the halocline and extends downward. The lowest point where the cone intersects the wall is at a depth of 62 meters. A cross-section diagram of the cave appears in *Advanced Diver Magazine 11*, March 2002.

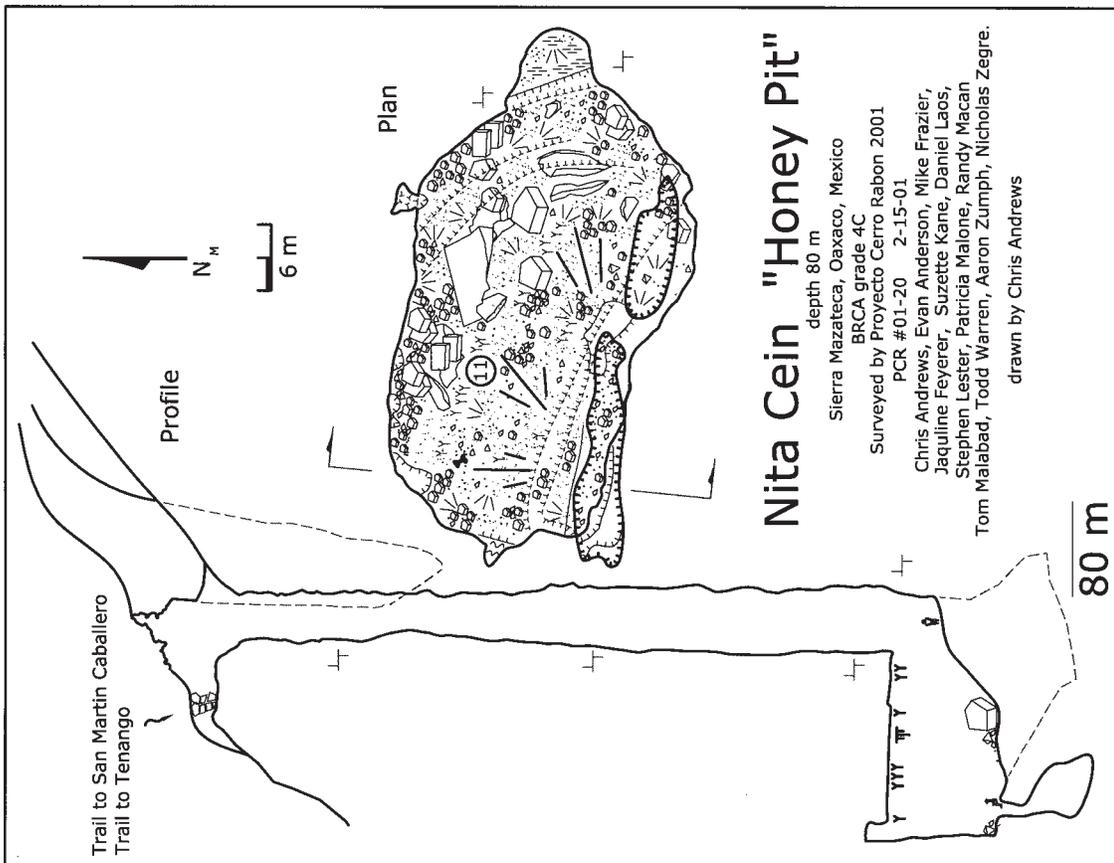
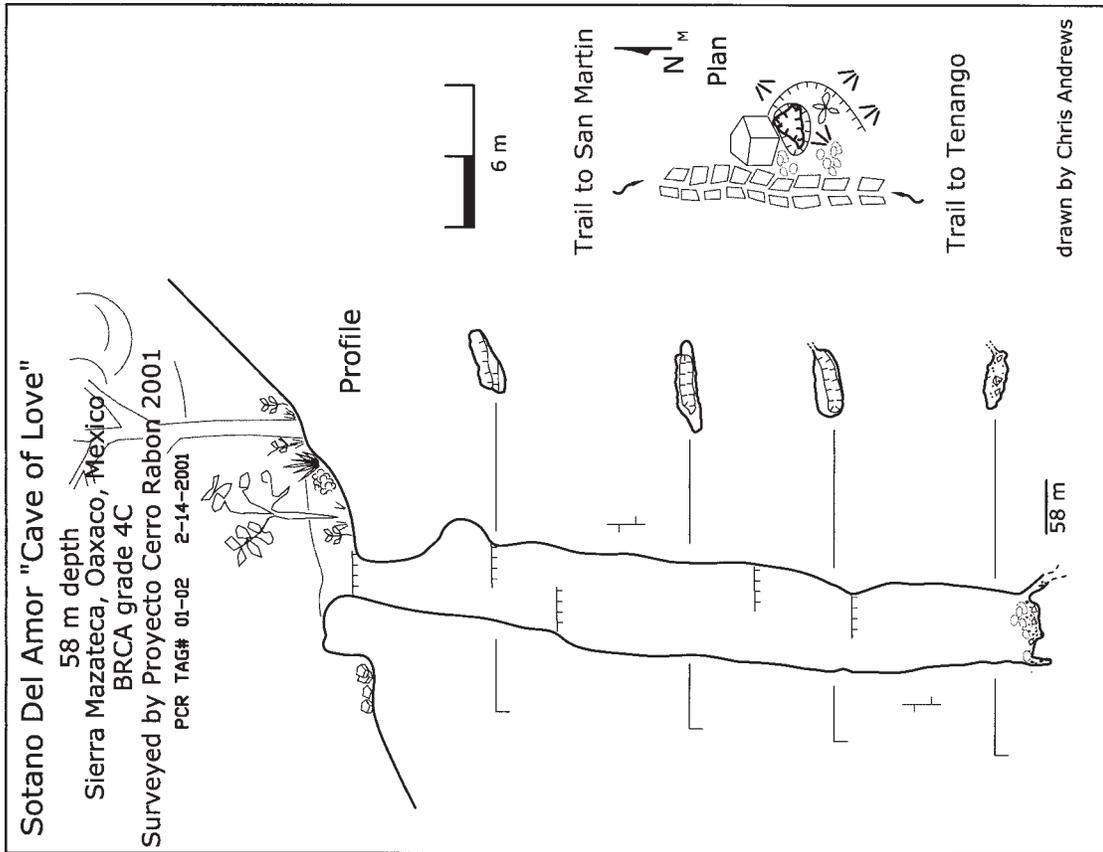
A cable-television film was shot in the Cenote Pet Cemetery area of **Sistema Nohoch Nah Chich** during November 8-15, 2001. Wes Skiles was the photographer, with assistance from Jill and Paul Heinerth and logistical support from Buddy Quattlebaum. The episode is called "Dreamchasers" and features cave diver Michael Kane of California. In January 2002, a German crew filmed another TV documentary in **Sistema Tuhs Xubaxa Aktun**, based at Cenote Nai Tutha. *Source*: Steve Gerrard in *Cave Diving News of the Riviera Maya*, March 2002.

Cave-diving biologist Jill Yager has received a Fulbright grant that will enable her to live in Puerto Morelos and conduct nine months of studies on the biology and water chemistry of **Sistema Crustacea**, **Sistema Taj Mahal**, and **Sistema Chac Mol**. Many will recall that Jill Yager discovered a new aquatic animal in a cave in the Bahamas that was not only a new genus and species, but also a new family and class (or subclass): Remipedia, Speleonectidae *Speleonectes lucayensis*. Remipedes have since been found in other anchialine caves, including some in the Yucatan Peninsula. *Source*: Steve Gerrard in *Cave Diving News of the Riviera Maya*, March 2002.

Nancy DeRosa and others have founded the Society of Akumal's







Vital Ecology (SAVE) to protect the cenotes and groundwater resources along the Caribbean coast of Quintana Roo, the area called the Riviera Maya. (See also article in this issue.) Deliberate sewage discharge and garbage dumps threaten the water. The organization has a web site at www.saverivieramaya.org. Source: Nancy DeRosa in *Underwater Speleology*, December 2001.

Sistema Aerolito de Paraíso on Isla de Cozumel is reported to have over 18 kilometers of underwater passage. A map of the cave appears in *Advanced Diver Magazine* 11, March 2002.

Laguna Bacalar is a long, narrow fresh-water lagoon just inland from Chetumal and just north of the border with Belize. A flight over the lagoon showed four blue holes. Proyecto Bacalar 2001 checked these and found that all are old sinkholes filled at the bottom. **Pozo**

Azul is 75 meters deep, **Blue Hole II** is 33 meters deep, **Blue Hole III** is 49 meters deep, and **Myrna's Blue Hole** is 53 meters deep. Other caves explored include one 50 meters offshore in the Caribbean Sea with 60 meters of passage, the only thing found that had any flow, and (yet another) **Pozo Azul**, right on the river that separates Mexico and Belize, near the village of La Union, that turned out to be a sinkhole 17 meters deep. Source: Andreas Matthes in *Underwater Speleology*, May 2001.

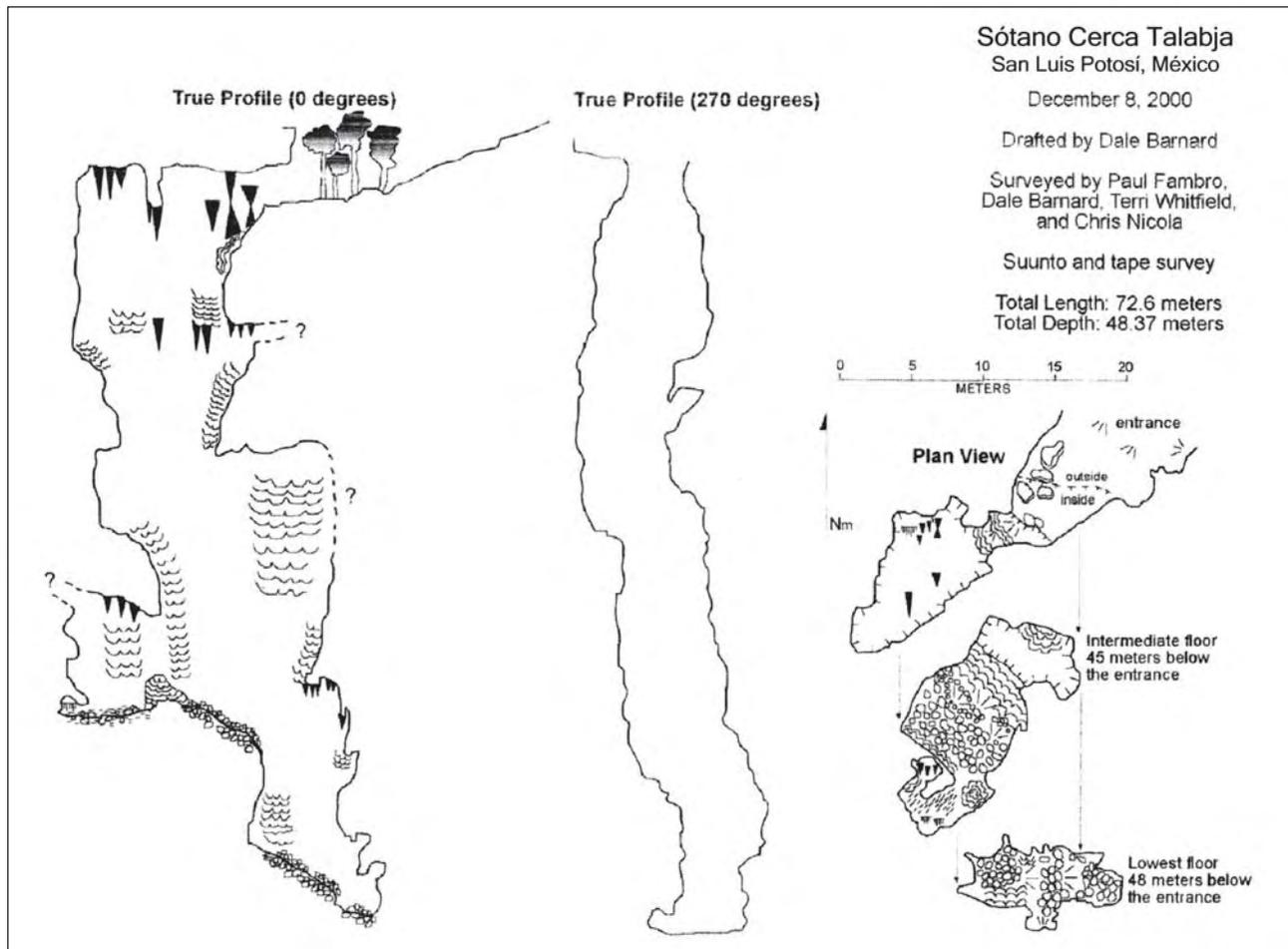
The island of Cozumel is separated from the mainland of Quintana Roo by a deep channel, so a shallow-water connection has never existed. The caves of Cozumel contain species not found on the mainland, including five species of shrimp and a new genus of copepod. Only one amphipod and one cirrolanid isopod are common to caves on Cozumel and on the

mainland. A completely white starfish, *Paxillasterina pompom*, is found in the caves of Cozumel. It is otherwise known only from the Atlantic coast of Panama. Source: Tom Illiffe in *Advanced Diver Magazine* 11, March 2002.

First discovered and explored in March 1997 by German Gunnar Wagner and Belgian Thierry Memimet, the **Tuhs Xubaxa Aktun** system (or Tuhx Cubaka Aktun—the hazards of Mayan names) presently consists of 10.9 kilometers of passages connecting twenty cenotes. A jaw with teeth and many other mastodon bones were found in the cave in February 2000. Source: Steve Gerrard in *Cave Diving News of the Riviera Maya*, March 2002.

SAN LUIS POTOSÍ

Cavers attempting to visit **Resumidero El Borbollón** and **Cueva del Tizar** in November 2001 were turned back by bad air. At **Puerto**



de Los Lobos, they found a huge swarm of bees. *Source:* Andy Harris in *Texas Caver*, December 2001.

In 2000, cavers of the new Proyecto Espeleológico Oxmolón began investigating caves in the vicinity of La Brecha, near Aquismón. Their trips and a number of caves are described in a project report published in January 2001. It includes maps of **Sótano del Cañón Barba**, **Sótano de Chuchumbex**, and **Sótano Cerca Talabja**. Subsequent trips are described in an article in this issue.

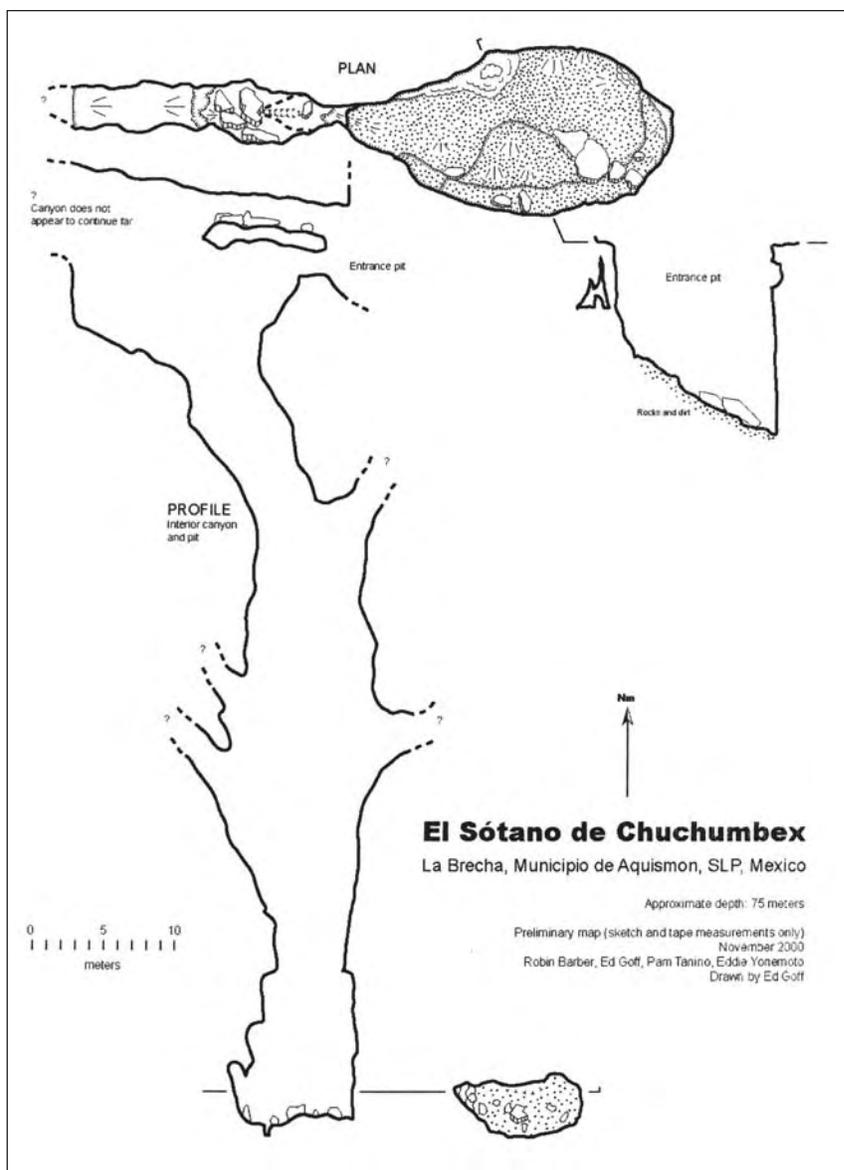
TABASCO

Among the caves in the Parque Estatal de Agua Blanca in southern Tabasco are **Gruta de Murallón**, an archaeological site, and **Ixtac-Ja**, partly improved for tourists. A somewhat confusing article on the area appears in the *NSS News*, January 2002.

TAMAULIPAS

In an expedition over New Years 2001, cavers visited three parts of the Proyecto Espeleológico Purificación area. During the first week, they explored and mapped 1716 meters of new passages in the Confusion Tubes in **Sistema Purificación**, working from Camp I near the Infiernillo entrance. See also Terri Treacy's article in this issue. During the second week, they looked for new entrances in the vicinity of their fieldhouse in Conrado Castillo and the high ridges above Revilla, finding twenty pits, including **Pozo Diamante de Kirsten**, 102 meters deep, and **Cueva Jardín**, 113 meters. *Source:* Pat Shaw and Dale Chase in *Death Coral Caver* 11, 2001.

Additional pushes in **Sótano de Caracol**, near Revilla, occurred over December 2001 and March 2002. (See *InnerSpace Odyssey* article in this issue and "Mexico News," *AMCS Activities Newsletter* 22.) Approximately 400 meters of new cave was found and surveyed, but the water and air both disappear through impassable cracks. The new length is 1044 meters, and the depth is very slightly over 300 meters. *Source:* Bill Stone and Bev Shade.



YUCATÁN

Actun Kaua is located under the town of Kaua, which is roughly midway between Valladolid and Chichen Itza. David McKenzie and James Reddell began the survey of the cave in 1974 and 1975 and mapped about 6.8 kilometers of maze. This complex cave served as inspiration to McKenzie to develop the Walls computer program for cave-survey-data processing and plotting. It can statistically examine survey data and determine where blunders and systematic errors are most likely to be present in a survey, and thus also identify the areas of a survey that are effectively error-free.

The cave is divided into a South Maze area, which is completely surveyed, and a North Maze. In trying to delineate the outer extent of the maze, McKenzie and Reddell extended two survey branches out from the North Maze. One led about 200 meters west into what is called the West Maze, which contains dozens of branching passages. The other survey extended north from the northeast end of the North Maze, further delimiting the eastern edge of the cave, then cut southwest through a maze area to connect to where the North and West mazes join. This survey formed a loop that encompassed what appeared to be a complicated portion of the cave.

In 1994, Peter Sprouse led a

group to Actun Kaua, and two teams surveyed within this loop. One systematically surveyed maze loops at its west end, and the other cut a west-to-east route through the middle of the maze and did some spray shots in the larger areas. Together they surveyed about 750 meters.

From December 23, 2001, to January 11, 2002, David McKenzie led another group to the cave with the primary objective to complete filling in the maze within that North Maze loop. He was accompanied for two to three weeks by Allan Cobb, Orion Knox, Linda Palit, and George Veni. James Reddell and Marcelino Reyes were present during much of that time, but focused on checking leads elsewhere in the area and found several interesting caves.

It turned out that the North Maze loop encompasses the most complicated part of the cave surveyed to date. Much of the passage is less than a meter high, and survey shots were often less than 3 meters long. Each night the survey data were entered into Walls, and any errors or questionable sections of survey were checked in the cave and corrected the next day to produce a high-precision survey. Because of the nature of the passages and quality sought for the survey, considerable time and effort were needed in this area, which is only 100 meters long by 30 to 80 meters wide. On average, a typical eight-hour survey day yielded 150 to 200 meters of passage within areas that are only 30 to 40 meters long by 10 to 15 meters wide. By the end of trip, this part of the North Maze was complete, except for one small section, and was found to contain 2.5 kilometers of passages and 181 loops.

In addition to the cave surveys, 3.3 kilometers of surface surveys were done, tying the cave to two cenotes and five wells. Both cenotes in town are said to lead to caves, with one supposedly connecting to Actun Kaua. Cenote Ya'ax-Ek is within a city park and has a trail leading down to a 7-meter-long cave to water. Cenote Chucab required a 14-meter rappel to water, but no air-filled passages were

found, although some possible underwater passages were seen.

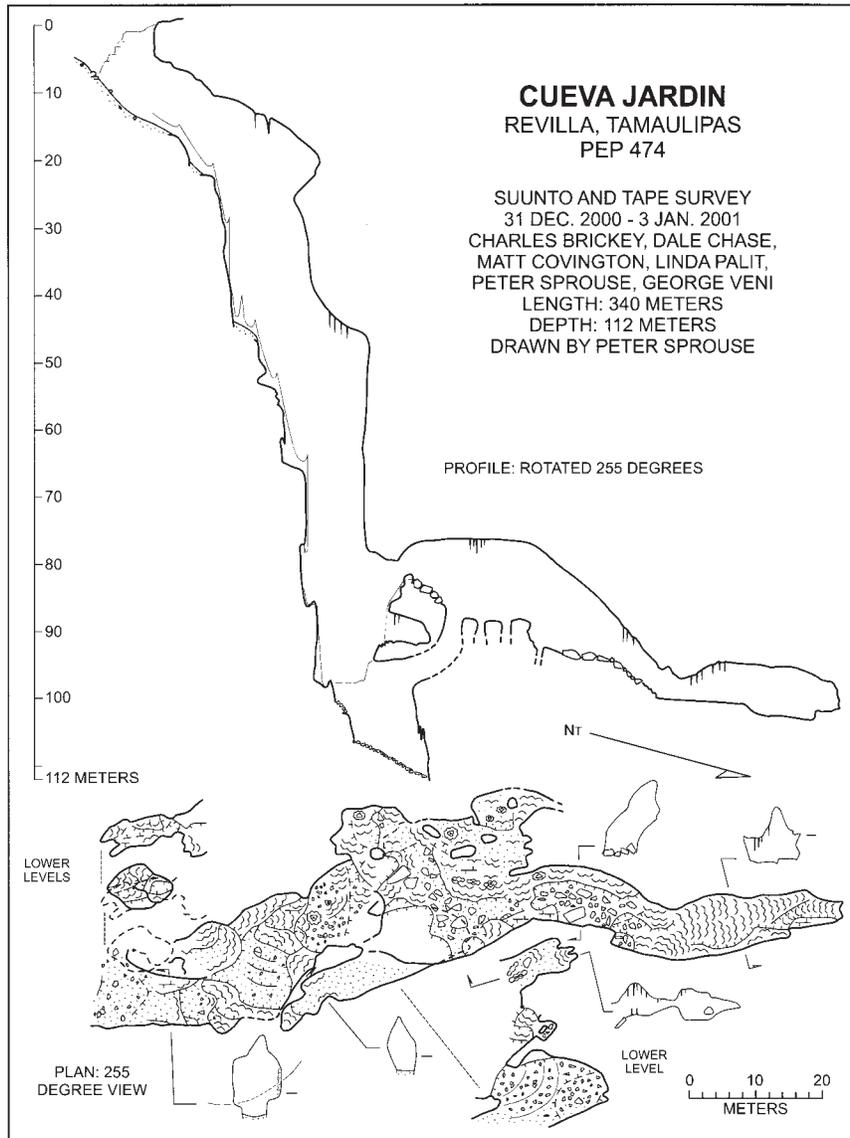
Three of the five wells intersect Actun Kaua, and the other two were rumored to intersect it. One of those two was descended, and no connection was found; the other well probably does not intersect the cave, based on the map. The wells are all about 1 meter in diameter and are located next to homes. Villagers reported that lost locals and gringos exploring the labyrinth have found some of the wells inside the cave and yelled until someone on the surface heard them and pulled them up with a rope.

Plans to return to Kaua are in progress. Objectives will be to further define the outer boundaries of the complex and then fill in the

multitudes of loops that occur in between. Actun Kaua currently has a surveyed length of 9.4 kilometers, a depth of 25.8 meters, and 453 surveyed loops. *Source:* George Veni.

The archaeological site Dzibilchaltun is located about 3 kilometers north of Mérida. Michael and Sherry Garman, Alex Warren, Jitka Hyniova, and Jakub Rohacek have surveyed the underwater cave at **Cenote Xlacah** there for a distance of about 900 meters. The water depth is 63 meters at their farthest point. *Source:* Michael Garman in *Advanced Diver Magazine* 11, March 2002.

Cave divers conducted the Yucatán 2001 project in two stages,



both based in Homun, about 50 kilometers southeast of Mérida. During the first stage, March 27 to April 1, twenty-eight cenotes were found and cataloged. Many of them turned out to be filled-in sinkholes with clear but shallow water. Some of them had large populations of blind fish, isopods, and amphipods, despite no large connection to a cave system. None appeared to have horizontal passages, although one may have a passage going off at 70 meters depth. Mixed-

gas diving will be necessary to check this. The second stage, the first week in June, made two significant discoveries. **Och 1** begins with a 15-meter rappel to the water. Below the surface, a tunnel 5 to 10 meters wide and 20 to 30 meters tall takes off. After about 50 meters, the passage splits, one way going to a huge room 30 meters in diameter and 40 meters tall, with the ceiling above water level. The penetration from the entrance is 100 meters. The other direction ends at a penetra-

tion of 90 meters. **Cenote Tuchen** has a large entrance room from which underwater passage goes past an air-filled room and another large room and ends at a penetration of 467 meters and a depth of 35 meters. Both caves need much more work. *Source: Advanced Diver Magazine 9, 2001, which contains artists' impressions of the maps of Och 1 and Tuchen; Andreas Matthes in Underwater Speleology, May 2001.*

DEEP CAVES OF MEXICO

Peter Sprouse
 April 2002
 Depth in meters

1	Sistema Huautla	Oaxaca	1475
2	Sistema Cheve	Oaxaca	1386
3	Akemati	Puebla	1226
4	Kijahe Xontjoa	Oaxaca	1223
5	Cueva Charco	Oaxaca	1166
6	Sistema Ocotempa	Puebla	1070
7	Akemabis	Puebla	1015
8	Sonconga	Oaxaca	1014
9	Guixani Ndia Kijao	Oaxaca	956
10	Sistema Purificación	Tamaulipas	953
11	Sistema Perrito	Oaxaca	906
12	Nita Cho	Oaxaca	894
13	Sistema Tepepa (Ehécatl+Niebla)	Puebla	880
14	Sótano de Agua de Carrizo	Oaxaca	843
15	Sótano de El Berro	Veracruz	838
16	Sótano de Trinidad	San Luis Potosí	834
17	Resumidero el Borbollón	San Luis Potosí	826
18	X'oy Tixa	Oaxaca	813
19	Nita Ka	Oaxaca	760
20	Sistema H31-H32-H35	Puebla	753
21	Sonyance	Oaxaca	745
22	Nita Xonga	Oaxaca	740
23	Yuá Nita	Oaxaca	704
24	Aztotempa	Puebla	700
25	Sótano de los Planos	Puebla	694
26	Sótano de Alfredo	Querétaro	673
27	Sistema Cuetzalan	Puebla	658
28	Sótano de Tilaco	Querétaro	649
29	Nita Nashí	Oaxaca	641
30	Cuaubtempa Superior	Puebla	640
31	Sistema Atlalaquía	Veracruz	623
32	Cueva de Diamante	Tamaulipas	621
33	R'ja Man Kijao	Oaxaca	613
34	Nita He	Oaxaca	594
35	Meandro Que Cruce (H54)	Puebla	588
36	Sistema del Encanto	Puebla	584
37	Yometa	Puebla	582
38	Sótano de las Coyotas	Guanajuato	581
39	Sótano Arriba Suyo	San Luis Potosí	563
40	Sistema Tepetlaxtli	Puebla	535
41	Sótano del Río Iglesia	Oaxaca	531
42	Sótano de Nogal	Querétaro	529
43	Resumidero de la Piedra Agujerada	San Luis Potosí	521
44	Grutas de Rancho Nuevo	Chiapas	520
45	Sótano de Ahuihuitzca	Veracruz	515
46	Sistema Soconusco	Chiapas	513
47	Sótano de las Golondrinas	San Luis Potosí	512
48	Hoya de las Conchas	Querétaro	508
49	Sótano de Los Hernandez	Querétaro	507
50	Sótano del Buque	Querétaro	506

Updates and corrections:

Peter Sprouse
 PO Box 8424
 Austin, Texas 78713
 psprouse@texas.net

Peter Sprouse
 April 2002
 Depth in meters

LONG CAVES OF MEXICO

1	Ox Bel Ha	Quintana Roo	96800
2	Sistema Purificación	Tamaulipas	93755
3	Nohoch Nah Chich	Quintana Roo	60985
4	Sistema Huautla	Oaxaca	55953
5	Sistema Dos Ojos	Quintana Roo	55322
6	Sistema Cuetzalan	Puebla	37676
7	Cueva del Tecolote	Tamaulipas	36562
8	Kijahe Xontjoa	Oaxaca	31373
9	Sistema Cheve	Oaxaca	24300
10	Sistema Tepepa (Ehécatl+Niebla)	Puebla	24000
11	Sistema Soconusco	Chiapas	21733
12	Coyalatl	Puebla	20000
13	Sistema Naranjal	Quintana Roo	19394
14	Sistema Yax Ch'en	Quintana Roo	18302
15	Sistema Sac Actun	Quintana Roo	17078
16	Sistema Pondazul (PonDeRosa)	Quintana Roo	14932
17	Cueva del Alpazat	Puebla	13676
18	Sistema Nohoch Kiin	Quintana Roo	13615
19	Cueva del Río La Venta	Chiapas	13000
20	Atlixicaya	Puebla	12200
21	Sistema San Andrés	Puebla	10988
22	Grutas de Rancho Nuevo	Chiapas	10218
23	Cueva del Arroyo Grande	Chiapas	10207
24	Cueva del Mano	Oaxaca	9790
25	Sistema Abejas	Quintana Roo	9742
26	El Chorro Grande	Chiapas	9650
27	Sistema Tepetlaxtli	Puebla	9600
28	Actún Kaua	Yucatán	9400
29	Cueva Quebrada	Quintana Roo	9000
30	Sótano de Las Calenturas	Tamaulipas	8308
31	Gruta del Tigre	Quintana Roo	8300
32	Cenote Chac Mool - Mojarra	Quintana Roo	8182
33	Sumidero Santa Elena	Puebla	7884
34	Cueva Yohualapa	Puebla	7820
35	Cueva de la Peña Colorada	Oaxaca	7793
36	Cueva de Comalapa	Veracruz	7750
37	Sótano del Arroyo	San Luis Potosí	7200
38	Sistema Perrito	Oaxaca	7148
39	Cueva de la Puente	San Luis Potosí	6978
40	Sistema Zoquiapan	Puebla	6597
41	Xongo Dwi Ni	Oaxaca	6500
42	Cueva Vinata	Michoacán	6460
43	Sumidero de Janotla (Teponahuas)	Puebla	6381
44	Cueva del Ferrocarril	Morelos	6100
45	Cueva Aerolito	Quintana Roo	6100
46	Sistema Cretácico (Suchomimus)	Nuevo León	6065
47	Cenote Zapoté	Quintana Roo	6000
48	Sistema Sima Grande	Puebla	5952
49	Gruta del Río Chontalcoatlán	Guerrero	5827
50	Sistema H31-H32-H35	Puebla	5745

DEEP PITS OF MEXICO

Peter Sprouse
 April 2002
 Depth in meters

1	El Sótano (de El Barro)	Entrance drop	Querétaro	410
2	Sótano de las Golondrinas	Entrance drop	San Luis Potosí	376
3	Sótano de Tomasa Kiahua	Entrance drop	Veracruz	330
4	Zacatón	Entrance drop	Tamaulipas	329
5	Sótano de Alhuastle	P'tit Quebec	Puebla	329
6	Nita Xonga	Psycho Killer	Oaxaca	310
7	Sotanita de Ahuacatlán	Second drop	Querétaro	288
8	Sótano del Arroyo Grande	Entrance drop	Chiapas	283
9	Sistema de la Lucha	Entrance drop	Chiapas	280
9	Sima Don Juan	Entrance drop	Chiapas	278
11	Sima Dos Puentes	La Ventana	Chiapas	250
11	Hálito de Oztotl	Entrance Drop	Oaxaca	250
13	Resumidero del Pozo Blanco	Entrance drop	Jalisco	233
13	Sótano del Aire	Entrance drop	San Luis Potosí	233
15	Sistema Ocotempa	Pozo Verde	Puebla	221
16	Sótano de los Planos	Puits Tannant	Puebla	220
16	Sótano de Eladio Martínez	Entrance drop	Veracruz	220
18	Sótano de Coatimundi	Entrance drop	San Luis Potosí	219
19	Sótano de Sendero	Entrance drop	San Luis Potosí	217
19	Sima de la Pedrada	Entrance drop	Chiapas	217
19	Resumidero el Borbollón	Tiro Grande	San Luis Potosí	217
22	Sima del Chikinibal	Entrance drop	Chiapas	214
23	Cueva del Tizar	Third drop	San Luis Potosí	212
24	Kijahe Xontjoa	Son On Jan	Oaxaca	210
25	Nacimiento del Río Mante	Macho Pit	Tamaulipas	206
26	Hoya de las Guaguas	Entrance drop	San Luis Potosí	202
27	Sistema H3-H4		Puebla	200
27	Kijahe Xontjoa	Lajao Se	Oaxaca	200
29	Sima La Funda	Entrance drop	Chiapas	198
30	Sótano de Soyate	Entrance drop	San Luis Potosí	195
31	Sótano de Alpupuluca	Entrance drop	Veracruz	190
31	Cuaubtempa	Pozo Con Carne	Puebla	190
31	Sótano de Tepetlaxtli no. 1	Entrance drop	Puebla	190
34	Sótano de Puerto de los Lobos	Entrance drop	San Luis Potosí	189
35	Sótano de Hermanos Peligrosos	Second drop	Veracruz	186
36	Sistema Soconusco	Darwin	Chiapas	180
36	Sima de Veinte Casas	Entrance drop	Chiapas	180
36	Ahuihuitzcapa	Entrance drop	Veracruz	180
36	Hoya de la Luz	Entrance drop	San Luis Potosí	180
40	Sima del Cedro	Entrance drop	Chiapas	175
41	Sótano de la Cuesta	Entrance drop	San Luis Potosí	174
42	Sima Dos Puentes	Entrance drop	Chiapas	172
43	Sótano de los Monos	Entrance drop	San Luis Potosí	171
43	Sótano de Otates	Third drop	Tamaulipas	171
43	El Socavón	Entrance drop	Querétaro	171
46	Sótano de los Ladrones	Entrance drop	Oaxaca	170
46	Nita Diplodicus	Entrance drop	Oaxaca	170
46	Sótano de Tepetlaxtli no. 2	Entrance drop	Puebla	170
49	Sótano de Agua de Carrizo	Flip Pit	Oaxaca	164
50	OC4, OC 8, Nita Sakafaai (tie)		Pue,Pue,Oax	160

CERRO RABÓN 1995–2000

Karlin Meyers

In 1984, Ernie Garza showed Blane Colton and me a picture of the Nacimiento del Río Oropan, a huge aquamarine resurgence in the Santo Domingo Canyon below a western extension of the Sierra Mazateca called the Cerro Rabón. Our objective became to find the cave above. The Río Oropan has a flow, depending on the season, of 3 to 15 cubic meters per second, so the cave system above has to be big. What was in fact found is a system that represents, as far as we can tell, a separate drainage system to the north, perhaps eventually to the Presa Miguel Aleman at Tilpan, some 12 kilometers to the northeast. This system, Kijahe Xontjoa, the Forgotten Window, lies only 5 kilometers from the Río Oropan, but the deep parts of the Kijahe are 150 meters below the elevation of that resurgence. Apparently tectonic overthrusting has made a drainage divide between the Kijahe and the resurgence, and the presumed Oropan cave system has yet to be discovered. Consensus, therefore, is that exploration of the Cerro Rabón plateau has only begun.

The Kijahe Xontjoa has, however, become one of the deepest caves in Mexico, and it is notable for being remote and still largely covered by a primary cloud forest that lends an exotic and biologically fascinating atmosphere to the region. The known system is somewhat different in morphology from the neighboring deep systems, Cheve and Huautla. Its major conduits plunge vertically downward, practically under the entrance doline, to the

–1000-meter level, where kilometers of horizontal labyrinths are encountered that represent a huge, ancient phreatic system. In fact, over half of the survey lies between –850 and –1200 meters.

It is puzzling, considering the region's annual rainfall of nearly 5 meters, approximately twice that of the Cheve and Huautla area, that no major underground river has been found anywhere in the area. The catchment for the Río Oropan probably lies just west of the Kijahe and includes a closed valley we call the Lost City due to the appearance of the karst in air photos. While we have made numerous forays into this remote area, no intensive caving has been accomplished due to the long distance from camp and our preoccupation with the growing Kijahe. Recently, a caving group from Indiana and Montana has been making efforts to explore this area.

Since discoveries from 1987 to 1994 are described in previous project publications [and see *AMCS Activities Newsletters* 17 and 18], I will continue here with the 1995 expedition. At the end of the 1993 season, the Kijahe was 1181 meters deep and 19 kilometers long. It was therefore no problem getting cavers from the United States, Switzerland, Belgium, England, and Russia interested in another expedition.

In March 1995, an international team of cavers hauled 900 kilograms of food and materials to the base camp a half-kilometer from San Martín Caballero for a three-

week stay. Cavers were Thomas Bitterli, Sebastien Grosjean, Christin Preiswerk, Arniko Böke, Laurent Déchanez, Patrick Hirzel, Corinne Kolly, Pierre-Yves Jennin, Michel Bovey, Roman Hapka, David Christian, Fabianne Rouvinez, Jean-Marc Jutzet, Bruno Manser, and Yvo Weidmann from Switzerland, Peter Harley from England, Serge Delaby and Sophie Verheyden from Belgium, Denis Provalov from Russia, and Karlin Meyers, Arnie Nelson, Artur Kruk, Matt Oliphant, Nancy Pistole, Blake Harrison, and Dominique Rouiller from the United States. In addition, there were four botany students from Switzerland who were doing studies in Mexico. With so many people, they were well prepared to push Kijahe Xontjoa and continue checking new and old areas for other caves.

A clearing a half-hour from basecamp, the Nita Ya Heke clearing, had produced by this time a large number of interesting caves concentrated in a small region, including Nita Sakafaai, 210 meters deep with a 160-meter pit, Nita Xcoa, 234 meters, Nita Ya Heke, 291 meters, Nita Ganola, 255 meters, and many smaller caves. Nita Terremoto, an entrance discovered in 1989 but never checked, was targeted first. The bottom of the large, 70-meter entrance pit was blocked by breakdown, but by moving some blocks and following good airflow, a horizontal labyrinth was found, and 480 meters was surveyed. The next survey team dropped another pit and tackled lots of mud and more small pits before they stopped

at -125 meters at a larger pit. The following day, a team armed with 200 meters of rope managed 400 meters of survey, which brought the cave to 350 meters deep and 1280 meters long. They returned tired but pleased, because Terremoto had passed the -300-meter mark, unlike the others in the Nita Ya Heke clearing, and was still going strong. A trip some days later found the next big pit blind except for a small window 10 meters up in a crack. This led to a nice 75-meter pit into a huge room, sadly the end of the cave at -470 meters.

A new trail, more to the west, was made and surveyed to the Kijahe. The goals were to improve the accuracy of the existing 20 kilometers of overland survey and to look farther north of the Kijahe valley for new caves. The most significant previous find in the area was Wind Cave, a 100-meter pit to a big collapse room under the doline. Numerous other pits were found and mapped, but none went over 100 meters deep, and there were no going leads.

After the first week, the first deep trips into the Kijahe were made. The main goal of the three-man first team was to establish a second camp, Camp Cairo, in the far region of the Sarcophagus and push the going leads in this area. They departed carrying 70 kilograms of material and had to rig the lower Kijahe on their way. Twenty hours later they set a camp at -1144 meters near the beginning of the Sarcophagus borehole, where there was water. Totally exhausted, they devoured their freeze-dried meals along with their silica-gel packets.

The next day they began surveying in a beautiful gallery named the Vrai Sucre (French for Real Sugar), which produced a bypass to the eerie Sarcophagus. A mop-up survey finished practically all the open leads in this area, and the next day they moved on to the next lead, in the Crocodile Gallery. Here they descended a ramp that brought them into a honeycomb labyrinth under the main borehole. After 150

meters of survey, they stopped at the top of a very large room with many galleries leading from it, a real Swiss cheese. They returned the next day with rope and began to check the many leads. One passage contains a stream that was followed upstream 200 meters to a sump. It probably is the same stream that flows through the breakdown in the Sarcophagus borehole. Another passage, with breakdown, brought them into another large room from which a 7-by-7-meter passage sloped down into an impressive lake. A long swim by one of the Swiss proved that the lake, the Caribbean Sea, was indeed a terminal sump 1200 meters below the main entrance. They headed out with 1.2 kilometers of new survey.

The four-person second team descended to Camp 1, the Bat Yeck Camp, and targeted a couple of interesting climbs near the camp. The first lead, in the Galerie des Pensées, led them down some 100 meters of pits to a room, where it ended. A bolt climb to a large window in the Popocatepetl Room was attempted, but rock quality deteriorated after 20 meters, and this was abandoned.

A large camp exchange was made, as six cavers headed out and two came in to join the one remaining in Camp 1. This new team continued to check leads in the breakdown galleries just past the North Sea. On the way to Beyond the Big Black, a 30-meter pit led them into the Subcomandante Marcos River. After 200 meters, this stream sumped at the junction of

two mazy passages, the Zapatista Underground. A return the next day netted 270 meters of survey to a breakdown area with very good airflow. They returned to Camp 1 just in time to meet a three-man team heading in to Camp Cairo.

Traffic in the deep shafts increased, as the Camp 1 team left the next day, only to meet an incoming team of four at -600 meters. Stories, leads, and survey notes were exchanged, as was a Hilti drill. The second Camp Cairo crew spent the next two days surveying mostly loops in the complex labyrinth and trying to make some sense of the area and find some airflow to lead them out. They were unsuccessful, but they netted 850 meters of survey, an estimated half of the maze. The new Camp 1 crew found more passages and loops in the Galerie des Pensées and the Zapatista Underground and then checked some leads on their way out.

Above, while the deep camps were busy, others were exploring new areas. So many features look attractive on air photos, but concern grew about the difficulty of systematic exploration in the complex jungle. Flagged and blazed trails are nearly impossible to find after three or four years. Fears were confirmed by an accidental resurvey. Efforts were therefore concentrated on So On Jan and the trail to the Lost City, the closed valley of sinks a few kilometers west of the Kijahe.

The trail to the Lost City was first blazed by cavers in 1989. In 1991, it took two days to reopen it and set a tiny jungle camp. The Lost City was

The Cerro Rabón plateau from the east. *Arniko Böke.*





In the Big Room in Kijahe.
Jean-Marc Jutzet.

briefly visited again in 1993, and this year the trail was again reopened, and the first detailed field notes on the area were made. Incidentally, as the Lost City group made its way through the high karst sketching deep dolines and fissures, another group of cavers was 1500 meters lower making a river traverse of the Santo Domingo Canyon. During the last days of the 1995 Cerro Rabón expedition, the Lost City crew stopped at a large, deep, perhaps 100-plus meters deep, pit with airflow. They flagged a tree and named the pit the Breath of Oztotl. Having no rope, they reluctantly returned to basecamp with the news.

Meanwhile, a group had entered So On Jan, which was connected at -600 meters to the Kijahe in 1993, to check leads near the bottom of the 209-meter pit. [A map of the entrance pit of So On Jan is in "Mexico News" in *AMCS Activities Newsletter* 21.] Climbing up in the tight meanders that follow the entrance shafts, they popped into a fossil canyon with great airflow. The next survey team continued following the air in dry passage.

After 380 meters, they stopped at the top of a deep pit. They dubbed the gallery the Lost City Transitway due to the direction it was heading, toward Lost City, of course. The pit was behaving like a huge vacuum-cleaner, so they called it the Staubsauger, German for Dust-sucker. The last cave trip of the expedition was made into the Lost City Transitway. The Staubsauger is a 100-meter popcorn covered pit ending in a huge breakdown room. Following the airflow down into the blocks, the two cavers dug into a small crawlway. After 15 meters, this windy tube passed into a large borehole, the Electrolux, which is probably the most voluminous passage in the Kijahe system. After only about 200 meters, however, the borehole funneled into a narrow but tall descending canyon with great airflow. With 850 meters of new survey, they turned around at the top of a pit, a good end point for the 1995 trip. The Kijahe was 1223 meters in total depth and over 25 kilometers long.

A smaller expedition took place in March 1997, with Laurent Déchanez, Natalie Gumy, Yvo Weidmann, Catherine Perret, and Jean-Marc Jutzet of Switzerland, Vincente Aspeita from Mexico, and Dale Bernard, Jennifer Townsden, and Ernie Garza from the United States.

There was a new pit discovery, Nita Gatziquin, Arch Cave, found only a stone's throw from the So On Jan entrance pit. A small, uninteresting meander in a doline led to a voluminous black pit. The pit was first rigged with a 30-meter rope, and Laurent reached a narrow platform next to a void. Jean-Marc then descended, and the two looked wide-eyed at each other as rocks fell below them for seven seconds. The ledge suddenly seemed much narrower. Gatziquin turned out to be a 200-meter blind pit of gargantuan

proportions [see map in "Mexico News" in *AMCS Activities Newsletter* 24].

A large amount of material was finally retrieved from the stash cave I Can't Believe It's Not Nita Sakafaai. Originally, the material had been stashed in Nita Sakafaai in 1993 to be used in 1995. But the last members of the 1995 group mistook a new cave for Nita Sakafaai and stashed the material there, leading to some days of nervous confusion at the beginning of the 1997 expedition.

The first deep survey trip went into So On Jan to continue in the canyon beyond the Electrolux borehole where the 1995 survey had ended. With 150 meters of new depth in the area, they ran out of rope at -600 meters and had to leave going canyon behind. A second deep trip was soon organized by four cavers. Starting with 300 meters of rope from the -600-meter level, they followed a series of dry pits and meanders until they arrived, using their last rope, in a large horizontal borehole, the San José Borehole, with many leads. Noting that this would be a good place to set a camp the following year, they returned satisfied to the surface after a thirty-two-hour trip.

The last days were spent making a foray to Lost City to reestablish the trail and descend the big pit found by Roman and David in 1995, whose tale of a hundred-meter-plus pit with air was good bait. Lots of material was retrieved from I Can't Believe It's Not Nita Sakafaai, and they took a 180-meter rope from the new rope-stash cave. With very heavy packs, it was slow going, and a camp was made by some big agaves in the pine forest only halfway to Lost City. Without the stove in the Lost City camp, they were reduced to a cold picnic. The Lost City camp was not reached by late afternoon the next day, so they decided to abandon the effort and return to basecamp.

A closing-of-the-camp feast was organized at Anselmo's in San Martín, where pizzas were made in his new wood-fired bread oven. We also saw that a new small clinic had been opened in San Martín.

A larger and longer trip took place in March 1998. Participants were Stan Allison, Roman Hapka, Artuk Kruk, Karlin Meyers, Thomas Bitterli, Jeff Delhorn, Blake Harrison, Dominique Rouillier, Jean-Marc Jutzet, Jeb Mosenfelder, Joel Despain, Merrilee Proffitt, and Brad Hacker. After securing letters of permission in Oaxaca City, they visited Leo Schibli there at the office of the Sociedad para el Estudio de los Recursos Bióticos de Oaxaca (SERBO) and heard some bad news. In the Chimalapas area, which contains the largest primary forests left in Mexico, field workers had been attacked by Africanized bees and one, a Mexican ornithologist, had been killed. (They later learned that some 40 percent of the Chimalapas has been ravaged by forest fires.) This was a hint at the environmental woes this expedition would experience. Viewing the Cerro Rabón area on Leo's large Landsat images, though, confirmed the importance of its unique environment.

The primary goal of this expedition was to push So On Jan past the 1997 end point at -850 meters. That new area trends away from the main Kijahe system toward the Río Oropan, which made it very interesting.

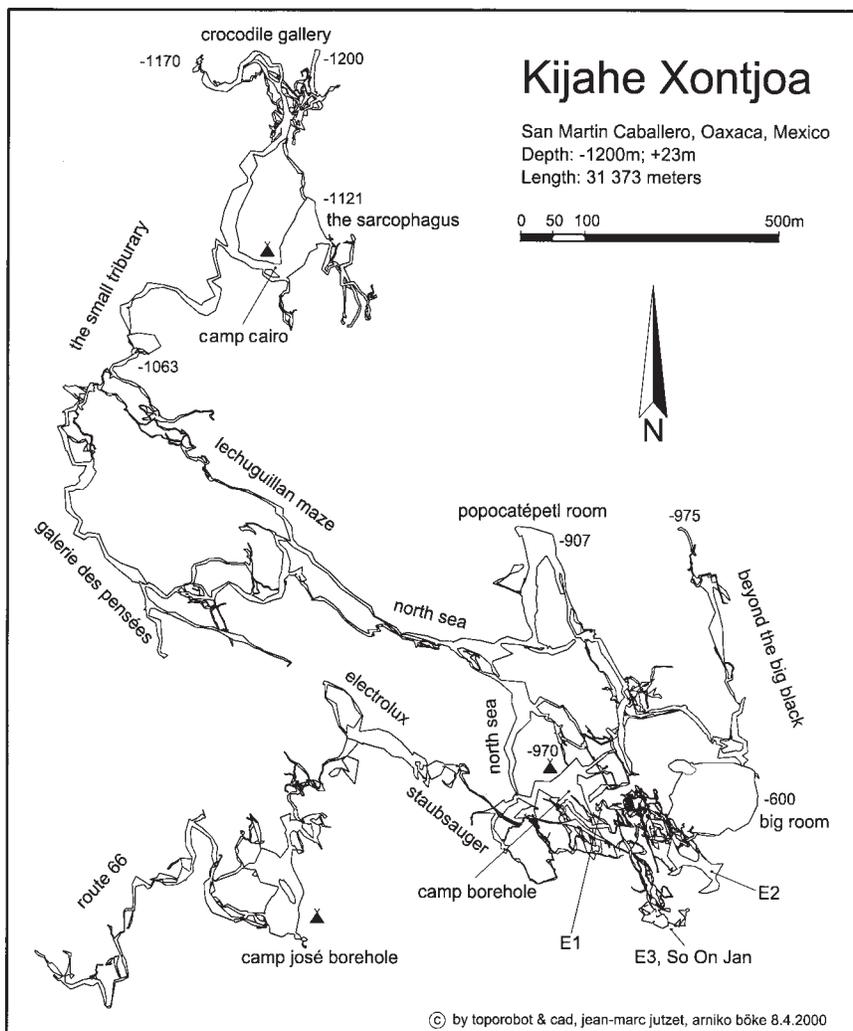
In Tuxtepec, where nearly all expedition supplies can be obtained, including carbide, they learned that it had been unusually dry for the last three months, as a result of El Niño, and they even saw in a newspaper that a large forest fire was being driven by high winds up the mountain from Ayautla toward Cerro Rabón. When they arrived in San Martín the next day, water was suddenly a very big issue. Some locals were being forced to buy water in Cerro Central three hours away. Anselmo immediately explained, not very necessarily, the need for a water project. In addition, sub-zero weather in January had killed all the young corn, adding to the misery in the area. And still the forest fires raged. For a while the cavers questioned the appropriateness of the time and place for a caving expedition, but they had made a big effort to get everyone there, so they could only try. Immediately they set up

rain-collecting tarps at basecamp. By extremely good luck, it suddenly rained for a few hours, and they collected about two hundred gallons of water. The expedition was on, and they celebrated by bringing out some of the eight liters of wine they had brought, which turned out to be all sherry. (Who did the shopping?)

Soon Karlin, Roman, and Artur prepared for the first deep trip to set a camp in the San José Borehole and find water for it. They feared that after three months without rain, So On Jan, normally a surprisingly dry cave, would have no drips. The 50 kilograms of supplies were in five cave packs, since larger duffels won't fit through the tight sections, and included ten liters of water, just in case. The team took nine hours to reach the camp. A very good drip was found only 50 meters from camp, so they didn't

need the twenty pounds of water.

The following day, they first checked the deep continuation of the borehole. A 35-meter pit, the Muddy Blues, led to a small room at -905 meters. A very tight squeeze at the bottom led down a small rift for 8 meters to a narrow meander with a pool. The airflow was outward, not into the cave like the air they were chasing, so they chose not to push this. Thus, for them, the cave ended at about -910 meters. Turning around, a reconnaissance of the main borehole was made. In the middle, a large breakdown pile that reaches to the ceiling makes orientation a bit confusing. The next day they decided to take some photos while surveying the borehole. This would justify having dragged all the of photo gear down. Ready, aim, whoops. No battery power, no photos. The large borehole occupied them for ten hours, during



A Tour of Kijahe Xontjoa

The Kijahe part of the Kijahe Xontjoa–So On Jan system was found deep in the verdant jungle on the last day of the 1989 Cerro Rabón expedition. The 25-meter rope drop into the collapse doline brings one to the entrance to a windy gallery. After a couple of short drops and climbs, one encounters a 45-centimeter slot in the floor where rocks fall for seven seconds. The totally free P199 was first done on a single 8-millimeter rope, somewhat like bungee jumping. At the bottom, a short climb to a large lead can be pushed deep into tight canyons and pits still not completely pushed, but the main route descends into a scalloped stream canyon, following the water for some 100 meters to where it disappears down a hole and the next drop is encountered. Forty-five meters lower, the cave divides into three galleries. The main, windy lead takes one into a dry, popcorn-encrusted meander that is the top of the Dry Pit Series, 120 meters of rapid descent. The other leads are blind or loop into the dry shafts. At the –500-meter level at the bottom of the Dry Pit Series, the cave is quite labyrinthine, and the first explorations were stopped by a sump at –530 meters. A large horizontal gallery in this area leads to a series of pits that descend to a large room at –620 meters. A window in one of these pits leads through a short gallery to an opening into a black void, the Big Room. This room is 120 meters by 160 meters by 100 meters high, and from one side of it a huge blind shaft descends another 155 meters. Rocks rolled into this pit make an impressive echo.

A tight canyon in the labyrinth below the Dry Pit Series leads to the stream and a series of wet pitches. At the bottom of the second wet pitch, So On Jan comes in through a dome at –600 meters. At the bottom of the wet series, at –800 meters, a few side leads take off, though these eventually end at –897 meters. The main lead continues down a wet 56-meter pit to a narrow canyon with

some downclimbs and a few tight spots. Then pits of 28 and 12 meters lead to a sump at –973 meters. A profile map of this much of the Kijahe appears in *AMCS Activities Newsletter* 18 as a foldout following page 64.

Above the sump pitch is a small gallery that leads into the beginning of a huge borehole. At this point the cave goes horizontal, and Camp 1, Camp Bat Yeck, is found. The Camp Borehole has two continuations. One is the Firefly Chimney. This large dome with good airflow has been climbed about 100 meters and still goes. One has the impression it is the bottom of another large cave coming in from the surface. The other continuation is a low, windy lake, the North Sea at –973 meters, which leads to the main part of the deep cave.

From the voluminous, blocky North Sea Passage, where the river is lost deep in the breakdown, the cave splits. Going right just after the borehole narrows takes one up and north to the towering Popocatepetl Room, where galleries continue on though the Lamella Gang, the Stromboli, and Beyond the Big Black, all large, dry, blocky walking galleries. A 30-meter pit in this area brings one to the Subcomandante Marcos River and the Zapata Maze, a lower level that eventually loops back into the main passages. This area has been checked quite thoroughly.

To the left or northwest out of the North Sea Passage, a long, blocky canyon with ancient phreatic features takes off with good airflow. After nearly 500 meters, the passage splits. To the left and down a ramp, one enters the more distinctly old phreatic passages of the British Islands, a low, labyrinthine section where –1000 meters was first surpassed. This area has no major deep leads. The passage above the ramp leads into a set of dry galleries and fissures that are very tight and hot going, like caving in Lechuguilla. This mazy section takes a bit of route-finding, but goes into a room about 10 meters across. To the right and down a windy passage is a deep pit, and to the left is another room with

gypsum needles up to 30 centimeters long. A series of climbs out of this room lead into the Galerie des Pensées borehole, which ended up looping back to the British Islands. This route, however, is longer than the Lechuguilla Maze.

The deep pit drops 80 meters into what is clearly an old vadose streamway at –1063 meters. Rounded cobbles up to 1 meter across and beautifully scalloped, clean rock hint at the large volumes of water that once raged through here. Upstream, the passage mysteriously ends after only 140 meters. Downstream, the canyon is soon blocked by breakdown. A large room overhead does not go. Underneath is a complex maze of bedrock and breakdown that can be penetrated after difficult route-finding. Soon water is heard spouting out of a sumped passage perched high on the left wall, and the borehole turns into a nice river passage. But, typically for Kijahe streams, it does not go far, and the water disappears into fissures after only 100 meters. Shortly beyond, a very large borehole is intersected. To the right, the borehole leads one into an ever-widening gallery past the location of Camp Cairo. Another stream is deep in the breakdown, but cannot be followed. Beyond Camp Cairo is the Sarcophagus, where the ceiling has collapsed along a flat bedding plane, leaving an eerie passage 2 meters or less high and some 30 meters wide. The rock here is very black and has a sulfurous smell when broken.

Left in the large borehole is the 25-meter-wide Crocodile Gallery heading north with airflow. Large breakdown blocks and climbs lead to the terminal breakdown after about 500 meters. Here air howls though the impenetrable breakdown. Back about 200 meters a ramp descends to the Labyrinth, 2 kilometers of honeycombed galleries and rooms with no apparent trend. One lead does go under the terminal breakdown with good air, where the last survey party turned around.—*Karlin Meyers*

which they found no promising leads. The great airflow in the canyon above somehow eluded them. In the end, a large window some 15 meters up on the wall was spotted. A climb and traverse was done to get into the 3-by-4-meter passage, which had the airflow. The next day, the survey continued into the new high lead, Route 66. Winding its way directly toward the Río Oropan, this nice large, often-decorated fossil passage passes through areas of vertical bedding that helped confirm thoughts that they were in another ancient base-level labyrinth. They were soon stopped by a pit and lack of rope and carbide. After a nine-hour ascent, they left So On Jan into a very dry forest. Smelling smoke, they feared that the forest fire was still burning and getting very near the Kijahe valley. Back at the Rat House basecamp, the smoke was indeed so thick one could not see San Martín 500 meters away across the doline. The fire still raged after eight days, and a *viento diablo* howled through the night, nearly tearing the metal off the house and driving more smoke and fire toward San Martín. There was little sleep, due to the noise and anxiety. The next afternoon, however, the prayed-for rains came. Everyone, including the locals, was laughing with relief. But then it rained and rained and rained . . .

Thomas, Stan, and Jean-Marc then departed for a six-day trip into So On Jan. They arrived at the camp

in five hours. Continuing on in the camp borehole, they surveyed 550 meters of small galleries that surround it. A loop was found that connects into Route 66, saving thirty minutes of travel but requiring a 4-meter ladder climb. In Route 66 they surveyed another 550 meters.

The 10-meter pit where the previous group stopped was rigged, and this led to a nice passage with gypsum flowers and needles up to 40 centimeters long. Route 66 has become one of the nicest passages in the whole system. On another day, the group surveyed down an 11-meter pit and got another 320 meters, following the good airflow that disappeared finally into a very unpromising breakdown. Climbing in it was stopped where rope would be needed to reach a possible hole higher in the breakdown. The rest of the collapse was fruitlessly scoured. Back a few hundred meters, Stan did a scary 30-meter climb to a blind balcony, and the team finished with an additional 270 meters of mop-up survey in Route 66 before leaving the cave.

Roman, Karlin, and Artur went to Nanda Nita, a multi-entrance stream cave located about forty minutes north of San Martín. While the horizontal cave had already been surveyed, the third entrance, a pit, was still open. They surveyed down a 71-meter pit to a bridge. Both sides continue down and join to form a nice, clean-washed descending tube with water and air,

but this suddenly ends in a 4-inch-wide fissure at -153 meters. The airflow had been lost, so they climbed back up to a small, tight gallery at -90 meters that did have strong airflow. In 20 meters the airflow went down a 0.35-meter-wide slot. Having been soaked by the entrance waterfall, they were quite chilled and declined the nasty slot.

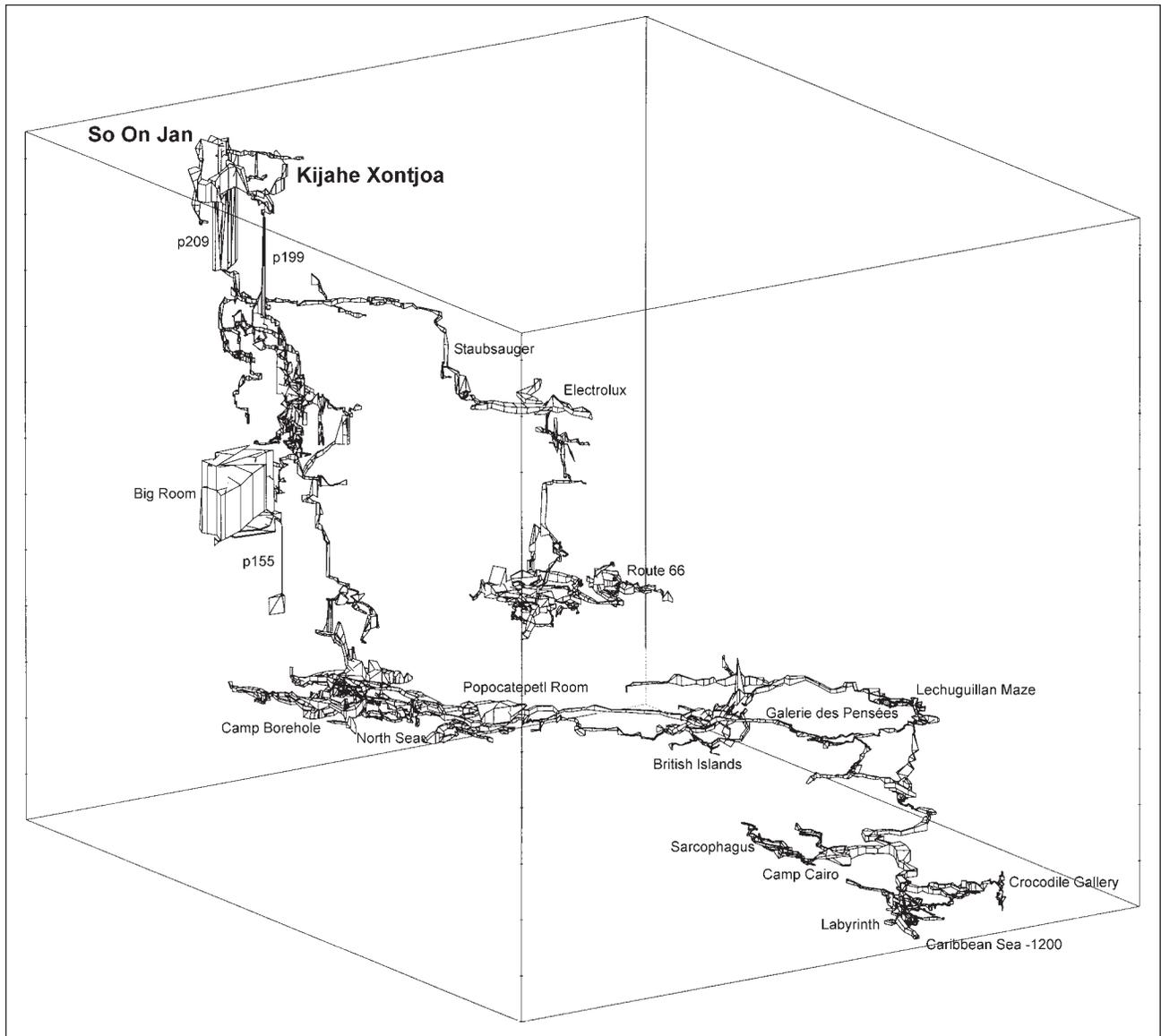
Stan, Jeff, and Thomas went to the Nita Ye Heke clearing armed with Thomas's excellent doline map. They spent two days surveying four new caves, but all were short and not deeper than 45 meters. They declared part of the clearing finished.

The next day, Stan, Jeff, and Thomas headed into cave, but this time the Kijahe. The goal was to check beyond the large window at the bottom of the 199-meter pit, a lead called simply Continuation 81. The traditional tie-off tree for the Kijahe doline had fallen, so rigging was a bit more awkward. At the bottom of P199 was a large stash of ropes, so with full bags they slowly climbed back up a bit and came to the 30-meter-pit lead left by Philippe Rouiller in 1989. Beyond the 30-meter pit were two very narrow and uninviting canyons leading off. Ten meters up, however, there was a huge window, but this passage too broke up into many small fissures with strong airflow. They then pendulomed across the pit to another meander, which continued about 40 meters to a nice, round 20-meter pit. Passing several leads in this pit, they followed the meander at the bottom for about 70 meters to the top of yet another pit, of 15 meters. Here they stopped, left the gear, and returned to the surface safely at 3 A.M.

Stan and Thomas returned to the Nita Ya Heke-Sakafaai region, which is a very confusing jumble of pits and fissures. They managed to survey into previously surveyed Taza de Baño and then concluded that the area had been well checked. So they headed to a doline that Thomas had marked on his map back in 1991, but got distracted

Karlin Meyers in the Crocodile Labyrinth. *Arniko Böke.*





along the way by another pit. They descended the 40-meter pit into Four Winds Cave and found a nicely decorated horizontal passage that intersects the doline they had been seeking and continues to a breakdown area after 300 meters.

Joined the next day by Karlin, the three returned to Four Winds Cave and its main going lead, but after 100 meters a very tricky climb was encountered. Unequipped to tackle the overhang, they left, after finding another lead to a pit. Some days later, after the arrival of Joel, Merrilee, and Brad, Stan took them to Four Winds Cave to check this last lead. The blind pit was traversed, but after 100 meters the strong airflow was lost down impenetrable

cracks. So Four Winds blew out after 500 meters.

According to a field map by Thomas, there are numerous interesting dolines in the region just uphill and northeast of the Kijahe doline. Thomas and Jed went to a promising-looking pit that turned out to be 80 meters to a small offset and another 56 meters to the bottom at a nice narrow canyon with strong airflow. They named it Hard Rock Cave due to the particularly hard limestone, and they turned around at -160 meters. Thomas returned the next day with Joel and Merrilee. They surveyed minor horizontal passages at the deepest point reached the day before and then continued down pits of 29 and

35 meters to a small room. The way on was a very tight vadose canyon to another small room with large helictites. Good air continued into an even tighter meander. After 6 difficult meters in this, a large 20-meter pit was reached, followed by pits of 15 and 5 meters. There are several windows in this deep area, but most of the airflow descends down the next pit. Out of rope, they left the cave. Several days later, Joel and Merrilee returned with Stan, who was unable to follow through the tightest meander. While the others went on to survey, Stan hammered away, enlarging the meander. Joel and Merrilee stopped at the top of what looks like a 30-meter pit with strong airflow. So far the cave

is 275 meters deep and 400 meters long.

The next day, Thomas took Joel and Merrilee to the Kijahe to push in Continuation 81. Some days of rain had made the passages quite wet. Encountering poor-quality rock, they spent some time rigging and looking for a drier route around some wet pits. After finding a dry meander, they stopped at the top of a 20-meter pit, a good end point for that trip. The next day they took Stan with them to So On Jan to look at some open leads in the Staub-sauger. The first lead went down an 8-meter drop to 100 meters of passage to a flowstone choke with good air. Stan completed two climbs that ended at the base of a shaft estimated to be 100 meters high, also with good air.

During the final days of the expedition, Brad, Jeb, and Thomas ventured into the region beyond Nita Tii, an hour from basecamp and on the upper trail to Tenango. They tried to relocate the big pit that had been found there by Roman and Thomas in 1995. During their overland survey, they located many

interesting pits, but did not find the big one. After seventy-one surface stations, they simply noted that there is lots to check during another expedition.

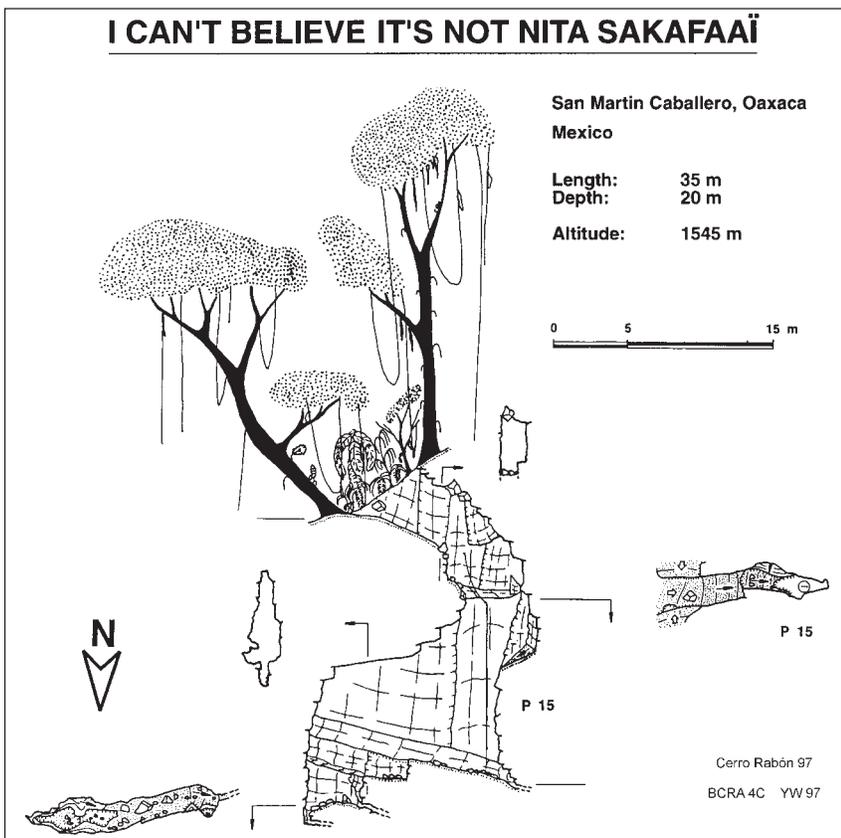
In all, the 1998 trip mapped 1.5 kilometers in eleven new caves and added over 2.5 kilometers deep in So On Jan, but the big extension hoped for in the San José Borehole fell a bit short of expectations. Hard Rock Cave, which has a couple of narrow spots, has very good airflow and potential to go deep before perhaps connecting into the main system.

In late fall of 1998, a tragic caving accident in Switzerland took the life of Thomas Bitterli. He succumbed while attempting to save a caver stranded on rope in a waterfall. For his friends and the Cerro Rabón project, this was an immense loss. He had been the key organizer and motivator for the project in recent years, as well as one of the strongest cavers. Needless to say, many of us were too dismayed to consider a trip in the following spring. But we all agreed that

Thomas's wish would be for us to continue in the Cerro Rabón, and so a small expedition was organized, mainly by Yvo Weidmann and Catherine Perret in Oaxaca, where they had been working with the SERBO environmental office for some fourteen months. Nathalie Gumy and Laurent Déchanez with their daughter Lea, Sybille Kilschmann, Michel Bovey, and Jean-Marc Jutzet joined the trip. Due to the small crew, no deep trips were made, but there were some adventures in the bush. They also oversaw a rain-water cistern project for the community of San Martín that was sponsored by the Swiss social aid organization ARPE, the Association pour la Réalisation de Projets de'Entraide. Initiated by the cavers of the Cerro Rabón project, its intention was to bring the most neutral and general benefit to the town. The cistern project was executed in a serious, professional manner, but the political ramifications were greatly underestimated. In the end it provided another target for the growing political animosities among the local people in San Martín. This we did not expect.

Ventures into the forested karst produced Live in Busch, a new pit discovered very near the So On Jan area and sporting another voluminous drop, of 220 meters. The small Kijahe valley now has four two-hundred-meter pits, all within 100 meters of each other.

A big effort was made to venture into the Lost City valley again. The forest camp was reached with a 200-meter rope, and a trip to the deep pit found by Roman and David in 1995 was made. Unfortunately, they found when they got there that a group of Americans had beat them to it, a great disappointment due to lack of communication between different expeditions. On the bright side, though, maybe they were lucky, because the pit turned out to be 260 meters deep. No one noticed burned areas, so apparently the moist deciduous trees that grow low in the Lost City valley were not disturbed by the fires of 1998, much to their relief. They later learned that the fire had moved very quickly, above the ground, and mostly on



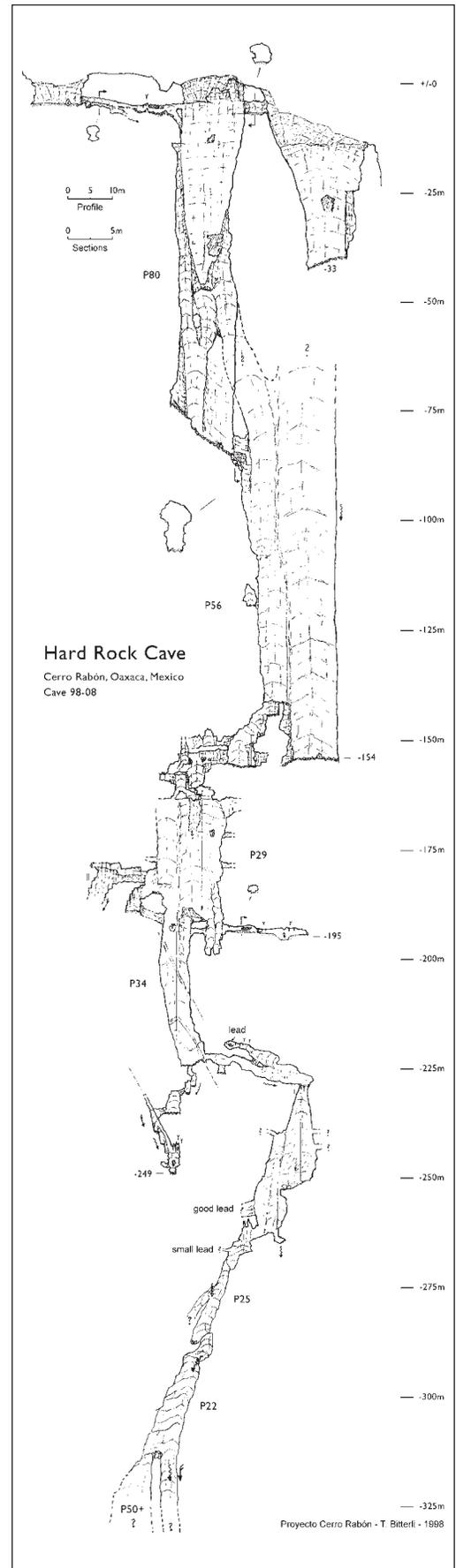
higher hills and ridges vegetated by pine and cypress forests. SERBO said that the Cerro Rabón has the largest tract of primary cypress forest in Mexico, or did have

By winter 1999, enough enthusiasm had returned that a trip was planned for March 2000. Rather quickly, fourteen participants were gathered: Nathalie Gumy, Laurent Déchanez, Jean-Marc Jutzet, Arniko Böke, Karlin Meyers, Stan Allison, Gosia Allison, Svanke Vogel, Herve Krummenacher, Peter Haberland, John Bradley, David Cole, Page Ashwell, and Martin Bochud. There were enough people to run two deep camps simultaneously. The chief goals were to try to finish the deep region in So On Jan and to push the deep labyrinth in the Kijahe. The quests for permission went very well in Oaxaca City and also Tenango, but the new PRD people in the *agente's* office in San Martín were not pleased with their presence, and granting of permission was put off until the *agente* arrived back from Mexico City at the end of the week. While the locals were for the most part very helpful and friendly, they felt a bit uneasy about this new development and sensed trouble. They were nevertheless allowed to begin the expedition, presumably due to their letter of permission from the *presidente* in Tenango, who was the father of the acting *agente* in San Martín. It was a bit difficult to plan exploration while fearing they might have to leave in less than a week, but local friends assured them that things would be okay, despite the fact that the office was for the moment in the hands of some hotheads. It turned out that the *agente* did not return until the end of the following week.

The gear stored in numerous places was all in good shape, and they did some shakedown trips into the main system, but nothing deep, initially. Stan, Gosia, and Karlin descended to -450 meters in So On Jan to a lead in the Staubsauger shaft that had been noticed by Thomas. After only 35 meters, it looped back under the pit and ended in breakdown and disappointment. They

returned to the base of the 30-meter pit just below P209, where Karlin discovered a small, going streamway just meters away from the end of the rope. After a quick look down 30 meters of small meander, they decided the lead was worth another trip. The next day, Stan, Jean-Marc, and Karlin returned, and they descended 45 meters of pits followed by 75 meters of nice clean meander. Still following good air and water, they began the next pit series, but soon ran out of rope. Arniko, Stan, and Gosia returned enthusiastically the next day loaded with rigging gear and 300 meters of rope, ready to go deep. They descended the next pit, 16 meters deep, into a narrowing meander. Doubting that it would go, they sent Stan ahead for a quick look. He found an 8-meter drop to a 30-meter water crawl, and then a 10-meter pit and 60 meters of meander left him at the top of yet another pit, where he stopped. Though the air and water went on, they decided one would have to be desperate to continue, so they left it for now.

Another lead-checking trip into So On Jan was made by Karlin and Page. They descended to the -550-meter level in the canyon beyond the Electrolux borehole. The first lead was a nice horizontal gallery, but the floor was soon covered with gypsum needles and flowers, and they turned around. The next lead was a breezy hole in the floor of the canyon, where they surveyed numerous small galleries and loops before descending the main drop. Page rigged into a wet shaft with lots of sharp blades of rock. A dicey redirection gave way, swinging Page into the wall, where he received a bloody head



wound. At the bottom, they escaped down a small pit that dropped back into the main canyon. The two prudently and slowly headed out and were passed on the trail by Jean-Marc, Martin, and Laurent, who were on their way to the San José camp in So On Jan for three days.

This deep crew found small but going leads in the San José Borehole, but they had to leave camp on schedule because of the tenuous political situation above. As they ascended, they noted other leads in the canyons above. Some of these, just below those that had been checked by Page and Karlin, were checked by Laurent, Herve, and Jean-Marc during the following week. They quickly found going passage, the first being a parallel 100-meter pit where they ran out of rope. Horizontal galleries were looked at and left unfinished. The surveys throughout the system show a very complex zone of dendritic passages between about -550 and -650 meters. Junctions are plentiful, and surveying and route finding take a lot of time there.

Meanwhile, Arniko led a trip down Continuation 81 in the Kijahe. Dragging along extra rope and rigging gear, his group took nearly seven hours to reach the previous end from the entrance. Therefore

The top of the 209-meter pit in So On Jan. *Arniko Böke.*



little was accomplished, and they returned unenthusiastic, describing a tight, miserable canyon still going.

A few of the new participants, Jean-Marc, and Laurent made a foray westward to the huge doline seen on air photos west of the Nita Ya Heke area. They found beautiful virgin jungle scenery, but no going caves.

A deep trip by four people was finally planned near the end of the expedition. They had waited long enough for the *agente* to show up, and if a Camp Cairo trip in the Kijahe was to take place, it couldn't wait any longer. In case permission was denied and basecamp had to be evacuated during the deep camp, a place and time to meet in Tuxtepec were set. Karlin, Arniko, Stan, and Page packed up for five days underground. Near the entrance, Page decided it would be more prudent to stay above. The others continued on in, rigging the wet zone from -650 to -950 meters as they descended. Crocodile Gallery was reached after twelve hours. They plodded over the breakdown blocks looking for Camp Cairo, which none of them had seen before. Bad news awaited them, however. Camp was found marked by rope and a large carbide bottle, but the borehole had experienced a major flood since the

last trip there in 1995, and the rest of the camp gear was gone. After an hour searching through breakdown, they found only three damaged Thermarests. Too tired to go back to Camp 1, they spent a cold night sleeping under space blankets. That the huge borehole had flooded was a sobering thought.

The next day they went to the terminal breakdown, last seen during a survey trip in 1991, above the Crocodile Labyrinth. Stan and Karlin shimmied their way up, down, and around, but found no good possibilities. They slowly realized that the sound of a waterfall just beyond the blocks was in fact the noise of airflow, which in places nearly blew out their ceiling-burners.

After nearly two hours, they gave up. This would be a job for a master blaster.

They then made their way back to Camp 1 to gather camp and sleeping material. Luckily Camp 1 had enough for six people, and they could take half to Camp Cairo. The round trip took eight hours, but they scored a half-pound of beef jerky.

After a better night's rest, they ventured into the Labyrinth, where finding a way through was another major objective. The previous day they had been going over huge blocks in a large borehole to the end of the cave. Now they filed down a ramp under the breakdown and immediately found themselves in an extensive boneyard. With passages leading off in all directions, they would have been totally lost without the map from the 1995 expedition. The day was spent getting oriented and checking some of the more than thirty open leads, many of which looped back into known passage. One could say there was more air than rock there.

On their fourth day underground, they ventured into the lower level of the Labyrinth and, using the map, toured the main hall and the river that flows in from the north, possibly the same river seen near camp. And finally they visited the Caribbean Sea, a very large terminal sump and the deepest point in the system.

Determined to find some airflow, they returned to some open leads higher up. Eventually a passage with air was found heading off the west side of the labyrinth. They came to a small lake, where Stan climbed up and over to a small passage in the ceiling. While waiting, Karlin crawled into a hole in the wall. This large crawlway had great airflow, and Karlin and Arniko scooped for some fifteen minutes before turning around. It went, but was not spacious. They found Stan, who gave his lead a thumbs-up, so they surveyed that way. The gallery was distinctly different from the Labyrinth and quickly picked up more air, to the point of being chilling. After 150 meters, they were running out of light and time. Stan

scrambled through some muddy breakdown for 80 meters to check ahead. It was narrow, blocky canyon, but it had good airflow and was located almost directly below the terminal breakdown in the borehole. Of course, right at the end of the expedition . . .

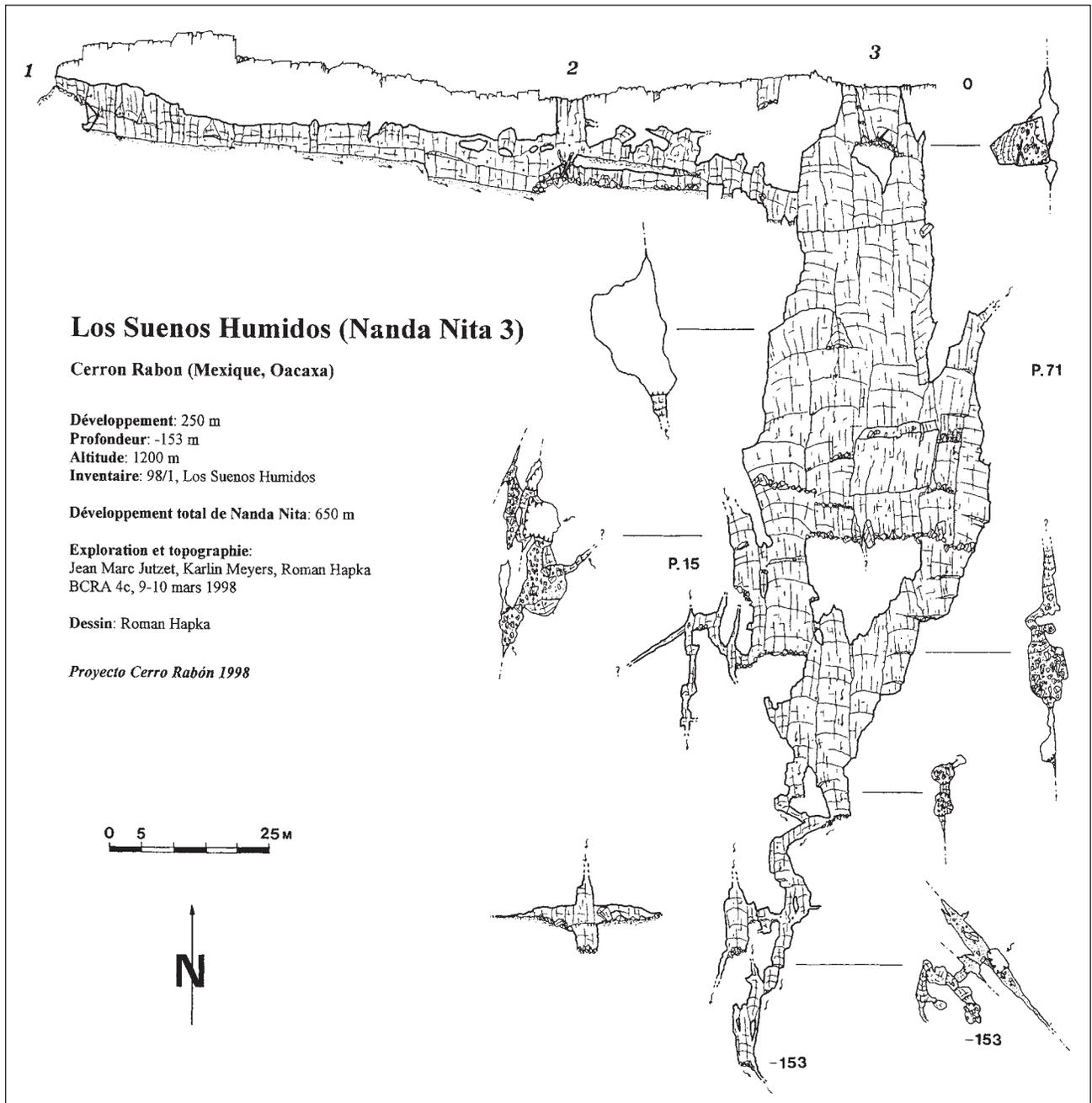
Returning through the new passage, Stan took a 3-meter fall that scared them a bit, but Stan was only bruised, luckily. Then near the ramp up out of the Labyrinth they paused to take some pictures. The equipment box exploded when Karlin

opened it, burning his hand rather severely. Stan had put used carbide inside.

The next morning they slowly headed out, derigging and stashing the ropes in the wet series as they went. The zone between -550 and -950 meters becomes an impassible maelstrom in high water, as was experienced in 1992, when a group was stranded for fifty hours in Camp 1. While jumaring up the 19-meter pit at -580 meters, Karlin heard a roar and stopped to listen. "It took me some five seconds to

realize a flood was coming. I looked up at the small passage above me and started hauling ass. At the same time I screamed to the others, who were in the horizontal passage below, 'Flood!' Just as I did, the shaft below me filled with thundering water. I couldn't imagine what had hit the others, but after twenty minutes I saw Arniko's helmet coming up through the waterfall. Shortly after came Stan. Both were high on adrenaline and soaked to the bone."

They had one more waterfall pitch to climb before losing the





Base camp during the 2000 expedition. *Arniko Böke.*

returned to the surface to wait for the others. The two rerigged down to the point reached in 1998, where they continued into a small shaft taking water and corkscrewing down some 45 meters, to where it split, with strong airflow. The pit directly below continued wet, and a dry pit continued down a few meters to one side. A bolt was set, a David rappelled on down the dry one, but was left dangling at the end of the rope 20 meters below the rig point in a very large pit with a floor an estimated 30 meters below him. With water and strong airflow it remains a very promising lead, but time was against us, and the next day the Cerro Rabón camp for 2000 was closed.

stream. The rope, which had been damaged previously, was not even visible in the torrent, so they made a 25-meter climb up a chimney and then, using the rope they had been carrying to replace the damaged one, executed a traverse over the waterfall to the canyon upstream. By now, an hour after the flood had arrived, the water-level had already dropped by a third. They then continued up into the "dry shafts," which were certainly not dry, though no one had seen them wet before, and they made a short stop at the -400-meter level. Had they been slower lower down, so that the flood had hit them deeper in the zone of wet shafts, they would have been in a very bad situation. The bottom of the P199 was filled with heavy rain, and to go up the long, free pitch was out of the question. Luckily, some years before, Patrick Deriaz had rigged a drier route up the side of the shaft, where many rebelay made simultaneous climbing possible. Thought still quite wet, it went well, and they left the cave into daylight. A cloudburst had occurred, filling the water cisterns in minutes and the cave at -600 meters two hours later.

Wet and tired, the three returned to basecamp, which was still there.

Formations in the Crocodile Labyrinth. *Arniko Böke.*

At last the real *agente* had reluctantly granted permission, although he did not want to be seen at our camp, fearing that fellow members of the PRD would accuse him of accepting a bribe.

A last-day push was made by David, Karlin, and Peter in Hard Rock Cave, found and begun in 1998. They descended quickly to the first tight meander at -225 meters. Taking 80 meters of rope with them, Karlin and David slowly squeezed through 6 meters of meander to the 20-meter pit. Peter was not able to make it through and

Returning cavers were often asked, "How did it go?" and too often the reply was "Out of rope!" In fact, the Cerro Rabón has gobbled up some 4 kilometers of rope, half of which is still rigged, and the number of known deep pits has grown with each expedition. Geologically, the plateau seems to have lacked impermeable strata at the surface to collect surface waters before dumping them into the limestone at the contacts, as apparently happened at Cheve and Huautla. Rain sank immediately and drained



rapidly through over 1000 meters of limestone before hitting the hydrologic base level. The result is a highly developed karst sieve of alpine character: any small hole could lead to something big. There are probably myriads of vertical conduits yet undiscovered. To date we have found no major underground river or "main drain," and the ubiquitous presence of good airflow near the surface and deep down indicates that there is still much more cave to be found. When one views the plan of the Kijahe-So On Jan system superimposed on a topo map, it is seen to underlie a small area of less than 2 square kilometers, which is not much compared to the 35 square kilometers of surface area so far considered.

After the 2000 expedition, the

Kijahe had grown to 31,373 meters long and 1223 meters deep. Although no booming borehole leads are known, many small ones are, and there is always that open window in the wall of a pit that we forgot to check . . .

Having a good basecamp, usually a rented house near San Martín, has had many advantages. It provided a comfortable and memorable place to cook, organize gear, and socialize, including with local people, so it was a great morale-booster and a fun part of the expedition experience.

Unfortunately, after fifteen years of visits to San Martín, our presence is not welcomed by all. In the last couple of years, intense political differences among the region's inhabitants have grown, and the

Cerro Rabón cavers have been caught in the crossfire. Although for the most part the locals have been very friendly and helpful, a small opposition group that has recently come into power has made it clear we are no longer welcome. We think it is obvious we are scapegoats in the local politics, but unfortunately cultural differences also play a role. Continued exploration in this area is uncertain, and future efforts will require some skilled diplomacy.

We have received generous support from sponsors we would like to thank: Mountain Safety Research, Sierra Designs, Pigeon Mountain Industries, Malden Mills and the Polartec Challenge Award, and Gonzo Guano Gear.

Cerro Rabón 1995-2000

Varias expediciones organizadas por espeleólogos suizos a la meseta de Cerro Rabón, en Oaxaca, se llevaron a cabo en 1995, 1997, 1998, 1999 y 2000. La principal cavidad del macizo es Kijahe Xontjoa, que a principios de 1995 tenía 1181 metros de profundidad y 19 kilómetros de longitud. Después de la expedición de 2000, la profundidad alcanzó los 1223 metros, y la longitud superó los 31 kilómetros. Hay muchos otros pozos en el área. En un radio de 100 metros desde la entrada a Kijahe hay tres pozos de más de 200 metros. Uno de ellos, So On Jan, conecta con Kijahe a -600 metros. A diferencia de las cercanas áreas de Cheve y Huautla, en el Cerro Rabón no hay rocas impermeables en la superficie que colecten y concentren el agua, así que no hay arroyos superficiales, ni siquiera en época de lluvias. Los suizos construyeron un sistema de recolección de agua de lluvia para la población de San Martín Caballero, cerca de su campamento base, pero a pesar de ello, problemas entre los lugareños han dificultado los viajes más recientes, y se requerirá diplomacia para continuar los trabajos en el área.

TABASCO 2001

Bob Stucklen

with a contribution by Jim Pisarowicz

On January 3, 2001, Jim Pisarowicz, Abby Snow, my wife Deb, and I met at Dave Lester's house in Littleton, Colorado, for the start of our trip to the state of Tabasco in Mexico. Our mode of travel was Jim's 1973 Pinzgauer, a surplus Swiss Army four-wheel-drive truck that Jim had outfitted with a plywood shell. Having been delayed two days in Texas by a fuel-pump problem, we arrived at 2:00 A.M. on January 9 at Teapa, Tabasco. Teapa is a city of about fifty thousand located fifty kilometers south of the state capitol, Villahermosa. We set up camp at Grutas de Coconá, a show cave adjacent to Teapa. Before we left there in the morning, we met one of the guides, Nicanor Jiménez Palomenques. He told us of some unmapped caves in the area and offered to guide us. One cave he described was called Gruta de las Canicas, which means Cave of the Marbles. We arranged to meet him at a bus stop near his home the following morning.

We proceeded on to Tapijulapa, a small town thirty kilometers southeast of Teapa. Our objective was to set up camp at the Centro Cultural, where previous Villa Luz expedition participants had stayed. To our disappointment, the quarters were unavailable. Several alternative locations were suggested. We settled on renting the second floor of a cement home in the nearby village of La Pila for fifty dollars a month. The owners chased out the chickens and turkeys, scrubbed the

Based on Deb Stucklen's notes on the trip.

tile floors, and hauled in some couches and chairs. Deb and I set up our tent in one room, and Jim and Abby set up hammocks on the patio.

Next morning, caving gear in hand, we met up with Nicanor, who guided us down dirt roads for about ten kilometers east of Teapa to a ranch, where we parked. For an hour, our guide led us over a muddy cow path, across a field, and over a log crossing a stream. The hike ended at the jungle hut of Chucho Guzmán and his family. Chucho was familiar with the nearby caves, which he explored when he did not have to tend the landowner's cattle. Chucho took us first to Gruta de las Canicas, decorated with draperies, flowstone, mammillaries, and rimstone throughout. He took us to a lower level full of dry rimstone pools containing cave pearls. At the lowest level, we were amazed to walk over a flat floor covered with cave pearls. From there, Chucho led us to one side of the room, where there was a belly crawl. In the short crawlway, the cave pearls acted as ball bearings for us to roll on. Shortly, we found ourselves in an extensive hallway, the floor being entirely covered with layers of cave pearls. We could readily scoop them up in our hands. I took photos and Jim took videos using his digital camcorder. We had never seen or heard of anything like this. A stoopway at the end of the hall took us to a room that rose to an exit.

Chucho then took us to Gruta del Tigre and a small cave that we named Tinaja. Tigre contained

Mayan pottery shards in the entrance room. In the same area is Gruta de los Mayas, where there are marks all around the walls of a small pit in the floor. Chucho said Mayan Indians made the marks as they collected clay for making pottery.

The next day, January 11, Chucho was unable to be with us, so we cleaned our gear, ran errands, and went to Grutas de Coconá for a tour given by Nicanor. Nicanor asked Deb for the English translations of all the things he said the formations looked like, such as an alligator or a king, so that he could give the tour in English as well as Spanish. Deb also translated Jim's articles on caves of Tabasco (see *AMCS Activities Newsletters* 16 and 17) into Spanish and gave copies to Jim and Nicanor the following week.

During the next four days, we surveyed the three caves we had been shown. Abby did an excellent job of sketching. January 13 was spent visiting the zoological and archaeological park in Villahermosa. On January 15, Chucho informed us he had made arrangements for us to meet with the Teapa officials on the following day.

On January 16, we met with the government officials in the *presidente's* office at the *ayuntamiento* in Teapa to report on our findings. They were impressed with Jim's videotape and Abby's sketches of Gruta de las Canicas. They offered us hotel accommodations in Teapa. We gladly accepted their offer, since this put us closer to the caves we were surveying.

After spending a day relocating,

we continued surveying. We took time to visit with the manager of a nearby banana plantation to ask permission for me to fly in to their airstrip next year. On the twentieth, a rainy day, Jim and Abby set out to survey between the cave entrances and map Gruta Reconocida, which was home to a colony of vampire bats. In the meantime, Deb and I went to the nearby library to find out more about Teapa.

On January 21, Chucho accompanied us in the Pinzgauer to where we could hike to a large cave that we named Gruta Mayor del Parque Estatal de la Sierra, near Arcadio Zentella, a small village eleven kilometers east of Teapa. Gruta de la Sierra was located on a steep jungle hillside a 3-kilometer hike from the village. It had three entrances with large breakdown blocks sloping steeply down to numerous flowstone speleothems. A column at least 20 meters in height was covered with cauliflower-like protrusions. This was, by far, the largest cave we visited on our trip. We would need

to return with rope to check out the vertical drop located in a lower crevice of the left-hand wall.

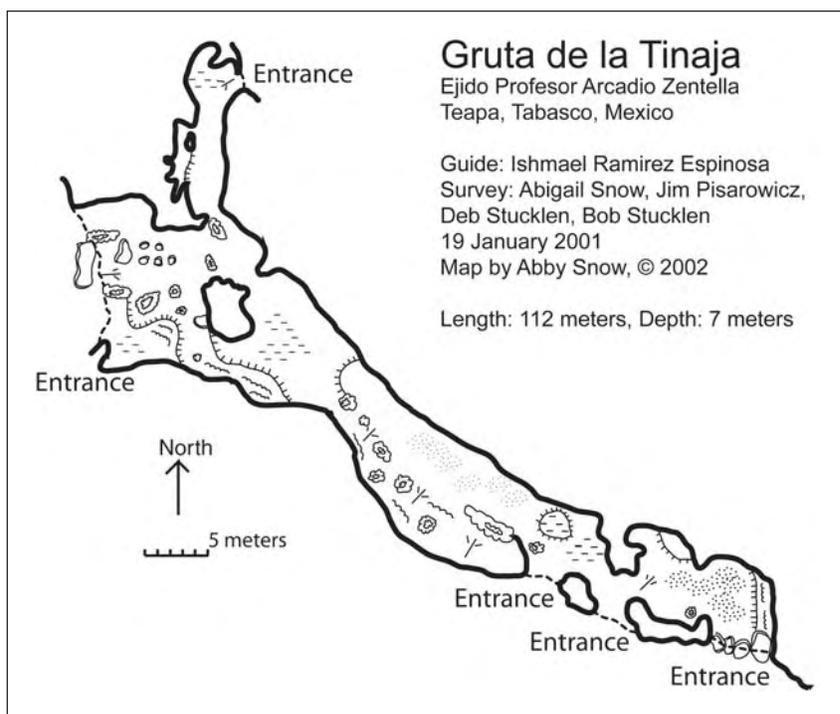
After a day of rest and errands, we returned to Gruta de la Sierra with climbing gear. Jim and Abby rappelled the drop, but the lower passages were choked with mud. We took photos and videos in the cave. The next day, Jim and Abby returned once more, and this time they found drops leading to well-decorated passages and a small underground lake the villagers in Arcadio Zentella had spoken of. Meanwhile Deb and I took photos of Mayan artifacts at the museum at Grutas de Coconá.

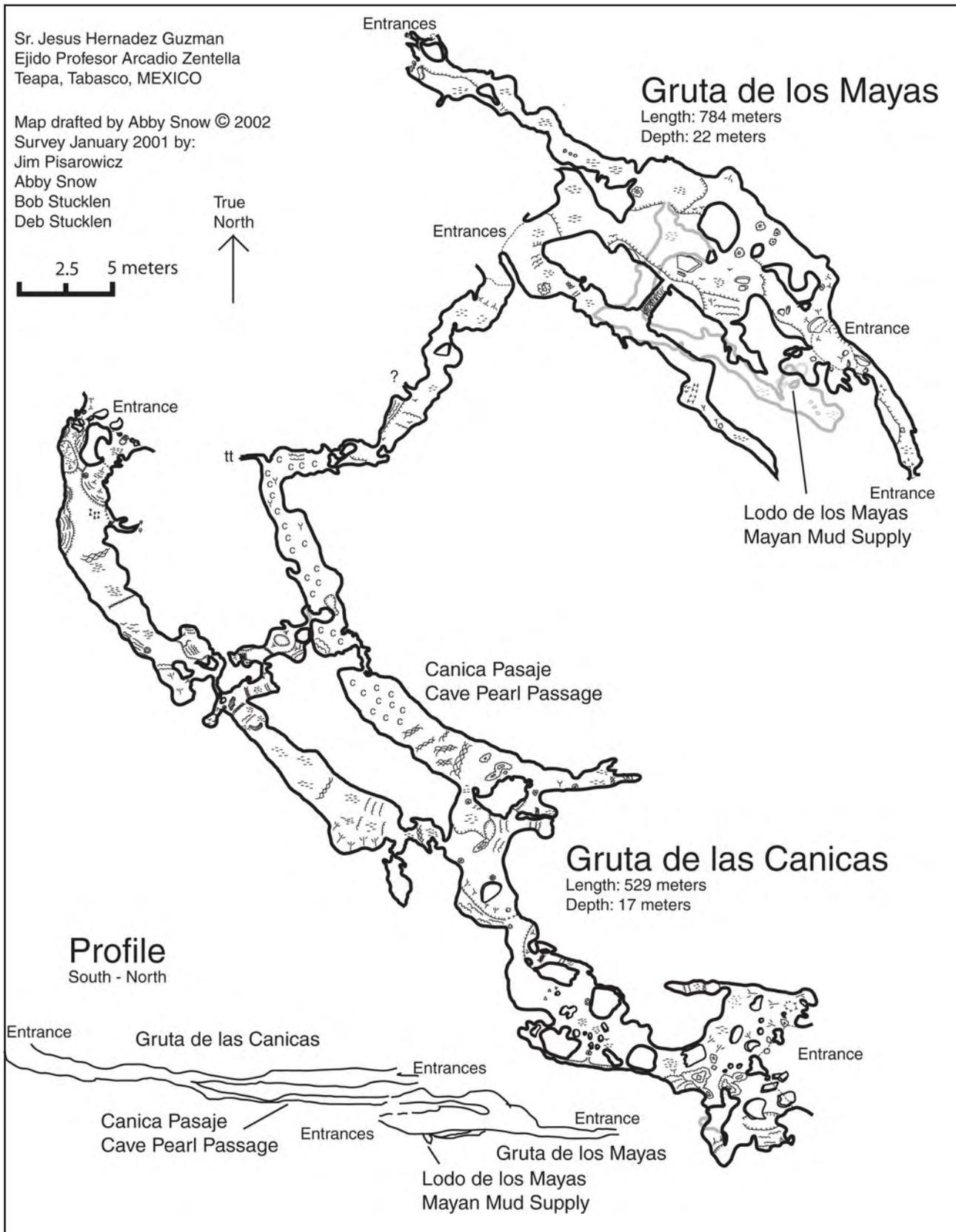
Thursday, January 25, we were invited to meet with numerous government officials at the *ayuntamiento* to hear their environmental and economic concerns for the region. They discussed the depletion of the rain forests, endangered animals, drought, pollution, overpopulation, health, and education. They asked what the caving community could do to coordinate

knowledge and efforts with Mexicans and to educate people in the United States about Mexico's efforts to solve its problems. We made arrangements to accompany the officials on January 30 to some of the caves.

The period from the twenty-sixth and the twenty-ninth was spent taking Abby to her bus in Villahermosa to return home, caving in Villa Luz, and touring the Palenque ruins.

On January 30, cave gear ready, we met an official dressed in street clothes in Teapa to go caving at Grutas de las Canicas, de los Mayas, and del Tigre. We made sure to bring all our lights and spare helmets. There were twelve more officials from Teapa and Villahermosa waiting for us when we arrived, all of them in street clothes. We walked to the Guzmán hut, where Chucho met us, beaming joyously. We shared our caving gear as much as possible. The officials were impressed with the cave pearls in Canicas, the pottery shards in Tigre, and the ancient finger scrapings in





Two Hundred Million Cave Pearls?

A trip into the Pasaje de las Canicas in Gruta de las Canicas is a truly amazing journey. Most cavers' previous cave experiences do not prepare them for the sight of a spacious passage that goes on and on with a floor deeply covered in cave pearls. Until I saw this passage I could not have imagined such a sight. We were not the first people to enter this fabulous cave. My field notes from a 1988 trip into the area indicate that Peter Lord mentioned a cave with lots of cave "marbles." We did not check out that lead at the time, because we were occupied with other caves, as described in *AMCS Activities Newsletters* 16 and 17. The cave entrance is a stone's throw from Gruta de los Mayas, in which Sr. Guzmán found Mayan artifacts that are now in a Tabascan museum. An article on the cave by Roberto Porter Núñez appeared in the August 1999 issue of *México Desconocido*.

After leaving Canicas that first

day, I remarked to the other cavers on the trip that I had never seen such an assemblage of cave pearls, and I had never heard of such a collection of cave pearls in any other cave. I thought that an estimate of the number of cave pearls in the cave would be appropriate.

My method to come up with the number of pearls in the cave was fairly simple and very crude, but probably gives a general ballpark estimate. On one trip into the cave I carried a small piece of PVC pipe. I pushed this pipe down into the cave pearls at ten different spots in the Pasaje de las Canicas. I scooped the pearls from around the pipe, slid a piece of flat aluminum under it, lifted it, and then counted the number of pearls in it. I then calculated the average number of pearls for the ten different sample locations. Dividing by the cross-sectional area of the PVC pipe gave the number of pearls per unit area. From the map of the cave I estimated the total floor space that was covered in pearls. With these data

in hand the number of cave pearls could be estimated.

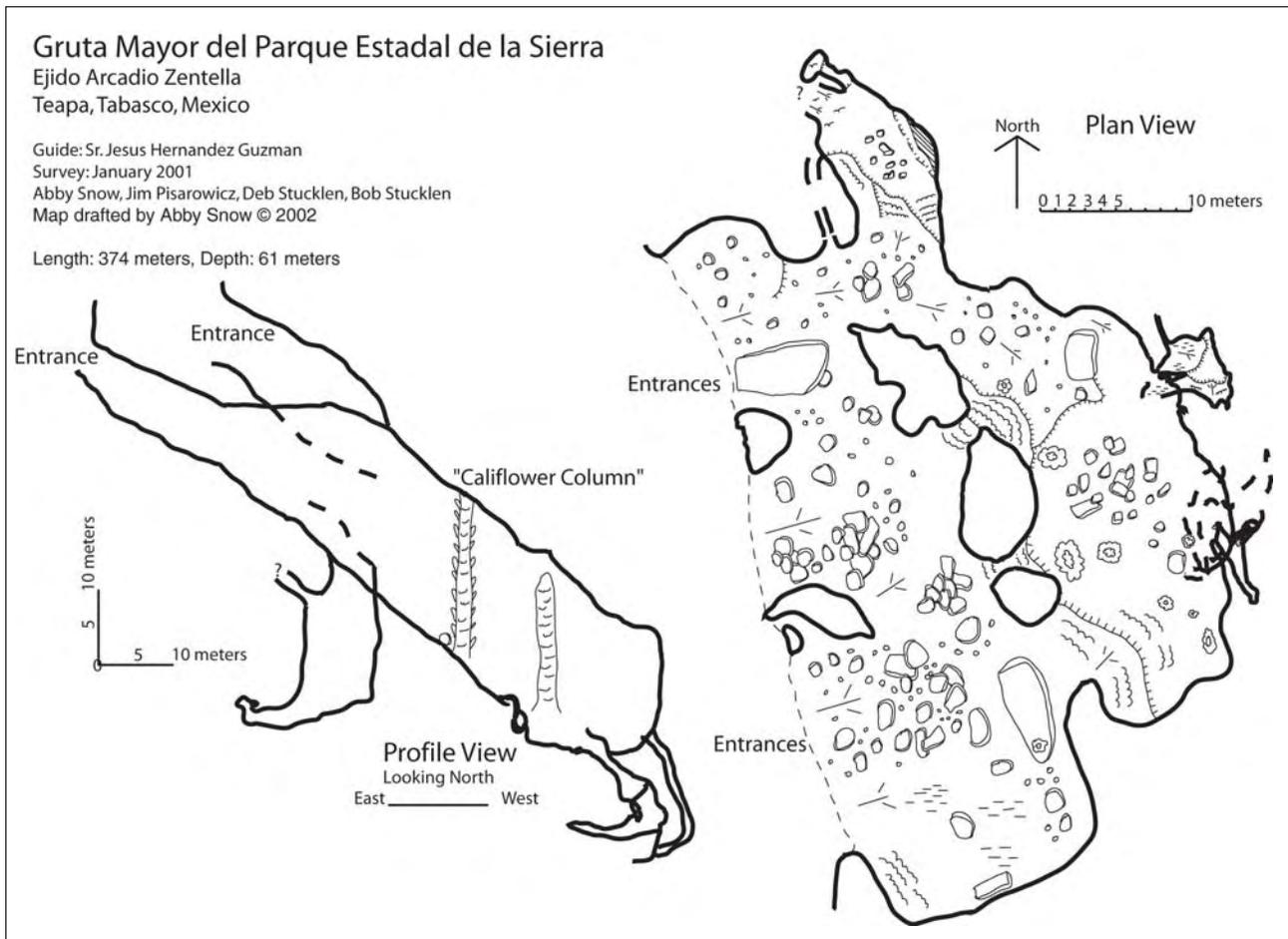
The calculation indicates that Gruta de las Canicas contains about two hundred million cave pearls. Of course this figure is only a rough estimate, because the samples were not taken in truly random locations. Another problem with the estimate is that below the loose cave pearls, the floor of the passage consists of cemented cave pearls, so the actual depth of the pearls is deeper than I sampled. Still, this figure provides an initial rough estimate of the number of cave pearls in this cave. Future trips into Canicas will try to refine this preliminary result.

It is intriguing to think about how such a vast number of cave pearls could have formed in this cave. The standard mechanism for the growth of cave pearls seems woefully inadequate to explain Canicas' pearls. Further research is definitely warranted.

—Jim Pisarowicz



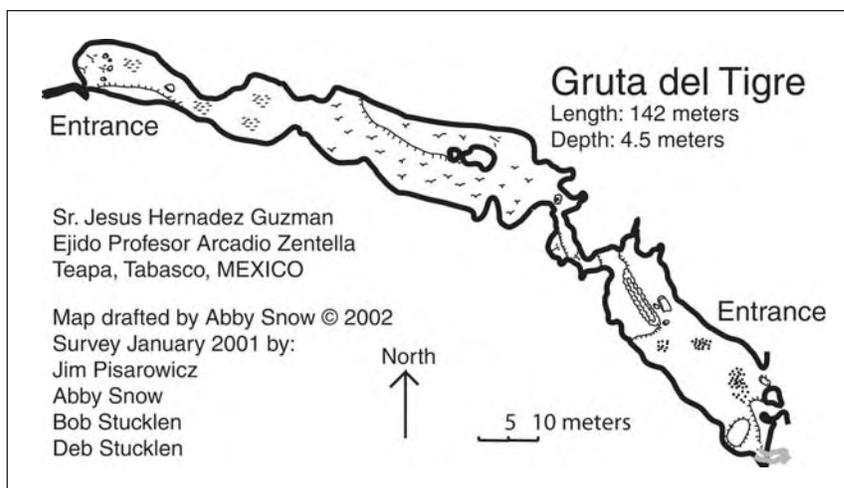
Typical cave pearls. Bob Stucklen.



Mayas. They returned to their vehicles muddy and happy.

The next day, the three of us returned to Canicas for a final photo trip. On February 1, we bid farewell to our hosts, and drove north toward home.

We are all concerned about the future of Gruta de las Canicas if it is opened as a show cave. Even though its cave pearls are abundant (see the sidebar), the collection of souvenirs could easily reduce this unique national treasure to a barren place.



Tabasco 2001

En enero de 2001 se topografiaron varias cuevas en la vecindad de Tapijulapa, Tabasco, entre las que se incluye la Gruta de las Canicas, que presenta grandes extensiones del piso cubiertas por cerca de doscientos millones de perlas de caverna.



The Pasaje de las Canicas.
Bob Stucklen.



THE EXPLORATION OF SISTEMA OX BEL HA

Bil Phillips

The Ox Bel Ha Cave System, Quintana Roo, encompasses 70,693* meters of surveyed and mapped underwater cave passage, with a maximum depth of 33 meters and an average depth of 15 meters. There are a total of forty-four cenotes connected to the system. The halocline is at a depth of about 9 meters where the aquifer empties into the Caribbean Sea and about 18 meters in the cave's inland reaches. Ox Bel Ha extends beneath a wide range of pristine terrains, from the ocean shoreline through mangroves, salt marsh, and saw grass to the dense jungle that hosts a myriad of plant and animal forms. Remains of walls and pyramid mounds witness previous occupation by ancient Maya throughout the area.

The discovery and exploration of Ox Bel Ha has taken years and is still going on. It was in February 1996 that Orane Douxami, Travis Mack, Sam Meacham, and Bil Phillips embarked on a jungle adventure with two Mayan guides in search of new cenotes. In the preceding months, Juan Toon and Juan Garcia had escorted us to several other cenotes in the dense Yucatan jungles south of Tulum. We were looking for an elusive Emerald

Cenote much deeper in the jungle. After two hours of bushwhacking and marching along unmarked paths, we arrived at the largest collapse area we had ever seen, a 500-meter stretch of the most pristine jungle one could imagine. We all stood speechless, gazing into the crystal waters of Cenote Canales.

Canales was beautiful, but it was also the home of a thriving crocodile population. Two years would pass before we returned to it. This trip, having studied aerial photographs of the area, Sam and Bil trudged farther back into the jungle to another staggering discovery. The Emerald Cenote, Esmeralda, proved to be a large open-water pool over 170 meters in length, sunken 12 meters below the surrounding jungle, and with two islands in the middle. This was too exciting to ignore, and the hike back to civilization passed quickly in non-stop discussion of what we had seen and its ramifications. Somehow even then it was clear that this would be the start of something big. The very next day, a reconnaissance dive confirmed our belief that this was going cave. It would take another eighteen months of meeting with the owner, Ejido Jose Maria Pino Suarez, planning, and hard work to establish just how big the cave actually is.

ESMERALDA, MAY-JUNE 1998. It was time for additional explorers to join the team. Fred Devos and Daniel Riordan joined Sam and Bil for a six-week expedition. Weeks of cutting 6 kilometers of horse trail were necessary before a day-camp for a generator and equipment store could be established at Cenote

Esmeralda and, later, moved to newly discovered Cenote Amber Sun. The hike in was now only an hour and a half, and the explorers continued to walk in and out daily along rough jungle tracks. The existence of the camp simplified logistics and reduced the loads that had to be carried in and out of the jungle, but the long hikes still increased the risks of dehydration and injury. Nevertheless, the first Esmeralda expedition was a great success. The four divers completed a total of twenty-nine dives, with bottom times often exceeding four hours, and explored and surveyed over 11 kilometers of cave passages connecting a total of eight entrance cenotes.

CHIKIN HA, JUNE 1998 TO MARCH 1999. While Bil, Sam, Fred, and Daniel were investigating the Esmeralda system, Bernd Birnbach and Christophe le Maillot were pursuing what at least at first appeared to be an unrelated effort starting from Cenote Del Mar. The French Cave Diving Federation had begun exploration from nearby Cenote Tarpon with some 300 meters of line, and subsequently Steve Gerard, Tamara Kendle, Steve Keene, and Sue Sharples connected to this line from Cenote Del Mar. Continuing from a lead that Sharples had found, Ted Cole and Tamara Kendle had then added an additional 1400 meters, bringing the total to about 1800 meters.

Bernd and Christophe resurveyed all existing lines and made new discoveries. By the end of a six-month period, they had explored and documented an additional 18 kilometers of new cave and were

*This article was prepared for AMCS Activities Newsletter 24, but the map did not arrive in time. The map is not up to date, but it gives a good idea of the complexity of the system. The statistics in the first paragraph are obsolete. An update to the end of 2001 follows the original article. It has been compiled by the editor from Bil Phillips's report on the December 2001 expedition.

starting to reach the limits of what could be accomplished in a single dive. This new cave system was Sistema Chikin Ha (Western Water). Although access to the original entry point was relatively easy, impenetrable mangrove prevented land access to all cenotes inland from Del Mar. As penetration distances increased, scooters, multiple stage bottles, and then finally separate set-up dives were required. Having switched to a more flexible and self-reliant side-mount configuration, Bernd and Christophe, with help from Daniel Riordan, then pursued the downstream side of Chikin Ha, where an important discovery was made. Sistema Chikin Ha drained directly into the Caribbean Sea through a total of three vents.

The two groups of explorers, in Esmeralda and Chikin Ha, did not pursue their efforts in isolation. As the two cave systems unfolded, a connection between the systems became increasingly likely. When computer-generated maps of both systems were overlaid on aerial photographs of the region, our hopes increased. Even allowing for errors in the surveys, the two cave systems were probably only 500 meters apart. Indeed, it became apparent that there might be another connection. Gary and Kay Walten had been exploring the neighboring Sistema Ya'ax Chen (Blue-Green Well). By connecting a chain of cenotes, they had succeeded in exploring about 18 kilometers of new

passage. Caves that had originally been separated by miles of jungle were now tantalizingly close, and the time had come to recognize this. In order to avoid the counterproductive competition that has plagued Mexican cave diving in the past, the three groups agreed that a new name would be in order should systems connect. The Mayan name Ox Bel Ha, Three Paths of Water, would encompass all the exploration, while still recognizing the three teams' efforts.

On March 13, 1999, the connection between Chikin Ha and Esmeralda was achieved. It required a dive of more than 3600 meters by Bernd and Christophe, using triple scooters and six stage bottles each, in addition to their back-mounted doubles. They started from Cenote Del Mar, and their bottom time exceeded eight hours. This accomplishment made the combined size of the cave over 33 kilometers, and the name Ox Bel Ha became official. The exploration and survey of the 21 kilometers of cave in the Chikin Ha part of the system had taken a total of fifty-nine dives. Fifteen cenotes were connected, and the three connections to the ocean made. The farthest penetration was 4200 meters. The connection to Ya'ax Chen remains elusive to this day.

Y A'AX KAI, MAY 1999. Once Esmeralda and Chikin Ha had been connected, further exploration became a formidable proposition.

Daily excursions, now reaching another half kilometer beyond the Esmeralda camp, through difficult terrain, combined with very long dives, were out of the question. The time had come for a step up in the activity, a full-blown jungle base camp. The first base camp was established at Cenote Ya'ax Kai (Blue Fish), which had previously been discovered in the course of dives from Esmeralda. After many weeks of trail clearing, the comforts of home were left behind, as the first camp-based expedition, which lasted four weeks, commenced. Sabine Schnittger joined the Esmeralda and Chikin Ha team members in a joint effort to push the far upstream reaches from Cenote Ya'ax Kai. We also had full-time support: Beto Segunza, the expedition horse Antar, and Don Celiano Herrera with his team of helpers, horses, and mules for transport of equipment and supplies. All members now dived with side-mount equipment configurations for increased self-sufficiency, and scooters and double stage bottles became standard issue, allowing for a working radius of over 2000 meters. Underwater times averaged four hours. Several double-scooter, triple-stage dives were also performed by buddy teams, in push dives in search of cenote entrances and future camp sites yet farther into the inland terrain.

Setting up a complete base camp over 6 kilometers back into the jungle presented serious physical and logistical challenges, but the trade-off came in the form of better surface support, more safety equipment, more manpower, better evacuation procedures and communications, and on-site map display and data storage. Although the workload of daily chores and equipment maintenance took on new dimensions, expedition-style efficiency prevailed, allowing for maximum performance and reduced physical stress. This paid off. In four weeks, with more than thirty-nine dives, the team of seven explored and surveyed an unparalleled

Cenote Esmeralda.
Sabine Schnittger.



14 kilometers of new cave. At over 47 kilometers, Sistema Ox Bel Ha became the third longest known water-filled cave system in the world. Five new cenotes were connected. In addition, biologist Samantha Smith of the Centro Ecologico de Akumal conducted hydrological studies, analyzed salinity levels, and sampled the water quality. In this rapidly developing and environmentally threatened region of Mexico, Ox Bel Ha's water proved to be pristine.

CENOTE XUX, DECEMBER 1999. The exploration, documentation, and study of Ox Bel Ha now demanded a much greater level of commitment and planning. In the summer of 1999, the Grupo de Exploración Ox Bel Ha was formed. GEO's founding members Bernd Birnbach, Fred Devos, Christophe le Maillot, Sam Meacham, Bil Phillips, Daniel Riordan, and Sabine Schnittger established this non-profit organization. After studying aerial photographs and making many jungle hikes, GEO concluded that exploration should continue in the vicinity of the southwestern part of the system at two cenotes, Cenote Xux (Wasp) and Cenote Xix (Dust), whose existence had originally been established through aerial photos. They had not been connected to Ox Bel Ha, but they lay in an open section of land between the Esmeralda part of the system and Ya'ax Chen. Underwater investigation of this area had initially proved frustrating. Mysterious water movement and confusing passageways suggested that a large breakdown area would prevent this section from ever being connected to Ox Bel Ha. But an initial reconnaissance dive performed by Fred found several passages that could potentially connect to Ox Bel Ha. The leads looked promising, and the decision was taken to risk a base camp at Xux in the hope of connecting it with Ox Bel Ha.

The camp established at Xux proved to be the foundation for GEO's most successful expedition to date. During the two-week project, team members dived in shifts and, with the help of field-blended

nitrox, safely executed fifty-nine dives. On the fourth day of exploration, Bil Phillips made the connection to the Esmeralda section of Ox Bel Ha. The cave reached out in all directions, and exploration raised as many questions as it answered. Passages heading from Xux toward Sistema Ya'ax Chen were blocked in a tannic-water breakdown area within an estimated few hundred feet of connecting. At the end of the project, a staggering 24,021 meters of passage had been explored and surveyed and sixteen new entrances discovered. The combined result of 70,650 meters made Sistema Ox Bel Ha the longest underwater cave in the world. With two large cave systems, Ya'ax Chen (18 kilometers) and Naranjal (20 kilometers) nearby and several prospects for new base camps, it looked like work in this colossal subterranean waterway had really just begun.

OTHER CAVE SYSTEMS, 2000. By the end of 1999, exploration of Ox Bel Ha had been an unqualified success. However, along with the vastly increased size of the system came correspondingly high logistics costs. In 2000 GEO turned its efforts toward the surrounding and more accessible cave systems Ya'ax Chen and Naranjal. Several attempts to connect Ya'ax Chen to Ox Bel Ha from the Ya'ax Chen side were unsuccessful, in spite of its close proximity. Exploration dives were conducted in the downstream section of Sistema Naranjal. Christophe and Bil discovered a hidden restriction and added 760 meters of passage. It was a breakthrough that had eluded explorers for several years. Named Snakes Man's Escape, this side-mount passage winds its way southeast toward Ox Bel Ha through a multitude of restrictions with considerable water flow.

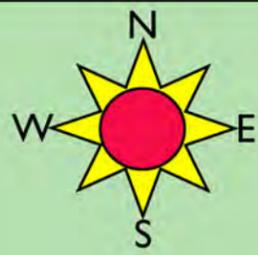
A cave called Ayim (Crocodile) is located approximately 2.5 kilometers inland from the farthest upstream reaches of the Ox Bel Ha system. This cenote covers an area of about 40 by 300 meters of marshy collapse containing a total of five open pools. Cave explorers Gary and Kay Walten first discovered the

system in 1997 and explored 1208 meters of passage on the upstream side. Since that time, GEO members Bernd Birnbach, Fred Devos, Sam Meacham, Bil Phillips, and Sabine Schnittger added an additional 1672 meters to both the upstream and downstream parts of the cave, establishing lines heading directly toward Ox Bel Ha's distant Jigsaw Reach.

The year 2000 culminated in a ten-day December expedition using only a day-camp to store tanks and equipment. From this location, Steve Bogaerts, Fred Devos, Christophe le Maillot, Bil Phillips, and Daniel Riordan conducted several dives into new passages. Christophe concentrated his efforts in the Naranjal siphon area and was successful in adding an additional 975 meters of passage. This route continues to wind its way downstream through seemingly endless side-mount restrictions and complex cave. Daniel worked the deeper, saltwater leads to investigate places believed to hold possible breakthroughs. Ultimately, this ended in disappointment. Sistema Naranjal now sits at 21,336 meters of explored cave, and a connection to Ox Bel Ha is even closer.

By the end of the expedition, Sistema Ayim had been surveyed to 8,166 meters. Yet a connection to Ox Bel Ha could not be found. As the lines were laid and the pattern of the new passages emerged, it became clear that the main trunk passage was veering off to the south, away from the destination we had anticipated, and heading toward an even more distant part of upstream Ox Bel Ha. Further exploration will be required. Our efforts are not finished in this region.

As this is being written, GEO is pursuing exciting new leads. Just weeks before the Ayim project, Jim Coke and Sam Meacham located a cenote in a strategic position between Naranjal and Ox Bel Ha. Jim and Sam were able to verify both upstream and downstream leads from this Cenote Andreas. Another important discovery was made on New Years Eve. Two kilometers inland from the farthest

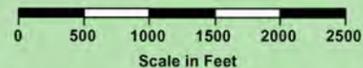


Sistema Ox Bel Ha

Ejido José María Pino Suárez, Quintana Roo, México

1999 length 231,792 feet

www.mexicocavediving.com



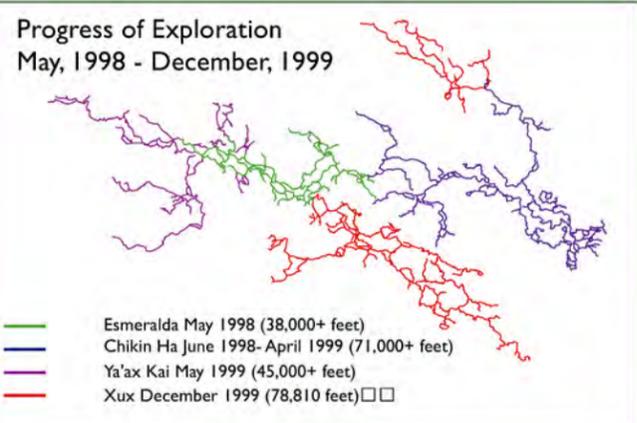
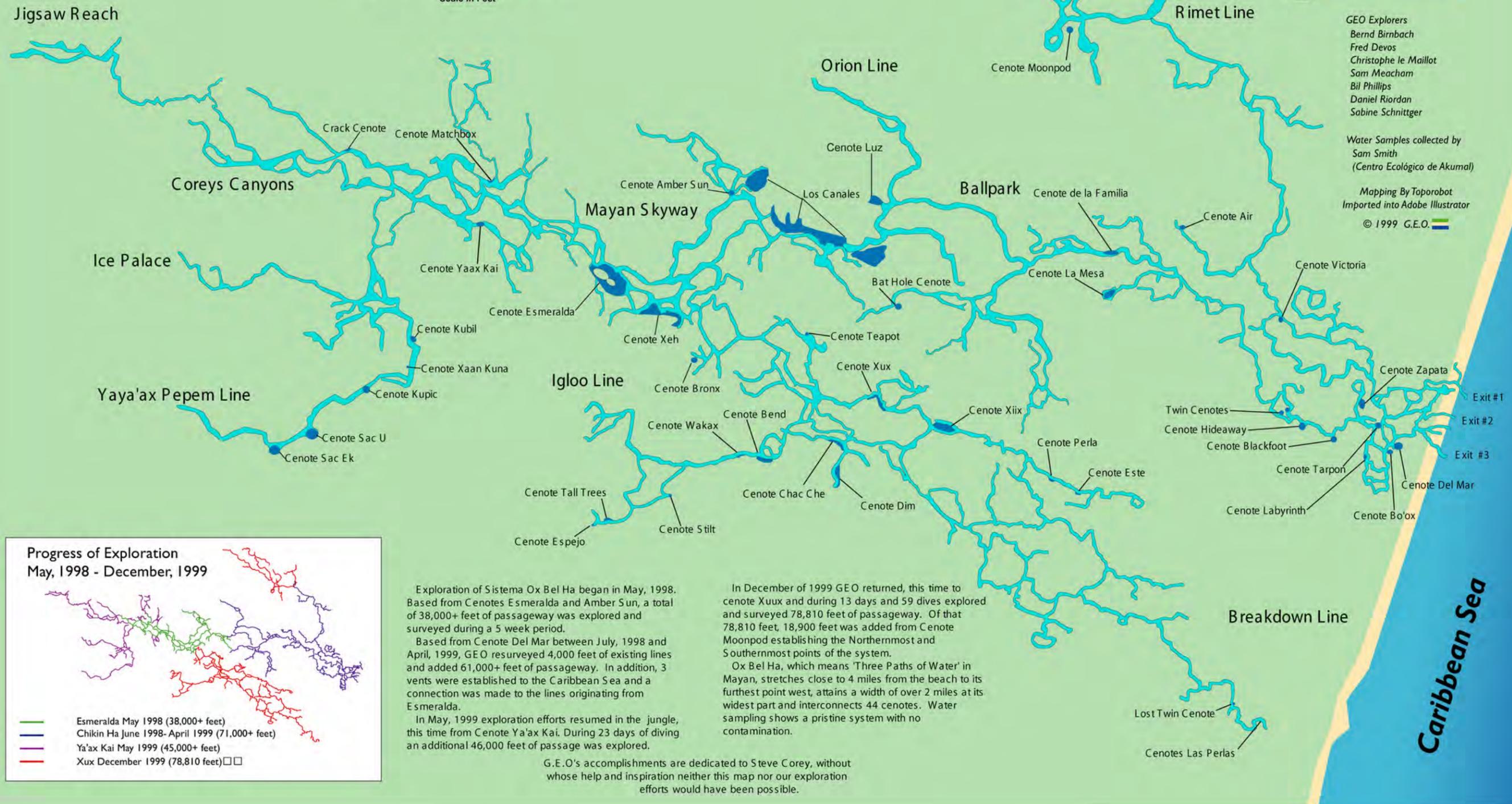
Grupo de Exploración Ox Bel Ha

GEO Explorers
 Bernd Birnbach
 Fred Devos
 Christophe le Maillot
 Sam Meacham
 Bil Phillips
 Daniel Riordan
 Sabine Schnittger

Water Samples collected by
 Sam Smith
 (Centro Ecológico de Akumal)

Mapping By Toporobot
 Imported into Adobe Illustrator

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Exploration of Sistema Ox Bel Ha began in May, 1998. Based from Cenotes Esmeralda and Amber Sun, a total of 38,000+ feet of passageway was explored and surveyed during a 5 week period.

Based from Cenote Del Mar between July, 1998 and April, 1999, GEO resurveyed 4,000 feet of existing lines and added 61,000+ feet of passageway. In addition, 3 vents were established to the Caribbean Sea and a connection was made to the lines originating from Esmeralda.

In May, 1999 exploration efforts resumed in the jungle, this time from Cenote Ya'ax Kai. During 23 days of diving an additional 46,000 feet of passage was explored.

In December of 1999 GEO returned, this time to cenote Xuux and during 13 days and 59 dives explored and surveyed 78,810 feet of passageway. Of that 78,810 feet, 18,900 feet was added from Cenote Moonpod establishing the Northernmost and Southernmost points of the system.

Ox Bel Ha, which means 'Three Paths of Water' in Mayan, stretches close to 4 miles from the beach to its furthest point west, attains a width of over 2 miles at its widest part and interconnects 44 cenotes. Water sampling shows a pristine system with no contamination.

G.E.O.'s accomplishments are dedicated to Steve Corey, without whose help and inspiration neither this map nor our exploration efforts would have been possible.

reaches of Ox Bel Ha, Cenote Chuup Ich (Swollen Eye) had been found on an aerial photograph. Steve Bogaerts, Bil Phillips, and a transport crew hacked their way out to Chuup Ich with one set of side-mount gear to make a recon dive. The effort found 600 meters of new cave in both upstream and downstream passages. Chuup Ich is bracketed by Naranjal and Ayim.

It was decided to use closed-circuit rebreathers to see exactly what Chuup Ich has to offer. All our previous explorations utilized open-circuit scuba, and to our knowledge closed-circuit rebreather technology had not been used for shallow, long-distance exploration here in Mexico before. Steve and Bil conducted a mini-project from March 31 to April 3, 2001. Utilizing Buddy Inspiration rebreathers, we learned a tremendous amount about the technology and were also successful in establishing the promise of the new cave system. Three dives resulted in 2400 meters of new cave. With the original 600 meters, Chuup Ich holds a total of over 3 kilometers of surveyed and mapped passages, along with two additional entrances.

Our fellow cave diver, friend, and first patron was Steven Douglas Corey. When our ability to continue our self-supported efforts was exhausted, Steve, believing in and sharing our vision, stepped in. Without his involvement, most of what we have accomplished would not have taken place. He will not be with us to take part in future projects. On November 9, 1999, he lost a two-year battle with cancer. On April 25, 2000, Steve found his final resting place in Sistema Ox Bel Ha when his ashes were set free in Cenote Esmeralda. The pursuit of our goals now has even greater meaning to us all. Thank you, Corey.

GEO would like to thank all its contributors for their support in our efforts here in Mexico's Riviera Maya: Standish Meacham, Don Keele and Joan Huton, Dave, Renate, and James Christy (Rendezvous Charters), Joe Anthony and Heidi Deja, Jane Morrison, Jana Smith, Gerry

Hill, Diver Dave, and the Grand Pooh Bah. The following gave support and assistance: Jane Emerson (Corey Electrical Engineering), Paul Beale and Vickie McNair (Aquanauts Dive Center), Joe Borovic, Bart and June Bjorkman (Enviro Dive Services), Lewis Cadenas (Baure Compressors Miami), James Coke IV, Ross Cowell, Juan Chio, Bob Hemm (Explorers Club of New York), Ivan Hernandez and Daniel Corredor (Aguakan SA de CV), Lamar Hires (Dive Rite), Eric Huurre (Skywriter Productions), Greg and Sally Hrehovecsic, Andrew Pitkin (Hyperbaric Medicine), Buddy Quattlebaum (Hidden Worlds Dive Center), the directors of the Quintana Roo Speleological Survey, Gunnar and Lina Wagner (Aktun Dive Center), and Mike Way (Colorado Alliance for Environmental Education.)

And special thanks to the landowners, the Ejido Jose Maria Pino Suarez and Commisario Mariono Dzul and the Ejido Tulúm. And our crew Beto Seguenza, Don Miguel Chiu, Don Selliano Herrera, Santos Mejia, Sr., Santos Mejia, Jr., Don Melesion, William, Jose, and Cristino.

Grupo de Exploración Ox Bel Ha:

Bernd Birnbach, Germany
Steve Bogaerts, England
Fred Devos, Canada
Christophe le Maillot, France
Sam Meacham, U. S. A.
Bil Phillips, Canada
Daniel Riordan, Mexico
Sabine Schnittger, Germany

UPDATE 2001. The Corey Memorial Expedition, December 1-14, 2001, was a flag expedition of the Explorers Club and sponsored by the Steven Douglas Corey Memorial Fund and other contributors. It included the first jungle camps since December 1999, but the Grupo Exploración Ox Bel Ha had not been idle. Mini-projects from cenotes with comparatively easy access had connected two systems to Ox Bel Ha within the past year, adding kilometers to its length.

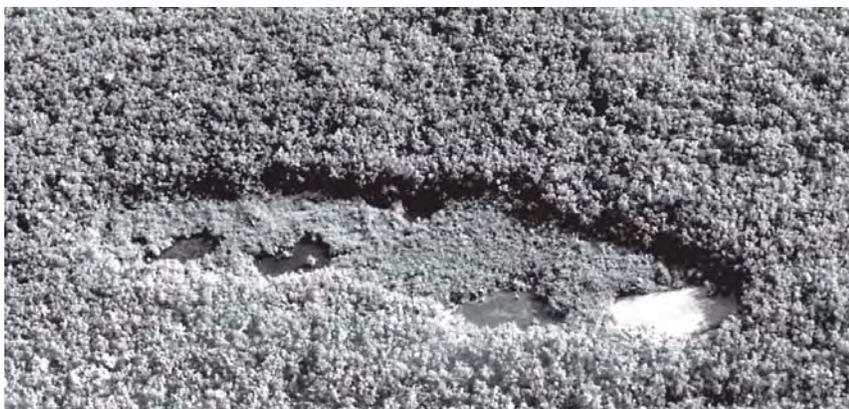
The first phase of the expedition used a supply base at Cenote Kristen, near the farthest upstream part of Ox Bel Ha, more than 7 kilometers

inland from the Caribbean Sea. In addition to collecting data for hydrological studies, the goals of this phase were to connect Sistema Ayim into the system and find a way from upstream Chuup Ich into the system without passing through open water in the cenote. On December 1, sixteen tanks, three diver-propulsion vehicles, three large packs of diving gear, two closed-circuit rebreathers, tarps, and supplies for a single attendant were carried over the 2-kilometer trail to Cenote Kristen. While the attendant watched the camp twenty-four hours a day, the divers and other support people walked in to the cenote each day in order to reduce the amount of food and camping equipment needed there.

A total of three rebreather dives and four open-circuit dives in side-mount configuration were performed safely. More than 1800 meters of new passage were explored and surveyed. The rebreathers proved valuable for extending bottom times to over four hours without requiring decompression or large amounts of gas. But the somewhat bulky profile of the rebreathers prevented the divers from penetrating a silty breakdown section toward Ayim. A switch to side-mounts was made, but even that was not effective. So much silt was stirred up by the pairs of divers that a very dangerous situation developed. Further attempts would have to be made by solo divers, but time ran out. Sistema Ayim and its 8000 meters of passage were still waiting, just out of grasp.

Fred Devos attempted to find a way around Cenote Chuup Ich, but could not, though he found a new passage heading in the wrong direction. Devos also took a water-data-recording probe to five locations in the system for Patricia Beddows.

The second phase of the expedition was conducted from Cenote Odyssey, near the middle of Ox Bel Ha and strategically located near Sistema San Andrés. On December 6, the whole camp was moved to Odyssey. This camp included food, a generator, a compressor, a two-hundred-pound K-bottle of oxygen



The Cenote Ayim collapsed area. *Sabine Schnittger.*

13 meters, below the halocline, and through heavy silt, multiple restrictions, and crumbling walls. After an hour of spooling line off his reel and occasionally back onto it, he finally broke through into clear water that led him to the line that had been installed by Fred Devos in Sistema Ayim back in December 2000. So that connection was finally made, and Ox Bel Ha now extended over 9 kilometers from the coast.

Diving from base camp, Bogaerts made a final attempt to extend his lines closer to Sistema Naranjol. On a dive with a DPV and five tanks, he added another 523 meters, but he was unable to make the elusive connection and returned the 1800 meters to camp.

On December 14, the expedition was over. During phase 2, seventeen dives were made, and more than 3 kilometers of new passage surveyed.

In addition to data gathered for Patricia Beddows that will give a clearer understanding of the hydrology of the area, the exploration efforts of the Grupo Exploración Ox Bel Ha brought the total length of the world's longest water-filled cave to about 96.8 kilometers. It is now the longest cave in Mexico. There are a total of fifty-seven cenotes tied into the system. Sistema Ox Bel Ha is only one of the numerous water-filled networks in this part of the Yucatan Peninsula. Continuing exploration will reveal the secrets of this fragile underground environment, where rapid development is occurring above.

for mixing nitrox, and a 14-by-24-foot tent, all hauled over 2 kilometers of trail. The first dive was by Bil Phillips, who needed to alter the existing lines. When he had originally explored this section, he had reached it from a distant cenote, so the directional markers on the line pointed the wrong way for this project. Phillips also collected water data for Beddows at three locations.

Then Daniel Riordan and Phillips explored to the north, attempting to find a route past Barrier Cenote. They worked their way along a horizontal crack some 60 meters wide but only 2 meters high for over 300 meters, until they could go no farther. Devos and Riordan explored to the northeast, discovering huge saltwater-filled tunnels, as well as some shallower passages with fresh water. Over 1500 meters of new line was installed in this area, which was mostly completed.

Steve Bogaerts pushed the Aluxe's Plain part of the cave toward Sistema San Andrés. The existing lines, which had been laid in 1999, ended in low bedding planes. On Bogaerts's first dive, he was able to install only 70 meters of new line, but persistence paid off. On the third try, he slipped through a small, silty crack and, though still in low passage, laid 600 meters of line. This route led him into a huge room and then on to Sistema San Andrés, some 1500 meters from base. The 2100 meters of San Andrés were thus added to Ox Bel Ha.

Meanwhile, Sam Meacham, Riordan, and Phillips worked westward from Cenote Odyssey, finding 1500 meters of previously unknown passage.

Meacham logged all the survey data into a computer in base camp, which provided an overall view of the progress in relation to other caves. As expected, the downstream lines in Sistema Naranjol are directly upstream from the new connection to San Andrés, and Sistema Ayim is just inland from the new passages found during phase 1. In the few days remaining, it was decided to push these locations.

Bil Phillips made a solo dive from Cenote Coca Ha, 4 kilometers from base camp. One horse carried four tanks, and another a pack of dive gear and a DPV. A five-foot crocodile had been seen in this brown-water cenote two days before, but none was seen the day of the dive. Descending quickly, Phillips began his dive to the end of the lines previously installed during dives out of Cenote Kristen. In thirty minutes, the DPV hauled him 1100 meters to where new exploration could begin. After fastening the DPV and one bottle to the line, he went on with three tanks. His route took him on a winding course with depths as shallow as 1 meter and as deep as

En febrero de 1996, se descubrió en Quintana Roo una nueva cueva en el Cenote Esmeralda. A través de los años, mediante la exploración subacuática y la conexión de otras cuevas, el Sistema Ox Bel Ha creció hasta alcanzar los 96.8 kilómetros de longitud. Es la cavidad mas larga de México y la mayor cavidad subacuática en el mundo. Tiene cincuenta y dos entradas distintas, todas cenotes. El mapa no se encuentra al día, pero muestra la complejidad de esta caverna.

WHERE DOES THE SEWAGE GO? THE KARST GROUNDWATER SYSTEM OF MUNICIPALIDAD SOLIDARIDAD, QUINTANA ROO

Patricia Beddows

The one and a half meters of rain falling on the Caribbean coast of the Yucatan peninsula each year is rapidly absorbed into the exposed limestone rock, where it forms a thin but extensive underground layer of fresh, potable water. The flow of groundwater through small fractures and joints in the rock over thousands of years has slowly dissolves the rock to form interconnected cave systems, where conduits often measure more than 5 meters in diameter. Almost fifty cave systems have been explored within the limits of the Municipalidad de Solidaridad, which encompasses a region from Playa del Carmen on the coast in the northeast to the inland town of Coba in the southwest. The total length of known water-filled cave exceeds 350 kilometers (Quintana Roo Speleological Survey, 2002), and indeed the area is a world-class type example of cenote karst.

The vast majority (97 percent) of the available fresh water is stored in the aquifer matrix, which is a very porous young limestone rock.

However, more than 99 percent of the actual fresh-water flow in the system occurs within the extensive flooded cave systems, where water velocities exceed several kilometers per day (Beddows, 1999). These systems are analogous to underground rivers that link the interior of the Yucatan peninsula to the numerous coastal springs, such as Xel Ha, Xcaret, Yalka, and Cenote Manati (Casa Cenote).

The fresh-water layer floats on an extensive body of salt water that is chemically similar to Caribbean Sea water. The high concentration of salt and other minerals in the saline water makes it dense enough to support the lighter fresh-water layer. The interface where mixing takes place between the fresh and saline water is called the halocline. The fresh-water layer varies from 5 meters thick near the coast to more than 20 meters thick 10 kilometers inland.

Circulation of saline water is known to occur beneath coastal and island aquifers in the Bahamas, Florida, Puerto Rico, and many

other locations worldwide. The overlying fresh water flows coastward and entrains the underlying saline water due to friction across the halocline. This causes the upper part of the saline water to flow in parallel towards the coast. Mixing across the halocline may also play a significant role in transferring saline water and other solutes or suspended solids it may hold into the fresh-water lens. The coastward flow of saline water will cause more ocean water to flow into the peninsula. The amount of mixing that occurs at the halocline is partly controlled by tides, which have a pumping effect on the aquifer. Tidal pumping is strongest at the coast and decreases in strength with distance inland. The well-connected cave systems are very effective at transmitting tidal forces within the Yucatan aquifer, and tidal variations in water level have been measured at 40 percent of the ocean amplitude 5 kilometers inland at Far Point Station in Sistema Nohoch Nah Chich in Solidaridad (Beddows, 1999).

In addition to the force of the coastward-flowing fresh water and the loss of saline water by mixing across the halocline, various other forces have been identified that may drive circulation in the underlying saline water. Differences in ocean-water elevation on opposite sides of the Yucatan Peninsula may drive circulation simply by gravity. Geothermal heat may increase the temperature of deep saline water,

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salvaguarda de los ecosistemas frágiles en Solidaridad. Edited by J.A. Huerta Illescas, G. Pérez de la Fuente, C. Llorens Cruset, and A. Dzay Graniel. Honorable Ayuntamiento de Solidaridad, Dirección General de Administración Urbana, Dirección de Medio Ambiente, Playa del Carmen, Quintana Roo, pp. 168-178.

reducing its density and generating buoyant circulation of saline water masses. Similar density-driven circulation may arise when very saline and dense water is created by evaporation in restricted lagoons or the dissolution of evaporite minerals. This dense water may then sink down through the aquifer, inducing groundwater flows (Whitaker and Smart, 1993). At present we have only limited understanding of the character and the mechanisms driving the fresh and saline groundwater circulation of the Caribbean Yucatan Peninsula aquifer, but observations since early 2000 indicate that the water discharging from the Caribbean Yucatan cave systems via submarine springs and *caletas* is approximately one-third to three-quarters saline water. It is clear from the large volumes of saline water leaving the aquifer that large volumes of saline water must be moving beneath the fresh-water layer in Solidaridad. This active circulation

of both fresh and saline water must be an integral part of the hydrological model on which water usage and waste disposal policies are based.

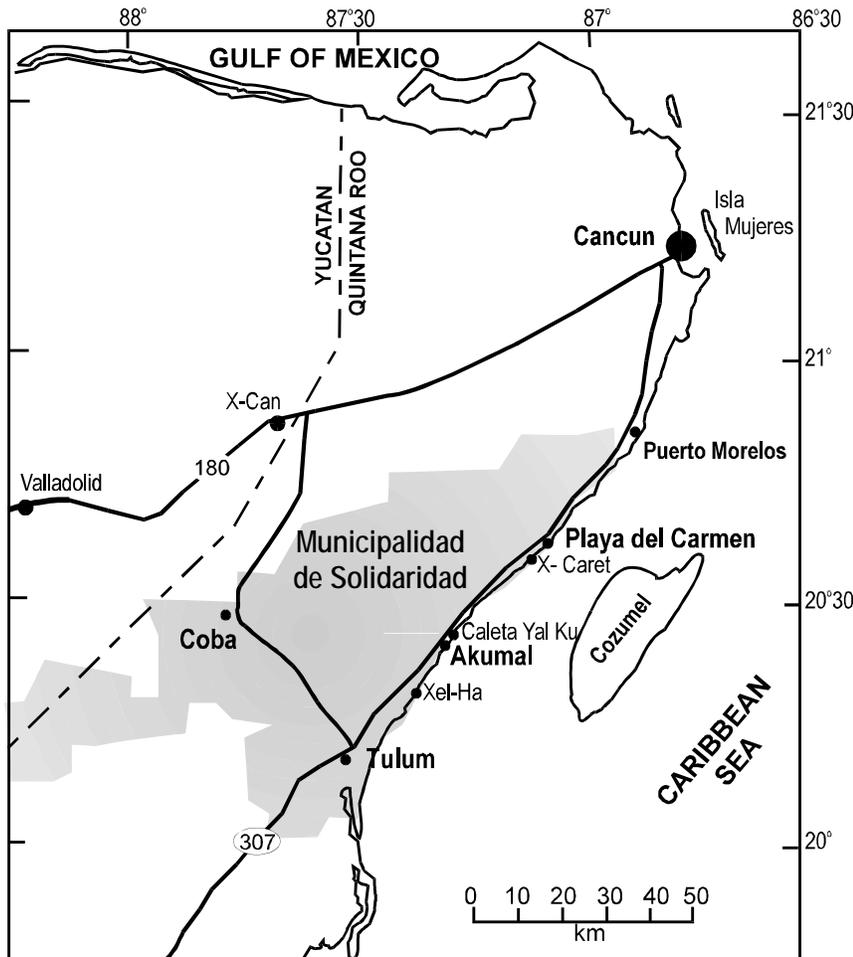
The *Municipalidad de Solidaridad* relies 100 percent on groundwater. The groundwater may be easily accessed in areas where the ceiling of a cave has dissolved or collapsed downwards, forming a cenote. Cenotes occur above caves and therefore often provide direct access to water-filled cave passages where the groundwater flow is concentrated. Well-known cenotes include Gran Cenote, Cenote Eden, and Car Wash Cenote. Alternatively, the cenote may open into areas of dry cave that sump at a groundwater pool, such as at Aktun Chen. Whether semi-dry or water filled, these cenotes attract locals and tourists for recreational activities such as swimming, snorkeling, bird watching, picnicking, and even technical scuba diving into the

flooded cave passages.

We must be concerned about the water quality of the flooded cave environment, because groundwater is the only source of potable water in the region. The cenotes used for potable water are generally those farther from the coast, as they have lower salt content. A good example of an inland cenote used for drinking water is Cenote Chemuyil, located 5.7 kilometers from the coast; it supplies water for developments, except Akumal Beach, along Highway 307 from just south of Puerto Aventuras to Xel-Ha. Larger luxury resorts often supply their water needs by drawing from supply cenotes or wells located on the farthest inland borders of their property, as is the case in Puerto Aventuras. Resorts without inland properties often draw groundwater from coastal cenotes or wells and use desalination plants to deal with the slightly brackish groundwater at those locations. The larger cities and towns such as Cancún (outside Solidaridad), Playa del Carmen, and Tulum all rely on inland well-fields located more than 10 kilometers from the coast.

Groundwater is not only a resource for water supply and aquatic activities, but also serves as a route to dispose of sewage effluent. The population of Solidaridad is growing at a phenomenal rate, and thus a corresponding increase in the amount of sewage generated poses a real challenge. At present, sewage effluent is handled in a variety of different ways while an adequate infrastructure is being planned and developed.

Soakaway pits or cesspits are used in many isolated and rural areas. They are also common, however, in many settlements, such as Pueblo Aventuras, Pueblo Akumal, and developing areas of Playa del Carmen, where there is no centralized provision for sewage collection or treatment. Soakaway or cesspit sewage is discharged into a hole in the ground, through which it enters the fresh-water layer. This sewage is generally untreated and may transmit pathogenic bacteria and viruses into the groundwater.



Tourist scuba divers preparing for a cavern tour at Cenote Taj Mahal. *Edward Mallon.*

Septic tanks are commonly used for individual homes and small developments, although they are highly unsuitable for use in Solidaridad. Septic tanks are designed to allow fecal solids to settle out of the liquid and pass the liquid into a drainage field. This drainage field should be in thick soil so that natural breakdown of nutrients and die-off of hazardous bacteria and viruses may occur. The soil cover in Solidaridad is very thin, rarely exceeding 20 centimeters, and is discontinuous, with extensive outcrops of bare rock. The soil is physically incapable of retaining liquid effluent long enough to provide the necessary slow filtration. When passed too rapidly, live bacteria and viruses may be transported to the lens of fresh groundwater.

The solids collected in septic tanks must be emptied regularly, approximately every six months to two years, or sewage solids will also overflow into the drain field and into the groundwater system. Homeowners are sometimes proud of never having to empty their septic tanks, but this is a likely indicator of groundwater contamination.

Some developments rely on simple, centralized sewage retaining tanks, particularly when situated immediately on the beach ridge or surrounded by mangrove. These tanks are pumped out periodically by ten-thousand-liter "aguas negras" trucks. Personal observations and numerous reports from local residents suggest that these trucks sometimes illicitly dump their raw sewage load onto the floor of abandoned quarries along Highway 307, where the surface limestone has been removed down to often less than 1 meter above the water table. It is unknown how prevalent this practice is, but the possibility of this moving and intermittent raw sewage source must be considered in any case of suspected contamination.

There is a growing reliance on "ecological" self-contained sewage-treatment systems in the form of



created wetlands and composting toilets, particularly in Puerto Morelos and in Akumal. Created wetlands are suitable for use with wet waste such as from flush toilets and showers. They rely on a closed cement basin with a well-designed plant-soil-gravel filtration system. The effluent is not released into the environment, but rather is taken up and converted into vegetation, which must be trimmed and cut down regularly. Composting toilets, on the other hand, are a dry system where an outhouse-style toilet is used to collect the feces and urine. The waste is composted below the toilet basin, and the unit is kept odorless by the use of a small electric fan. Despite these two systems being the most sustainable method in this karst environment, they remain underutilized in this region and should be aggressively promoted.

The large tourist developments along the coast are increasingly dependent on modern multi-stage sewage-treatment plants. In the cases of Puerto Aventuras Resort, Barcelo Hotel, Moon Palace Resort, and Bahía Príncipe, among others, large volumes of the treated effluent are used for landscape and golf-course irrigation, where much of the nutrients is consumed by the vegetation if the liquid is retained by the thin soil layer. Any excess

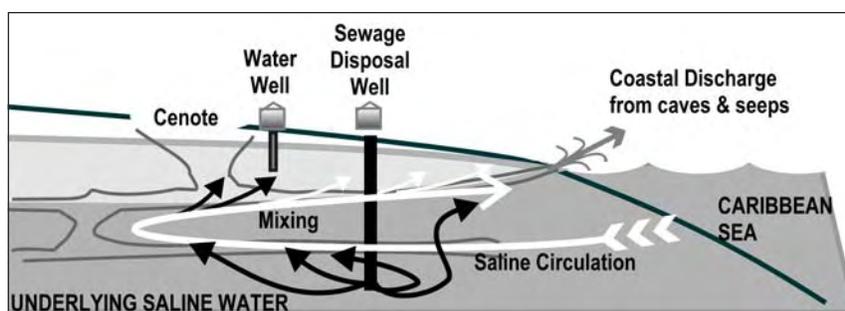
that passes through the soil layer will contaminate the surface of the fresh-water lens. During the rainy season or at peak occupancy times, excess treated effluent from the resorts is disposed of via injection wells that penetrate to depths of 60 meters or greater as per Comisión Nacional del Agua mandate.

Sewage effluent is a mixture of fresh, low-density water with human waste, greases, and chemicals such as soap products from kitchens, laundry facilities, and bathrooms. The overall mixture is lighter and less dense than the saline water into which it is pumped, and the effluent will float upward through the limestone matrix until it reaches the halocline. At the halocline, some mixing into the fresh water occurs, particularly within two kilometers the coast, where tidal pumping of the aquifer is the strongest. Even if the effluent mixes adequately with the saline water once it is injected into the ground and does not buoyantly rise, it may still be carried by the inland circulation of the saline water and eventually discharge at the coast onto the reef. Both scenarios may compromise the quality of the fresh-water layer from below, and there may also be direct discharge of contaminated saline water to the coastal *caletas* and springs.

The discharge of contaminated

brackish water can adversely affect coastal environments. Groundwater-tracing experiments in Sistema Nohoch Nah Chich have shown that the fresh water may travel more than 2 kilometers per day (Beddows, 1999), which is typical of groundwater flow rates in cave systems. At such flow rates, waste will travel quickly through the caves away from the point source and is unlikely to be adequately dispersed or diluted. Groundwater-tracing experiments in the Florida Keys, a karst environment similar to that of the Caribbean Yucatan shore where effluent-disposal wells have also been used, have shown tracers traveling from the disposal well to the marine surface water at a rate of 840 meters per day, thus highlighting the potential for rapid deterioration of near-shore water quality (Paul et al., 1997). Most of the disposal wells in Solidaridad are associated with resorts on the coastal side of Highway 307 and are less than 2 kilometers from the coast. This is precisely the zone prone to host major caves, which are known to occur at depths similar to that to which the disposal wells are drilled, 60 to 100 meters. Thus the possibility for rapid movement of injected wastewater is very high.

The most common test for raw sewage contamination is to determine the number of fecal coliform bacteria present in 100 milliliters of water. Every warm-blooded animal, including livestock and humans, harbors fecal coliform bacteria in its digestive system. Natural water bodies are expected to have some fecal coliform present, sometimes to levels of several tens of colonies per 100 milliliters of water. Fecal coliform bacteria do not necessarily directly affect human health, but they serve as an indicator of sewage effluent contamination that may also carry more serious pathogens, such as cholera bacteria, cryptosporidium protozoan parasites, and hepatitis virus. Treated sewage effluent is generally disinfected with chlorine, so that the fecal bacteria and some other pathogens are killed. So although a fecal coliform test result of 50 or more colonies per 100 milliliters of water



General model of groundwater circulation in the density-stratified karst aquifer on the Caribbean coast of Quintana Roo. Sewage effluent pumped into a disposal well may circulate inland and then to springs on the coast.

may in fact represent a healthy result for natural water bodies, a low or even zero count may not indicate that the water is free from treated sewage.

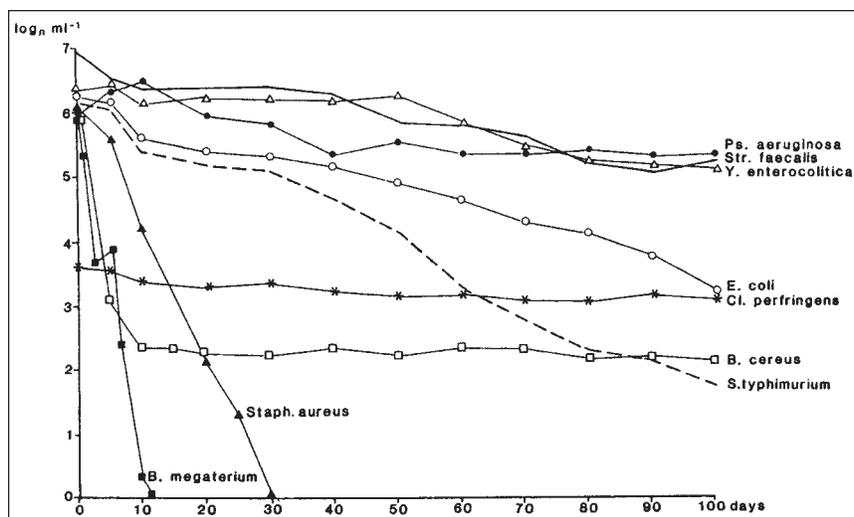
An alternative strategy to assess water quality, particularly where contamination from treated sewage is suspected, is to test for elevated levels of nutrients such as nitrates, phosphates, and ammonia that derive from sewage effluent and for changes in physical characteristics of the water such as the amount of dissolved oxygen, which is depleted when organic waste from effluent is present.

Significant additions of nutrients to the groundwater may disturb the ecological balance of a hidden environment where unique and endemic species are found, such as remipedes and blind cave fish (Escobar-Briones et al., 1997; Iliffe, 1992). At present, only limited studies of nutrient cycling have been undertaken on these submerged cave environments (Pohlman et al., 1997; Yager and Madden, 2002), but general knowledge of semi-closed ecosystems suggests that persistent or intermittent nutrient loading from sewage effluent can induce an explosion in the number of primary consumers, followed by a population crash if the nutrient source is depleted. The biological breakdown of the added organic matter will reduce the dissolved-oxygen content of the water, which may asphyxiate the higher-order animal species such as fish.

Nutrient loading is also extremely detrimental to coral-reef environments. All effluent pumped into the

ground will ultimately be discharged onto the coastal barrier reef system via coastal springs, *caletas*, and groundwater seeps in the sand. The profusion of marine life in the coral-reef environment belies its fragile nature. The system is very easily disturbed by excess nutrients such as nitrates and phosphates. Algae reproduce rapidly in response to added nutrients, and these form unsightly and uninviting green mats covering the coral forests, limiting the sunlight that reaches them and ultimately killing them.

The intensive exploration and survey of flooded cave passages on the Caribbean coast of the Yucatan Peninsula begun in the 1980s now provides a unique opportunity to access the interior of an aquifer. In 2000, the University of Bristol's Carbonate Processes and Palaeoenvironments Research Group launched an integrated, multidisciplinary research program to better understand the aquifer on the Caribbean coast of the Yucatan by using technical cave diving to access and instrument the flooded cave passages. The principal aims of this research are to better understand the character of and controls on the linked fresh and saline groundwater flows, to study the important geochemical and geomicrobiological processes that may enhance cave development and prove to be the base of the food-chain in the cave ecosystem, and to study the cave geomorphology so that we may understand when and how the cave systems formed. We



Survival time in groundwater at 10±1°C of nine species of microorganisms that may affect human health (Kaddu-Malindwa et al., 1983). Significant numbers survive beyond 100 days.

have established a monitoring network to collect data on groundwater levels, flow velocities, salinity, and temperature. We have collected groundwater samples for chemical and microbiological analysis and made extensive visual observations of the shape and distribution of cave passages. Of particular interest has been the successful sampling of three sites in the saline-water zone below 60 meters depth with the vital assistance of local cave divers and dive shops. Through this ongoing research effort, with anticipated completion by 2003, we hope to advance our scientific understanding of this karst groundwater system and thereby help local agencies and governments develop sustainable water-resource-management practices for this valuable sole-source aquifer, on which the region's health and economic development depends.

The karst groundwater system of the Caribbean Yucatan coast is valuable in many ways. It hosts a unique endemic ecology, it is widely used for recreational water activities, it is the sole source of potable water for the Municipalidad de

Current meter being removed from the south branch of Xel Ha Caleta by Patricia Beddows and Marike Jasper.
Edward Mallon.

Solidaridad, and it is also used as a sink to dispose of the region's sewage effluent. This paper has discussed how the various sewage-disposal practices in Solidaridad may negatively impact the quality of the thin fresh-water layer both from above when treated and untreated sewage infiltrates to the water table and from below when sewage-treatment-plant effluent is pumped into the underlying saline water. All effluent introduced to the aquifer will circulate with the groundwater,



damaging the underground environment, and ultimately be discharged onto the coastal barrier reef, where it may induce detrimental algal blooms. I question the sustainability of current sewage-disposal practices, particularly in light of the expected increase in sewage production due to continued tourism development along the coast. Alternative sewage-disposal practices must be implemented on a large scale to prevent degradation of this water resource and avoid impacts on human health. One potential solution for large resorts and urban centers is the additional processing of sewage-treatment-plant effluent through created wetlands, thus eliminating the use of disposal wells.

We wish to thank the numerous dedicated individuals in Quintana Roo and the United Kingdom who have generously provided their time, energy, and resources to the University of Bristol's research efforts. Financial and logistical assistance from the following groups is also gratefully acknowledged: Aanderaa Instruments, Akumal Dive Shop, British Cave Research Association, British Sedimentological Association, Centro Ecológico Akumal, Grupo Exploración Ox Bel

Ha, Hidden Worlds Dive Shop, Municipalidad de Solidaridad, R. S. Aqua, Royal Geographical Society, Royal Society, Southampton Oceanographic Centre, University of Bristol, and Xel Ha Park.

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Patricia Beddows tends to instruments in a cave (frame from a digital video).
Andreas Kuecha.



¿A Donde van las Aguas Residuales?

El Municipio de Solidaridad, localizado en la costa Caribe de la Península de Yucatán, México, es completamente dependiente del lente subterráneo de agua dulce y potable que flota encima de agua densa salina en este acuífero cárstico estratificado. El acuífero se usa simultáneamente para actividades recreativas acuáticas por la población local y los turistas, y también se depositan aguas residuales. Los escasos conocimientos sobre los mecanismos y carácter de la circulación de las aguas subterráneas, cuestionan la sostenibilidad del uso múltiple de este acuífero. Actualmente, se emplea una variedad de métodos de disposición de agua residual, los cuales pueden afectar en varias formas la calidad del agua subterránea. Se recomienda que se implementen estrategias alternativas de tratamiento del agua residual para proteger la calidad de los recursos hidráulicos, en vista del desarrollo fenomenal del turismo de esta zona.

2001 INNERSPACE ODYSSEY EXPEDITION

Bev Shade and Bill Stone

with contributions by Jason Mallinson and Rick Stanton

During the winter and spring of 2001, the U.S. Deep Caving Team fielded a three-and-a-half-month expedition to Sistema Huautla and Sistema Cheve in Oaxaca and Sistema Purificación in Tamaulipas. The effort was aimed at identifying potential avenues for breakthroughs in these three caves, where no changes in depth had taken place in eight or more years. Twenty participants from five countries were involved in the project.

At the beginning of Phase 1, Page Ashwell, Bev Shade, José Soriano, Bill Stone, Gustavo Vela, and Andy Zellner arrived in the village of San Agustín Zaragoza on the Huautla Plateau in Oaxaca on January 21, 2001. We rented two houses in the village for kitchen and sleeping space and started unpacking. The next day, Mark Crapelle arrived; he had been vacationing on the east coast before heading up into the mountains to join us.

The next four weeks were spent rechecking previously explored caves trying to find a continuation of the Río Iglesia, which sinks in the Penthouse chamber of Sótano del Río Iglesia at -280 meters. The motivation for this was the 1994 discovery of an underground junction of what is presumably the Río

Phase 1 team: Bill Stone, Bev Shade, Gusa Vela, Andy Zellner, Page Ashwell, Jose Antonio Soriano, Jason Mallinson, and Mark Crapelle. *Bill Stone.*

Iglesia with the San Agustín River beyond the San Agustín sump at a depth of 1450 meters, forming the long-sought main drain for Huautla. [See *AMCS Activities Newsletter* 21.] The water entering lower San Agustín arches out from a 6-by-6-meter borehole in the form of a 12-meter waterfall. The trick, now, was to find a way into that tunnel other than diving 655 meters through the San Agustín sump. Many previous teams, including Huautla Project expeditions in 1978 and 1980, had scoured Río Iglesia pretty hard. But we thought it was at least worth another look.

Another option in the pursuit of the Río Iglesia was Cueva de San Agustín. Cueva de San Agustín is a fossil river cave located less than 200 meters from our mess hall, on the mountain knoll behind the village. We had noticed on the 1969 Canadian map that the final room,

known as the Sala Doble, contained a high dome with a waterfall pouring in. The chamber is at a depth of 474 meters beneath the entrance and measures 250 meters long by 30 meters wide. Entry into the chamber is by way of a spectacular 115-meter freefall shaft known as the Sima Larga. The Sala Doble is at the same elevation inside the mountain as the Río Iglesia where it disappears below the Penthouse. Just 100 meters separate the two rooms underground. Our plan was to set an underground camp in the Sala Doble and use hammer drills to scale the big dome at the far end of the chamber. We hoped it would lead up over a drainage divide to passage that might go south, cross under the Sótano del Río Iglesia, and connect with the active river.

There are nineteen vertical pitches to the bottom of Cueva de San Agustín. By January 26 they had





Hiking to work, Bev Shade passes through the stalactite curtain in the center of the Sala Double, Cueva San Agustín. *Bill Stone.*

been rigged with some 600 meters of PMI rope, and the first underground camp had been established. During the next six days, Crapelle, Shade, Soriano, and Stone took turns leading the climb up the waterfall, while Ashwell, Vela, and Zellner pushed other climbing leads around the Sala Doble.

At the conclusion of our first climbing effort, we had scaled 90 meters and were looking across the top of the shaft into an infeasible canyon leading south toward Río Iglesia. Getting into this canyon required more rope and drill batteries, so we returned to the surface. Three days later Crapelle, Shade, Soriano, and Stone returned for a second five-day push. A day after our arrival in the underground camp, a storm upstairs dumped some 15 centimeters of water, and the 90-meter waterfall emptying into the Sala Doble quintupled in volume, filling the chamber with a fine mist. The waterfall on the route to our lead also noticeably increased in flow, which meant that everyone got wet between camp and the new lead. One of the real luxuries of the first camp had been

staying dry. The infeasible canyon gained another 50 meters of elevation in a series of shorter pitches led by Crapelle and Soriano, passing through several spectacular collections of helictites. Unfortunately, the photo strobes chose this time not to work, so we were not able to take any pictures of what are surely some of the best formations in Huautla. At an elevation of 140 meters above our underground camp the new route connected back into Cueva de San Agustín at a short branch off the main tunnel previously thought to have no outlet. We added 566 meters to the length of the cave. The new passage has several climbing leads that we did not have time to check. The largest dome can be reached rather quickly by taking the only left-hand tunnel off the main route to

the Sima Larga. Neither did we have time to pursue the source of the waterfall in the dome we climbed out of the Sala Doble. It enters via a steep flowstone slope just above roof level of the Sala Doble, while the more obvious route we followed to the connection did not carry water.

It is worth mentioning that there are three down-trending holes taking water in the Sala Doble, all along the north wall. Unfortunately, all end in very compacted breakdown. The water filters down the wall in a series of impassably small crevices. Clearly that water goes down and connects with Río Iglesia somewhere under the Penthouse.

After connecting our climbing route to the main passage, we broke camp and derigged. Since our new discovery connected to the main route, our four-person team split into two groups, each derigging one way up

to the passage junction. In this way, we were able to recover virtually all of the gear we used in the bolt climbs. The cave was derigged on February 8 and 9.

Meanwhile, during the second camp at the bottom of the Cueva de San Agustín, Ashwell, Vela, and Zellner rigged Sótano del Río Iglesia down to the -280-meter level and set a three-day camp in the huge Penthouse, a roughly circular room measuring 130 meters in diameter. There the cave splits. The water sinks into breakdown, while the main downstream tunnel, leading to the deepest portion of the cave at -535 meters, has been blocked by debris since sometime shortly after its discovery in 1967. This debris was washed in during the summer rainy seasons. Because no one had seen this section of the cave since the late 1960s, we hoped to find some climbing leads that had been overlooked. Jason Mallinson had arrived from England, and after several days of sorting dive gear, he joined them in the cave

Eight flashes illuminate the Sima Grande, the spectacular 115-meter shaft at the bottom of Cueva San Agustín. Bev Shade fired the flash every 14 meters during her ascent.

Bill Stone.



Crossing the Río Santo Domingo at dusk. The cliffs in the distance rise 500 meters above the river. *Bill Stone.*



camp. They dug open the blockage to the deeper sections of the cave and came to the lip of a shaft leading down, probably Taffy's Terror on the old Canadian map. Excited by their success in reopening this section of cave, they left the cave to fetch more rope and rigging hardware. Their arrival on the surface coincided with the beginning of the three days of heavy rain that created the spectacular waterfall in the Sala Doble. When the team returned to Sótano del Río Iglesia, the dug crawlway was flooded shut again.

Following the derig of the Cueva de San Agustín, we were joined by Marcin Gala and Kasia Biernaka from Poland. Most of the team then returned to the Penthouse on a single-day recon. Although the downstream crawlway remained impassable, Ashwell discovered a new canyon tunnel entering the Penthouse from the south and carrying a substantial flow of water from the recent rains. Several weeks later, Shade and Stone returned to this canyon with climbing gear and scaled three waterfall shafts, mapping 184 meters of passage in the process. It still continues to the southeast. Further work

in Río Iglesia was deferred due to the arrival of the Phase 2 team on February 18, when Zellner and Ashwell returned home to the United States.

For Phase 2, we were joined by new team members Rick Stanton, Greg Horne, and Charles Brickey. The primary focus of this part of the expedition was the fossil resurgence cave known as Cueva de la Mano. This dry cave is located in

the Santo Domingo Canyon and lies immediately above the springs that drain Sistema Cheve. It is connected in several places to the active spring tunnel. While the canyon and cave are both hot and muggy, the water coming out of the Cheve is beautifully cold (16°C) and clear.

Cueva de la Mano had been explored extensively by several previous expeditions between 1989 and 1995, and we knew progress would be difficult. The general consensus was that the dry cave was finished, but in 1997 our team had explored a sump at the end of the cave that continued beyond the range of the limited diving equipment on hand. Those dives had been made by Jason Mallinson and Rick Stanton, who were both interested in a second attempt with more sophisticated equipment. Furthermore, discussions with Nancy Pistole, Matt Oliphant, and Peter Bosted revealed the existence of several climbing leads near the southern end of the dry passage.

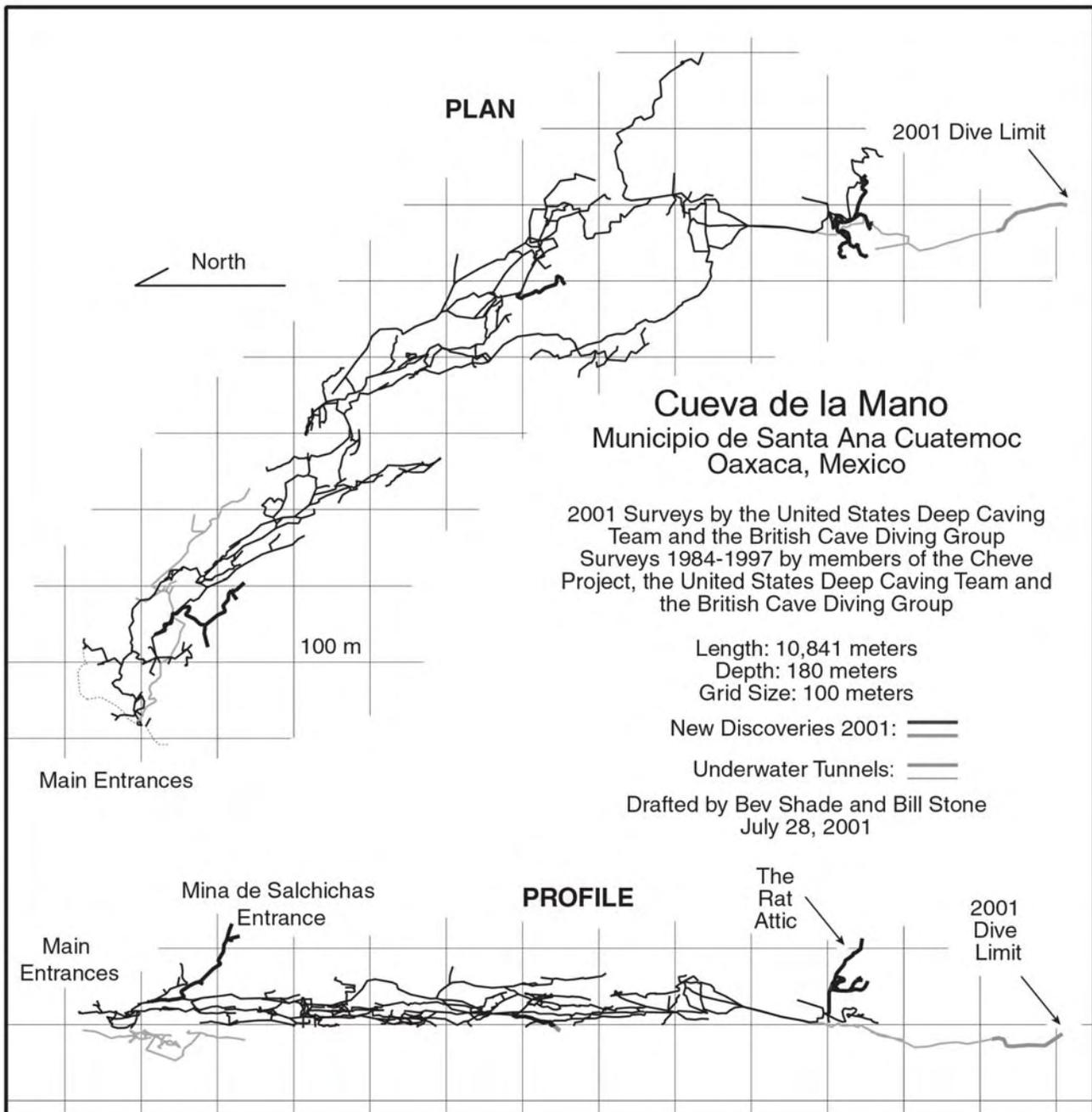
Bev Shade during the derig of Cueva San Agustín. Thirty pieces of rope were tied end to end for hauling up the drops. *Bill Stone.*



On February 21 we hired sixteen burros and guides from the small village of San Simon, on the northern edge of the Santo Domingo Canyon where a new road had just been completed from Mazatán, and transported equipment to establish a six-week basecamp near the entrance to Mano. Since Mallinson had stopped in 1997 only due to a shortage of air in a tunnel measuring 8 meters high by 5 meters wide at a water depth of 30 meters, the diving effort merited first priority. If a team of divers got through the

sump and into dry chambers beyond, they could survey back toward the known dry cave and look for leads that bypassed the sump. During our first several days, the entire team transported diving gear, including new carbon-epoxy tanks containing helium-oxygen and several compact rebreathers, to the southernmost sump. Mallinson and Stanton then began a series of sixteen solo dives, on alternate days except those required for gear repair. They reached a maximum penetration of 458 meters from dive

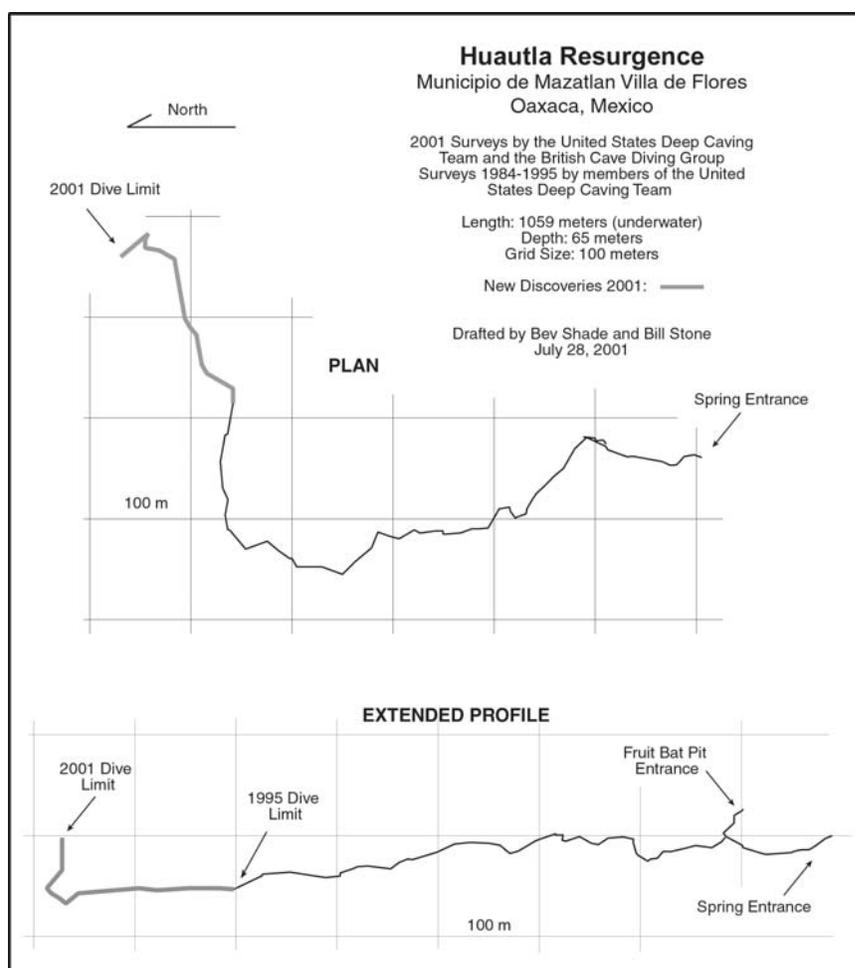
base before running out of leads. Just beyond where Mallinson had stopped in 1997, the tunnel began branching into ever-lower bedding-plane openings. Ultimately, all of these were pushed to a point where it was physically impossible to dive any farther, even by crawling underwater. On his last dive, Mallinson took a hammer with him. After removing his rebreather and bailout tanks he bashed on the fractured bedding-plane roof until he was able to move forward a few meters, pushing both bailout bottles



ahead of him, until the bedding plane lowered again. Hopefully, this is not the only connection from the resurgence area to Cheve and Charco.

While Mallinson and Stanton pushed dive leads, the rest of the crew looked for dry leads, pushed climbing leads, and went ridge-walking. By wading around the head of the southern sump, we could reach a small crawlway that led to the southernmost dry passages. This crawl leads to a decent-sized room, but all the passages beyond this room are fairly small and unpleasant. Horne and Shade visited this section to look at potential climbing leads that Nancy Pistole had kindly marked on old survey notes. They did not find some of them, found several that were not marked, and were non-plussed, finally settling on a different lead entirely. This area backs up during high water, so the walls are coated with damp brown mud. However, we felt that we could see a bit of white limestone high in the room and estimated the dome to be at least 20 or 30 meters high. We pushed this lead for a month. Shade and Stone led the first series of pitches up the big shaft to a complex intersection at a point 40 meters vertically above the sump. Close to the floor, the wall was layered mud and soft flowstone. This hard-to-protect combination gave way to sharp, horizontal marble fins. Forty meters up, we were relieved to reach a big ledge with several horizontal leads. One passage went through a very well decorated section named the Rat Palace. Most of the passages at or above this ledge were well decorated with both calcite and aragonite formations. In all, 436 meters of new horizontal tunnels were mapped in this area, including a spectacularly beautiful gallery completely lined with pristine dogtooth spar.

Gala, Biernaka, and Soriano now joined the climbing teams in this area. A total of eight pitches were scaled in different directions from the junction ledge. The highest point was reached four pitches above the ledge, 99 meters vertically above the sump. All of these climbs



ended where large boulders wedged into fractures in the ceiling blocked farther progress. Apparently we had climbed up into a fracture zone, perhaps beneath the base of an enormous room. Although air flowed up into several of the ceiling leads, none of them could be pursued safely, at least not from below while on rope. This breakdown appears to be both vertically and horizontally extensive.

One mystery of Cueva de la Mano was resolved this year. The entrance, located about 20 meters above the active spring, usually has a strong wind blowing either in or out, suggesting the presence of a large cave system with a higher entrance. However, the air is not strong enough or cold enough to signal a direct connection with Cueva Cheve. Furthermore, beyond a large junction located 300 meters from the entrance, the wind dies, and the remaining 925 meters of travel to the southern sump are

humid and stagnant. During our month-long stay at Mano base-camp, we were visited several times by villagers from the small town of Santa Ana Cuatemoc, on the south side of the canyon. They made these trips despite a four-hour trek on horseback through stiflingly hot jungle. Although we had obtained official permission, these parties were nonetheless armed, usually with rifles and shotguns, and confrontational at first. We laid out the map we had been working on and offered tours of the cave. Ultimately, two groups entered the cave, the second one taking a four-hour trip with us to the sump. Suspicion waned as their understanding improved. Soon, they informed us that some 140 meters vertically up the mountain toward Santa Ana, one of their hunting dogs had come across a shaft leading down into the canyon wall. Rapid negotiations followed. They guided us to the pit, which our

Diving in Cueva de la Mano

These reports on diving in Cueva de la Mano appeared, in somewhat different form, in the *Cave Diving Group* [Great Britain] *Newsletter*, numbers 124 (July 1997) and 142 (January 2002). The telegraphic style, only slightly ameliorated by editing, is traditional in that journal.

January 11, 1997. The static terminal sump was dived by Stanton with two 4-liter cylinders. Twenty-seven meters of line was laid, to surface in the full flow of the Cueva Cheve river. A large fossil passage was also evident. Thinking we had hit the big time, Stanton returned for Mallinson, who, not having a wetsuit, borrowed Stanton's jacket, leaving Stanton to dive through in his long johns. On the far side, the water welled up from another sump. The large, rising tube led back to a blockage and onward to another sump. It was clear that it had been visited before, probably via a bypass to the sump. While Mallinson investigated this, Stanton continued the dive. The smaller, continuing sump reverted back to a larger passage, then choked. A small tube bypassed this and was followed to -16 meters. This contained only some of the flow, so the line was wound back to a belay and time was spent looking for other alternatives.

January 13. Mallinson proceeded past Stanton's limit down a descending tube requiring side-mounts to -23 meters, where it entered a low, hading rift. Seeing dark spaces lower, he belayed the line and swam down through a rift until it broke out into the side of a large tunnel at -26 meters, heading north and south. The diver swam south, in a tunnel 15 to 20 meters wide and more than 5 meters high, until he reached -33 meters. Here not having a buoyancy compensator was causing difficulties, so he surveyed back. The passage continues big.

January 15. Mallinson pushed on from the previous limit, this time with streamlined BC and stage bottle. It was awkward squeezing through the rift with wings. The large tunnel continued, and 115 meters of line was laid at an average depth of 30 meters to a narrow canyon. Mallinson tried to surface from -23 meters in the canyon, but falling silt and debris caused a silt-out and the roof pinched out at -7 meters. This is probably a dead end, and the main tunnel has been missed, which would be easy due to the width of the tunnel preceding this section. Mallinson surveyed back to the previous limit and returned to the entry point at the rift.

The large passage heading north, downstream, was lined. This ascended for 50 meters up a boulder ramp to a chamber at -10 meters with a possible air bell above. Surfacing was not possible due to the amount of deco required. This point may be on the far side of boulders noted in the initial part of the sump where the current is evident. The diver returned, surveying, to the rift and spent his deco time doing underwater aerobics to keep warm.

February 20, 2001. Carry team of eight sherpas took all dive equipment to the 1-kilometer sump, ready for Mallinson and Stanton the next day.

February 21. Mallinson dived first on a chest-mounted homemade rebreather with open-circuit side-mounts as bailout. The sump line was repaired as far as the junction with the deep tunnel. The sump was then followed to Mallinson's 1997 downstream limit beneath an aven. Meanwhile Stanton had dived with his homemade rebreather to the boulder choke above this aven. Here Mallinson's bubbles were seen to emerge from a small hole beneath the diver. Eventually Mallinson managed to squeeze through, minus rebreather, and make the physical connection. This connection was obviously not large enough to use the back-mounted Cis-Lunar

rebreathers. Thus all dives in this sump were done using the homemade rebreathers in various modes of closed, semi-closed, and something in between, depending on whether an oxygen sensor was being used or not.

Stanton then followed the upstream tunnel to the shaft upward at approximately 330 meters into the sump that was Mallinson's limit in 1997, when he had surfaced at the shaft in on off-route airbell. Stanton then found the main continuation of the tunnel, a short section of passage to a deep-looking shaft that was not descended.

February 22. Stanton and Mallinson ascended the second shaft to a small airbell at the top. This was clearly off route, so the divers made plans that Mallinson would continue into the new deep shaft while Stanton tidied up the line in the shaft area. This done, Stanton returned to the new main tunnel and laid some more line from Mallinson's limit up to a depth of 16 meters.

February 23. Mallinson continued from the limit at -16 meters to a large boulder choke that blocked the passage. A small hole up through boulders was seen but not attempted. A side passage was noted and partially explored. It emits strong current.

Stanton dived to the end of the line, surveying all the new passage. The end fans out to a choke of boulders with no apparent way through, but most of the current is coming through small passages below this level. One small passage was spotted, but it was a committing squeeze that was left for another dive, when the disturbed silt had settled. Dive time 90 minutes.

February 25. Mallinson swam to the present end and removed his rebreather to pass a small hole in the boulder choke. The hole had to be hammered to remove an obstruction. Beyond the hole, inside the choke, a passage went for 10 meters to a dead end. Various holes were looked at, but no way on was found. It is very silty inside the choke, indicating little cur-

rent. Back on the correct side of the hole, he donned the rebreather, and other side passages were looked for. A possible shaft upward was noted on the return, but the rebreather then flooded, requiring the diver to use his open-circuit side-mounted bailout tanks. Dive time 2 hours.

Stanton surveyed all the uncharted passage.

February 27. Mallinson ascended the possible shaft noted on the previous dive to an airbell that is a dead end. A further upward passage in the deeper section was ascended, but this pinched out after 10 meters in a silt-out. A side passage was noted farther towards the terminal boulder choke. This was left for a later dive due to the decompression requirements already accumulated.

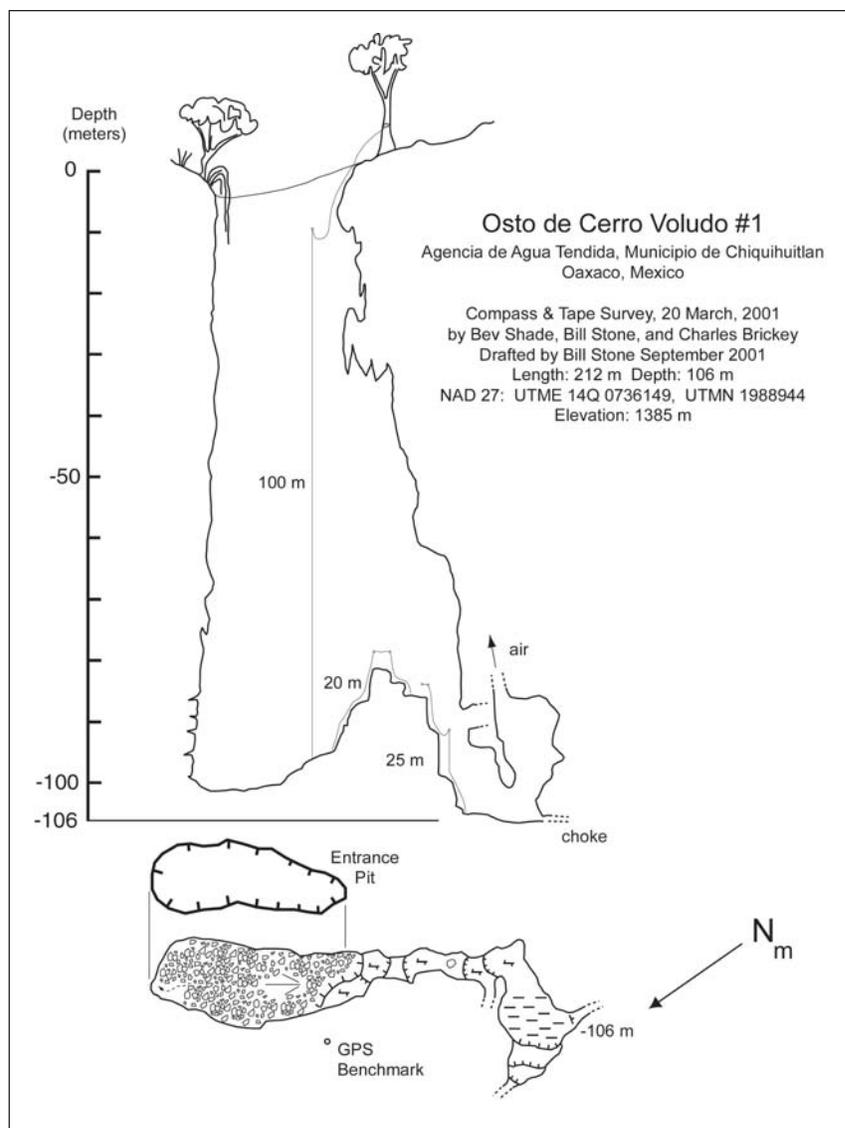
March 1. This dive was aborted 200 meters into the sump when Mallinson realized the Sofnolime in the rebreather was spent and unusable. Open-circuit bailout was used to regain the surface.

March 3. Stanton attempted to push the lead found on the last dive. Technical difficulties with his rebreather curtailed the dive.

March 4. After removing his rebreather, Mallinson followed a small tunnel emitting a strong current for 20 meters along a low passage with fallen (and falling) slabs to an obstruction caused by a larger slab. The passage could be seen to continue beyond, so an attempt at moving the slabs was made. After 10 minutes digging, the diver had to return to the rebreather and then to base. Dive time 2.5 hours.

March 5. The slabs at the end point were again attacked by Mallinson, and after a further 15 minutes excavation, a way through was made. The tunnel enlarged slightly, but after 5 meters more, the current could be seen coming from a very tight spot. This was the last dive in this cave for this expedition.

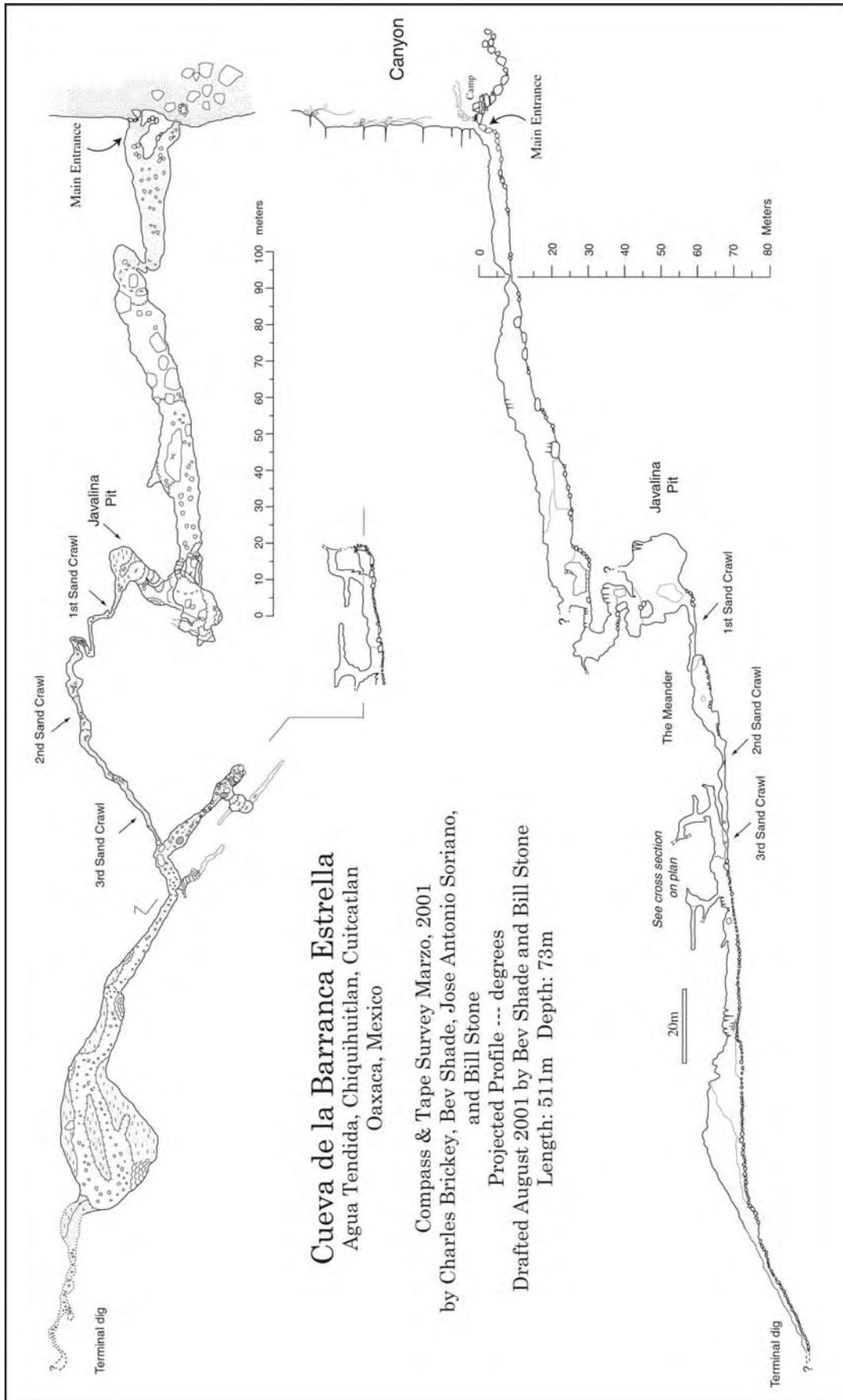
—Rick Stanton and Jason Mallinson



teammate Soriano ultimately named Mina de Salchichas, the Hot Dog Mine.

Salchichas was full of surprises, including extensive archaeological remains and stepped terraces along the tunnel wall that almost certainly host burial sites, probably dating back 1500 years. The extensive construction and large artifacts are even more impressive considering that it has a pit entrance with several drops. The second drop ends in waist-deep bat guano and, of course, thousands of bats. The guano slope trailed off for nearly a hundred meters into a heavily decorated Carlsbad-like chamber and continued below to a borehole measuring 8 meters in diameter. Initially, we hoped that this might be a tunnel

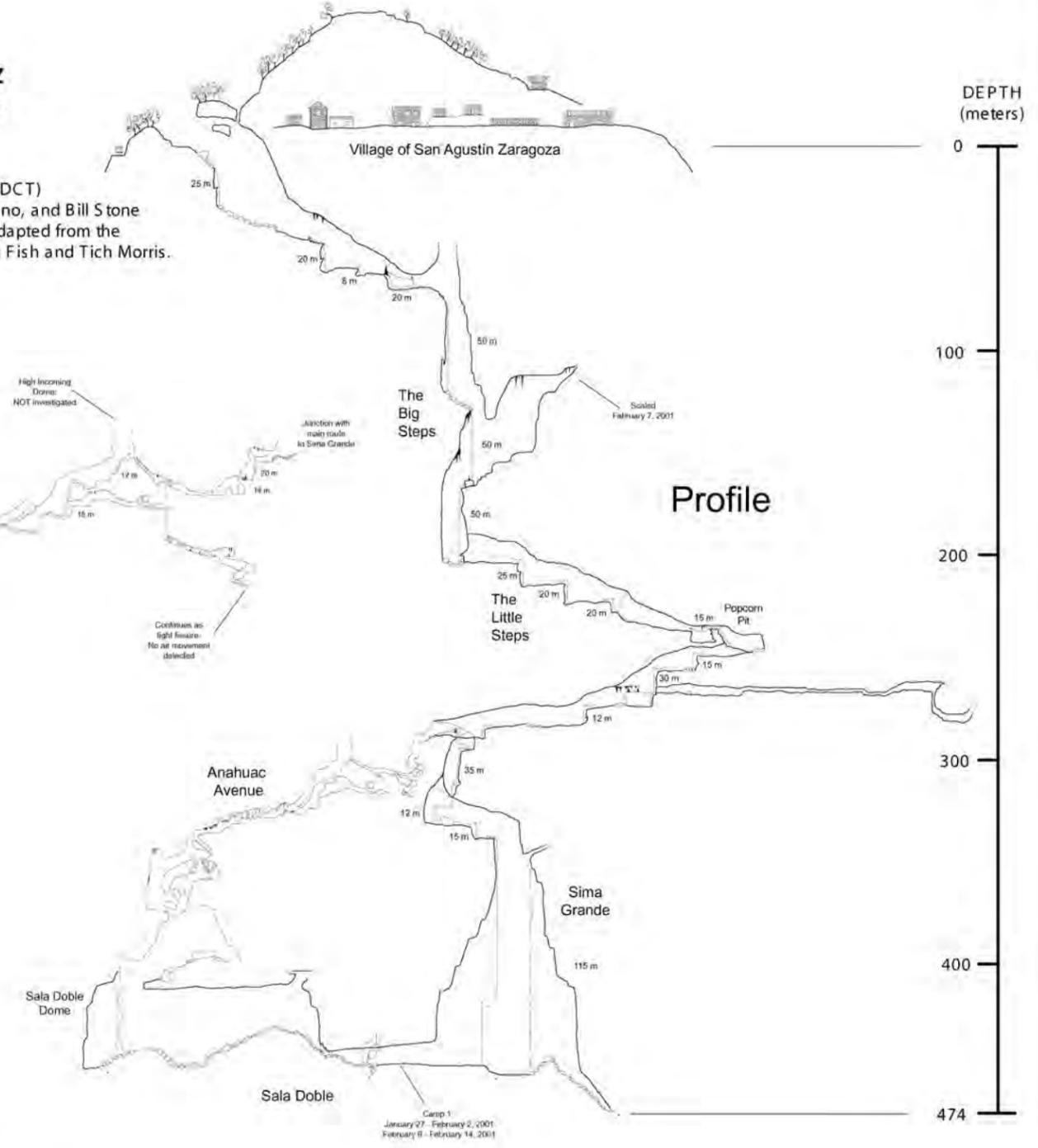
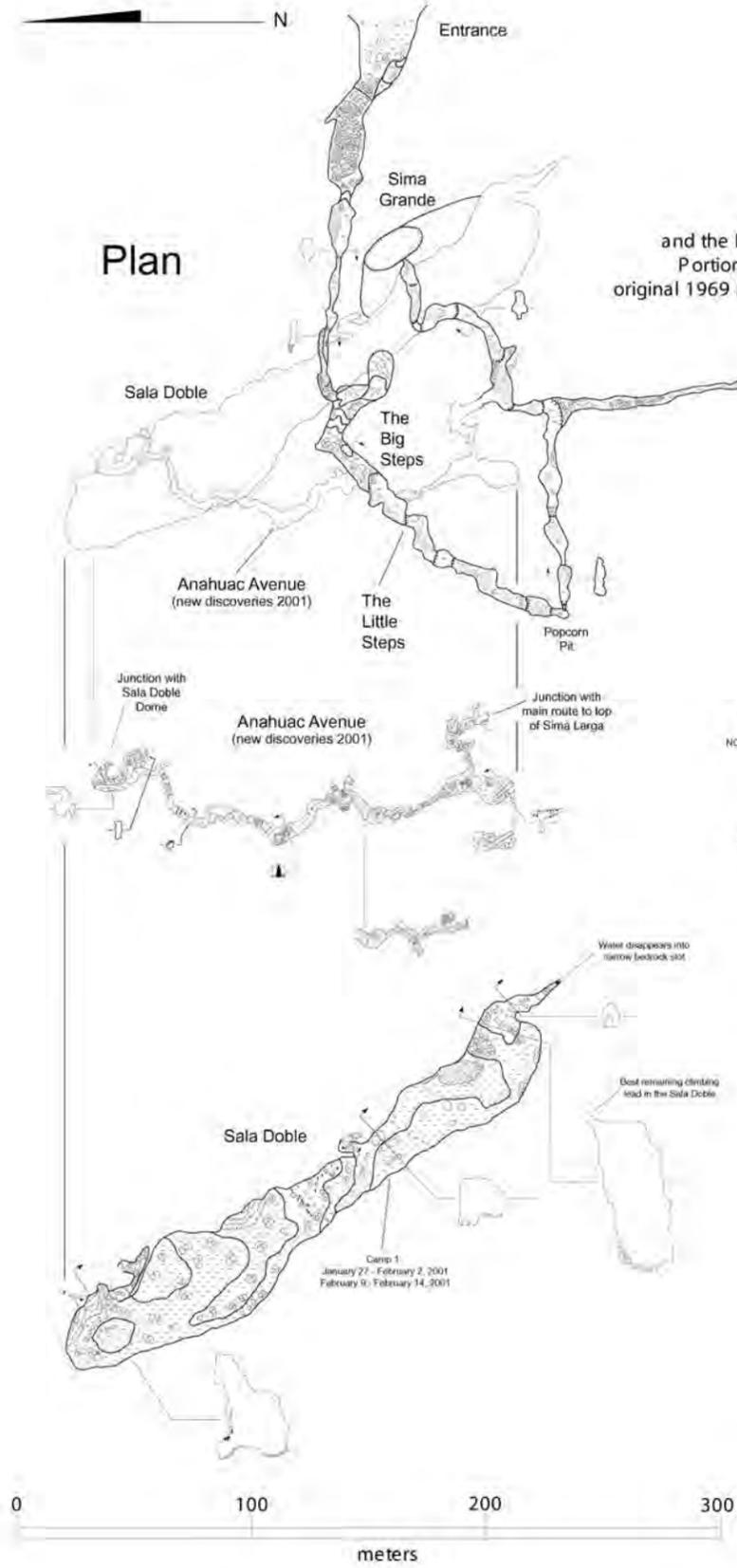
parallel to Cueva de la Mano, but survey stations were found in this passage. Fortunately a recoverable station was found near the junction of the Mina de Salchichas and the main passage, so that our survey was easy to connect to the old survey data. We were grateful for the careful work of previous expeditions to mark survey points. This passage joins the rest of the cave at the main junction in Mano where the air disappears. So the mystery of the airflow had been solved: the high entrance at Mina de Salchichas provides a driving force for the wind due to its significantly higher elevation. It is also the main entrance for the significant bat population in the cave, easily several thousand. It is worth a note of



Cueva San Agustín

San Agustín Zaragoza
Municipio de Huautla de Jiménez
Distrito de Teotitlan del Camino
Oaxaca, México

2001 Surveys by the United States Deep Caving Team (USDCT) and the Huautla Project: Bev Shade, Mark Crapelle, Jose Antonio Soriano, and Bill Stone
Portions of the Plan Map outline above the Sima Grande have been adapted from the original 1969 MUCCC map presented in the Canadian Caver Journal by John Fish and Tich Morris.
Drafted January - April 2002 by Bill Stone



General Exploration and Rigging Notes:

- 1) Numbers beside vertical pitches indicate rope length in meters required for rigging.
- 2) The Sala Doble Dome, and the pitches above it, were scaled from the bottom up using aid climbing techniques. The climbing effort took 11 days based from Camp 1 in the Sala Doble.
- 3) Three significant climbing leads remain uninvestigated: the waterfall source for the Sala Doble Dome; the flowstone dome at the southeast end of the Sala Doble; and the high dome shown near the top of Anahuac Avenue.
- 4) Four separate water sources sink into the breakdown floor of the Sala Doble along the northeast wall. It is possible that with significant effort the sink closest to Camp 1 (see profile) might be followed. It is plugged with jagged breakdown, but the size of these boulders is smaller than elsewhere seen in the Sala Doble.

warning that two members of the expedition, Gala and Horne, subsequently contracted histoplasmosis, with Gala spending two weeks in the hospital following his return to Poland. Both had visited the I Guano Go tunnel that leads to the southeastern-most sections of Mano, which is far from the Mina de Salchichas entrance.

The 2001 expedition mapped 942 meters of new tunnels in Cueva de la Mano, bringing the total length to 10,841 meters and increasing the depth significantly, to 179 meters. The route onward toward Cueva Cheve, however, remains elusive.

With Mano finished, pending a breakthrough to the other side of whatever geologic feature is blocking current exploration, we turned our attention to the Huautla Resurgence. Due to the unusual geology of the Sierra Mazateca and the Sierra Juárez, it turns out that the springs for the two vast, deep systems in these two mountains, respectively Huautla to the north and Cheve to the south, are both in the same canyon. From Mano base-camp it was only a kilometer and a half downstream to the Huautla springs, or about an hour's strong hiking with dive kit, including a good deal of river traversing in chest-to-neck-deep water. We began staging MK5 rebreathers and carbon-epoxy SCI tanks down there at the end of the first week of March.

On an earlier expedition in May of 1995, Jill and Paul Heinerth and

Noel Sloan had reached 769 meters penetration at 55 meters depth in the Huautla Resurgence, with the tunnel headed downward. Rick Stanton and Jason Mallinson managed to re-line the first 769 meters; rainy-season flows in the intervening six years had shredded the original guide line. They extended exploration an additional 290 meters to where, on March 9, Mallinson surfaced in an airbell at a penetration distance from the entrance of 1059 meters. This location is approximately 100 meters inside the east wall of the Peña Colorado canyon. The airbell is 15 meters in diameter and is connected to another airbell of equal size by a swim-through fissure with air overhead. An 8-meter-wide, 5-meter-high air-filled tunnel with stalagmites could be seen leading off from the roof of the first airbell. Unfortunately, there was no beach, and the only way out of the water will be via a 10-meter aid climb.

The maximum water depth reached during these four dives was 65 meters, at a point almost directly beneath the floor of the Peña Colorado canyon. Approximately 1200 meters north of this point is the Cueva de la Peña Colorado, an extensive cave explored in 1984 by the



Jason Mallinson tops off a pair of tanks for a dive in the southern sumps in Cueva del Mano. *Bill Stone.*

USDCT. The discovery of an air-filled tunnel beyond the Huautla resurgence marks an important breakthrough in the exploration of Sistema Huautla. It now remains for a dedicated expedition, or several, with waterproof bolting equipment and a much larger cave-diver complement to link the Huautla Resurgence to the Cueva de la Peña Colorado and extend exploration from there to the Sistema Huautla, 9 kilometers to the north.

The remainder of the month of March was spent on long reconnaissance hikes based out of the village of Santa Ana Cuatemoc. Two of the visitors to our basecamp in the canyon lived in this town and offered to host us for exploration work in the middle karst zone between Sistema Cheve and its resurgence.

Phase 2 team: Greg Horne, Elizabeth Gutierrez, Jason Mallinson, Jose Antonio Soriano, Bev Shade, Bill Stone, Rick Stanton. Not shown are Charles Brickey, Mark Crapelle, Marcin Gala, and Kasia Biernacka. *Bill Stone.*



Diving the Huautla Resurgence

These reports on diving in the Huautla Resurgence appeared, in somewhat different form, in the *Cave Diving Group* [Great Britain] *Newsletter*, number 142 (January 2002). The telegraphic style, only slightly ameliorated by editing, is traditional in that journal.

March 6, 2001. It was expected that most of the line installed in 1995 would have been washed out and shredded by the current, so this dive by Stanton was to repair and replace it far as far as could be reached. Following the trail of old line remnants eased what would have been complicated route-finding. Sump 2 had multi-level passages in a maze-like configuration, and all the tubes here are clean-washed with sharp erosion features. Beyond, the passage did not fit the description, and the second air chamber with the 1-meter cascade could not be found. This may have been due to higher water levels. The passage changed nature to a 6-meter-diameter phreatic tube with whalebacks of silt on the floor. The diver turned back to base when all the line carried had been laid. The swim out from approximately 600 meters from the entrance was much faster than the inward time due to the strong current. Dive time 2.5 hours.

March 7. Mallinson continued relining the known passage from Stanton's limit of the day before, using a Cis-Lunar MK5 rebreather and two side-mount tanks. The route finding was easy due to remnants of the old line, which needed repair in places. The end of the old line was reached at 900 meters and 40 meters depth. Here a gravel ramp led down to -60 meters, and from the base of this a large passage rose up to -50 meters, where it leveled off and

continued large. Silt and gravel banks showed high-flow current patterns, indicating this was the main way forward. Before the diver returned to base, 100 meters of line was laid beyond the old limit. On the return, an hour of decompression was required before the airbell between Sumps 1 and 2, due to the need to surface momentarily there. Dive time for the 1-kilometer penetration was 3.5 hours.

March 8. Stanton continued on from Mallinson's limit. The passage remained at 52 meters depth. The visibility was such that it was hard to maintain contact with both walls of the large tunnel. After about 150 meters of progress, the depth had increased to 65 meters at a marked elbow in the passage, beyond which it rose steeply over walls of large boulders to a chamber with a floor at 30 meters depth. A full circumnavigation of the walls was completed, only to return to the starting point with no obvious continuation having been found. As it was clear that this was still the main flow, the only way on had to be vertically upwards, so an ascent was made to a depth of 16 meters along one wall of the vast chamber. At this point it was felt that a second diver, arriving here in a much shorter time, would be able to achieve more due to less decompression obligation, so a return to base was made. Dive time 4.5 hours.

March 9. The objective of Mallinson's dive was to progress to the limit of Stanton's line at -16 meters as quickly as possible to minimize the decompression required to surface at this point. Mallinson reached the end of the line after 45 minutes, and at this point the computer showed 45 minutes of decompression. Forays

around the shaft during decompression stops every 3 meters tended to dislodge fine silt from above, so these were kept to a minimum, although a route upwards was found.

After completing the final stop at 3 meters, Mallinson surfaced into a large airbell with mud-covered slopes and vertical walls. Swimming around the edges of the airbell showed there was no easy exit from the water, and in fact finding somewhere to tie off the line was difficult. A narrow rift on the surface led through to another large airbell, but this was domed, with no possible above-water exit. Back in the first airbell, a hole in the roof could be seen leading into what looked like a further fossil chamber with two large stalactites hanging from the roof. Unfortunately no safe exit from the water was possible without backup from another diver. Losing a mask, fin, or cylinder into the 30-meter-deep pool would be disastrous.

Forty-five minutes after surfacing, Mallinson descended to the base of the shaft and headed back to the elbow at -65 meters, looking for alternate routes. This was continued back along the deep tunnel, but nothing obvious was found. Visibility at this time was not good for route-finding, so things could have been missed.

Mallinson eventually decided to head for home, and after 1 hour 40 minutes of decompression, the last dive out through Sump 1 could be started. The total dive time for this penetration was 5 hours. The copious amounts of mud and silt in the shaft above -16 meters at the end leads Mallinson to assume that this is off the main route and a continuing passage has been missed somewhere.

—Jason Mallinson and Rick Stanton

From this new base, we were guided to three new caves. Osto de Cerro Voludo #1 contained a spectacular freefall 100-meter entrance shaft. It ultimately reached a total depth of 106 meters and a length of 212 meters before being plugged with dirt fill.

Several kilometers farther north, in the depths of the Barranca Estrella, Star Canyon, we were guided to Cueva de la Barranca Estrella, a fossil river sink, now dry, which we explored to a depth of 73 meters and length of 511 meters. Almost the entire cave is composed of large passages, indicating that it was once the path of a significant river, but in many places this large passage contains a lot of dry surface dirt and debris, which shows that it has been inactive for a long time. In several places this fill makes the cave unpleasantly small. The end of the cave is plugged by debris and has poor airflow. After several days of exploration, we noticed a decline in air quality just from our presence. Local hunters have filled the entrance with logs to keep their quarry from escaping into the cave.

During our retreat from this gorge we resolved a long-standing question about Sistema Cheve. The resurgence spring that boils up below the entrance to Cueva del Mano flows an enormous amount of cold, clear water, as mentioned previously. Only two cave systems, Sistema Cheve and Cueva Charco, are currently known to contribute

to this flow of internal drainage from the Sierra Juárez. Both of these caves have been dye-traced to the Cheve resurgence. But the flows observed at the deepest points of exploration in these two caves do not account for even a quarter of the flow seen at the resurgence. Somewhere, something significant makes up the missing flow. While undertaking our long-range hikes to Cerro Voludo, we daily crossed a substantial river issuing from the head of Durazno Canyon into Star Canyon. Local Cuicatec residents in this area told us that the majority of the flow originates from large springs a short distance up the canyon. At the time, we thought nothing of this. However, as we approached Cueva de la Barranca Estrella it was apparent that the substantial river had disappeared, because the arroyo we were in was completely dry. After three days of exploration at Barranca Estrella, we decided to bushwhack back up the gorge to find out why. On the way, we discovered an amazing karst feature. The river flowing from Durazno canyon plummets over a 5-meter waterfall into a boiling plunge pool and sinks immediately. The upstream side of the waterfall is luxuriant, verdant jungle; the downstream side is a



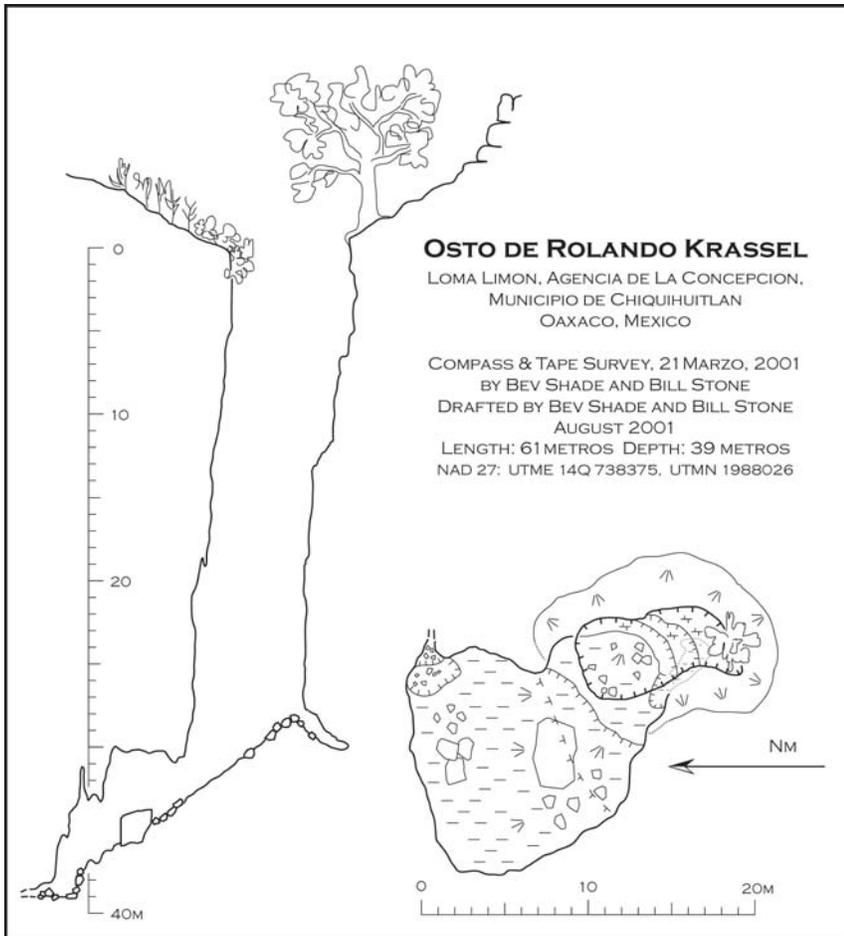
Country still making *aguardiente caña* from cane sugar. Bill Stone.

bleached-white, dry arroyo with rounded cobbles. The entire river had disappeared over a distance of 3 or 4 meters. Shade and Brickey swam into the plunge-pool lake, but could only find narrow fissures where the river sank. Although there is no humanly passable entrance, it is clear that this river accounts for a significant portion of the flow that boils up at the Mano resurgence.

Our final piece of work in this area was the exploration of Sótano de Rolando Krassel, located at the bottom of a giant doline in the middle of a lush sugar-cane plantation. This is a blind pit of 48 meters depth and 61 meters length. There are no other significant karst features on the property, but Krassel's plantation does harbor a remarkable still. Rolando's father was a German engineer, and his handiwork was evident in the mostly stainless-steel construction of the continuous-feed still. It uses steam, temperature control, and pre-heaters to finely tune the output, which appears as a roughly 100-proof rum at the end of the Brobdingnagian contraption. It is probably the only *aguardiente* in the



Imar Playas on the Main Traverse 400 meters inside Cueva del Mano. Bill Stone.



sierra that is safe to drink. He also grows very good coffee.

At the end of March, the expedition packed up houses that had been rented since January in the village of San Agustín Zaragoza, loaded equipment, and began the two-day drive north to the coastal lowlands town of Ciudad Victoria in the state of Tamaulipas. The only remaining team members by now were Shade, Soriano, and Stone. Along the way we had the unusual opportunity to see guerilla-leader Subcomandante Marcos's convoy returning from Mexico City to Chiapas following his historic meeting with *Presidente* Vicente Fox.

On Sunday, April 1, we met new team members for Phase 3 in a tree-lined park in downtown Ciudad Victoria, Tamaulipas. Cave divers Robbie Warke and Pete Mulholland flew in from England. James Brown drove in from Oregon with Bart Hogan. Mark Minton drove from

New Mexico, and Yvonne Droms and Joe Meppelink arrived from Texas, bringing the team to ten. From Victoria our caravan of five four-wheel-drive vehicles proceeded four hours up into the Sierra Madre Oriental range to the west before setting camp at the edge of the Infiernillo Canyon.

Our objective was to revisit the Infiernillo Sumps, last investigated in 1993 and left with two going underwater leads. These sumps are the lowest part of Sistema Purificación, 953 meters deep and 93.8 kilometers long. The cave has seven mapped entrances, of which Infiernillo is the lowest and closest to the sumps. Our hope was to dive through one of these sumps and surface to the west in a borehole that would continue the cave's descent toward springs located near the coastal lowlands. The Infiernillo cliff entrance is a fossil passage. Local residents claim that after extremely heavy, persistent rains, water can back up from the sumps and actually

flow out the entrance, which is roughly 50 meters higher than the sump levels while we were there. Even if a given year's high water level does not reach the entrance, there is still a huge difference between the high and low water levels. For this reason, we planned to visit the cave at the driest time of the year.

The entire team spent one day moving all the diving and camp gear up the arroyo to the cave entrance, where the loads were moved efficiently up the 40-meter entrance drop on a 100-meter-long tyrolean line. The next day most of the group continued to move gear farther into the cave, where an underground camp was set just 100 meters from the sumps. The dive team was well equipped, with two MK5 rebreathers, nine large-capacity carbon-fiber tanks charged with heliox 86/14, HID underwater lights, and a kilometer of dive line. Learning from the 1993 visit, when divers used wetsuits and found the water bitingly cold, we used argon-inflated drysuits and wore heavy pile undergarments. The dive team was made up of Mulholland, Warke, Brown, and Stone.

While all this staging was going on, Minton and Shade hiked up the steep arroyo directly west of the entrance. They gained about 250 meters of elevation from the canyon floor, and went a short distance both north and south at this elevation, but got stopped by cliffs. They found one shallow shelter cave and some cascades of tufa or old flowstone on cliff faces above us. At the end of the day, the non-divers met back at the vehicles and drove higher up the mountain, past the small town of Revilla.

About fifteen years ago, William Russell and Mark Minton discovered a shaft on the ridge south of Revilla, almost 1500 meters above the Infiernillo entrance. They named it Sótano del Caracol, Snail Pit. During ten years of intermittent work Caracol was pushed to a depth of 232 meters, just 323 meters distant from the entrance.

The Infiernillo Sumps have the potential to add a significant amount of depth to Sistema Purificación at

the lower end of the system. Caracol has the potential to add another 400 meters of vertical extent to the top of the big cave system. Our hope in the spring of 2001 was to get through the tight stuff in Caracol and deep enough that sufficient in-feeder passages had joined to form large corridors that would lead north, and down, toward Sistema Purificación. Caracol is at the top of a big anticline that plunges to the north, so this situation is geologically feasible. For this reason, many groups have worked on the same ridge for more than twenty years. There is no shortage of pits and caves on this ridge, but they are usually short and clogged with surface debris. Caracol is very unusual in this area for going more than 50 meters deep and also for its consistently strong airflow. Although there were no known going leads, Mark was interested in several possible climbing leads.

During the first week at Caracol, those not in the dive camp at Infiernillo started work near the previous end of exploration, at the bottom of the last long drop, The 45. They split into two groups, one, consisting of Minton, Droms, and Meppelink, to push climbing leads and the other, of Hogan, Shade, and Soriano, to survey the two short drops below The 45, which had been explored briefly by Minton in November 1998. At that time the cave had been wetter and the drops had appeared to end at a blind dome. The first climbing lead ended quickly. By that time, the survey team had found a very low passage

at the base of the known cave. It had surely been below water on the previous trip. The passage was too small to get through, but it had very strong airflow. The airflow encouraged the survey team to give up the survey temporarily in favor of this exciting dig. The same group returned the next day to continue the dig. Droms and Minton took over the dig effort on the following day, and got through into a phreatic tube of stoop-walking size, which they followed about 80 meters to a short drop. On the next day, Hogan, Shade, and Soriano surveyed the new section of cave to 270 meters depth, where the passage suddenly took a sharp turn down dip and dead-ended against a rock wall. A short climb by Soriano revealed that there was a very narrow crevice on the other side of this wall. The bottom of the crevice was marginally passable for a few meters, before it could be seen to make a sharp switchback to the southeast for about 15 meters and then return to a northwest heading. The passage was very small, and they were not sure if it was passable.

By this time, the diving recon team from Infiernillo had traveled up the mountain to the Proyecto Espeleológico Purificación field house in Conrado Castillo, after a five-day camp. The Left Hand Sump had been extended westward by Brown, and the Main Sump had been connected by Stone and Mulholland to the Echo Sump, another underwater tunnel located some 300 meters closer to the entrance at the bottom of a 10-meter vertical

shaft. Many leads remained, but the plan called for a team meeting at Conrado Castillo after the first week's work to see which area merited further attention. Since most of the non-divers were going to leave in another week, the entire team moved up to the Caracol camp.

During the next week at Caracol, two climbing leads were investigated, one in The 45 and the other in the Salto del Viento, the big, 90-meter freefall shaft that is the centerpiece of Caracol. Neither inspired great hope, although they did not definitively end. The lead at the bottom of the cave had been so discouraging that everyone was looking for better options. When those options had been exhausted, Droms, Hogan, Shade, Stone, and Warke returned to the bottom of the cave to see if the airflow that had been felt at the dig could be found lower in the cave. Droms and Warke elected to improve rigging in higher parts of the cave, while Hogan, Shade, and Stone pushed through the nasty tight crawlway at the end of the cave, Fools Go Rushing In. On the other side of the Fools crawl was a breakdown-floored chamber about 12 meters in diameter. There are several leads with airflow out of this room, which is at a depth of 282 meters. The cave now has a surveyed length of 677 meters.

When Minton, Droms, Hogan, and Meppelink returned to the States in mid-April, the remaining six cavers launched a second underground camp in Infiernillo. Over the course of the five-day camp, efforts focused on pushing the Main Sump lead from the Echo Sump shaft. In 1993, divers Noel Sloan, Steve Porter, and Bill Stone had reached a penetration in the Main Sump of 155 meters. In April 2001 the line was extended to 306 meters penetration during the first diving camp. When Mulholland surfaced in Echo Sump and looked up the



Camp in Infiernillo for the second dive push at Echo Sump. Pete Mulholland, Robbie Warke, Bev Shade, Jim Brown, and Jose Antonio Soriano. *Bill Stone.*

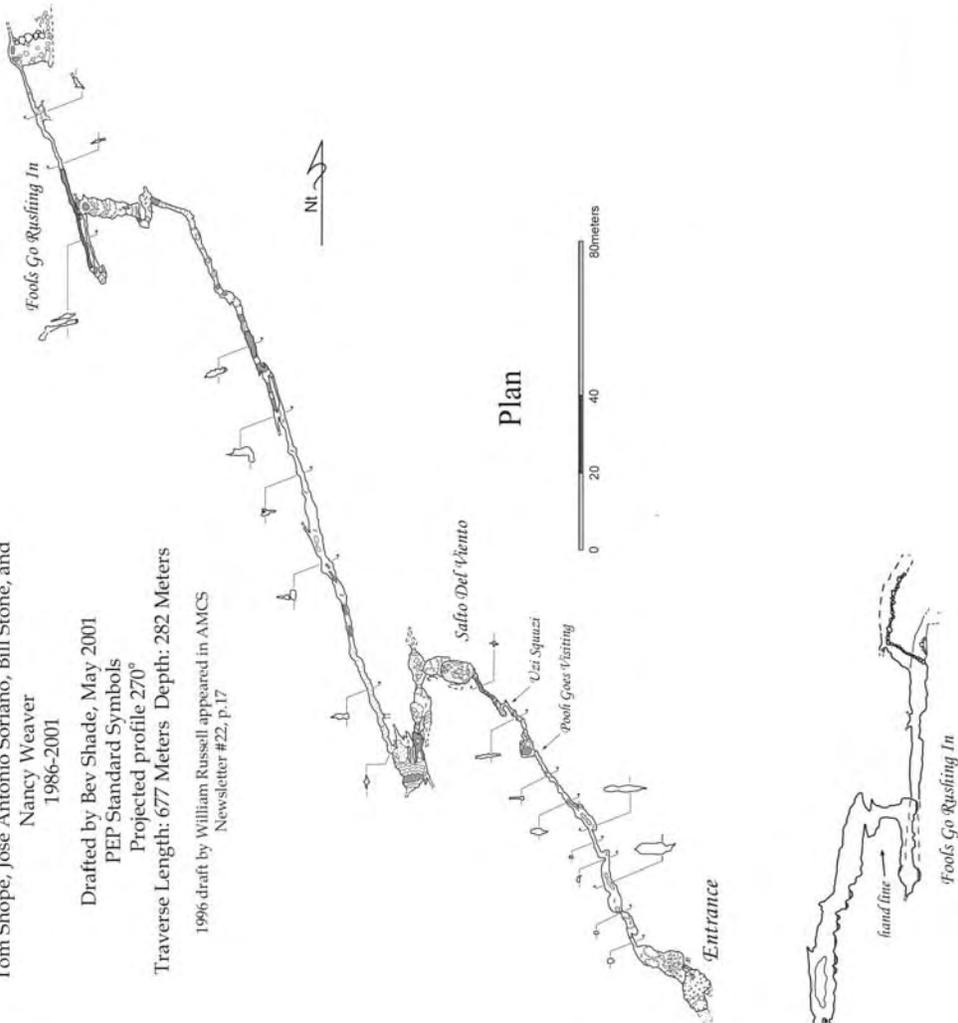
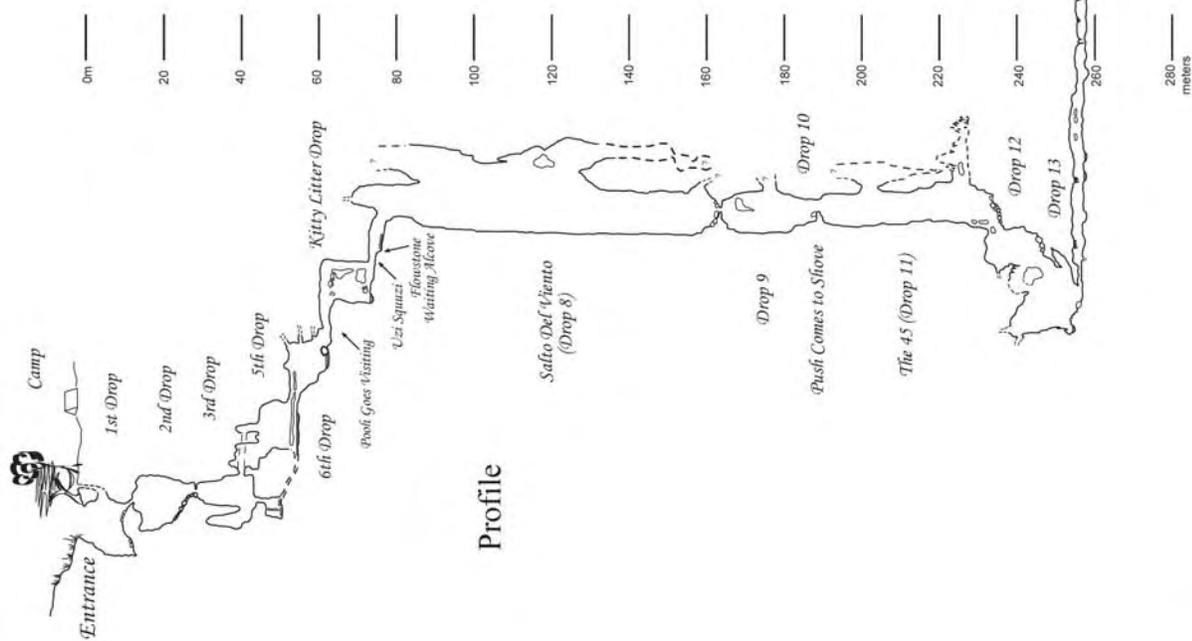
Sótano del Caracol

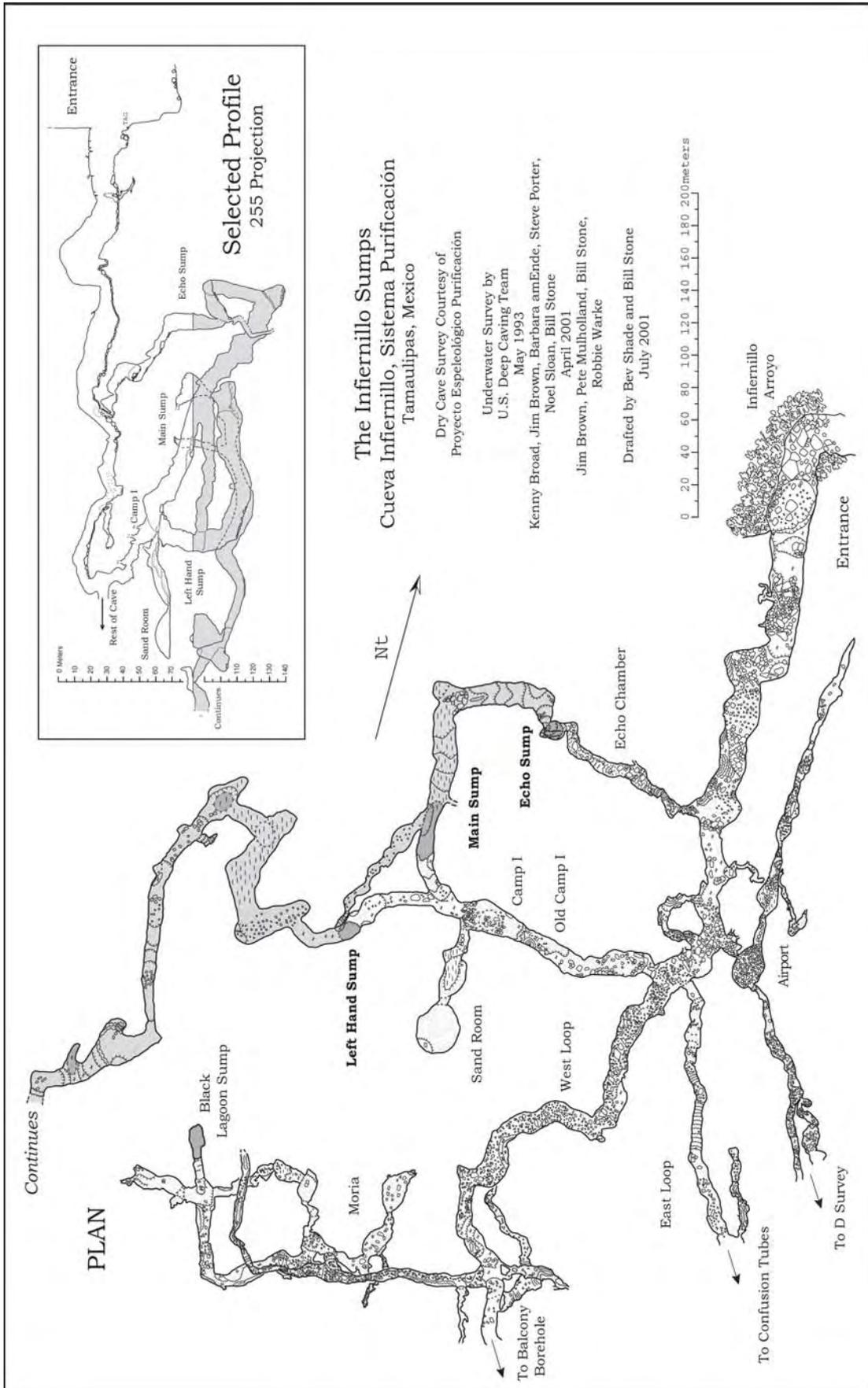
Ejido Revilla

Tamaulipas, Mexico

Suunto & Tape survey by
Wayne Bockleman, Yvonne Droms, Bart Hogan, Joe
Meppelink, Mark Minton, Terry Raines, Bev Shade,
Tom Shope, José Antonio Soriano, Bill Stone, and
Nancy Weaver
1986-2001

Drafted by Bev Shade, May 2001
PEP Standard Symbols
Projected profile 270°
Traverse Length: 677 Meters Depth: 282 Meters
1996 draft by William Russell appeared in AMCS
Newsletter #22, p.17







Mulholland and Brown gear up for a dive in the Left Hand Sump in Infiernillo. *Bill Stone.*

sheer-sided shaft rising more than 10 meters above him, he thought he had arrived in virgin territory. A look at the survey data, however, convinced us that a connection had been achieved. Sure enough, when we hiked down that tunnel and rigged the shaft, there was Pete's dive line, pristinely white, tied off to the wall. But that gave us an idea. If we had some sort of diving platform down at the water level, we could cut off 300 meters of underwater tunnel and proceed directly into unknown territory. Everyone quickly bought into the idea, and a platform was designed at the PEP field house in Conrado Castillo. During the second week at Caracol, workers at the nearby sawmill in Revilla cut fresh pine to our specifications, and the platform was fitted together, then disassembled for transport to the cave.

Subsequent dives in Echo Sump by Mulholland and Stone led downward to a depth of 50 meters underwater. Exploration stopped at a restriction 1 meter tall and 2 meters wide. Normally this would not have presented much of a problem, but a deep layer of silt reduced

the visibility to zero as Mulholland searched for a line tie-off. A second attempt by Stone the following day failed because the visibility remained zero from the previous day's efforts, which suggested there was little or no flow. The underwater survey data showed the passage doubling back under the previously surveyed dry passage toward the main cave. Together with the small size, poor visibility, and lack of flow, the fact that the tunnel headed east instead of west led to the conclusion that this was not the main drainage route.

The following day Mulholland made a through-trip from Echo Sump to the Main Sump, largely for the purpose of transporting the diving apparatus back to the Main Sump in preparation for further dives in the Left Hand Sump. Along the way,

following discussions with Stone, he rechecked the deepest point in Sump 1, in an area where the passage makes an abrupt bend, but found no continuing tunnel. This bend, at 57 meters water depth, remains the deepest point in Sistema Purificación.

In 1993 the Left Hand Sump had been surveyed to a penetration of 195 meters by Jim Brown. During the first diving camp in 2001, Brown extended that to a penetration of 486 meters. Brown subsequently made a diving through-trip from the Left Hand Sump to the Main Sump via a tunnel discovered by Kenny Broad in 1993 but never fully explored. This opened access to the Left Hand Sump from the much easier sandy beach entry of the Main Sump, as opposed to the 10-meter rappel into the Left Hand Sump. During the second diving camp, Jim Brown and Pete Mulholland found several air bells along this

route, but found no dry tunnels leading out of them. The Left Hand Sump is consistently large, approximately 10 to 12 meters wide and 8 meters tall, with very good visibility. It is currently heading west-southwest in the general direction of Moria and the Isopod River, two large upstream passages that have been known for over two decades. We speculate that the Left Hand Sump may intersect the water from Moria and the Isopod River before continuing north.

The Infiernillo Sumps appear to be a backwater to a hypothetical main flow. Altogether 591 meters of new underwater passage were discovered in April 2001, bringing the total underwater length of the Infiernillo sump complex to 969 meters and the cave to 94.8 kilometers.

With the final dive by Mulholland and Brown in the Left Hand Sump, the Inner-Space Odyssey expedition came to a close. We managed to map 3.7 kilometers of virgin territory in caves considered long finished. Nearly all of it was due to the diving and climbing technologies that were

Sorting gear back in Texas at the end of April. *Bill Stone.*



used by the team. It is of some note that team members scaled nearly 500 meters of vertical shafts with a perfect safety record. Likewise, the cracking of the Huautla Resurgence at 1059 meters from the spring rising is an important milestone that may open a back door to Sistema Huautla. A return trip to Caracol is planned for March-April of 2002.

Team Members during Phase 1, in Oaxaca, were Page Ashwell (U.S.), Kasia Biernaka (Poland), Mark Crapelle (Canada), Marcin Gala (Poland), Jason Mallinson (U.K.), Bev Shade (U.S.), José Antonio

Soriano (Mexico), Bill Stone (U.S.), Gustavo Vela Turcott (Mexico), and Andy Zellner (U.S.).

Team Members during Phase 2, also in Oaxaca, were Kasia Biernaka (Poland), Charles Brickey (U.S.), Mark Crapelle (Canada), Marcin Gala (Poland), Greg Horne (Canada), Jason Mallinson (U.K.), Bev Shade (U.S.), Jose Antonio Soriano (Mexico), Rick Stanton (U.K.), and Bill Stone (U.S.).

Team Members during Phase 3 were James Brown (U.S.), Yvonne Droms (U.S.), Bart Hogan (U.S.), Joe Meppelink (U.S.), Mark Minton (U.S.), Pete Mulholland (U.K.), Bev

Shade (U.S.), Jose Antonio Soriano (Mexico), Bill Stone (U.S.), and Robbie Warke (U.K.).

The U.S. Deep Caving Team gratefully acknowledges the support of the following sponsors: Proyecto Espeleológico Purificación, Sopakco, Structural Composites Industries, Hitachi, Diversified Fastening Systems USA, Air Products and Chemicals, Pigeon Mountain Industries, Underwater Kinetics, Dogwood City Grotto, NSS Cave Diving Section, Oregon Freeze Dry, Dive Rite, Liberty Mountain Sports, Cis-Lunar Development Labs, Sue Shade, and A. James King, Jr.

Expedición Odisea del Espacio Interior

En invierno y primavera del 2001, el U.S. Deep Caving Team pasó tres meses en México. El primer mes estuvieron basados en San Agustín Zaragoza, cerca de Huautla, Oaxaca, en búsqueda del río que desaparece en el fondo del Sótano del Río Iglesia. Además de revisar Iglesia, en donde se hicieron varias escaladas de domos con buriles, se escalaron 140 metros por encima del campamento en Cueva de San Agustín, pero no se hicieron descubrimientos importantes. El segundo mes lo pasaron en el cañón del río Santo Domingo, en las resurgencias de los sistemas Cheve y Huautla. En la primera, los espeleobuzos exploraron las porciones sumergidas, mientras los demás escalaron algunos domos. Mediante el empleo de respiradores de circuito cerrado, la resurgencia de Huautla fue buceada por una distancia de 1059 metros a una profundidad máxima de 65 metros. Los buzos salieron a la base de un domo, y pudieron observar una gran continuación en la parte alta, pero les fue imposible salir del agua. Debido a la descompresión, el viaje redondo hasta este punto requiere cinco y media horas de buceo. El tercer mes fue dedicado a bucear los sifones en la porción de Infiernillo del Sistema Purificación, en Tamaulipas, y a continuar la exploración del Sótano de Caracol, cerca de Revilla, en la parte alta de las montañas.

CUEVA DE LOS CRISTALES

Carlos Lazcano Sahagún

The first time I visited the Cave of the Crystals in Chihuahua, in August 2000, it was impossible for me to stop thinking about Gruta de Yaax-Nik, in Yucatán, which I wrote about in *AMCS Activities Newsletter 17*. I had thought I'd never have an opportunity to visit another cave of similar beauty, because such caves are very rare. I had been wrong, and what I saw in the Cave of the Crystals left me gaping. And not only me, but also my friend Claude Chabert, a French speleologist whom I had invited to come along because he was in Chihuahua at the time. I saw Claude's surprise was as great as mine, and that gave me more confidence that we were seeing something really amazing and unique, because Claude, as shown by his *Atlas of the Great Caves of the World* and other books, is a speleologist who knows the world of caves, and he does not get carried away by any little hollow, even if it is touted as the best of the best.

The story of the Cave of the Crystals started at the beginning of April 2000, when Eloy Delgado and his brother Javier were operating a large and powerful drill to make an exploratory tunnel 300 meters deep in the mine at Naica. Suddenly, the drill hit emptiness, and they saw a little hole that seemed to go into a larger cavity. They, like other workers in the mine, were used to the fact that every now and then their excavations hit cracks or fissures of small size, 2 or 3 meters at the most, as they follow mineral veins or tunnel for other reasons. These cracks

are almost always full of crystals of gypsum, which is very common in the mine, and many workers take them out to sell them to the numerous collectors who arrive in Naica in search of them. Nevertheless, when they opened up the hole, Eloy realized that it was something bigger than usual.

With some difficulty, the brothers passed the narrow hole, arriving in a room of some size. They were amazed by what they saw. They had penetrated into a kind of geode or bubble around 8 meters in diameter, lined with crystals, white and sharp, of great size. Even though the crystals were gypsum, they realized they were completely different in size from what they usually found. Wherever they shined their lights, the brightness of the crystals made the cavity shine. Seeing this, they stopped drilling and immediately notified Ing. Roberto González, manager of the mine, who sent qualified personnel to inspect the find. He was told that the cavity, even though small, showed uncommon crystallization. Conscious that this was a treasure that Nature had been jealously keeping, he ordered the tunnel diverted to avoid damage to the crystals.

A few days later, when the drilling of the tunnel had resumed, another cavity full of crystals was found a few meters away, this one a bit bigger. When it was inspected, the surprised miners found another room full of gigantic selenite crystals. (Selenite is a crystal form of gypsum.) Because the temperature in this cave was 60 degrees C

(140°F) and the humidity was 100 percent, the miners could not explore beyond the first room. Again, González ordered the tunnel rerouted, and he ordered the original route closed with a concrete wall and a steel door when one of the mine workers attacked one of the megacrystals, trying to take it out in pieces to sell in the market.

Because I know geologists in Chihuahua, I heard a rumor two months later of this new cave of great beauty in Naica, and I called Ing. González, who kindly not only allowed me to visit the mine and the cave, but also asked me to make it known to the press, because he considered it an outstanding discovery worth reporting.

The Peñoles Company runs the mine, which produces mainly lead, but also some silver, copper, and zinc. We went to see the cave in a company truck, guided by Carlos Valles, one of the mine's security people. We went through about 4 kilometers of rooms and tunnels until we reached a depth of 300 meters. The temperature was high, and we could feel the humidity. We stopped in front of a concrete wall with a steel door. Carlos opened it, and we walked onto a concrete ramp, where it felt like the heat had doubled. At the end of the ramp we saw the entrance to the cave, and when we passed through it, we felt as if we were going into a furnace. We immediately started sweating copiously. I had never felt so hot.

For a moment, we forgot the heat, because in front of us was a room full of crystals of immense size.







They were undoubtedly the biggest crystals I had seen in my entire life. They came from everywhere and went in all directions, joining the floor and the ceiling. Some, totally transparent in places, seemed like beams of light crossing the chamber, filling it with white. Others looked like enormous crystal bars, long and square. Four, five, six, and even seven meters long, we estimated, and reaching the diameters of a person. Amazing! That's when I thought of Yaax-Nik and how subterranean beauty can take unexpected forms.

Our astonished inspection had only begun when we realized we couldn't stay very long. The heat was overwhelming. I tried to take a picture, but the view through my camera was more than blurred, and my hands were so sweaty they made it even wetter, so we decided to leave for a while to rest. We had not been in there more than two minutes. As we went back out the ramp, we felt the atmosphere cool, and when we got out into the mine tunnel we felt cold, even though the temperature there was still over 40 degrees C.

Crystals the size of the amazing cones in the Cave of the Crystals are due to several unusual conditions. Between 3 and 5 kilometers below the surface, there is a chamber of high-temperature magma. That heats the entire interior of the mountain, and the deeper you go, the hotter it is. The active tunnels in the mine are 700 meters deep, and work is possible there only because of ventilation and air conditioning. There are parts of the mine that don't have that ventilation, such as the Cave of the Crystals, and then you feel the real temperature of the mountain.

Photo subjects: Page 73 bottom, Humberto Delgado. Page 73 top and page 75 right, Octavio Galindo. Page 74 left, Eloy Hernández. Page 74 right, Sonia Estrada. Page 75 left, Joaquín Berruecos.
Carlos Lazcano.

The cave formed along a fault and was flooded with water that was hot, maybe 50 degrees C or more, and had a high content of dissolved sulfate from its circulation through the mineralized cracks and crevices. In the stable space of the cave, the crystals grew for thousands of years, maybe hundreds of thousands, covering the walls and ceilings until they reached the dimensions that we see now, something fantastic that only Nature, with more imagination than ours, could have created. Some time later, the water level lowered, leaving the cave dry and ready to be discovered. Now, the natural water level is 700 meters deep, and the mine has to pump out forty thousand gallons per minute, day and night, of 55-degree-C water.

While we were recovering from the heat, I was preparing my camera to try to take a series of pictures. Of course I had thought of the possibility that it would be damaged by the climate of the place. That's why I took a camera totally manual and mechanical, nothing electronic. It wasn't the first time I had encountered a hot and humid cave. Tolantongo, with its hot river, is just as bad. Now I would test my experience as a cave photographer.

When we entered the cave again, I positioned myself in a strategic place and started shooting. Even though I could clean the lens quickly, I could never really frame a picture, because by the time I looked through it, the lens was misty again, so I had to just aim by eye, estimating distances to set the lens opening and flash intensity. Between the shots, which weren't very many, I could see that the cave isn't very large, maybe 30 meters in diameter, mostly covered by the megacrystals of selenite. I couldn't look around very much, because in a couple of minutes the heat chased us out again.

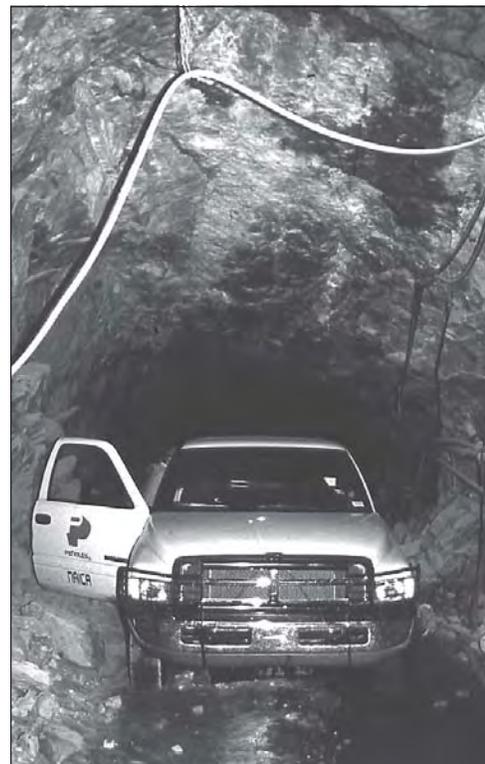
After another rest, we went back in, now to explore. We climbed up and down among the giant crystals, something

I and probably nobody else had ever imagined, because these were the first crystals discovered of this size.

A few days later, I returned to the cave, and Richard Fisher, an explorer from Tucson, went with me. The pictures I had taken during my first visit, the first ever taken of the cave, had come out all right, so this time I came prepared to take a more complete series. I could not explore much more than I had before, because of the heat. This time we stayed inside for ten minutes, which left us so exhausted and dehydrated that we didn't have the spirit to visit other parts of the mine we were interested in. Later on, I've made other visits to take more pictures and try to explore a little bit more. It seems like the cave consists of only this room, not very big but immensely marvelous, but the truth is I can't say I've explored it all, because the heat allows only a few minutes inside. Mapping is impossible.

Between these visits, I have studied other caves in the world that are

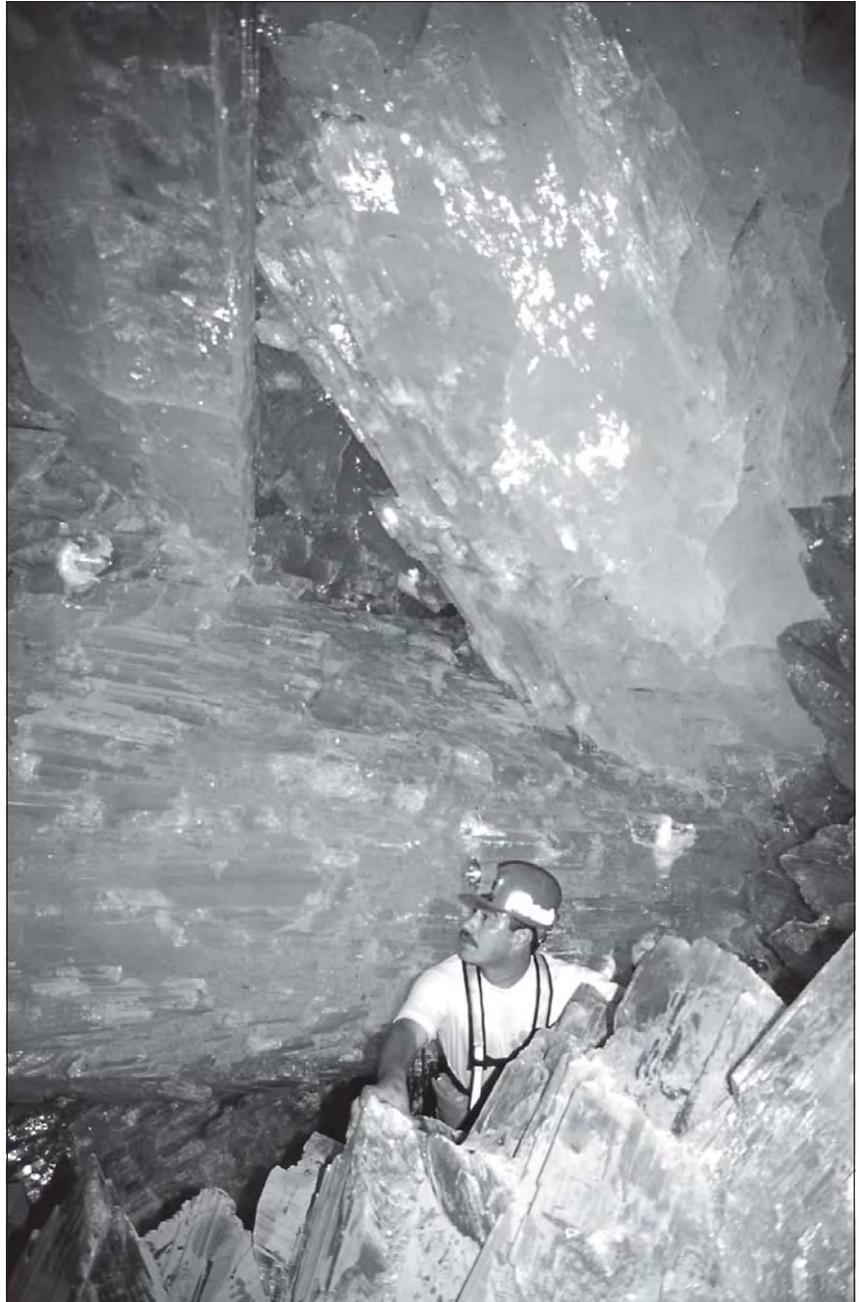
Cueva de los Cristales is 4 kilometers into the mine at a depth of 300 meters. *Carlos Lazcano.*



Humberto Delgado in Cave of the Crystals. *Carlos Lazcano.*

known for their crystals. Nothing else is like Cave of the Crystals, or comes close. The Cave of the Swords, in the same mine, comes closest, but it is still far from equal.

Those of us who have seen the Cave of the Crystals worry about the care and conservation of the cave. The managers of the Naica mine are totally aware of this. Peñoles Company has accepted the suggestion that the cave be opened to the public as a measure to prevent the workers from destroying it. Two crystals have already been cut up by some of the miners. Right now, ways it might be made accessible are being studied, as is whether some ventilation to make it more comfortable will affect the crystals. Once this has been done, it will be opened in a very controlled way so that others can admire the things we marveled at.



Cueva de los Cristales

En abril de 2000 se intersectaron dos nuevas cavidades naturales en la profunda mina de Naica, Chihuahua. El mayor de estos salones contiene cristales de selenita de hasta 7 metros de largo, los mayores cristales jamás encontrados en una cueva. El salón está a 300 metros de profundidad y es solo accesible a través de la mina, y no ha sido topografiado o explorado totalmente, ya que en su interior la temperatura alcanza los 60 grados Centígrados, y la humedad es del 100%.

A NEW MAP OF SAC ACTUN, QUINTANA ROO

Bil Phillips

Sistema Sac Actun was originally discovered by James Coke IV in 1986 and explored by Jim and H. Ayala, L. Conlin, S. DeCarlo, J. DeGroot, C. Goulet, R. Ribb, T. Young, J. Zumrick, and the late Parker Turner. [See article and early map in *AMCS Activities Newsletter* 17.] The result was 4330 meters of spectacular passages and rooms. This survey, mostly performed by Jim Coke and Tom Young, was then drafted by Coke and published in 1993, setting the standard as the most detailed underwater cave cartography ever done. The system, while relatively small by international standards, still holds its own as one of the most spectacular displays of underwater speleothems.

From an exploration point of view, the cave sat relatively dormant for several years, as the original explorers' work was considered thorough, and most divers were unable to visit even all the charted passages. The ends of the existing dive lines were at least a single stage bottle away, and the maze of decorations, twisting and turning passages, and restrictions made this cave a technical challenge. Heaven forbid that one should accidentally break anything while maneuvering among the decorations. Several cavers did poke away in the far reaches, adding little line.

It wasn't until the middle 1990s that this system grew significantly. In 1995-96, Dan Lins and Chuck Stevens, assisted by Woody Jasper and Bob Messersmith, surprised the cave-diving community by adding 1631 meters to Coke and Ed Forelli's

lines on the siphon side of Cenote Grande, beyond Snake Cenote. Because of major restrictions and high flow, this section had previously been thought impassable. At the same time, Bil Phillips, Kurt Olsen, and Mike Heusick made the first dives in Cenote Calimba, a small, partly dry cave a third of a kilometer north, off the road to Coba. Sam Meacham later joined Bil to make the connection between Calimba and the Paso de los Dos Pozos section of Sac Actun, through an infamous passage subsequently named the Boa Restriction. Further exploration by Daniel Riordan and Phillips, along with Bernd Birnbach, Pablo Diaz, Steve Gerrard, Kate Lewis, Eulgioe Martirezneto, and Jana Smith, resulted in the addition of 4975 meters on the upstream side, almost doubling the length of the cave.

By the early summer of 1998, Sac Actun was no longer the little cave of the past. It contained over 11 kilometers of explored passages and ranked as the fifth longest in the Yucatan and unquestionably one of the most impressive and revered water-filled caves found anywhere in the world. Meanwhile, a mile to the southeast, Bill Gavin, George Irvine, Mike Madden, Hilario Hiler, Dan Lins, and Andreas Matthes had explored the Naval system, accessible only from a military airfield. In March 1999, Dan Lins invited Bil Phillips to return with him to the downstream reaches of Sac Actun, from Cenote Grande, in pursuit of a connection to Cenote Naval. It took four dives through a number of serious side-mount restrictions and 580 meters of new passage to finally make the connection. The total length of Sac Actun is now 17

kilometers. An additional 5400 meters of Sistema Naval lies on the downstream side of Cenote Naval, separated by 500 meters of open water, and only an estimated 230 meters from the other end of Sistema Naval is Sistema Abejas, with 9 kilometers of passage. [See area map in "Mexico News," *AMCS Activities Newsletter* 24.]

In view of all the developments since Jim Coke's original cartography in the early 1990s, Jim suggested that it was time to redraw the map. Through the efforts of Jim Coke, Hazel Barton, Marike Jasper, Dan Lins, Andreas Matthes, and Bil Phillips, that is exactly what happened. Years of exploration and survey data were consolidated. Several months of hard work drawing at the same scale as Jim's earlier map resulted in a working map 3 by 6.5 feet in size. A full-size reproduction of this map is now posted at Cenote Grande, the main entrance to Sac Actun. Smaller versions are also available.

La caverna subacuática de Sac Actún, Quintana Roo, solamente medía 4300 metros cuando se publicó el mapa en el *AMCS Activities Newsletter* 17 en 1988. Las exploraciones recientes conectaron Sac Actún al Cenote Calimba y al Cenote Naval, incrementando la longitud a 17 kilómetros. La posible conexión en el futuro con otras cuevas más cercanas a la costa extendería la cavidad otros 15 kilómetros.

A version of this article appeared in *Underwater Speleology*, volume 28 number 6, December 2001.

SISTEMA SAC ACTUN EXPLORATION HISTORY

- The original exploration of this fragile system began in 1987 by James Cook IV setting the stage for all that was to follow.
- In 1987 Jim and Tom Young produced and published the original copyrighted map documenting 14,200 feet of caves of the most breath taking water filled cave visited by cave divers.
- The early to mid 1990's resulted in further exploration efforts expanding Sistema Sac Actun to over double its original size.
- The Snake Cenote to downstream Sac Actun was discovered by James Cook IV in November 1989. In May 1993, Dan Line successfully penetrated the "Tusser Restriction" and continued leading exploration efforts of the downstream side.
- By 1998 Sac Actun was being explored from the furthest upstream reaches and the downstream side.
- A connection from the upstream Calimba section to Paso de Los Pozos was made on April 11 1998 by Sam Madsen and Bill A. Phillips through the winding "Boa Restriction"
- In 1998 an exploration project in Sistema Naval was conducted by Dan Line, Mike Madden, Andrew Mathews and Chuck Stevens. The "Road to Sac" was discovered by Chuck Stevens and Dan Line in December of 1998.
- Discovery of the "Trap Door" (furthest upstream Sistema Sac Actun) was made by Bill Phillips and Daniel Riordan on May 22 1997 resulting in 7,888 feet of new cave.
- On March 12 1988 "Johnson Street" opened its entrance to Bill A. Phillips.
- During March and April 1998 Daniel Riordan revisited and explored the "Hour Glass" section.
- On March 13 1989 the long sought after connection of Sac Actun and Sistema Naval was made by Dan Line and Bill A. Phillips bringing Sac Actun to its current size of 88,034 feet.
- Many additional explorers have made considerable contributions and are listed and recognized in the "Section Headings"

THE QRSS HAS ARCHIVED SURVEY DATA SINCE, AND CONTINUES TO UPDATE ITS SURVEY DATA BASES ON EXPLORATION IN THE STATE OF QUINTANA ROO, MEXICO. THE QRSS INVITES ALL CAVE EXPLORERS TO CONTRIBUTE. FOR THE PRESERVATION, OF EXPLORATION, HISTORY, AND CONSERVATION, OR LEARN MORE, PLEASE CONTACT THE QRSS.

SISTEMA SAC ACTUN

TULUM, QUINTANA ROO MEXICO

20° 14' 44.4" N LATITUDE 87° 27' 50.9" W LONGITUDE

TOTAL SURVEYED CAVE PASSAGE
56,034 FEET / 17,084 METERS

TAKE ONLY MEMORIES, LEAVE JUST BUBBLES, KILL NOTHING BUT TIME

CENOTE DIVERS

Please don't enter the Cavern Zone without a qualified guide. Remember that any problems that may occur, will require you swim back to the surface. Due to the cavern calling you will not be able to execute a vertical ascent. Stay within natural day light. It is your best reference to the exit. Becoming disoriented and not being able to find the exit, is the greatest hazard of cavern diving. Please insure that your guide is qualified to take you into this unique environment.

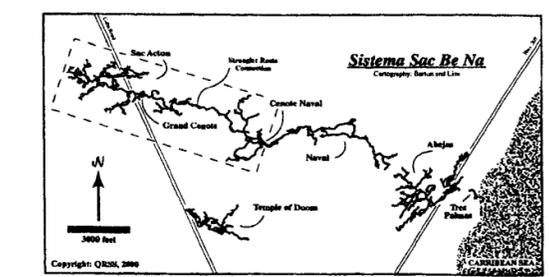
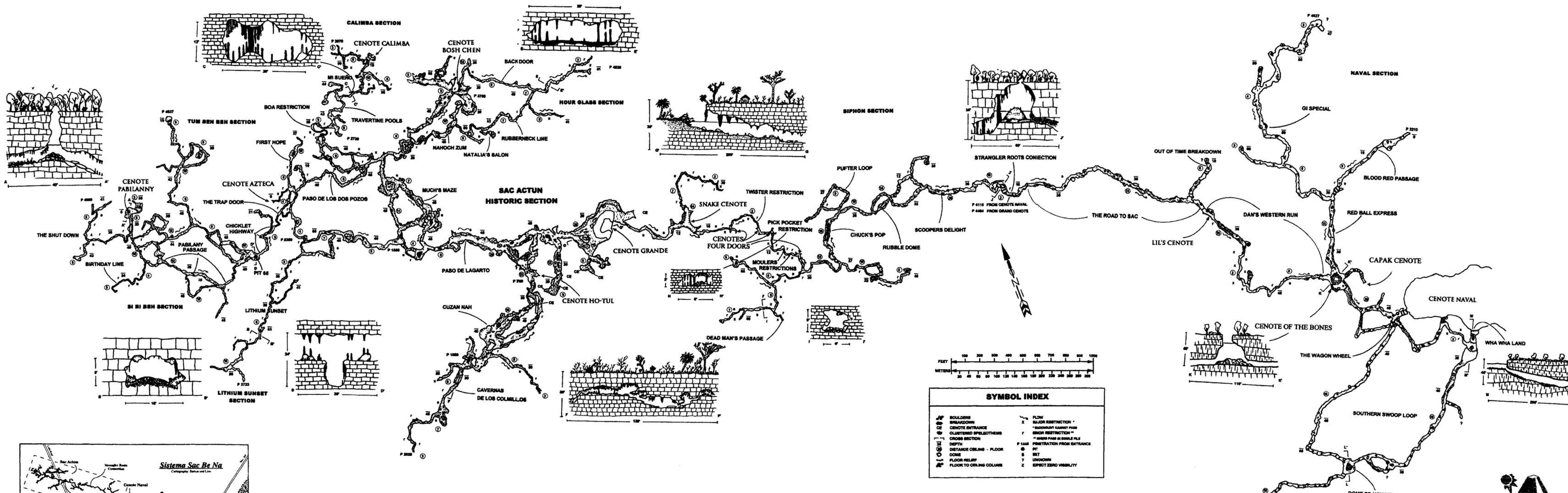
CENOTE GUIDES

Cenote guides are dive masters or instructors who have completed a Full Cave Course. Qualified guides use double tanks, regulators and safety lines. They tour no more than 4 divers at a time. They do a detailed dive briefing that includes, safety procedures, swimming techniques, communications, and equipment modifications for cavern diving.

CAVE DIVERS

Be considerate of other dive teams and practice safe cave diving procedures. Plan your dives with conservation and preservation in mind. Avoid any physical contact with the cave. Use discretion based on the weakest member in the team. Please remember that using extended range equipment will expand your impact on the cave. Ensure that you have a continuous guideline and reference to your exit. Remain close to the guideline at all times. Enhance your own safety and practice proper conservation procedures by minimizing impact to the pristine areas away from the guideline. It is illegal to remove Speleothems or alter the cave in any way.

THE ORIGINAL EXPLORERS ASK THAT YOU HELP PRESERVE EXPLORATION AND SURVEY HISTORY. DO NOT ALTER THE GUIDE LINES. PLEASE DO NOT REMOVE LINE ARROWS. THEY ARE THE ORIGINAL SURVEY STATION MARKERS. PLEASE DO NOT DESTROY FOREVER WHAT OTHERS HAVE WORKED SO HARD TO ACHIEVE!



<p>SI BI BEH SECTION EXPLORED BY B. BIRNBACH S. GERRARD P. DIAZ K. LEWIS B. PHILLIPS D. RIORDAN</p>	<p>TUM BEN BEN SECTION EXPLORED BY B. PHILLIPS D. RIORDAN</p>	<p>CALIMBA SECTION EXPLORED BY J. GONZALLAS M. HEUSICK S. MEACHAM K. OLSEN B. PHILLIPS J. SMITH</p>	<p>LITHIUM SUNSET SECTION EXPLORED BY B. BIRNBACH B. PHILLIPS D. RIORDAN C. LE MAILLOT J. WALKER</p>	<p>HOOR GLASS SECTION EXPLORED BY B. PHILLIPS D. RIORDAN E. MARTINEZ</p>	<p>SAC ACTUN HISTORIC SECTION EXPLORED AND SURVEYED BY H. AYALA C. COULET J. COKE R. RIBB S. DE CARLO P. PARKER J. DE GROOT Y. YOUNG J. ZUMMIRICK</p>	<p>SIPHON SECTION EXPLORED BY J. COKE E. FIORELLI W. JASPER D. LINS B. MESSERSMITH B. PHILLIPS C. PYLE C. STEVENS G. WALLEN</p>	<p>NAVAL SECTION EXPLORED BY B. GAVIN H. HILLER D. LINS D. LINS M. MADDEN A. MATTHEWS C. STEVENS</p>
<p>SURVEYED BY B. PHILLIPS D. RIORDAN</p>	<p>SURVEYED BY B. PHILLIPS D. RIORDAN</p>	<p>SURVEYED BY B. PHILLIPS</p>	<p>SURVEYED BY B. PHILLIPS C. LE MAILLOT D. RIORDAN</p>	<p>SURVEYED BY B. PHILLIPS D. RIORDAN</p>	<p>SURVEYED BY D. LINS B. PHILLIPS C. STEVENS</p>	<p>SURVEYED BY D. LINS A. MATTHEWS M. MADDEN C. STEVENS</p>	



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M. JASPER

SEARCHING FOR CAVES NEAR EL CIELO, TAMAULIPAS

Gerald Moni

location maps by Hal Love

For the last forty years, cavers have been looking for *cuevas* and *sótanos* at and near El Cielo, a research center located in the Sierra de Guatemala. Starting in November 1996, a group of mainly TAG cavers started searching the Sierra de Guatemala for new caves and relocating the few known caves. We also planned to check out three leads that Peter Sprouse had seen on a flight over the area in the 1970s. We made five trips to the area between November 1996 and December 1998.

Our group consisted of sixteen cavers during Thanksgiving Week 1996. We camped at the town of Julilo, which is 15 kilometers north of El Cielo. It is reached from the town of Encino on Highway 85. A dirt road from Encino goes through Julilo to Joya de Salas, a large sinkhole valley. There are several abandoned houses in Julilo, and one family still lives there. We split into three groups and spent five days finding and exploring twenty-two caves in that area. At least four of the caves were already known to American cavers, but our big find, Sótano de los Tres Ojos Verdes, was virgin. (See article in *AMCS Activities Newsletter* 22.)

On Monday and Tuesday, Gerald Moni, Marion Ziemons, Andy Zellner, and others ridgewalked on the east slope of the valley of Joya de Salas. We were looking for one of the leads that Peter had told us about. We were in the right general area, but we did not find any caves or karst features large enough to be seen from the air. Three small caves were found, Sótano de Mariana, Cueva de Timas, and Cueva de

Zellner. On Wednesday, Gerald, Andy, Jim, and others went to El Cielo to locate and explore Sótano de Harrison. They never did find this pit, but Doug Strait did find Sótano de Ebano. The same day, a local guide led us to Sótano de Cristales.

On Monday, Jim Smith, Doug Strait, John Stembel, and Susan Stembel searched several kilometers northeast of Julilo. They found three small caves. On Tuesday, Jim and Doug explored several kilometers northwest of Julilo and found two pits. Alan Cressler and others walked from the camp at Julilo and found several pits. They checked out another lead and found that it was a large karst feature, a sink with a headwall. On Wednesday, they found Sótano de los Tres Ojos Verdes. The cave is 176 meters deep, with two pits, one of 128 meters.

The second trip was over Easter Week 1997. The four cavers were Gerald Moni, Jim Smith, E. T. Davis, and Dave DeHart. On Sunday, March 22, Jim and Dave ridgewalked the Sótano de los Tres Ojos Verdes area and found three pits before meeting up with Gerald and E. T. that afternoon to search for caves west of San Pablo with guide Jilario. He showed us five caves and pits. When we got back, we found that our tents had been entered and various items stolen. We left the area and went to El Cielo, where we found a new guide named Juan Manuel Cordova Álvarez. He showed us two well-visited caves, Harrison Sinkhole and Crystal Cave, known for forty years. Afterward he showed us three new pits.

On Wednesday, we drove toward Joya de Salas. On the way, we searched for 2000 Meter Cave. We found Sótano de Gallos instead. This pit is near 2000 Meter Cave, but neither the location nor the description matches the information on 2000 Meter Cave in the *Association for Mexican Cave Studies Newsletter*, volume 1 number 3, March 1965. After exploring the roadside pit, we spent the rest of the day clearing an old logging road.

On Thursday, we found another of Peter Sprouse's leads, a large karst feature 60 meters long, 10 meters wide, and 10 meters deep. One side can be downclimbed, and the other side opens into the jungle. On Friday, Jim and Dave revisited the Tres Ojos area and descended Sótano Trogon, a virgin 39-meter pit. The other two pits they had found on Sunday were not done. During the week, we explored twelve caves.

The third trip was Thanksgiving Week 1997. We drove up an overgrown road that goes 23.2 kilometers northward, from the junction of the El Cielo and Joya de Salas roads at Julilo. We checked the sides of the road, ridgewalked, and had one Mexican show us three caves. The area was not checked well, but the eleven caves we found are probably most of the easily found ones. See the road log.

The fourth trip was Easter Week 1998. Four cavers, Ted Wilson, Jim Smith, Andy Zellner, and Marion O. Smith, started at Gómez Farías and searched for new and known caves along the road to El Refugio. In El Refugio, they visited Sótano de los

CAVES OF THE EL CIELO AREA

	cave number*	location map	horiz.** length (m)	vertical extent (m)	deepest pit (m)	number of pits
Gomez Farias quad (F14A49)						
Sótano de la Joya de Salas	TM25	4	1039	376	70	10
Sótano de la Sierra Cucharas	TM45	6	80	100	65	1
Sótano de Abraham	TM54	2	6	37	36	1
Cueva de Ajoles	TM56	2	70	36	30	1
Sótano de Alvarez	TM57	1	15	46	16	4
Pozo de Arco Fluido	TM58	1	30	24	24	1
Cueva de Cañón de Diablo	TM62	1	50	18		
Sótano de Cardenas	TM63	2	14	23	22	1
Sótano de Cristales	TM66	1	23	41	39	1
Crystal Cave	TM67	1	55	10		
Sótano de Ebano	TM68	1	10	52	49	2
Sótano de Escudo Escondido	TM69	2	13	31	31	1
Sótano de Gallos	TM70	3	4	26	26	1
Sótano de Guano Lomito	TM72	1	50	15	9	1
Harrison Sinkhole	TM74	1	47	45	37	1
Cueva de Jilario	TM77	1	80	15		
Cueva de Julilo	TM78	2	65	13		
Sótano de Ladrones	TM79	1	12	27	27	1
Cueva Madriguera del Oso	TM81	5	60	12		
Sótano de Manuel	TM82	1	40	45	34	1
Sótano de Mariana	TM83	3	80	30	26	1
Joya de la Mina Barita	TM84	2	100	61	44	1
Sótano de Muchos Insectos	TM86	3	35	40	28	1
Cueva de Murcielago Atacante	TM87	1	3	22	22	1
Sótano de Musgo de Arbol	TM88	1	4	22	21	1
Cueva de Ninfa del Bosque	TM91	5	25	5		
Sótano de Ojos de Aguila	TM92	5	90	40	26	2
Sótano de Plan	TM98	1	6	23	23	1
Sotanito de Plan	TM99	1	6	15	14	1
Cueva de la Polilla	TM100	1	25	15		
Sótano de San Pablo	TM106	1	60	85	79	1
Sótano de Santa Maria	TM108	2	75	55	41	1
Cueva de Timas	TM112	3	16	13	6	1
Sótano de los Tres Ojos Verdes	TM114	2	52	176	128	2
Sótano Trogon	TM115	2	8	39	39	1
Cueva de Zellner	TM117	3	65	13		
Sótano Sin Bichos	TM118	7	10	20	10	1
Cueva de Carrera	TM119	5	60	30		
Sótano de Cigarro	TM120	2	6	35	35	1
Cueva de la Cima de San José	TM121	6	250	80		
Sótano de Jabalies	TM126	5	25	24	16	1
Cueva de Mono	TM128	5	55	15		
Cueva Parada de Descansar	TM131	5	50	15		
Sótano del Queso Grande	TM132	5	10	13	8	2
Sótano Reencontrado	TM134	5	5	18	16	1
Pozo de Vapor	TM137	5	20	47	41	2
Cueva de Carmen	TM139	4	40	8		
Cueva de los Leones	TM140	4	135	50	11	1

CAVES OF THE EL CIELO AREA continued

	cave number*	location map	horiz.** length (m)	vertical extent (m)	deepest pit (m)	number of pits
Llera de Canales quad (F14A39)						
Grieta Desesperada	TM124	8	100	43	20	2
Cueva de Leo	TM127	8	18	5		
Sótano Ultimo	TM136	8	3	22	22	1
El Llano de Azuas quad (F14A48)						
Cueva del Entierro	TM122	9	28	5		
Cueva del Papecido	TM130	9	40	5		
Ocampo quad (F14A58)						
Cueva de Graciano	TM41	10	104	30		
Cueva Escalera de Raices	TM123	10	16	12		
Sótano de los Guacamayos	TM125	10	66	146	140	1
Cueva Obscura	TM129	10	36	20		
Cueva de las Raices	TM133	10	20	5		
Cueva de El Refugio	TM135	10	103	5		
Sótano de Ventana del Arroyo	TM138	10	15	10	9	1
Loma Alta quad (F14A59)						
Bee Cave	TM3	12	125	110	74	1
Sótano de Caballo Moro	TM4	11	326	196	146	1
Cueva de Coahuila	TM12	11	100	25		
Cueva de los Misioneros	TM28	11	450	60	40	3?
Cueva y Sótano San Rafael	TM44	13	60	30	18	1

* Number in the author's Mexican Cave Survey.

** Length of the projection of the cave onto horizontal plane.

Guacamayos. This cave has a 140-meter pit. Killer bees were living in a crack on the high, western side of the pit. Maria Alejandrina Chagoya, who guided them to the cave, lives in the first house on the south side of the *llano* at El Refugio. They found and explored several new caves near El Refugio. They then drove back to El Elefante and went north looking for new caves, but found only one, Sótano sin Bichos, northeast of El Indio. In all, they explored twelve caves. See the road log.

The fifth and last trip was Christmas 1998. The group consisted of Gerald Moni, David Cole, and Aaron Atz. We followed the logging

road from Encino to Joya de Salas. We found only one new cave and visited two known caves.

During our five trips to this area, we found few caves and even fewer caves that are worth doing. The lack of local people in the area can only partially explain our lack of success. For some reason, this area is cave-poor.

CAVE DESCRIPTIONS

Gómez Farías Quadrangle

25. Sótano de la Joya de Salas. A description and map of this cave appear in AMCS Bulletin 1, *Caves of the Inter-American Highway*, pp 48–50.

45. Sótano de la Sierra Cucharas. From the town of Gómez Farías, take the road up the escarpment that goes toward Alta Cima. There is a shallow sinkhole on the south side of the road where it goes through gap at the top of the escarpment. Walk along west side of sink and 100 to 200 meters into the jungle.

The pit entrance is in a fissure about 7 by 20 meters. The best rig point is on the north side. At the bottom of the 65-meter pit, a breakdown slope and climb down lead to a small passage that goes about 20 meters.

54. Sótano de Abraham. One and a half kilometers from Julilo along the road to El Povenir, visible from

Road log from the junction of the El Cielo road and Joya de Salas road at Julilo on the Gómez Farías topo northward to the southern end of the Llera de Canales topo.

miles	kms	
0	0	Junction of the El Cielo road and the Joya de Salas road at Julilo.
0.9	1.4	Junction of Joya de Salas road with northward road.
1.5	2.4	Sótano de Cigarro is 20 meters right (east) of northward road.
3.7	6.0	Sótano de Jabalies is 1 meter right (northeast) of road.
4.5	7.2	Sótano del Queso Grande is 2 meters left (north) of road.
5.8	9.3	Sótano de Ojos de Aguila is 10 m left (west) of road.
6.5	10.5	Sótano Reencontrado is 600 meters right (east-northeast) of road.
6.7	10.8	First loop trail to right (west). Pozo de Vapor is 30 meters down trail and 4 meters to the left (southwest).
6.8	10.9	Second loop trail, loop trail rejoins road on right.
6.9	11.1	Cueva Parada de Descansar, a large shelter cave 60 meters on right (east).
7.1	11.4	Open field with water tank. To the left (northwest) in the jungle are Cueva de Carrera and Cueva de Mono.
10.5	16.9	Major ravine that was used for camping.
11.9	19.2	Open field with house and pond.
13.9	22.4	Sótano Ultimo is 10 meters right (northeast) of road.
14.0	22.5	Grieta Desesperada is 300 right (east) of road.
14.2	22.9	Field near end of road.
14.4	23.2	End of road. Trail goes northwest toward Carabanchel.

the road 18 meters to the east.

A 5-by-5-meter open-air pit 36.6 meters deep. A small alcove at the bottom shows evidence of flooding.

56. Cueva de Ajoles. Located just west of the road to Joya de Salas 1.5 kilometers north of Julilo, 250 meters past the junction of the main road to Joya de Salas with a north-south road.

A huge shelter 18 meters high and 70 meters wide, with a steep slope extending 16 meters down and 30 meters back. Massive floor-to-ceiling formations are in the south end of the room. A second entrance is a 30.3-meter pit from a hole 2 meters across east-to-west and 2.5 meters north-to-south. A potential archaeological site, but no evidence of occupation was seen.

57. Sótano de Alvarez. Seven tenths of a kilometer southwest of El Cielo, 15 meters northwest of the road that goes from El Cielo to San Pablo. It is directly across the road from a roadside pit 3 meters deep.

The pit entrance is 4 by 3 meters. The pit drops 10 meters to a room from which a passage 5 meters long slopes down 1.2 meters to a 16-meter pit. From the bottom of this pit, a 6-meter-long canyon, a 2.5-meter climb down, and 3 more meters of passage lead to the third pit, which drops 5 meters to a room. From there, a 15-meter-long crawl leads to a fourth pit, estimated to be 9 meters deep, but too tight to

enter without hammering. Slight air-flow.

58. Pozo de Arco Fluido. In the jungle 1.6 kilometers south-southwest of San Pablo.

There are three pit entrances. Entrance 1 is 1.3 by 1.2 meters at the top and drops 24 meters, with a ledge 10 meters down. Entrance 2 is 7 meters southeast of Entrance 1, is 2 by 8 meters wide, and is 17 meters deep. Entrance 3 is a small skylight between the other two. From the bottom of entrance 1, a canyon goes under the skylight to the bottom of Entrance 2. Another passage goes from the bottom of Entrance 1 to a flowstone wall in a dome.

62. Cueva de Cañón de Diablo. One kilometer southwest of San Pablo, on the northeast slope of the canyon.

From the main entrance, 8 meters wide and 4 meters high, the passage slopes down 12 meters vertically into a room 20 meters across. An 8-meter climb up at the other end of the room leads to a small second entrance.

63. Sótano de Cardenas. On the north side of a populated valley, 2.9 kilometers south-southeast of Julilo and 0.8 kilometers east of the road from Julilo to El Cielo.

The entrance to the 22-meter pit is 14 meters north-south and 5 meters east-west. There are no leads at the bottom.

66. Sótano de Cristales. East of the

main road, on a hillside facing 220 degrees, 0.9 kilometers northwest of El Cielo. Two hundred meters northwest of number 82.

The main entrance is a pit 39 meters deep from the high side and 15 meters by 10 meters wide. A second entrance, 2 meters by 1 meter, is 3 meters downhill from the main entrance, and a third entrance, 2.6 by 1 meters, is 9 meters downhill from the main entrance. The room at the bottom is 23 meters across.

67. Crystal Cave. This cave is 100 meters south of El Cielo. It was mentioned in *Association for Mexican Cave Studies Newsletter*, vol. 4, no. 3, from which the accompanying map is taken.

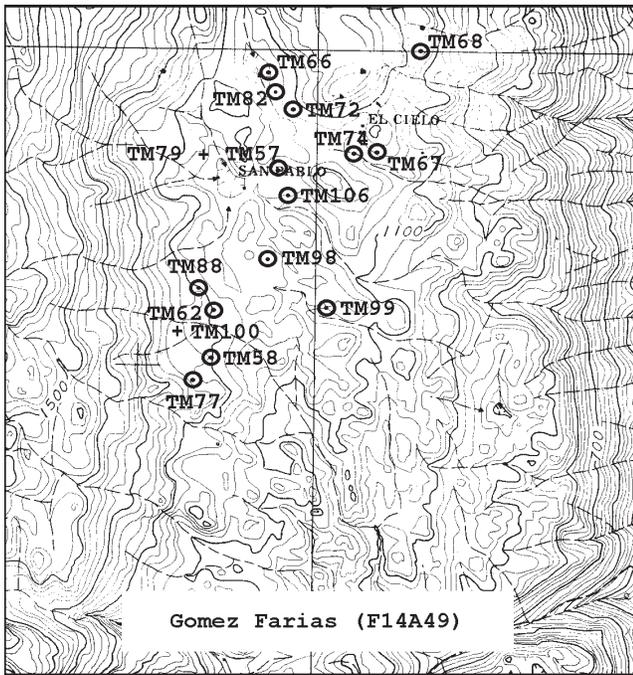
68. Sótano de Ebano. On a hillside facing 130 degrees 0.8 kilometers northeast of El Cielo, 40 meters from and 12 meters above a trail and 65 meters below another trail.

The 49-meter entrance pit is 1.6 by 2.6 meters at the top and enlarges to 5 meters in diameter about 30 meters down. From the bottom, a short stoopway leads 5 meters to a small, well-decorated room. Across the pit, a 3-meter climb up leads to a tight crack from which an undescended pit drops about 6 meters to a dirt floor, apparently blind.

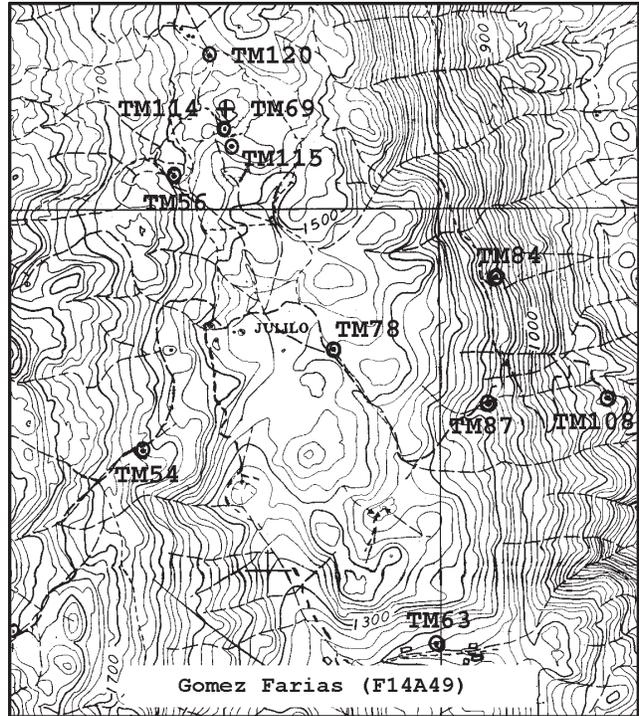
69. Sótano de Escudo Escondido. A half-kilometer east of the north-south road, 1.5 kilometers north of Julilo and 0.5 kilometers northeast of the road junction. It is 25 meters east of number 114.

Road log, compiled by Andy Zellner, from the junction of Highway 85 and the Gómez Farías road to Gómez Farías, up the mountain and west to Alta Cima, El Elefante, and El Refugio.

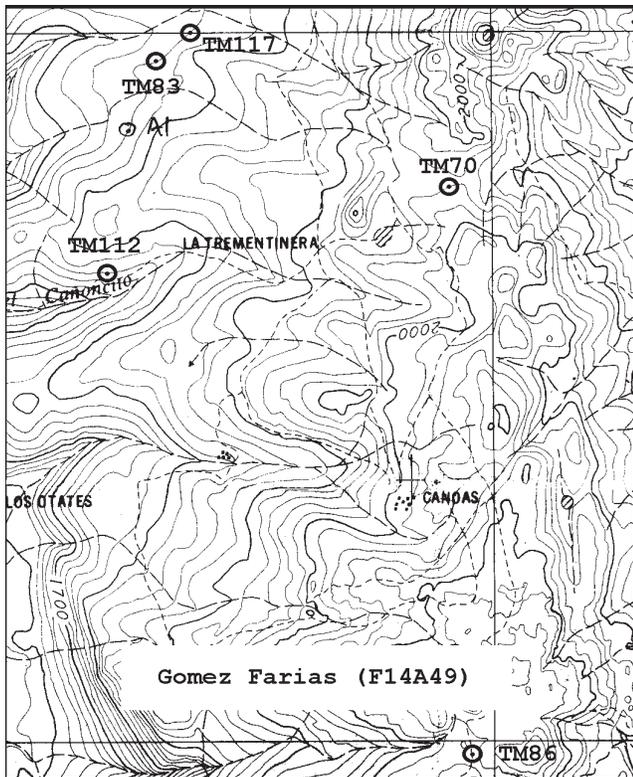
miles	kms	
0	0	Junction of Highway 85 and the Gómez Farías road.
7.0	11.3	Gómez Farías plaza, elevation 380 meters.
7.2	11.6	Pavement ends.
7.6	12.2	Road curves down into valley. Side road on right.
8.1	13.0	Sign at junction of aqueduct trail and road up mountain. Road goes up to the left.
11.6	18.7	Top of grade; road levels out.
12.4	20.0	Parking on right (north) for Sótano de la Sierra Cucharas, a 65-meter pit. Pit is south of the road beyond two small corn fields and to the left (east) along a foot trail about 20 minutes walk from the road.
14.2	22.9	Road tees at El Cielo sign. Turn left toward Alta Cima.
14.4	23.2	Alta Cima. Pass through gate. Road from here is recommended for four-wheel-drive vehicles only.
15.3	24.6	Side road to left (south).
16.0	25.8	Gated side road to south.
16.4	26.4	Flat, grassy area suitable for camping. Side jeep road continues to north.
17.0	27.4	Uphill side road to north.
17.1	27.5	Side road to south.
17.2	27.7	Side road to north.
17.4	28.0	Road splits; lower is main road.
17.9	28.8	Splits come together.
18.2	29.3	Research station cabanas. Pass through two gates.
18.9	30.4	San José. As you enter from the south, the faint main road turns sharply west before you reach "No Tronar Cohetes" sign. Guides are available here to several local caves. As road begins ascending from the <i>llano</i> containing San José, it splits briefly. Left is main road. Road from here has some steep, rough sections as it ascends.
20.0	32.2	Old side road angles back to right (northwest).
20.4	32.8	Old side road goes downhill to left (west).
20.5	33.0	Side road to left (south).
20.6	33.2	Side road/path to right.
20.7	33.3	Gate entering La Gloria.
20.9	33.6	Gate leaving La Gloria.
21.8	35.1	Old road/path to right (north) with log across road.
22.9	36.9	El Elefante junction. Road to right (northwest) goes 6.1 kilometers to El Indio (2165 meters elevation).
23.1	37.2	El Elefante.
23.3	37.5	Gate. Begin descending to Manantiales.
23.6	38.0	Manantiales. Continue east until road makes a right turn directly in front of a row of houses. Follow it to the right (south) out of Manantiales. Caves reported on left as you leave town.
24.0	38.6	Turn right (west) up steep road. Straight ahead (downhill) reportedly ends at a <i>milpa</i> . E5 painted on rock near junction.
24.7	39.8	Gate.
24.8	39.9	Steep downhill section.
26.0	41.9	Y junction. From Manantiales, you approach junction on upper right arm of Y. Continue past junction a few feet. Then back down the left upper arm (toward the west) about 150 meters to a place where you can turn around; do so. The stem of the Y reportedly goes to Ocampo.
26.7	43.0	Old side road on right (east) at curve at start of steep section.
27.0	43.5	Hoya Ruiz. Old metal water tank on north side of road in overgrown clearing.
27.2	43.8	Old side road angling down to north.
27.3	44.0	Old side road to right (northwest). Small trees in road.
29.3	47.2	Level spot in road that was used for camping. Two small caves 15–20 meters to west.
29.8	48.0	Road junction. Bear right (northeast) to El Refugio. Road to left reportedly ends soon.
30.3	48.8	El Refugio <i>llano</i> .



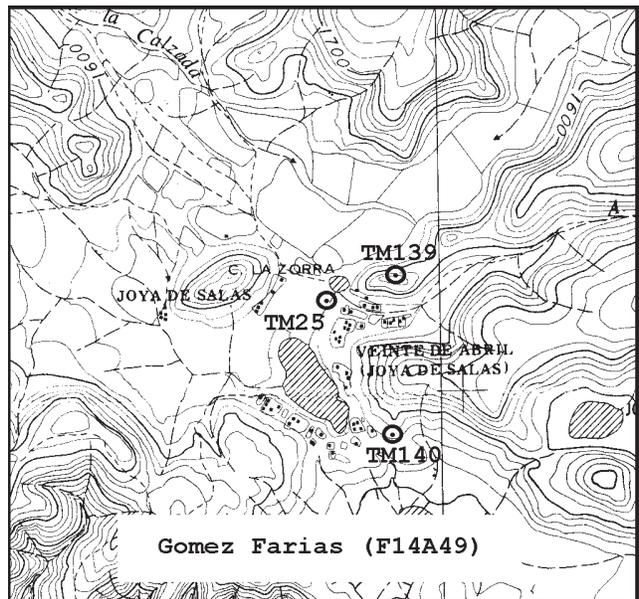
Map 1



Map 2

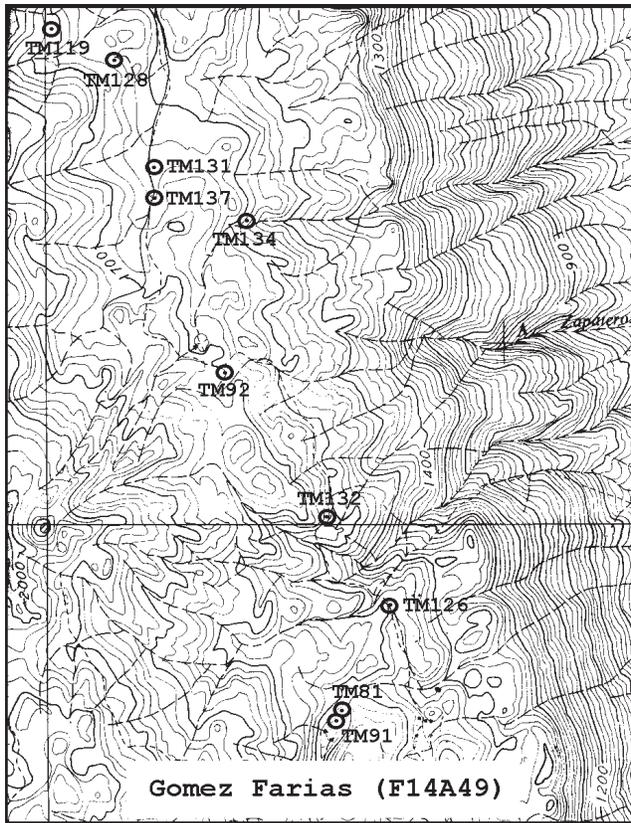


Map 3

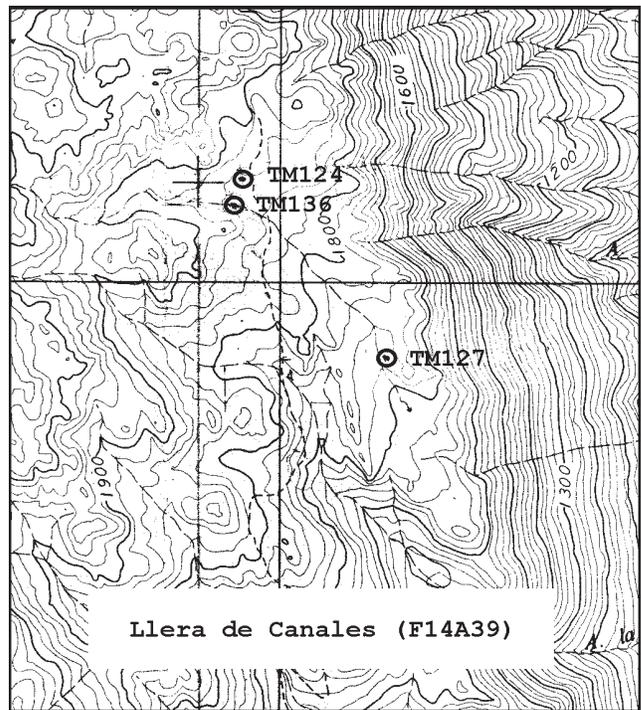


Map 4

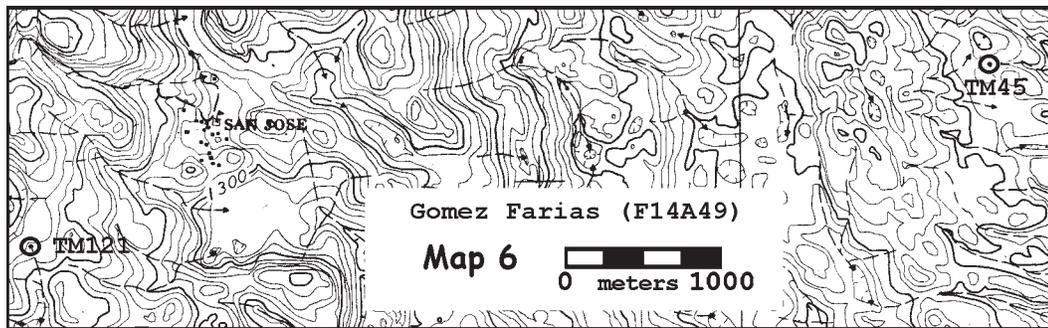




Map 5
0 meters 1000



Map 8
0 meters 1000



Map 6
0 meters 1000

The entrance is an obscure crack 5.2 meters long and 1.5 meters wide in a large limestone pinnacle. The nice wall-drop is 30.8 meters deep into a 15-meter-long chamber with nice formations, including a large shield. There is a bat colony in a dome. A map of the cave appears in *AMCS Activities Newsletter* 22, page 115.

70. Sótano de Gallos. Three meters east-southeast of the Julilo-Joya de Salas road, 6.3 kilometers northwest of Julilo.

The pit is 1.2 by 1.5 meters at the top and 26 meters deep. The bottom is 4 meters across, with no leads. This cave is close to the reported location of 2000

Meter Cave (*Association for Mexican Cave Studies Newsletter*, vol. 1, no. 3, p. 25), but neither the exact location nor the description agrees.

72. Sótano de Guano Lomito. Slightly north and 300 meters west of El Cielo, and 25 meters south of the El Cielo-Julilo road.

The pit's entrance is 8 by 2 meters, and it is 9 meters deep. There is a very small skylight entrance 3 meters to the south. The room at the bottom is 30 meters long and contains a small hill of guano. A side passage goes 15 meters to a room 8 meters long.

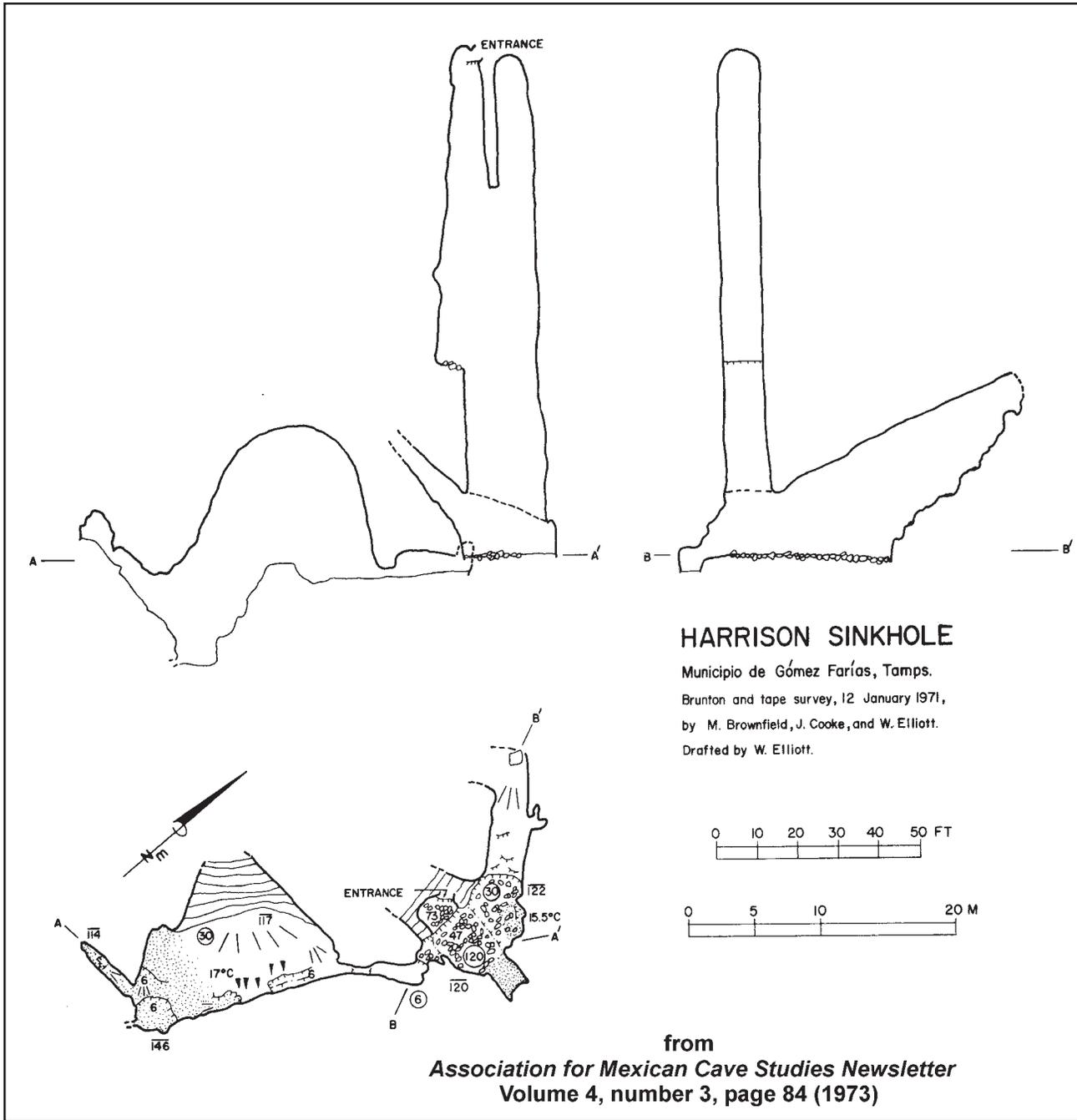
74. Harrison Sinkhole. From the southernmost house in El Cielo shown

on the topo, 10 meters down and 75 meters southwest, in a sinkhole.

This cave is reported in *Association for Mexican Cave Studies Newsletter*, vol. 4, no. 3, from which the accompanying map is taken.

77. Cueva de Jilario. The entrance is in a cliff 8 meters high, facing 160 degrees, 1.7 kilometers southwest of San Pablo.

The 10-meter-wide and 7-meter-high entrance slopes down 10 meters vertically into a room 25 meters across and 15 meters high. A side passage goes right 15 meters, and another, to the left, goes through a tight squeeze into a small room. The cave has many large



formations, many with roots hanging from them.

78. Cueva de Julilo. Ten meters east of the main road, 0.5 kilometers southeast of Julilo, in a sink 10 meters in diameter.

The entrance is 6 meters wide and 3 high. The sloping passage 12 meters wide goes 50 meters to a 5-meter, blind climb down. A side passage goes 12 meters to a small room.

79. Sótano de Ladrones. One hundred meters south-southeast of the road 0.6 kilometers southwest of El

Cielo toward San Pablo. There is a small pit 3 meters deep at the southeast side of the road 200 meters west-northwest of Sótano de Ladrones.

The main entrance is 4 by 2.5 meters. There is a small entrance 4 meters away. The entrance pit is 25 meters deep and blind, with the second entrance as a skylight. Ten meters down, you can swing into a parallel, 27-meter pit, 5 meters wide at the bottom.

81. Cueva Madriguera del Oso (Bear Den Cave). Slightly west and 4.7 kilometers north of Julilo; 150 meters

northeast of number 91.

Walk-in entrance to a passage that slopes down 60 meters to a crawlway end.

82. Sótano de Manuel. On a hillside east of the main road, 0.8 kilometers northwest of El Cielo; 200 meters south-east of number 66.

A pit 10 by 7 meters at the top and 34 meters deep.

83. Sótano de Mariana. North-northwest 3.5 kilometers from Canoas, just north of a main trail going downhill. Number 117 is 200 meters northeast, on

the same trail.

The entrance pit drops about 10 meters into a chamber 15 by 6 meters with a 2.5-meter-tall flowstone mound. The drop continues down a flowstone slope and a small pit 1 meter in diameter to a total depth of 26 meters. At the bottom a passage 6 meters tall and 5 meters wide goes 20 meters one way and 30 the other. It contains several large columns, lots of guano, and no airflow.

84. Joya de la Mina Barita. Slightly north and 2.1 kilometers east of Julilo. About 1 kilometer north of the road up the mountain to Julilo, 50 meters below a side road that takes off from a curve at the 1100-meter contour. The side road leads to a barite mine.

The entrance is 100 meters in diameter and very undercut at the rig point, which gives a 44.5-meter drop. There are large trees and ferns on the bottom, and large formations under the overhang.

86. Sótano de Muchos Insectos. On the west side of the road 3.9 kilometers northwest of Julilo, 7 meters from it. Slightly east and 2 kilometers south of Candas.

The entrance pit is 8 meters across and 28 meters deep, with a major ledge at 23 meters. A rubble slope leads about 25 meters to a dome 6 meters in diameter and 10 meters high.

87. Cueva del Murcielago Atacante. Visible in an arroyo, 10 meters south of the road up the mountain to Julilo; 2.1 kilometers southeast of Julilo.

The 21.6-meter pit has an entrance 1 meter wide and long. A short passage at the bottom leads to a narrow, 10-meter-high dome containing bats.

88. Sótano de Musgo de Arbol. One kilometer southwest of San Pablo and 100 meters north-northwest of number 62.

The pit drops 21 meters from an entrance 1.2 meters in diameter to a bottom 4 meters across.

91. Cueva de Ninfa del Bosque (Wood Nymph Cave). Slightly west and 4.6 kilometers north of Julilo; 150 meters southwest of number 81.

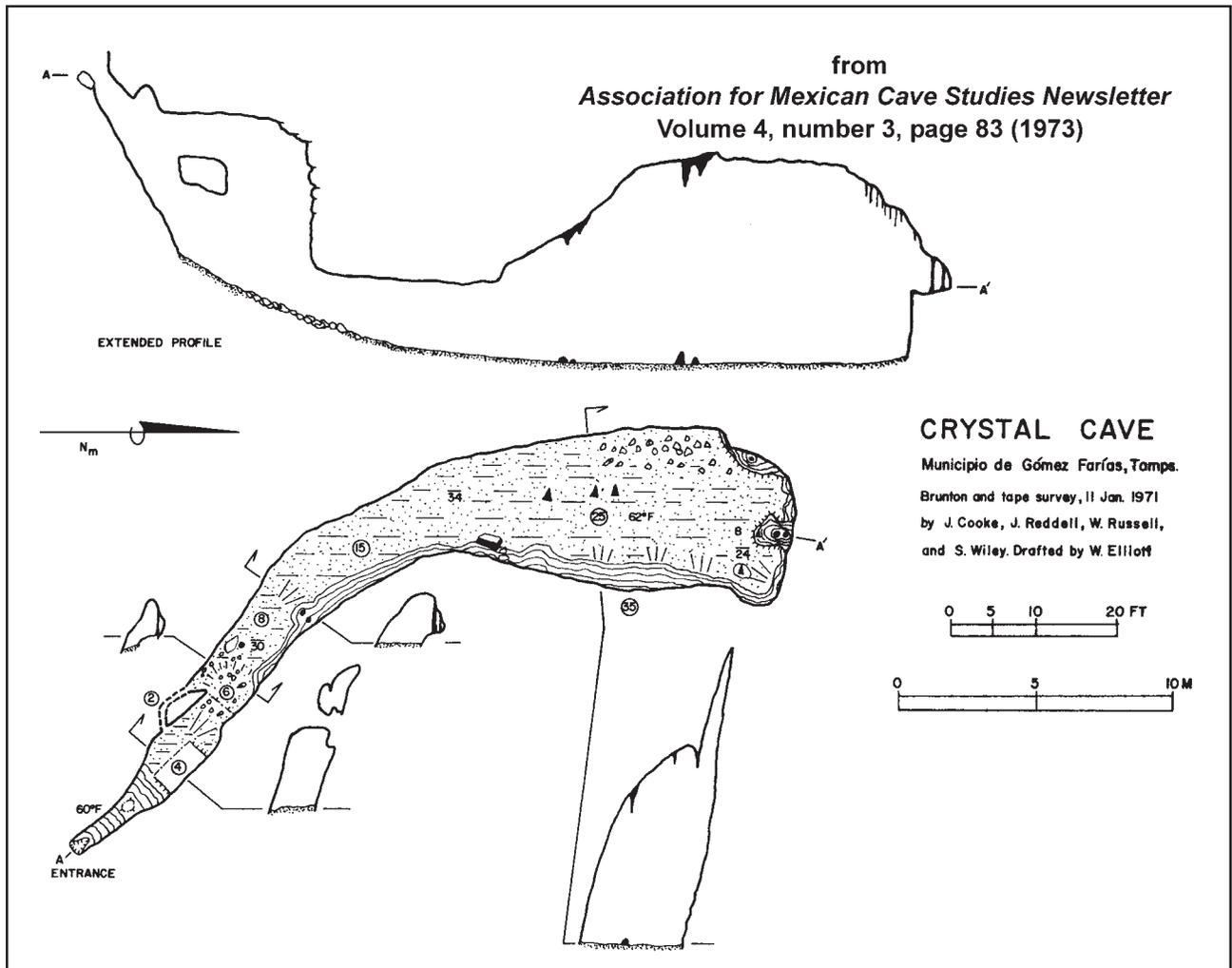
Walk-in entrance 2.5 meters wide and 3 meters high leads to 25-meter-long passage sloping downward 5 meters to chamber 1.2 meters high at end. Two other crawlway entrances.

92. Sótano de Ojos de Aguila. Four meters above (south of) road, 9.3 kilometers from junction of El Cielo and Joya de Salas roads at Julilo; 7.5 kilometers north-northwest of Julilo.

From an entrance 10 by 4 meters, a pit drops 26 meters. A second pit is 5 meters deep.

98. Sótano de Plan. Plan is about 300 meters past San Pablo on the road. Just before the road enters a large cultivated area, there is a major trail to the right. Follow it about 50 meters, then go left about 15 meters. The cave is 1.4 kilometers southwest of El Cielo.

Pit opening is triangular, about 5



meters on a side. The 23-meter drop has plenty of rockfall. Possible dig in small room at the bottom, but no airflow.

99. Sotanito de Plan. Right next to the road on the west side, after the road crosses the field and reenters the woods (see number 98). Slightly west and 1.4 kilometers south of El Cielo.

Entrance to 14-meter pit is 2 meters in diameter. There is a ledge 8 meters down. Small room at the bottom, and an alcove with a parallel dome.

100. Cueva de la Polilla. On the northeast side of Cañón de Diablo, 1 kilometer southwest of San Pablo. Lower in the same sink as the second entrance to number 62.

The entrance is 4 meters wide and 2 meters high. The passage slopes down to a small hole around a flowstone plug. Ahead, a 5-meter climb down leads to a room 10 meters across. A side passage goes 10 meters before becoming too tight.

106. Sótano de San Pablo. Two hundred meters from the road to the east from San Pablo, and at a bearing of 150 degrees from the first houses on the right in San Pablo, in a flat area; 0.85 kilometers southwest of El Cielo.

The top of the pit is 20 by 7 meters. From a rigging point on the southeast, the 79-meter drop is free after the first 40 meters. A beautiful pit into a decorated room 30 by 40 meters that slopes down to a depth of about 85 meters. No promising leads.

108. Sótano de Santa Maria. This cave was reported in AMCS Bulletin 1, *Caves of the Inter-American Highway*, p. 51. It is 7 meters south of the road, 3.2 kilometers east-southeast of Julilo.

The 15-by-6-meter entrance allows rappels of from 41 meters on the high

side to 35 meters on the low. There are many formations and a long break-down slope to a total depth of 55 meters.

112. Cueva de Timas. Northwest 2.6 kilometers from Canoas, 15 meters north of the main road to Joya de Salas, and 3 meters east of a major trail heading northward from the road.

The entrance is 1 by 2 meters at the bottom of a sink 12 meters across. A 2.5-meter climb down leads to 7 meters of walking passage to a small alcove with a narrow chute sloping down 3 meters vertically to a 6-meter pit. The room at the bottom, 6 meters tall and 5 meters wide, is the end of the cave.

114. Sótano de los Tres Ojos Verdes. About 1.5 kilometers north of Julilo, 0.5 kilometers northeast of the junction of the main Joya de Salas road with the north-south road. In an obscure 4-by-5-meter sink surrounded by karst pinacles.

There are three openings in the top of the 35-meter entrance drop into a large, decorated canyon. Down-slope 9 meters is the top of a 130-meter pit with massive formations all the way down and a large room at the bottom. There is an article on the exploration of the cave, with a map, in *AMCS Activities Newsletter* 22, pp. 114-116.

115. Sótano Trogon. In a shallow sink 100 meters from a logging road.

Entrance is 2.5 by 1.5 meters. From a rig on the uphill side, the drop is 22.2 meters sheer to a ledge and slope to the bottom at 39 meters. There are no leads.

117. Cueva de Zellner. North-northwest 3.6 kilometers from Canoas, 8 meters south of a major trail. Number 83 is 200 meters southwest along the same trail.

The entrance passage is 0.8 meters wide and 0.7 meters high and slopes down 1.5 meters to a crawlway 12 meters long. A small hole in the floor leads down to a dirt-floored room 10 meters in diameter. A walking passage slopes down 3 meters to a short passage 6 meters tall and wide that ends in dirt fill.

118. Sótano sin Bichos (Bug-Free Pit). Near the bottom of a large, 500-meter-long sink below and 1 kilometer east of the abandoned village of El Indio. An old logging road, now burro trail, runs east-west through the

sink, and the cave is 30 to 40 meters north of the trail near the lowest point in the sink.

The entrance is a 3-meter-diameter hole in the hillside. The floor slopes steeply down 5 meters to a 10-meter drop into a room 10 meters wide that has a few holes in the floor that go down another meter or so. No leads or airflow.

119. Cueva de Carrera. There is an open field with a water tank 11.4 kilometers north of the road junction in Julilo. The cave is in a sinkhole 40 meters long, 20 wide, and 25 deep, 1.4 kilometers northwest of the field. The trail to the cave leaves the road 150 meters north of the field.

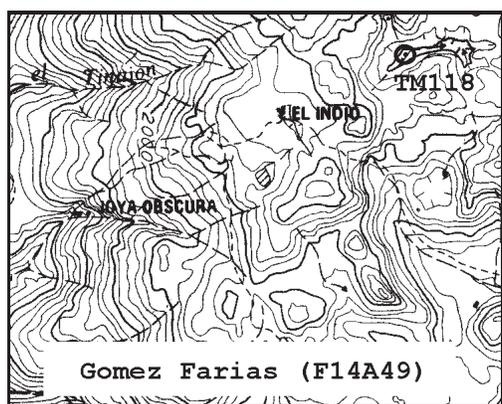
A 6-by-6-meter entrance leads to an entrance room 20 meters wide that slopes downward for 40 meters, to where a 4-meter-long passage goes through a tight crawl into a 12-meter-long room.

120. Sótano de Cigarro. East 20 meters from the road north out of Julilo, 2.4 kilometers from the junction there. South 300 meters from an abandoned logging camp shown on the topo map, and 50 meters south of a junction with an old logging road that heads east.

From a 1-by-1-meter entrance, a pit drops 35 meters, passing a major ledge 6 meters above the floor. From the bottom, which is 2 by 2 meters, a too-tight crack goes down at least another 10 meters.

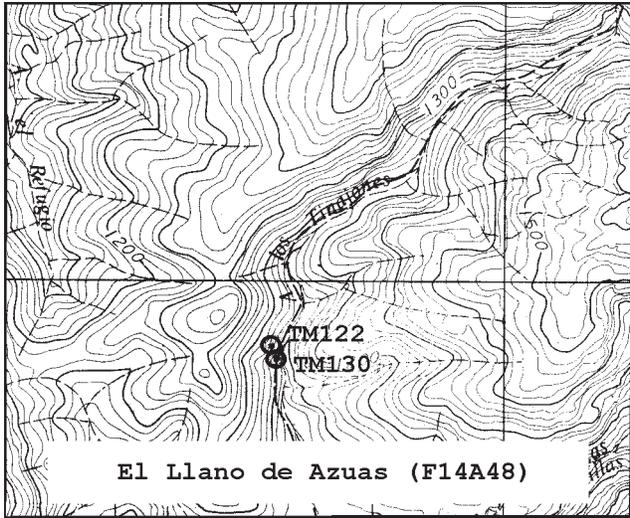
121. Cueva de la Cima de San José. Near the top of a hill above the town of San José, about 1 kilometer west of the village and 200 meters higher. An abandoned logging road can be followed from the town halfway to the cave, and a rock-lined path leads the rest of the way. Sign warns that permission must be obtained to enter.

The entrance is a 7-meter-high, 3-meter-wide hole at the base of a rocky cliff. A path leads down a steep, rocky slope 15 meters to the floor of the first large room, about 25 meters in diameter and 10 meters high, with large draperies and flowstone mounds covering the walls and floor. At the far end, a flowstone mound 15 meters high and 10 meters in diameter has dammed up a pool 7 meters long, 5 meters wide, and at least 1 meter deep. One can climb a flowstone wall above the pool for a very nice view of the whole entrance area.

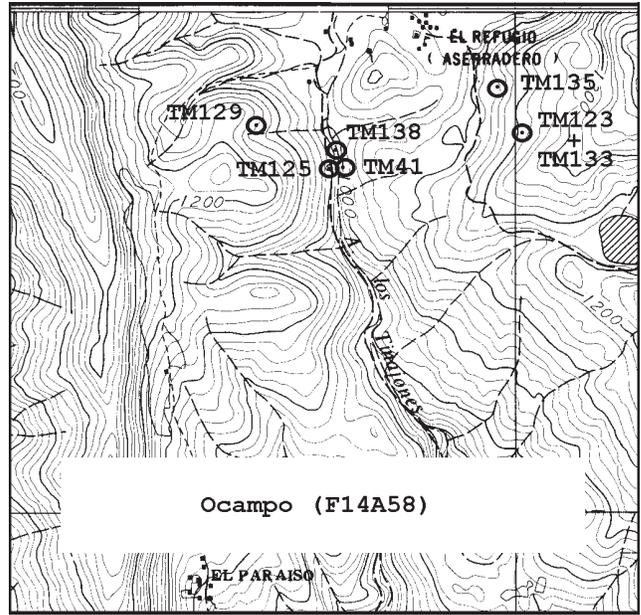


Map 7

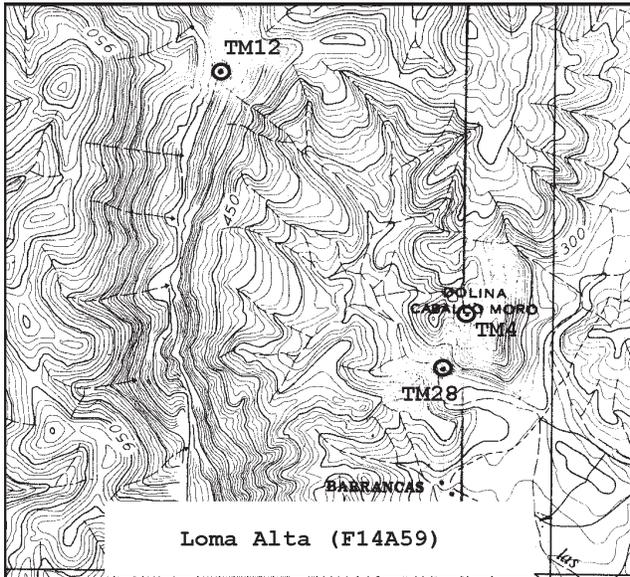




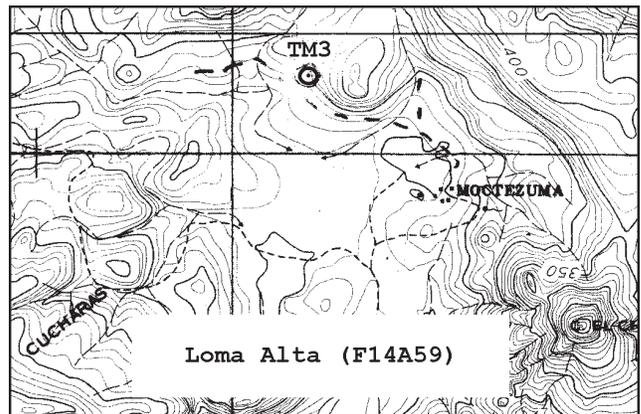
Map 9 0 meters 1000



Map 10 0 meters 1000



Map 11 0 meters 1000



Map 12 0 meters 1000

Climbing over the large flowstone mound discloses that the entrance room is just the upper end of a much longer chamber that slopes down at a 30-degree angle for another hundred meters or so, retaining its height and width the whole way. The slope is slippery, but can be free-climbed by clinging to formations. A 5-meter difficult climb at the bottom of the slope leads to the muddy floor of the final room, 6 meters in diameter.

About halfway down the main slope, a large ledge leads to a side passage 7 meters high, 5 meters wide, and at least 15 meters long. This passage is also heavily decorated, and several

scary climbs on flowstone must be made to get to the end. Another brief description of this cave appeared in "Mexico News" in *AMCS Activities Newsletter* 18, p. 16.

126. Sótano de Jabalies. One meter northeast of the road going north out of Julilo, 6.0 kilometers from the junction there.

From its 1.2-by-1-meter entrance, the pit drops 16 meters. From the bottom of the rope, the cave slopes down another 10 meters. A short crawl goes to a room that can also be reached by a climb over a formation higher up.

128. Cueva de Mono. Near number 119, 0.8 kilometers northwest of the

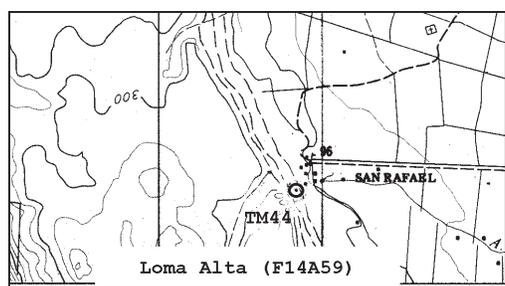
same open field, in a sink 10 by 8 meters and 10 meters deep.

A 10-meter climb down into the sink leads to a passage 10 meters wide and 6 meters high that slopes downward for 50 meters. Halfway down, on the right, is a 10-meter-long side passage.

131. Cueva Parade de Descansar. North 11.1 kilometers from the junction at Julilo, 60 meters east of the road. A trail leads to the cave.

A large shelter cave 50 meters across and 15 meters high, with 50 meters of mazy passages at various levels. The cave is used as a camping spot by locals who come to gather palms.

132. Sótano de Queso Grande. Two



Map 13

0 meters 1000

meters north of the road north out of Julilo, 7.2 kilometers from the junction there. At the top of a ridge, just as the road crests it.

From entrance 1 by 0.3 meters, the entrance pit drops 5 meters to a ledge, from which a second pit goes 8 meters to the bottom, 6 by 4 meters with a flowstone wall.

134. Sótano Reencontrado. East-northeast 600 meters from the road north out of Julilo, 10.5 kilometers from the junction there; 750 meters southeast of number 137. About 40 meters in elevation below the road.

Blind pit 16 meters deep, 2 by 2.5 meters at the top and 1.5 by 5 meters at the bottom.

137. Pozo de Vapor. North 10.8 kilometers from the road junction at Julilo. Four meters southwest of a trail that loops from the main road, 30 meters down the trail.

The entrance pit is 3 by 2.5 meters at the top and 41 meters deep. The bottom is 10 by 3 meters, and passage goes 3 meters to a 5-meter pit, at the bottom of which is a room 3 meters across.

139. Cueva de Carmen. Near the top of a ridge on the east side of the valley of Joya de Salas; 600 meters east-northeast of number 25 and 90 meters vertically above the valley floor.

The entrance is 6 meters high and wide. A walking passage goes back 30 meters to a 6-meter crawl to the end. At the entrance, a 2-meter climb up to the left leads to a small passage that goes back 10 meters.

140. Cueva de los Leones. In a sink 11 meters long, 5 wide, and 4 deep, on the southeast side of the Joya de Salas valley; 30 meters east of a dirt road and 10 meters southeast of a water pipe. Southeast 1.1 kilometers from number 25.

A steep talus slope leads down from an entrance 6 meters wide and 1.8 meters high. The passage is 8 meters

high and 3 meters wide, and after 60 meters, including 25 meters of down-climbs, an 11-meter pit drops into a room, from which a 3-meter climb down leads to 30 meters of passage ending in low crawl. There are 50 meters of upper-level passage above the crawl. The cave has good airflow, but it is lost somewhere before the end.

Llera de Canales Quadrangle

124. Grieta Desesperada. On the north side of a large double sinkhole 300 meters east of the road 22.5 kilometers north from the junction at Julilo.

The walk-in entrance is 4 meters wide and 2.5 meters high, and the passage slopes downward for 8 meters to a passage that goes right 2.5 meters to a 2-meter climb down to the lip of an 11-meter pit. The pit drops into a chamber 6 by 9 meters in size. From there, a 4-meter-diameter passage goes down another 2 meters, and 30 meters of passage leads to a 20-meter pit with a dirt floor and no leads.

127. Cueva de Leo. East 800 meters from the northern road, and 1.4 kilometers southeast of number 136.

The entrance is 1 meter square in a vertical-walled sink 3 meters deep. The walking passage goes back 15 meters, and there is a 3-meter side passage. The back half of the cave contained roughly thirty bats.

136. Sótano Ultimo. North 22.4 kilometers from the junction at Julilo, 10 meters northeast of the road.

The pit is 2.5 by 2 meters at the top, 3 by 2 meters at the bottom, and 22 meters deep. There are no leads.

El Llano de Azuas Quadrangle

122. Cueva del Entierro. Located 1.2 kilometers north of the village of El Refugio, 60 meters above and 150 meters west of Arroyo los Tinajeros, the large arroyo that runs past El Refugio, past number 125, and on toward El Tigre. The cave is on a steep hillside about 30 meters north of a shallow, steep ravine, directly above a 3-meter drop in the ravine.

The 8-meter-wide entrance is 3 meters high and leads to a chamber 3 meters high, 15 meters wide, and only 5 meters deep, which makes the cave

look more like a shelter than a real cave. In the west wall of the room a 2-meter-diameter opening leads to a sinuous canyon 1.5 meters wide and about 15 meters long. A crack in the floor of this passage drops a dusty 5 meters to a dry, dead-end floor. In the southern end of the entrance room are some old, dry flowstone mounds and a floor of dirt and silt. From this thick layer of dirt, our local guide had dug the remains of a human burial some time before. The leg and arm bones and part of a skull were easily identified, but no artifacts were noted and no attempt was made to investigate further.

130. Cueva del Papecido. Visible from an abandoned logging road that runs along the east side of Arroyo los Tinajeros, which runs past El Refugio, in a 10-meter bluff just west of the arroyo; 1 kilometer north of El Refugio.

A walking passage with some breakdown extends straight into the hillside for 16 meters. The cave continues 15 or 20 meters as a hands-and-knees crawl, bending around to the right to where it emerges on the hillside a little above and to the north of the main entrance. Less than 10 meters inside the main entrance, there is a tiny alcove in the north wall containing some broken pottery, smooth, spherical, unadorned, and just out of reach. At least two high leads in this part of the cave were not pushed.

Ocampo Quadrangle

41. Cueva de Graciano. Follow the road south out of El Refugio, a village that no longer exists, about 1000 meters to where a trail leads east 100 meters to the sink 10 meters across and 9 meters deep that contains the entrance; 3.5 kilometers northeast of El Paraiso.

The entrance is 10 meters high and 15 meters wide and slopes downward to a 5-meter climb, below which there is second 5-meter climb down that leads to 60 meters of walking passage, at the end of which a climb goes down 2 meters to the end of the cave.

123. Cueva Escalera de Raices. West 25 meters from the road from Manantiales to El Refugio, 1.5 kilometers (along the road) from El Refugio. This and number 133 are in small outcrops, barely visible through foliage from the road.

The entrance is a 4-meter-deep shaft, 2 by 3 meters across, barely climbable

by using roots as a ladder on the south side. A 3-meter-wide, 2-meter-high passage goes 8 meters to a 5-meter climb down to a 2-meter-high, narrow passage that goes 6 meters to the end. No airflow, very dry.

125. Sótano de los Guacamayos. Southwest 1.1 kilometers from the village of El Refugio, just west of Arroyo los Tinajones.

The entrance to this large pit is 30 meters wide by 60 meters long. The drop is 140 meters to a bottom that is 50 by 65 meters. The discovery and exploration of the pit are described in *Association for Mexican Cave Studies Newsletter*, vol 5, no. 2-3, pp. 56-57, from which the accompanying map is reprinted.

129. Cueva Obscura. On the western edge of an overgrown field on a hillside 120 meters above and 1 kilometer west-southwest of El Refugio, in trees about 15 meters from the clearing, in a shallow, rocky ravine.

The entrance is 2 to 3 meters high and wide, but is nearly covered by boulders and appears to be several smaller entrances into the same room, which is 5 meters in diameter and has a steeply sloping floor. A high lead goes up another 7 meters to a flowstone- and spider-filled alcove. From the base of the slope, a hands-and-knees crawl goes 10 meters to a junction. Ahead ends in 5 meters, and to the left a difficult, narrow 5-meter climb down reaches the lowest point in the cave, where it is too tight, although rocks rattle down another 3 meters. No other leads, and no airflow.

133. Cueva de las Raices. Northwest 20 meters from a road. See number 123.

The entrance is a small hole less than 1 meter in diameter at the base of a natural rock wall 1.5 meters high. A 1.5-meter-diameter enlarged-joint passage goes 8 meters to a junction in a room 2 meters high. Left goes 6 meters to breakdown, and right does too. Near the junction, a body-size hole drops 2 meters to what looked like a too-tight hole, which was not pushed. No airflow. Numerous roots dangle from the ceiling, hence the name Raices (roots).

135. Cueva de El Refugio. On a dry, forested hillside, 40 vertical meters above the logging road from El Refugio to Manantiales. A faint trail leads from the road up to the cave, which is roughly 500 meters from El Refugio.

The entrance is 3 meters high and 10 wide and consists of two openings separated by a rock pillar. Just inside is the largest room in the cave, 7 meters wide and about 15 meters long, with a flat floor and heavily decorated ceiling and walls. A passage in the back right corner goes as a hands-and-knees crawl for 15 meters to a flowstone choke.

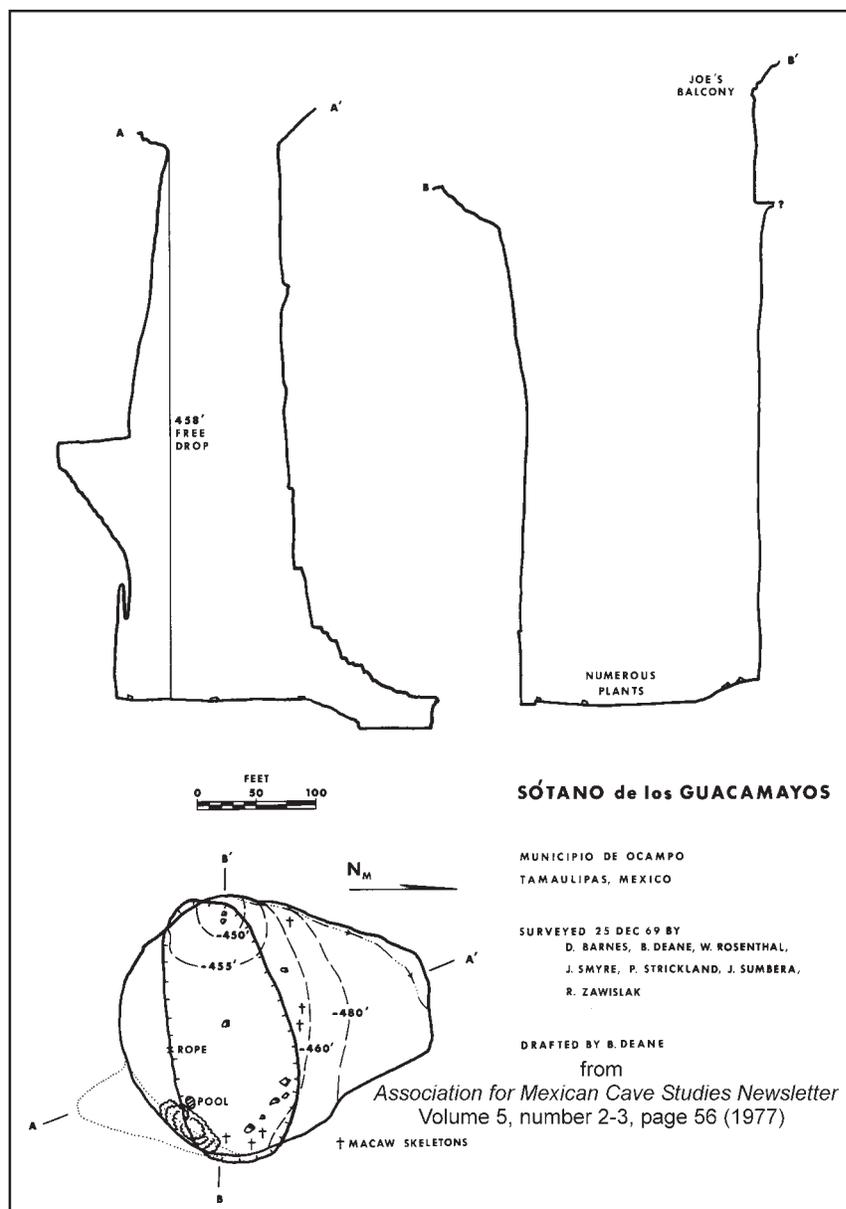
To the left, a 1-meter-high, 3-meter-wide crawl goes for about 8 meters to the second large room, 10 meters in diameter and about 5 meters high. All the walls are copiously decorated by very dry formations, and one can climb the guano-encrusted formations along the back wall into a few alcoves that go nowhere. On the right side of the room,

two smaller leads form a 30-meter loop.

The cave is very dry and seems to have been silted up, as tips of stalactites are buried deep in the floor. There are quite a few names on the walls, and most of the smaller formations have been broken. There is no airflow anywhere in the cave.

138. Sótano de Ventana del Arroyo. An overgrown karst feature in the middle of Arroyo los Tinajeros, about 100 to 200 meters north of Sótano de Guacamayos.

The upper entrance is a 9-meter pit, 2 meters wide at the top. At the bottom, the pit opens into a 3-meter-high, 4-meter-wide opening back out to the arroyo. One side passage climbs up 4 meters.



Loma Alta Quadrangle

3. Bee Cave. At about 1.5 kilometers, the road from Moctezuma goes across a wide valley and then approaches a hill. Follow the road for about 250 meters, to where the pit is about 150 meters north of the road at the edge of jungle.

The entrance is 40 meters long and 30 meters wide. Rigging on the high side, to the west, gives a free drop, measured at 74 meters. The passage at the bottom is large and floods in wet weather. The cave is described more thoroughly in *AMCS Bulletin 1, Caves of the Inter-American Highway*, p. 53.

4. Sótano de Caballo Moro. Shown as a flat area 3.9 kilometers north of the village of Coahuila on the topo map and marked Dolina Caballo Moro. North 500 meters and 85 meters higher than number 28.

The pit entrance is 150 meters long and 100 meters wide. The north side can be rigged for a 146-meter drop. The south side has been descended down a slope to the top of a 49-meter drop. At the bottom is a large, deep lake. Thirty

meters of passage goes to a junction. Straight ahead is a large river 10 meters wide and 4 to 15 meters deep, with a strong current flowing into a sump. From the junction, a climb up leads to a large passage that goes to a room with a lake. A crawlway was pushed for 50 meters, but not to its end. A mapping trip into the cave is described in *AMCS Activities Newsletter 11*, p. 22. The map appears in the blind fish project article elsewhere in this issue.

12. Cueva de Coahuila. At the base of 150-meter-high cliffs. Follow trail up canyon past number 4; after 1 to 2 kilometers, the trail is on the left side of a creekbed. The creek will gain 300 meters in elevation to the base of the cliff. From number 4, 2.7 kilometers northwest; from village of Coahuila, 6.5 kilometers north-northwest.

Entrance is 25 meters wide and 20 meters high. The cave is one large room 75 meters across and 25 meters high, with nice formations.

28. Cueva de los Misioneros. Slightly west and 2.7 kilometers north of village of Coahuila; south of and below number 4. On east side of valley, 6 meters

above streambed.

The lower entrance is 5 meters wide and 1 high. A second entrance, above the first, is 5 by 5 meters. The passages join within 5 meters into a passage about 6 by 6 meters. Thirty meters inside there is a 5-meter pit, followed by a climb back up. After 100 meters, the main passage splits. To the right is a 4-meter climb down, a crawl, and then a 10-meter pit. To the left is a pit about 40 meters deep that was descended in 1980 into very bad air, but with a reported additional muddy pit below (see *AMCS Activities Newsletter 11*, p. 22).

44. Cueva y Sótano San Rafael. Vertically 80 meters above the village of San Rafael; above and slightly south of the spring.

A 15-meter-long cave, walking and dusty, has a 5-by-3-meter entrance at the edge of an 18-meter pit. The top of the pit is 25 meters long and 10 meters wide, crossed by a natural bridge. The bottom is about 20 meters long, with about 30 meters of passages.

Espeleólogos del sureste de los Estados Unidos hicieron varios viajes a la Sierra de Guatemala, Tamaulipas, para buscar cuevas. Se describen y ubican las cavidades conocidas en el área. El Sótano de la Joya de Salas se conoce desde hace muchos años, y sigue siendo el más profundo del área.

RECENT FIELD INVESTIGATIONS OF BLIND ASTYANAX

Jean Krejca

The Mexican blind tetra, genus *Astyanax*, is the most-studied species of troglobite. One of the reasons it is so interesting to cave biologists is that it can still interbreed with its fully eyed and pigmented surface ancestor, which occupies streams in Mexico and parts of Texas. They make excellent laboratory organisms, because they are hardy and breed easily in captivity, as evidenced by their popularity in the pet trade. Earlier work on these fish showed that there have been at least four independent cave invasions by this species, meaning that on at least four occasions surface fish entered caves and became cave-adapted. Each time, a different evolutionary path was taken to develop troglomorphic characteristics, such as eyelessness, loss of pigment, an increase in the number of "taste buds" in and around the mouth, and a decrease in the number and increase in the size of eggs. This makes, of course, an excellent natural experiment for evolutionary biologists to test hypotheses about the process of natural selection. One particular question that has been debated among cave biologists is whether selective pressure acts underground in favor of the loss of characteristics such as eyes and pigment or there is simply genetic drift from random mutations that causes loss of these things in caves, where there is no selective pressure for keeping them. Recent work using transplants of lens tissues from eyed to eyeless fish and

vice versa showed that the loss of the eye is actually a gain in function of a gene called sonic hedgehog, a gene that inhibits eye growth. It appears, then, that selection is actually favoring the loss of eyes, which is a gain in caves due to the energy required to create and maintain them.

The following reports cover two separate trips that had the objective of collecting specimens of *Astyanax* that occur in places where both eyed and eyeless populations are in the same cave. These specimens will be used for population-genetics work that will examine the persistence of polymorphisms that are presumably in the same population, since they are in the same cave.

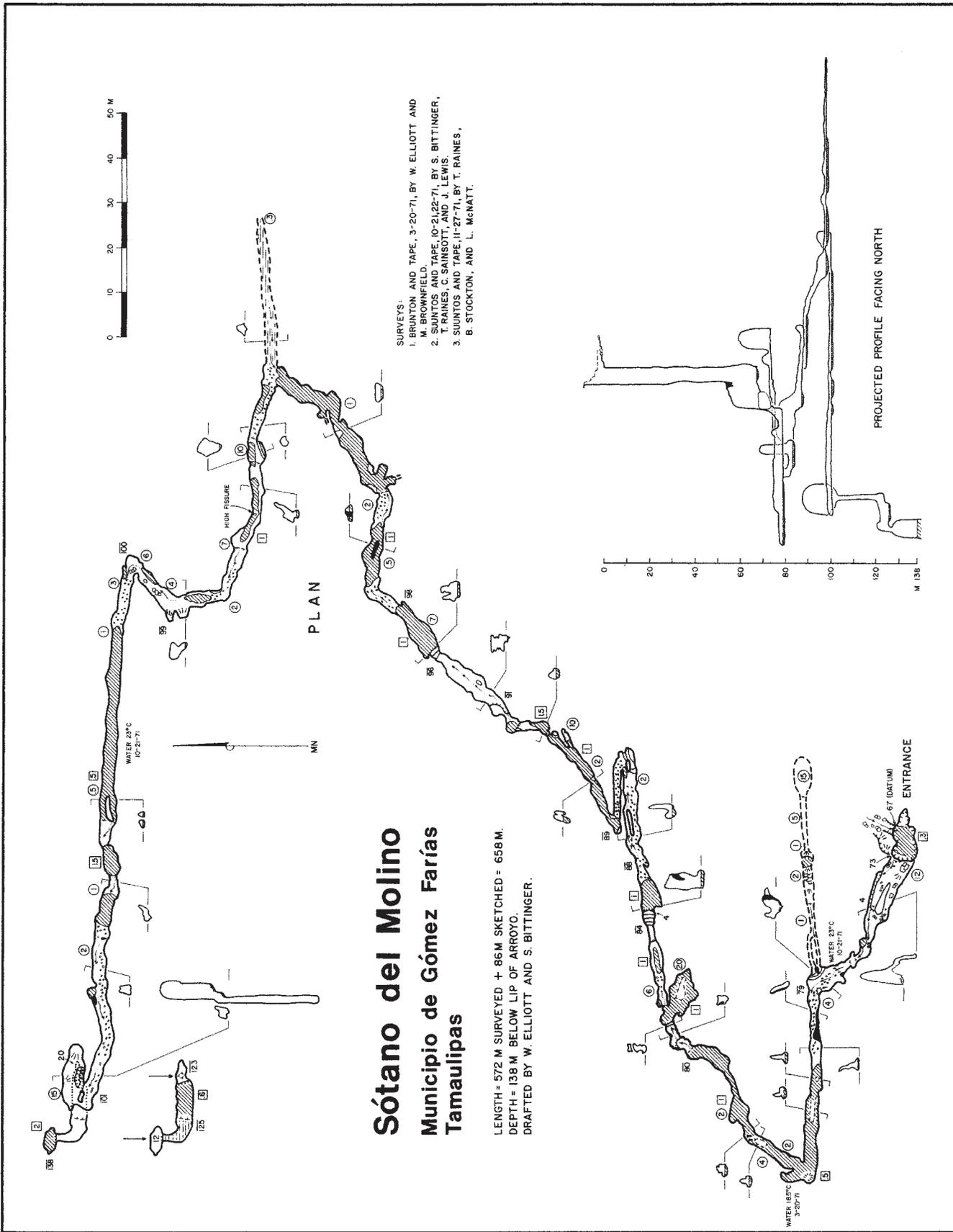
On October 19, 2000, Vivian Loftin and I met Jaime Moreno, a.k.a. James Brown, roving cave bum currently from Seattle, at the Austin airport and left for the bor-

der. The next morning in Ciudad Victoria we met Francisco (Paco) Garcia de Leon, a professor at the Instituto Tecnológico in Victoria, and Horst Wilkins and Ulrike from Germany. The research is a collaboration between Victoria Tec, the University of Hamburg, and the University of Texas at Austin.

Early the next morning three Tec students joined us, Aldo Guevara and Fernando Vanoge Eligio, who had been on previous caving expeditions of the Proyecto Espeleológico Purificación and our Blind Cat Research Team, and Lizeth Martínez Garcia, a new caver. After finding a hotel in Mante, we set out for our first destination, Sótano de Caballo Moro, Tamaulipas. We arrived in the small town of Coahuila, about 9 kilometers northeast of Ocampo, which is the closest you can drive to the cave. After about an hour of hiking with two guides, when we were good and deep into



Hybrid and blind fish.
Jean Krejca.



Sótano del Molino
Municipio de Gómez Farías
Tamaulipas

LENGTH = 572 M. SURVEYED + 86 M. SKETCHED = 658 M.
 DEPTH = 138 M. BELOW LIP OF ARROYO.
 DRAFTED BY W. ELLIOTT AND S. BITTINGER.

SURVEYS:
 1. BRUNTON AND TAPE, 3-20-71, BY W. ELLIOTT AND M. BROWNFIELD.
 2. SUUNTOS AND TAPE, 10-21,22-71, BY S. BITTINGER, T. RAINES, C. SAINSBOTT, AND J. LEWIS.
 3. SUUNTOS AND TAPE, 11-27-71, BY T. RAINES, B. STOCKTON, AND L. McNATT.

abundant cactus in a steep-walled valley where the GPS wouldn't work, the guides admitted that they had never been to the doline. So we all split up and hiked up the hillside to find it. I managed to reach a saddle where I caught a glimpse of a suspicious-looking arroyo, which ran into the one we'd been in, but much farther upstream. After some hours, we regrouped, and the four of us, minus Paco, who had gone into town for stitches where sharp limestone had sliced his hand, hiked upstream to the place I had seen. We were rewarded by finally finding the edge of the sinkhole at sunset. There was a roar from the waterfall entering the cave and a racket from parakeets at the entrance.

On October 21, having seen that we were up against an extremely steep-sided and deep doline, we packed up all our rope and headed out at an early hour. We chopped, waded, and wrestled our way through thick brush to a rigging point at the south end, where we rigged 90 meters of rope on three drops, largely in a waterfall, finally reaching the cave entrance. This entrance is remote, extremely scenic, and dangerous. From deep in an enormous doline you can look up to see an impressive, dripping cathedral-like overhang that frames the dark cave entrance, where a layer of mist hangs in the darkness. In the other direction is a three-level waterfall over travertine that feeds the cave. In every direction are steep walls from which we saw three spontaneous rock falls in two days.

Only two of us reached the bottom that day. Despite lots of surface evidence of flooding from the worst hurricane in twenty-five years, there was dry ground to land on at the bottom, where a large breakdown pile slopes down to a pool with a swift current. The visibility in the water was poor, but I nevertheless managed to net two fish in the time it took Viv to ascend.

On the twenty-second, having determined that collecting was possible, we returned with the big guns. Aldo, Fernando, and Jaime joined us and brought down a seine

and material to construct traps. The traps, cut from plastic bottles and baited with meat, proved effective for *Speocirolana* isopods, but not fish, which were caught by seining. We noticed that the water level had dropped 2 meters since the day before, and occasionally strange loud noises would emanate from the far end of the pool, perhaps resulting from the draining of the cave. We returned to town barely before dawn in a torrential downpour. We spent the next afternoon seining in local creeks for surface *Astyanax*.

Our final goal was to get samples of eyed and eyeless fish from Sótano de Yerbániz, San Luis Potosí. Our day on October 24 began with the discovery that a large bee hive was directly under the ideal natural anchor for the entrance drop, so we rigged as far as possible from there. This put us on a large ledge, where a rebelay made the rope too short to reach the bottom. So we reluctantly used our rope for the second drop to reach the upper level of the cave. We found surface *Astyanax* in small pools in the mazy passages at this level. After some searching, we found a good way down to the second level and used our third-level rope to get there. Paco and Aldo did some seining on the second level and came up with some *Tilapia*, an invasive species, as well as *Astyanax*. This is the first *Tilapia* found in a cave, as far as we know, and there is some suggestion that the two fish are competing there. We seined and used dip nets to catch eyed *Astyanax* and *Speocirolana* isopods at this level, but the fish were not eyeless, so the search was on for the way down to the third level, a flowstone-covered ledge over a gaping black maw. I returned to the top of the

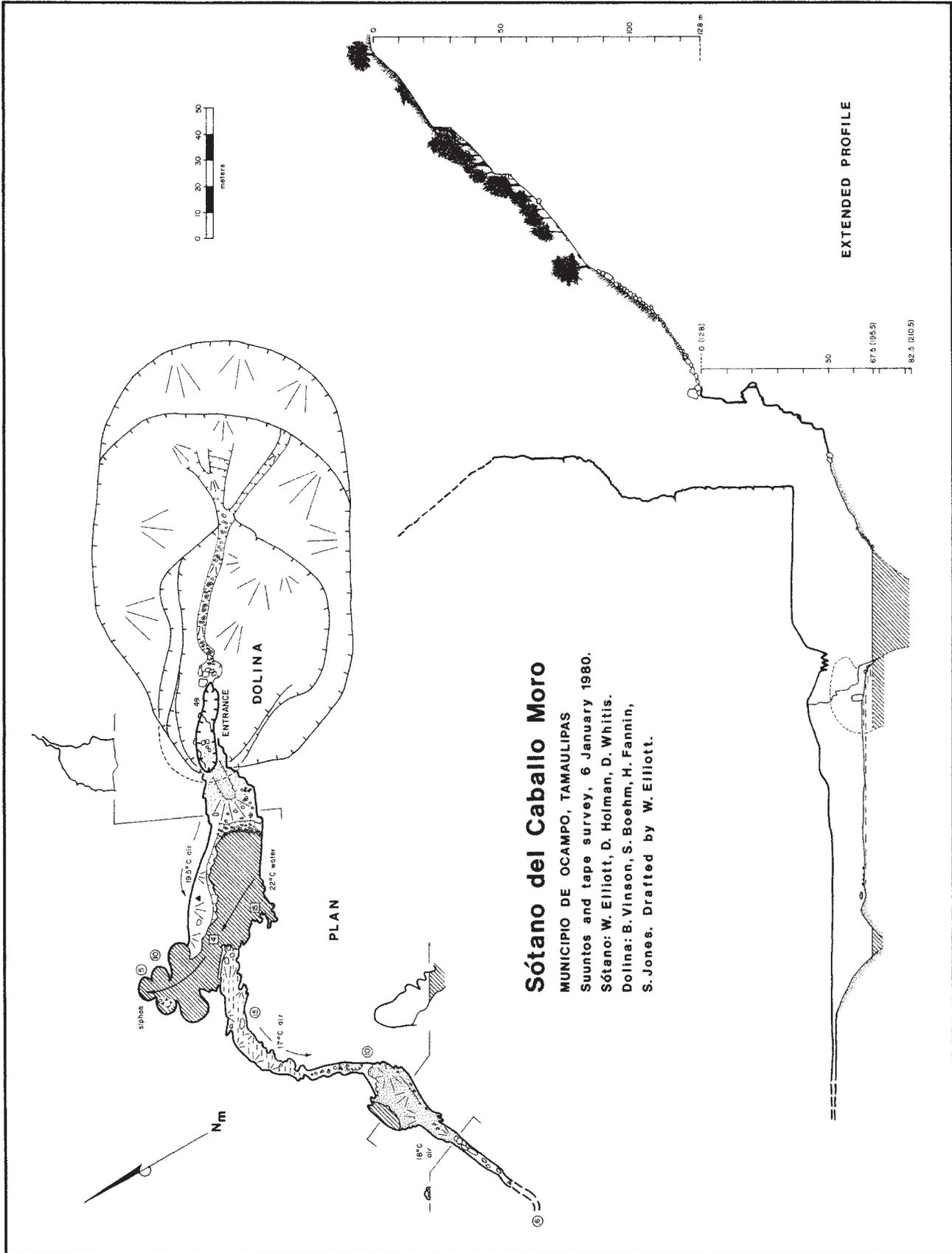


Horst and Ulrike sorting fish.
Jean Krejca.

second drop, left someone there with every scrap of material we had, and did a pulldown rappel so we could use that rope on the third drop. At the bottom, Aldo and I found extremely abundant eyeless *Astyanax* in two pools at the bottom.

Vivian at Caballo Moro. Jean Krejca.







Justin on rope at the entrance to Sótano de Yerbaniz.

Jean Krejca and Vivian Loftin.

One right at the bottom of the rope was full of tiny fish, and a pool some 15 by 30 meters in size on the other side of the room had fish of many sizes.

It was a successful trip, with collections of eyed and eyeless *Astyanax* from a couple of the more difficult sites where they are known.

In January 2002, four of us boarded a fifteen-passenger van in Austin, Texas, and made our way to Ciudad Mante. Richard Borowsky was leading the trip, with Vivian Loftin, Justin Shaw, and me as the faithful fish-catchers. We stayed at the Los Arcos hotel in Mante, which was 135 pesos per night with a good supply of hot water in the shower. The rooms smelled kinda funny, though, so I can't be sure how good the deal was.

On January 7, after a bit of discussion with nearby residents, we were escorted through orange fields and prickly pear to beautiful Sótano del Molino, Tamaulipas, a sheer-

Jean and Justin hunting fish in Cueva del Río Subterráneo.

Vivian Loftin.

walled 68-meter pit. Blind *Astyanax* were collected in pools between 10 and 100 meters into the cave. We traveled through approximately another 500 meters of the cave, seeing some noteworthy troglotic fauna, including harvestmen, two terrestrial species of isopod and *Speocirolana*, Thysanura insects, and spiders. A recently deceased coral snake was curled up in the middle of a pile of breakdown.

The next morning, we drove to Ciudad Valles, then went searching for Sótano del Toro, San Luis Potosí. An escort led us down a series of two-track roads, past a small dammed stock pond, and to within 30 meters of the cave entrance. Locals referred to the cave as Sótano de Juan Blanco. There we collected nine *Astyanax*, of which two had small eyes

and some pigment, including a tail spot, one had very tiny rudimentary eyes and no pigment, and the rest lacked pigment and eyes entirely. This may be the first record of hybrids at this site. It would be interesting to return here with a mask to check the underwater potential here. The water-filled joint is about 1 meters wide and 1 or 2 meters long. While several of us were

fishing, Justin was collecting terrestrial fauna in the upper-level passage.

On January 9, we rigged Yerbaniz off of a large block that is lodged above the deepest part of the entrance drop. This allowed for a nearly free rappel all the way to the first level. A cursory look found no surface fish here, so we proceeded quickly to the next level, where both *Tilapia* and surface *Astyanax* were found. Between the second and third levels we ran into a bunch of *Speocirolana* isopods in the small pools in the flowstone. Finally, at the first pool in the deepest level, we ran into hybrid *Astyanax* and a whole lot of blind ones. I estimated fifteen hundred fish in the top foot of water in the pool, which was about 10 by 30 meters in area. The visibility was too poor to see any deeper into the water. Other notable troglotic fauna were *Hoplobunus* harvestmen and a schizomid.

On January 10, we went to Cueva de la Curva, San Luis Potosí. Following the railroad to the curve, we dropped down into the valley to see the impressive array of colorful graffiti at the entrance. We made our way downstream in search of water, walking, stooping, crawling, belly-crawling Not much water was to be found, but in the small pools we came up with several blind *Astyanax* and *Speocirolana* isopods. At the back of the cave, we could hear a train roaring overhead.



Viv watched the face-sized fishing spiders cringe when blasts went off at the nearby quarry.

A good-sized arroyo is captured by the entrance to Cueva del Río Subterráneo, San Luis Potosí. On January 11 we collected fish from the pool 10 meters in, cichlids, mollies, and both eyed and blind *Astyanax*. We traversed the entire cave, including a 3-meter climb-down where we rigged a handline. It's an excellent cave with big stream passage and a few swims. The next day, on the way home, we collected at several surface streams to obtain eyed specimens for comparative work.

El pez ciego mexicano *Astyanax* ha sido estudiados por biólogos, puesto que es capaz de reproducirse con sus parientes superficiales. Se visitaron cuevas en la Sierra de El Abra, Tamaulipas y San Luis Potosí, para coleccionar especímenes para realizar estudios genéticos sobre la evolución de los peces troglobios.

THE LONG CRAWL

Terri Treacy

“Are you okay?” Pat and Laura called out in unison as they peered down into the little tube I had just fallen into.

“No, I’m not . . . I hurt my ankle . . . I think it’s serious.”

We had completed our first survey shot of the day only moments before. It was December 21, 2001, the first day of a week-long exploration-and-survey camp in Sistema Purificación, Tamaulipas. The day before, while Bill (Carlos) Nasby stayed above ground guarding our vehicles, Dale Chase, Rob Garrett, Barbara Luke, Erin Lynch, Laura Rosales, Charley Savvas, Pat Shaw, Peter Sprouse, and I set up camp at Camp I, about 500 meters inside the Infiernillo entrance. Today we set off as three teams to explore three of the hundreds of leads in the Confusion Tubes.

Pat, Laura, and I arrived at our tube assignment, the Chimichanga Tube, about 900 meters from camp and began to survey at a four-way junction. Our lead was, we found out later, the most obvious passage taking off straight ahead. It produced quite a bit of survey later in the trip. But we thought our lead was a small tube taking off a few meters above the floor, Pat climbed up into it, and we made our first survey shot. As Laura sketched, I began the climb up the wall. I recall the wall being very smooth, with few options for hand or foot holds. About halfway up the climb, the hold I chose for my left hand peeled off the wall, and I went down. After first hitting the floor where I had begun the climb, I continued to fall into a small tube in

the floor. As I was falling into that lower tube, I had a vivid cartoonish vision of falling forever through an endless series of tubes, down, down, down. But reality quickly returned when my fall was stopped by another floor.

I knew immediately that something bad had happened to my ankle, but I was feeling really lucky that it was an ankle, not my back or head or femur. I would be all right, and I would be able to get out under my own power. Pat scrambled back down the drop, and he and Laura began asking me all the right questions to assess the extent of my injuries. When we were all satisfied I could safely move, they suggested I climb out of the small tube I had landed in so that Pat could look at the ankle. I had already removed my boot and noticed that the ankle and foot had begun to swell. I suddenly experienced a wave of intense nausea, for which Laura gave me a date to eat. She assured me it would help, and it did.

Since it had not been a very long time since the others had dropped us off at our lead, I suggested that Pat and Laura attempt to find them. It didn’t take them long to decide that trying to find them in the incredible, immense maze of tubes was futile, and they soon returned. While they were gone, I decided that I could get back to camp if my ankle was wrapped with adequate protection. I told Pat that I would like to have my ankle wrapped with as much padding as possible. We inventoried the contents of our packs and came up with a soft splint of two strategically tied bandanas

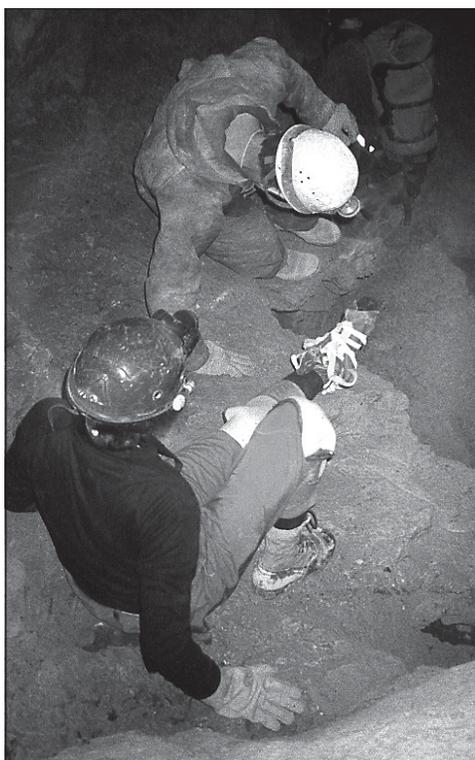
covered with a shirt and protected by a vinyl survey-book bag. After the bag was securely taped on with adhesive tape from our first aid kit and I had swallowed a few aspirins, we were ready for the long journey back to camp.

Maneuvering through the Confusion Tubes went smoothly. I quickly learned how to move without letting my foot bump the floor or walls or other obstacles. What concerned me most at the moment was thinking about the 14-meter drop that lay ahead. Normally an exposed but easy climb down 10 meters to a narrow ledge 4 meters off the floor, I knew there was no way I could negotiate it all with only one foot. Fortunately, Pat and Laura each had a length of webbing in their packs. Pat tied the webbing around my waist and climbed down ahead to spot me, while Laura belayed from the top. While I rested and waited in a secure spot halfway down, Pat rigged the webbing for the remaining few meters of the drop, and I was able to use it for a body rappel. I was very anxious and nervous during this whole procedure, but Pat remained steadfast in assuring me that everything would be just fine. And indeed it was.

Safely on the bottom, it was time for a rest and more aspirin. Ahead of us we knew that we were supposed to take a small passage to the left, or we would end up going in the wrong direction, into the D Survey. On the way in, Peter had pointed out the landmark for the correct passage, a large boulder with some reflective tape on it. But before reaching the correct turn we

found a similar spot and proceeded down the wrong passage. It wasn't long before I knew we had made a mistake. I was getting pretty tired, so I asked my companions to let me rest and to check ahead to see if they could figure out where we should go. They came back with a happy report of footprints and familiar-looking passage. Off we went, and indeed the passage did look familiar, because we had looped back into the passage we had come through on the way in. The problem was, we then followed that passage the wrong way, back into the cave, right past the junction with the reflective tape on the rock without recognizing it. Rather than turn right at that junction, we turned left and ended up going off into the D Survey, with its characteristic sharp, dusty, silt-covered breakdown. It should have dawned on me right away that we had gone wrong, but I guess I was distracted. It was somewhere along here, where the floor was fairly level, that Pat convinced me to let him carry me piggyback. That went well until he tripped and down we went. Fortunately,

Dale Chase and Terri Treacy at a short climb. *Peter Sprouse.*



he controlled the descent remarkably well, and I was able to carefully roll off his back to the safety of the floor.

As I sat on that silty floor, I felt sure we had gone the wrong direction, so again I asked for a break while my heroes went ahead to check the way. Each time I took a rest, Laura encouraged me to eat something and drink water. Soon, Laura came back and excitedly exclaimed she had found a survey station, D10. We'd gone a long way the wrong way. I was too nervous about falling to allow Pat to piggyback me again, so my friends patiently stood by as I crawled or scooted my way through the passage. After crawling back out of the D Survey, I asked for another rest break and another recon. Laura cheerfully obliged and came back a short while later exclaiming that she had found a pit. After a bit of debriefing, I realized that this was the drop they had belayed me down earlier. It became clear to me where we had gone wrong, and it was just a matter of finding the rock with the tape. Eventually we were back on the slow and arduous correct track to camp.

Although it took considerable concentration to move without further injuring my ankle, my thoughts often drifted to the next obstacle, the Jump Rock. As we got closer to it, I tried to convince Pat to let me wait while he went back to camp to retrieve a rope and some gear so I could rappel. Pat, however, with his never-ending optimism, felt confident that he could get me down the drop and thought it would be better to keep moving. So I concentrated on willing the others to come along so I would have more spotters. I had started to nervously make my way down to where the climb gets tricky when we

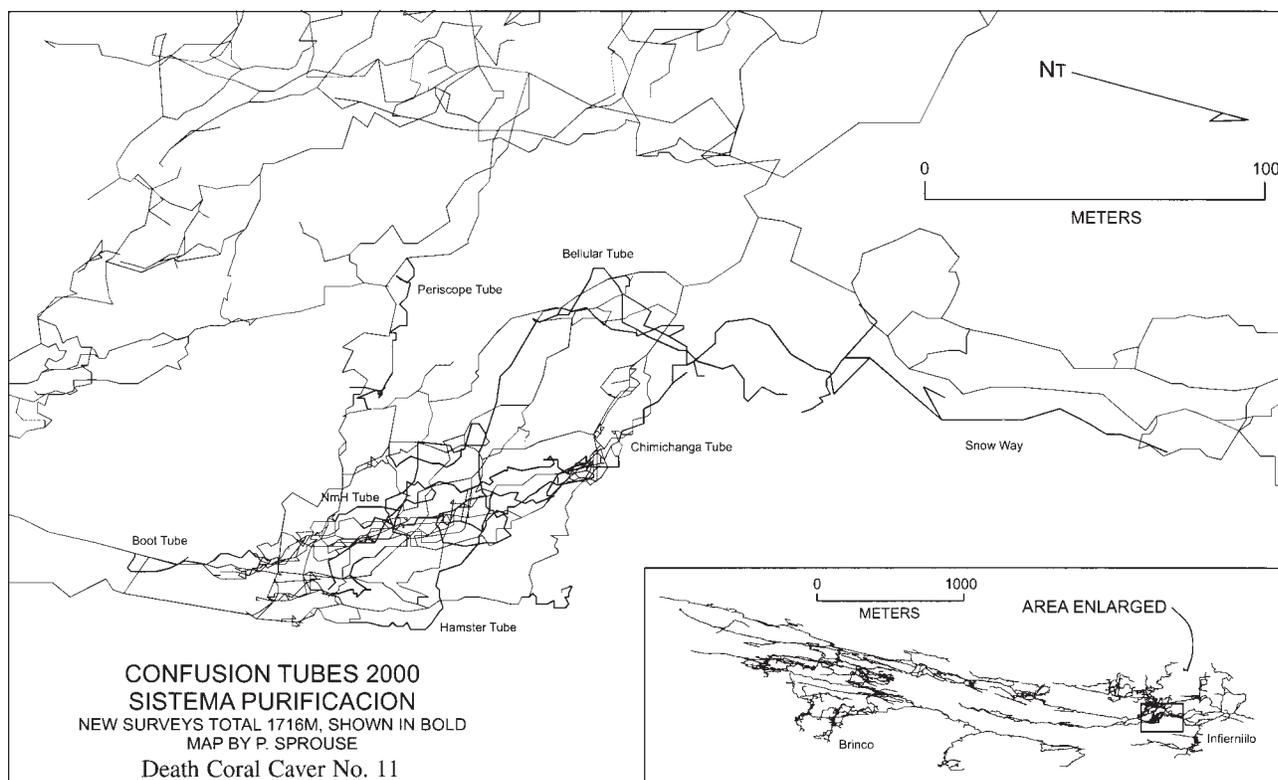


Pat Shaw carrying Terri in the East Loop. *Peter Sprouse.*

heard voices, including Peter asking, "How y'all doing?" I felt such relief at that point. I don't think it would have gone well if I hadn't had the extra help at this juncture.

Before long we were all back in camp, me after eight-plus hours of crawling and scooting. Almost everyone was hopeful that I had suffered a bad sprain and by morning would be feeling better. I was dubious, but I didn't let on. As Charley examined and re-splinted my ankle, a lively discussion ensued as to which of the stronger pain killers we had in camp I could safely take on top of the ten or twelve aspirins I had taken during the day. Charley made the call that I should leave the cave the next day and seek medical attention. My camp mate, Barbara, took over Laura's feminine nurturing, making sure I had everything I needed, and was incredibly patient with my restlessness throughout the night.

By mid-morning the next day, my belongings had been packed up for me, decisions had been made as to who would accompany me out of the cave, and we were ready to set off for the entrance. However, as I attempted to move



about, the stronger pain medicine I had taken during the night caused nausea and shakiness. I had to lie down and let the effects wear off before I felt steady enough to negotiate the numerous little climbs and scrambles ahead of me.

The trip to the entrance took only about an hour and a half. The configuration of the passage is such that I was able to propel myself along by leaning on waist-high rocks with my hands or hip and swinging my bad leg forward, which actually went quite quickly. The 30-meter entrance rappel was easy, and now all that lay ahead was negotiating the huge boulders in the arroyo. Pat and Rob took turns providing knee and back ladders where needed. Peter went ahead, and he and Carlos managed to get the truck a bit closer to the arroyo. When I reached the road, I allowed Pat to piggyback me to the truck, where Carlos presented me with crutches he had fashioned out of small tree limbs.

Laura, Peter, and I set off for the border. It was a very long and painful ride down the bumpy mountain road to the highway. By midnight, about thirty-two hours after the

accident, we arrived at a Brownsville, Texas, emergency room. Although I was not optimistic that it was just a sprain, I really thought they would slap a cast on my leg and I would be able to go back to Mexico and recuperate in the mountains. So it was big disappointment when I was told that I had broken my tibia and fibula and that surgery, involving plates and screws, was going to be required.

I really didn't want to have this procedure done in Brownsville, where I would be alone and stranded afterward, so I opted for a temporary splint, a ride to Austin the next day, and a flight the day after that to St. Louis, where Jim Rode-maker picked me up for the drive to the Carbondale, Illinois, hospital. By this time it was Christmas Eve, so a second temporary cast was

installed and I was sent home for three more days to await surgery.

Everyone was so great in helping me out. I just can't thank them enough. The whole crew was incredibly understanding, patient, and competent. I am especially grateful to Peter for driving me all the way to Austin (he literally turned around and returned to Infiernillo as soon as I and my belongings were out of his truck), and to Jubal Grubb and Laura for getting me to the Austin airport. But my biggest thank-you has to go to Jim, who took care of me, waiting on me hand and foot, for two months.

My main regret about the whole incident? Why the hell did it have to happen on the first day of a three-week trip?

Durante un viaje de topografía a los Tubos de Confusión, en la porción de Infiernillo del Sistema Purificación, Tamaulipas, Terri Treacy se cayó y se fracturó el tobillo. Se arrastró más de 900 metros de regreso al campamento subterráneo, y al día siguiente se arrastró otros 500 metros hasta la entrada, desde donde se le ayudó a bajar al cañón y de allí a los vehículo. Llegó al hospital treinta y dos horas después del accidente.

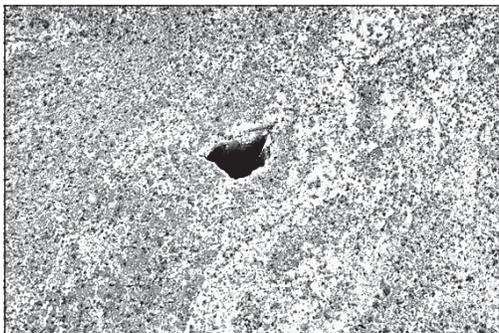
THE BLACK HOLE OF COAHUILA

Peter Sprouse

Look at that!" Leonard put his Cessna into a steep bank so we could peer straight down into the black hole that had just appeared in the desert scrub. This was to be one of the last flights of the summer 1999 outing of the Oztotl Flying Club, and we had hit pay dirt. Leonard Pruitt, Laura Rosales, Aldo Guevara, Brian McMillan, Cathy Winfrey, Bev Shade, Jubal Grubb, and I were scouting the mountains south of Cuatro Ciénegas, Coahuila, not finding much up to this point, when our fortunes turned.

Eighteen months passed before we mounted an expedition to the remote Sierra Australia to explore the pit. Vivian Loftin, Terri Whitfield, and I left Austin bound for a rendezvous at a restaurant in Cuatro Ciénegas with an assortment of fellow cavers. OFC veterans Leonard, Jubal, Brian, and Laura were along, as well as Andy Gluesenkamp, James Lopez, and Grace Borengasser. Victorio Calvo from the Monterrey Tec caving group showed up, with more from his club to follow later on. The photos taken from the plane had done the trick of drawing in a crowd.

Pozo Chuzo from the air. Peter Sprouse.



We assembled into a caravan and headed south toward Torreón. Before we left the Cuatro Ciénegas valley, we stopped for a swim in the enchanting pool called Pozo Churince, a sort of Caribbean experience in the desert. The Cuatro Ciénegas valley contains thousands of geothermal springs and lakes, and has more than 70 endemic species, making it one of the world's most significant and bio-diverse habitats. The government has declared it a national protected area, and most of the springs can only be visited by special arrangement, but several along the highway are open to the public.

Upon reaching the Valle el Sobaco, nearly a hundred kilometers to the south, we turned off the highway and spent quite a bit of time ferreting out a dirt track that would take us into Cañon Carlota, where we would need to start our hike up to the cave. We managed to reach the canyon mouth before dark and set camp. Andy and Vivian set to work on the case of Corona *caguamas*, while Victorio drove back to the highway later that night to guide the other seven Tec cavers in. These were Fofo González, Rubén Gutiérrez, Patrick Meade, Ramon, Naayeli, Scout, and Miguel. They had been told to look for a dirt road going off of the highway at a certain point. As they slowed down to look, out of the darkness stumbled Victorio, falling over a fence with *caguama* in hand.

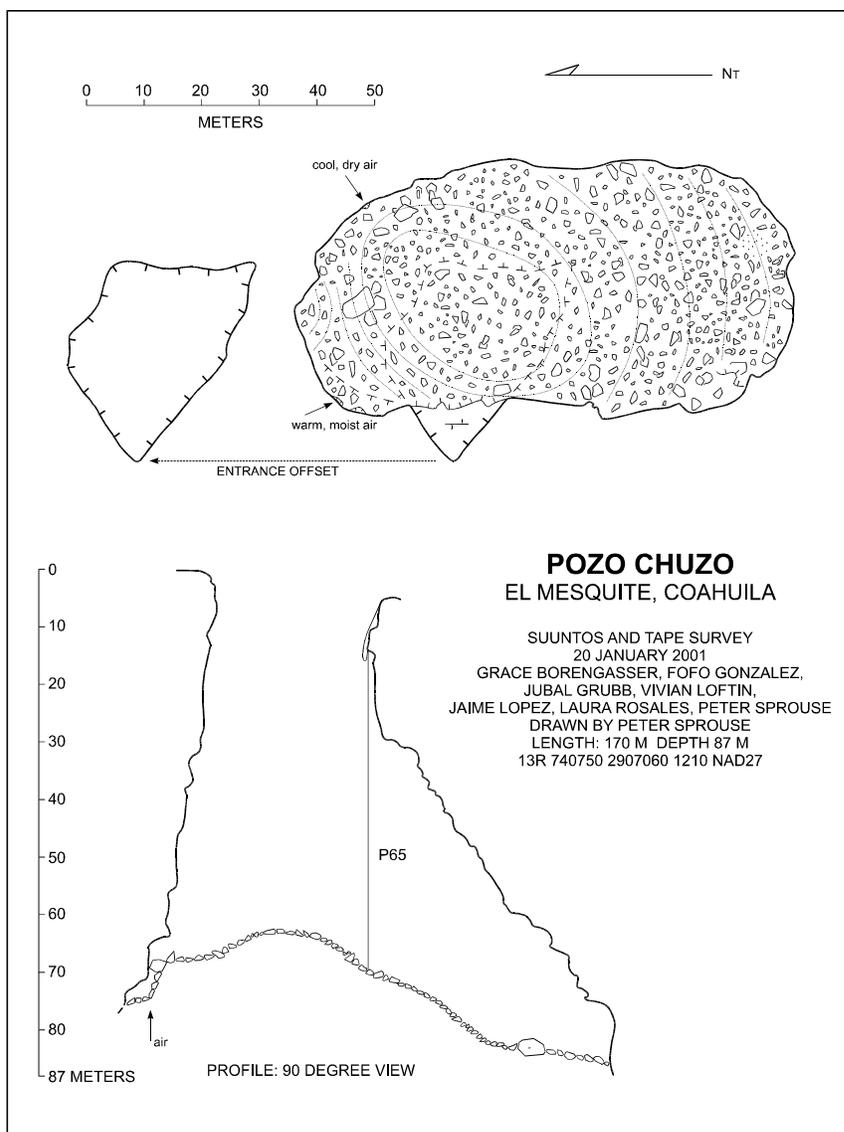
The next morning we set off hiking east up the canyon, some eighteen strong.

Not far in, we spotted an entrance on the south side and hiked up to it. It had a burned ceiling and various minor artifacts and faint pictographs. Scout found an arrowhead nearby. Then we went up the side of the canyon to the top of the mesa, where the walking was easy. After a 4-kilometer hike, we spotted the pit entrance. It was no disappointment, measuring about 30 meters across. Peering in, we could see a breakdown floor below. There were no trees to rig from, so the drill was essential. A deviation got me to a ledge 10 meters down, where I drilled a bolt for a nice 55-meter free hang. The pit belled out nicely over a huge breakdown mountain. I landed on a boulder slope and called up for the others to come down. The view up toward the entrance as they rappelled in was quite spectacular.

Fofo and I started looking along the walls for a way into the breakdown. At the north end of the chamber Fofo found an area blowing warm, moist air. The rocks around it were green with algae where the moisture hit the dry desert air. We opened a hole, but Fofo only got down a couple of meters. We returned to the bottom of the rope to help with the survey. Vivian, Jubal, and James began to map one way around the wall, and Laura, Fofo, and I formed a second team to map the other way. Then Terri and I went to have another look Fofo's dig. We opened a hole big enough for her to get through. She got to another dig and needed help and a hammer, so I called to Jubal on the radio. He went in with Laura and Grace, but they couldn't get much farther. It

was getting dark, so we began to climb out. Unfortunately, not everyone got a chance to do the pit. Andy and some of the others had tried to walk to a large sinkhole we'd seen from the plane about a kilometer away, but they ran out of daylight. As I was climbing out of the pit, a few rocks fell in, knocking loose a bigger rock on the bottom that rolled onto Terri's foot. But she got out okay and was able to walk back. In the desert darkness the GPS was a great help getting us back to camp. We named the pit Pozo Chuzo, after the arrowhead that Scout had found along the hike up.

The next day we packed up and headed north, stopping at Pozo la Becerra for some nice snorkeling. A month later Andy took a group back to Pozo Chuzo to try and push the blowing breakdown lead, but couldn't get much farther. The air seems to be coming straight up through the breakdown floor, rather than along the bedrock wall, and the rocks were very unstable. Given the size of the collapse chamber, it could be a deep pile of rocks. But the damp breeze hints at a possible river passage below, perhaps even the water that feeds the Cuatro Ciénegas springs. They also hiked to the other sinkhole, but it was plugged.

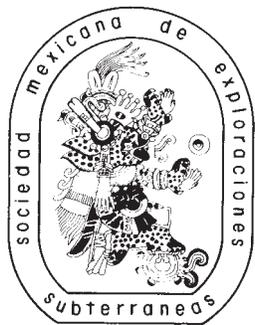


El Hoyo Negro de Coahuila

El Pozo Chuso, en la Sierra Australia de Coahuila, fue localizado primeramente desde el aire. Espeleólogos de Texas y México visitaron y topografiaron la cavidad en enero de 2001. El tiro tuvo 65 metros, y la profundidad total de la cueva es de 87 metros.

Rappel into Pozo Chuzo.
Peter Sprouse.





MIXTLANCINGO, THE RIVER OF THE UNDERWORLD

Ramón Espinasa-Pereña

We first heard of the Mixtlancingo River sinks at a geological conference at UNAM. Several pictures of dolomite karst towers were shown, but what sparked our interest was one photo of a magnificent resurgence at the foot of an impressive hundred-meter-high headwall. While studying the topographic maps of the area, we found out that the Mixtlancingo is located southeast of the city of Chilpancingo, Guerrero. It is born near the town of Coaxtlahuacán, at the base of Volcán Negro, a non-volcanic mountain named for the dark color of the forest that covers it and the frequent cloud cap. The river follows a narrow gorge before reaching the Mixtlancingo Plain at the foot of the Azoguaclare Mountain Range, which is characterized by huge dolomite towers covered in thick vegetation and has no clear roads or paths marked on the map. The river appeared to disappear in a series of gorges and sinks until it resurges at the foot of the famous headwall that marks the southern limit of the Azoguaclare Range and flows steeply down a canyon, eventually joining the Apetlanca-Papagayo Rivers. In Nahuatl, Mixtlancingo means the river of the Mictlan, the Kingdom of the Underworld, and it is described by Sahagún as being "a green serpent in the middle of two hills that join one another." The dead must cross the river on their way to the Mictlan paradise.

In December 1992, a small Sociedad Mexicana de Exploraciones Subterráneas group reached the town of La Laguna, the nearest

inhabited place. During a week based in the town's school building, where we established camp, we found that a logging road could be followed almost to the place where the river goes underground into the Primer Resumidero. A healthy flow of over 1 cubic meter per second enters a narrow underground canyon and immediately plunges down a series of cascades, where we couldn't follow without some complex rigging. About a kilometer away and over a ridge, we found a narrow gorge where the river again could be heard, but reaching it required a rigged descent down a lateral ravine. Once on the river, we followed it upstream, coming immediately to a small resurgence entrance, which was explored upstream to the base of a thundering cascade. Downstream, we followed the gorge for a few hundred meters to where the river dropped down a series of very impressive cascades before disappearing into the Segundo Resumidero. On the left wall was a large stalagmite and a log that had been perched on it by a huge flood, resembling a figure of Christ on the cross, so we named the gorge Cañón del Cristo. Also found on the recce was a smaller sink, which was baptized Resumidero Chico for the small stream that entered it, in spite of the 50-meter-wide entrance.

As soon as Mexpeleo 92 had ended, Sergio Nuño, Pablo de la Mora, Javier Borau, Omar Villalpando, and Luis Fernando Garduño were easily convinced to join the recce team of Ruth Diamant, Humberto Tachiquin (Tachi), and me. Camp was established at La Laguna's school. From the logging road we

rigged a 50-meter rope to get us easily into the Primer Resumidero entrance. The passage is shaped like a high and narrow canyon, 30 to 50 meters high, but only 1 to 5 meters wide at the bottom. Most cascades were easily rigged, since the water had carved narrow chutes at the edge of each pitch, leaving ledge systems that could be traversed before descending, avoiding the direct force of the water. Most of the pitches required rigging several meters of traverse line, and this often involved short climbs up to a suitable ledge and many rebelayes. On two push trips we rigged nine cascades and climbed down several others, before coming out at the resurgence in Cañón del Cristo. It is a short cave, 750 meters long, but very inspiring, sporting, and beautiful. A third, reverse through-trip was necessary to survey and derig.

Having finished the first, shorter underground section, I felt somewhat frustrated. When I started caving in the early 80s, river caving was the big attraction. I read enviously the Yochib exploration accounts and about the first forays into the Zoquitlán area of southern Puebla. In Zongolica, the French were entering torrential rivers like Popoca, Cuetzaloxtoc, Atlalaquia de Aticpac, and El Boquerón. Of course, all the Huautla articles and pictures focused on the wet canyons. Being a Mexico City caver, I had of course done the Dos Bocas systems, and my caving dreams were always wet, involving thundering cascades, difficult traverses, and complex rigging. The exploration of Tolan-tongo, in Hidalgo, had given me a foretaste, and my search for active

streamways was a strong motivation for talking the Brits into restarting exploration in Cuetzalan, Puebla. I had great expectations about Mixtlancingo, and the Primer Resumidero had not fulfilled them. I did not know that my dreams were about to become true.

In February '93, the same group returned, ready to tackle the apparently much harder Segundo Resumidero. The entrance, located at the end of the Cañón del Cristo gorge, is one of the most impressive entrances I've ever seen. Just to reach the dripline, a series of four progressively bigger cascades has to be rigged. The first two were easily bypassed, thanks to a lateral tunnel on the left that avoided the worst of the falls. Beyond was the narrowest point in the gorge, and the whole river cascades in from the right, hitting the left wall and blocking the passage at floor level. A wire ladder allowed us to descend to the pool below and aided in doing a traverse under the direct force of the waterfall. Once out of the spray, we could make out the darkness below that was the entrance proper. A traverse on the right, with the help of several bolts, allowed for a dry hang of 15 meters into a large, stormy pool already in twilight. Firing up our carbide lamps and electric backups, we proceeded into the Segundo Resumidero.

A couple of easy rapids led to the edge of an 8-meter pitch. No ledges this time, so a series of three bolts was necessary to get down it. A narrow canal with a strong current followed, ending in another pitch. Fortunately, a ledge started on the right just at the edge of the cascade, so a bolt and deviation placed us 4 meters lower, in a somber canal. Twenty meters later we were looking down a narrow pitch. The water, arcing out from the edge, was hitting the wall in front before reaching a pool 10 meters below. No outlet could be seen from above. Ruthy traversed onto a slick tree trunk stuck right at the edge of the pitch and rigged a line down on the right side, out of the force of the water. Once in the pool below, she managed to cross under the cascade by

clawing her way against the current along the right wall, reaching a cobble beach on the other side. With a rope fixed, Paso de las Uñas was almost easy.

Below us we could see the next 10-meter cascade. Before reaching the bottom, the water was hitting a ledge and spraying out in a fearsome way into the continuing canal. Deciding to avoid the bottom of the canyon, I gave Ruthy a boost to a ledge on the left, from where a delicate traverse was rigged toward a protruding spur, baptized Cabo del Miedo, Cape Fear. From there, an easy descent took us back to the water beyond the spray of the cascade. The river flowed into a flowstone blockage and logjam, but a narrow window could be reached by an exposed climb on the left. Having reached it, we discovered that we had run out of rope, so we could only look down another narrow canal disappearing around a bend, and hear the roar of another cascade farther ahead.

The survey out was relatively easy, since we had progressed only a little over 200 meters, using about 250 meters of rope. During the derig, a couple of ropes were lost, swept away by the force of the current. Out of time, we returned to Mexico City, vowing to return as soon as possible.

It's Guerrero; it doesn't rain in November. With these wise words, spoken by a certain member of the SMES whose name will remain untold, and an insatiable curiosity, Sergio, Luis Fernando, Javier, Ruthy, Francisco Ruiz (Curro), Claudia Galicia, Jose A. Soriano, my father, and I arrived at La Laguna on the morning of October 29, 1993. After establishing camp, we proceeded down into Cañón del Cristo, only to find the Mixtlancingo incredibly swollen, brown, and foamy. After rigging the first three cascades and reaching the ladder pitch and traverse, we finally came to our senses as we contemplated the impossible river crossing necessary at this point. We derigged and slowly returned to camp.

The following day we decided to split into two groups. Sergio, Luis

Fernando, Curro, Claudia, and Soriano began exploration and mapping of Resumidero Chico. The entrance chamber gave way to a series of steep downclimbs. Following the water, they found the little stream disappearing into an impenetrable fissure. The main passage continued among large breakdown boulders into a wide muddy passage that finally ended in a muddy sump. As Claudia, Curro, and Soriano finished some details on the survey, Luis Fernando and Sergio started searching for leads, finally locating an obscure pitch among boulders. Rigging a short handline, they quickly disappeared into the wide, bouldery canyon that followed.

Meanwhile, the rest of us were searching for new entrances among the dolomite towers of Cerro el Viejo, above the known course of the underground Mixtlancingo, following the tale told to us by the *comisario* in La Laguna about a hole where the river could be heard below. After following narrow trails with many switchbacks among karst towers, usually finding at their ends small flat dolines used for agriculture, we returned to the truck, having enjoyed a sunny, beautiful day. We arrived at the edge of the Resumidero Chico doline ten minutes before 6 P.M., the agreed time. At about 6, we noticed some small clouds climbing the pass below Cerro el Viejo. Ten minutes later, a huge downpour was falling. The road, together with several smaller streams on the hillside, immediately turned into a river feeding red, muddy water into the doline. Trying not to get overly concerned, Javier and I geared up and went into the doline, hoping to find them coming out or waiting at the entrance chamber. When we got there, the chamber was empty. The tiny stream had metamorphosed into a swollen, red, raging river, completely blocking the narrow downclimbs.

As we contemplated crossing the river to look for another route down, we saw lights ahead. Curro and Claudia were coming out, and soon we were able to talk. The flood had hit them as Sergio and Luis

Fernando had reached the base of the short pitch. Given a shouted warning, they had ran back into the lower passage. Since then, nothing was known of them, and the head of the pitch was completely blocked by the water. Leaving Soriano at the edge of the stream, they had found a series of easy climbs bypassing the cascades. Javier and Claudia were sent out to drive back to La Laguna and retrieve ropes, wetsuits, and rigging gear, while Curro and I went back down to assess the situation.

When we arrived at the edge of the pitch, Soriano was already rigging himself to the rope, and he announced that the flood pulse had passed and the pitch was passable. He went down, and as I followed he ran down the passage. When I reached the bottom, I saw three lights coming back. Sergio and Luis Fernando were okay. On the way out, they told their story. On hearing the warning shouts, they had run downstream to a widening of the passage, where Sergio had noticed a high ledge. They had reached it in time to remain dry. They had remained there for a while, listening to the roaring, muddy river crashing down the climb that had stopped their scoop, and when they had noticed the level dropping and figured they could return upstream safely, they had started moving. Soon they met Soriano coming to the rescue.

When we reached the road, we saw the lights of Javier's truck coming down. I could see the fear in my dad's eyes as he counted heads and his relief when he saw we were all out. That night some of us stayed up until very late, talking and generally unwinding.

The next day we avoided any underground adventures, and

instead followed the logging roads to the southeast of La Laguna, reaching the eastern escarpment of the Mixtlancingo Plateau. We returned to Mexico City a bit wiser, having learned not to try to start the dry season by decree.

In the early morning hours of December 18, Sergio, Curro, Pablo, Luis Fernando, Tachi, Ruthy, and I reached La Laguna and immediately crashed for the remainder of the night. When we woke up, Sergio and Luis Fernando expressed their desire to return to the going lead in Resumidero Chico. Pablo and Curro offered to join them, while Ruthy and Tachi volunteered to go with me to Segundo Resumidero and begin rigging.

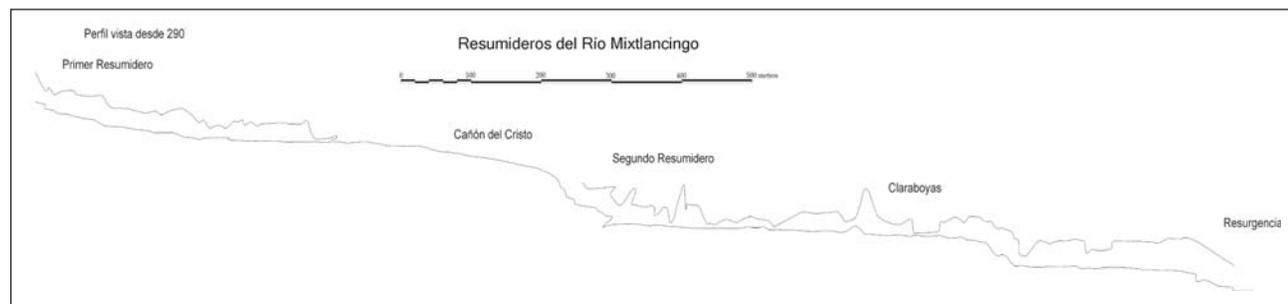
The first team found a small sump a few meters from the climb that had stopped them in November. Meanwhile, we discovered, upon reaching the edge of Paso de las Uñas, that the jammed log wasn't there anymore. The cascade also sounded different. Tachi pioneered a hard traverse on the left that took us over a bridge to a freehang above Cabo del Miedo. Touching down on the ancient cobble beach, I was surprised by the changes. The pool that we had crossed in Paso de las Uñas was gone, and the cascade had doubled in height, to over 20 meters. The cobbles I was standing on were now a fragile bridge suspended 10 meters above the turbulence, the key chockstones that had dammed the pool having been flushed out by the summer rains. Still rigged to the rope above, I pendulumed to the rock spur of Cabo del Miedo and rigged the line. The others followed, and we reached the window, last year's final point. The logjam had also been washed out, so Ruthy

entered the virgin canal with a rope. A few seconds later she called us, warning that the rope was not tied at her end. A short climb at the edge of the following cascade gave access to a small ledge with bare walls. The cascade sloped downward, and the thunder prevented any conversation. We could see turbulence several meters away, and the only possible way on involved a difficult traverse on the right that would require bolts. Having spent already many hours on this warm-up trip, we decided to return the next day.

In the early morning of the nineteenth, a truck stopping at the school entrance awakened us all. Louise Hose, Jim Pisarowicz, and Emi Janecek joined us for the remainder of the expedition. That day they joined Sergio, Pablo, Curro, and Luis Fernando on a rigging and photo through-trip of Primer Resumidero.

Meanwhile Ruthy, Tachi and I were rigging the new cascade in Segundo Resumidero. After placing a bolt at the ledge to tie in the end of the canal rope, Tachi climbed on the right with the help of some formations, retying the rope a few times, until reaching the protruding wall at the right. Placing a bolt, he then proceeded to rappel down toward the gorge. As he reached it, he braced against the opposite wall and placed another bolt. Then he returned to our ledge.

Briefly, he described what followed. Below was the bottom of the cascade, but a descent straight down looked dangerous. The gorge was narrow enough at the top to bridge with arms and legs, and a ledge was visible on the right a few meters ahead, but reaching it might risk a pendulum that could end with the caver crashing into the waterfall. Ruthy decided she



wanted some action. She crossed the traverse, and when she reached the last bolt, she tied a knot on the remaining rope about 4 meters down and, locking her descender, started bridging across the traverse. It was soon apparent that the left wall was turning left and the canyon becoming too wide to chimney, but Ruthy managed to extend herself enough to reach the edge of the ledge and, with a dynamic move, pull herself onto the ledge. After she drilled a bolt, we followed across Los Olanes, the Draperies, traverse. From the other end of the ledge, a short drop returned us to river level at the head of a windy, low-ceilinged canal with a strong current. Placing some polypropylene rope to help on the upward journey, we eased ourselves into the water.

The passage soon regained its height, turning into a very high and narrow canyon. No more cascades were encountered, although several rapids were rigged with canal ropes of polypropylene. A few hundred meters later, we could see light ahead, and we quickly reached the base of a huge skylight entrance some 50 meters high and about 20 meters wide, with many *vencejos*, swifts like those in Golondrinas, living on the walls. After making sure that the underground canyon continued, we started the long trip back up.

The next day Sergio and the Americans volunteered to resurvey Resumidero Chico, since the previous survey notes had been lost in the flood. Meanwhile Ruthy, Tachi, and I surveyed our previous scoop, and Pablo, Curro, and Luis Fernando decided to grab some glory ahead of us. While surveying, we noticed a smaller skylight a few hundred meters before the big one. After a couple of hours, we passed under La Gran Claraboya, the Big Skylight, and kept on surveying. The passage remained high and narrow, we passed a couple rigged rapids, and after a couple more hours, as we were getting really cold, we started hearing the dings of a bolt being driven and could soon hear some conversations above the sound of the river. We emerged

from the canyon into a larger chamber 20 meters wide and 40 meters long. Up on the right we could see the others' lights, while on the left the river crashed onto some large breakdown blocks. Still surveying, we climbed to the right, across a rigged traverse, to the ledge where Curro and Pablo were resting. Luis Fernando was placing a bolt farther out, from where he planned to descend to the tip of a breakdown block that jutted out toward the canyon below. An ominous roar could be plainly heard coming from the darkness ahead.

Checking our supplies, we discovered that both groups were low on carbide, so when Luis Fernando finished placing the bolt, we told him we should start heading out. He went ahead down to the breakdown block to take a look, but reported being able to see only a short cascade below and mist in the canyon ahead. Whatever was roaring ahead would have to wait for the next year. On the way out, all the shorter ropes in the horizontal section were derigged. The following day Louise, Curro, and Sergio derigged the Segundo Resumidero, while Tachi, Luis Fernando, and Ruthy helped me take photos and derig in Primer Resumidero.

It was 8 P.M., and Sergio and I had been waiting at La Laguna for almost two hours. We had traveled in Sergio's truck, loaded with all the expedition gear, while Ruthy, Pablo, Curro, Claudia, Tachi, Luis Fernando, Jesús Reyes, and Javier filled up Javier's truck. Five kilometers before La Laguna we had last seen them right behind us, so we figured out something wrong must have happened. When we backtracked the 5 kilometers, we found out. On a blind curve they had turned too far right and hit a small ditch at least 1.5 meters deep. In the dark and without lamps, which were in Sergio's truck, they had slowly begun filling the trench with rocks and lifting the truck. Once we arrived, the lifting of the truck went quickly, so after having lost only four hours, we fell asleep on the side of the road. Such was the inauspicious start for the April 1994

Mixtlancingo expedition.

On the eleventh, Javier, Claudia, Tachi, and Jesús started rigging Segundo Resumidero. It was later in the dry season, and they found the stream was smaller, but surprisingly its temperature was a lot colder than usual. After the entrance series had been rigged and they had reached the edge of Paso de las Uñas, those not actually doing the rigging rebelled due to cold, and so they all left the cave.

The following morning Tachi, Luis Fernando, and Jesús decided to join me in rigging and pushing beyond last year's final point, and all the others decided to go find one of the skylights with the help of the *comisario*. Once we were inside the cave, the low water levels helped simplify the rigging. The Paso de las Uñas lake was there again, the cobble dam having been rebuilt by a new logjam, but we still rigged the upper traverse as we had the previous year. The Olanes pitch was easily rigged down the main water chute instead of last year's difficult traverse. Having reached the horizontal passage, we started going down quickly. As we were going under the small skylight, we heard voices and saw a rope coming down, and so decided to wait for the others' descent. Once down, Ruthy decided she would join us, while Javier, Pablo, and Curro were sent upstream to derig the entrance series, since the surface walk to and from the skylight was supposed to be easier and would be used as our main route. We decided to continue our push until about 8 P.M.

The known section of passage was literally run down, more to escape the cold than from excitement about the exploration. When we reached last year's farthest point, Luis Fernando went ahead, and we started what has probably been the best pushing trip I've ever been involved in. The rigging immediately got difficult. The roar ahead, which should not have been there in the diminished water level of the season, could be plainly heard. Three short pitches were rigged in quick succession, including a very photogenic cascade. The roar ahead was getting scary, since we knew the

stream we were following could not be the cause and could still not tell what was. Another small pitch appeared, and when I reached the bottom and turned around, I was surprised by the most amazing view in the cave. A river as large as or larger than the main one was pouring out from some small holes in the ceiling and crashing down into the narrow canyon, blocking it completely from wall to wall. No way through was apparent.

Remembering the place, famous among kayakers, where the Gallinas River falls into the Santa Maria, we named the place El Tamul. On the left a rock spur allowed a view into a stormy pool halfway through the cascade. Using a canal rope for a belay, I walked down the continuation of the canyon into the maelstrom. My carbide was immediately blown out, and my electric light only created reflections in the crashing water that effectively blinded me. Feeling the pressure of falling water on my helmet, I turned my electric off and proceeded ahead, lighted only by the reflections of the others' lamps. Suddenly the pressure was gone, and I was on the other side. As I turned my light on, I noticed Tachi in the first cascade, Primer Resumidero. *Ramon Espinasa.*



the river had increased in strength and, at the same time, lost my footing. Fortunately, I regained my stance before being washed downriver. The short cascade that followed was rigged with the tail of rope that was left.

Once the rope had been rigged, the others followed. It was already 8:20 P.M. Since we were out of rope, we decided to scoop ahead to the next pitch. A few swims and canals later, we saw a rope hanging from a log jammed between the walls 15 meters above, one of the ropes lost over a year earlier. Carrying it with us, we quickly used it at another short pitch farther ahead. Short rapids followed, and then some canals that we swam through. Suddenly the ceiling went up into a high breakdown dome. Squeezing ourselves under a large block, we popped up in a larger passage, about 10 meters wide, floored with huge eroded gours among which the river had carved a narrow, cascading gorge. All considerations of time forgotten, our goal now was to reach the resurgence below the famous headwall. Although the gradient was quite steep and every 5 or 10 meters a waterfall threatened to stop our progress,

we managed to advance almost another hundred meters before being stopped by an unclimbable cascade. As we were contemplating the falls and canyon ahead, we were suddenly startled by something flying towards us and took some seconds to recognize it as a *vencejo*. This could only mean we had made it, and the resurgence had to be just ahead, invisible because of the hour. We were elated and very happy as we started on our way out.

At 2:30 A.M. we were lost in the tower karst. When we had reached the rope at the Claraboya Chica, the 80 meters of jumaring had been a welcome warm-up. Then, relying on Ruth's orienteering, we tried to follow an obscure path marked with occasional flagging.

After several wrong turns, we finally found the main path and met with Pablo, Javier, and Curro, who had been waiting for us at the truck since eleven, and were seriously concerned by now. Although the drive up to La Laguna was uneventful, we were not in bed until 5:00 A.M. on the thirteenth, my birthday.

The next morning, or rather about midday, we spent ages preparing breakfast. After taking a short hike in the woods around town, I returned to the schoolhouse right at the hottest time of day. Everyone was hanging in hammocks, except Tachi, Luis Fernando, and Jesús, the youngsters, who were still eating while daydreaming about ice cream and banana splits. Although the truck owners took some convincing, we drove to the stream near the eastern escarpment, where a dip in some pools finally woke us up and helped make the afternoon seem shorter. We returned to prepare the gear for the following day and cooked a tremendous supper to boost calorie levels in preparation for what we knew would be an epic trip.

Friday, April 14; wake up call at 7:30. Immediately there was movement in every corner. Breakfast, final packing, and equipment check, and by 9:00 everyone was inside the truck. When Luis Fernando started to point out that, as incredible as it sounded, we were all ready at the appointed time, he discovered his lamp was without a jet. Total stop to look for it. Finally we left the school after only ten minutes' delay, a new SMES record.

This time following the correct route, we reached the Claraboya Chica entrance two hours later, having passed by a beautiful surface canyon ending at the pitch entrance. Tachi, Jesús, Ruthy, and I went in first, intending to map our scoop of two days before. We almost ran all the way to the breakdown chamber and started surveying. Used to working together, we moved efficiently, so the others only caught us past Tamul. They kept on going to start rigging the next cascade. About two hours later we caught up with them as they got off rope at the

base of the pitch, where they reported that, although they could now see the light from outside, several small cascades still needed to be rigged. When we were given the clear signal, we surveyed down two rigged pitches joined by a long rigged traverse. The last pitch, already bathed in surface light, ends at a beautiful pool, and we swam out of the cave. Behind us was a majestic wall, vertical to overhanging and at least a hundred meters high, with the river emerging from a 30-meter-high cleft at its base. From the exit pool, the river drops quickly down a series of unclimbable

cascades, and we could see the river crashing down a very steep surface canyon, finally disappearing from view around a corner. In front we saw mountain ranges extending as far as can be seen. Vertical cliffs surrounded us, and no surface route back was apparent.

Although the view was great, we couldn't help feeling sorry that the cave had been finished. The dream, the challenge that had lasted for three years and five expeditions, was over.

The return trip was very tiring. We split into groups to avoid waiting at the base of each pitch, but this

resulted in the last group having to derig and carry all the ropes. When we reached the foot of Clara-boya Chica, Sergio was exhausted and Curro was feeling ill, but they managed to climb the pitch by themselves. Once out, we pulled the rope and proceeded toward the truck. Again we got lost in the brush surrounding the surface canyon, but we finally made it to the schoolhouse in the early morning hours of the fifteenth. The next day we packed up and returned to Mexico City. Now, to search for a new dream.

Mixtlancingo, el río del Inframundo

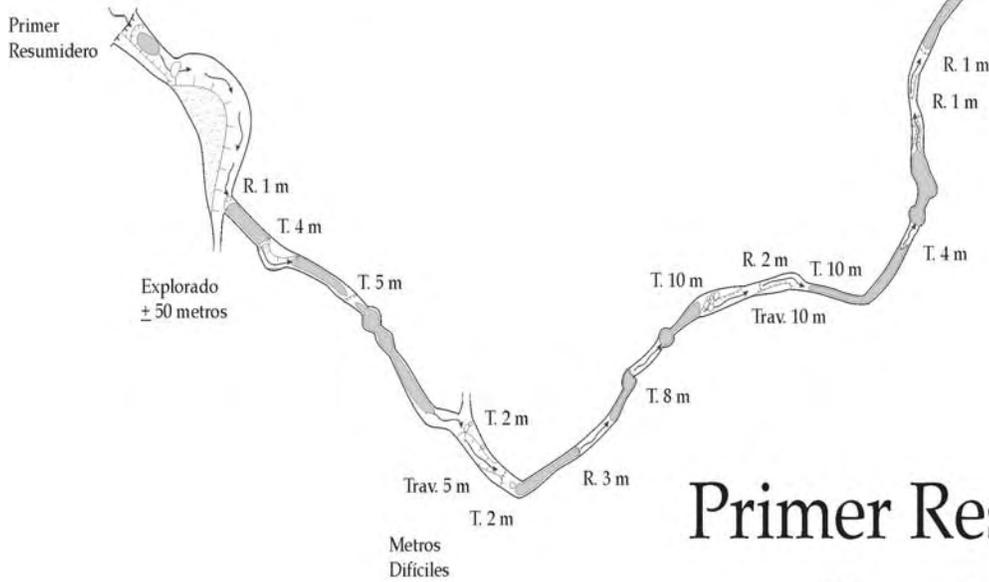
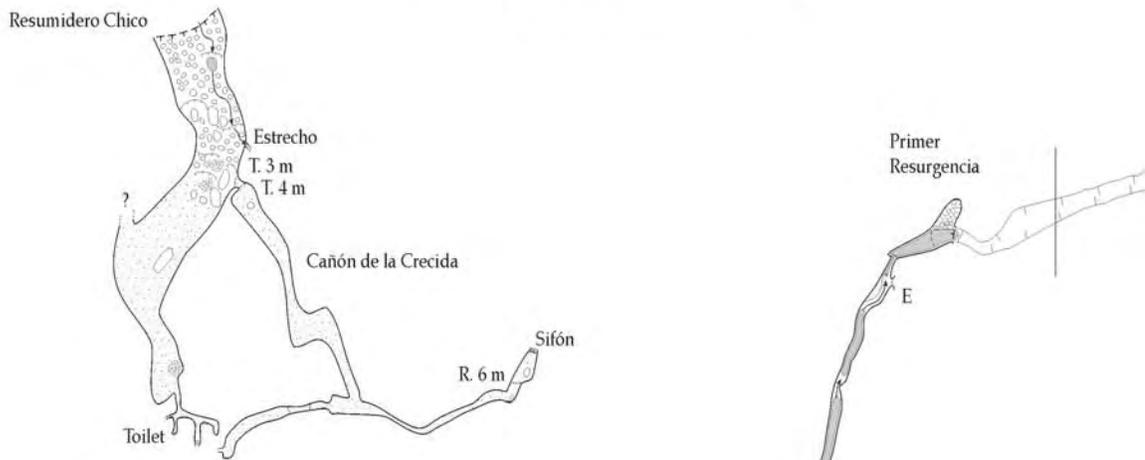
Durante 5 expediciones, un grupo de la SMES exploró los Resumideros del Río Mixtlancingo, situados en una región remota de la Sierra de Guerrero. El caudal de $1 \text{ m}^3/\text{s}$, la naturaleza estrecha de las galerías y el gradiente elevado resultaron en cavidades sumamente técnicas, en las que cada cascada requirió de travesías con muchos fraccionamientos y desviaciones. El Primer Resumidero tuvo 705 m de pasajes y resultó de 42 m de hondo, mientras que el Segundo Resumidero tuvo 1,746 m de largo y 143 m de desnivel, y están separadas por un cañón superficial de 341 m de largo. Una tercera cavidad, el Resumidero chico, que usualmente solo lleva un pequeño arroyo, fue explorada por 510 metros hasta una profundidad de 104 metros, y fue el escenario de una crecida que afortunadamente solo resultó en un buen susto.

(See map on following pages.)

Resumidero Chico

Longitud: 510 m

Desnivel: 104 m



Primer Resumidero

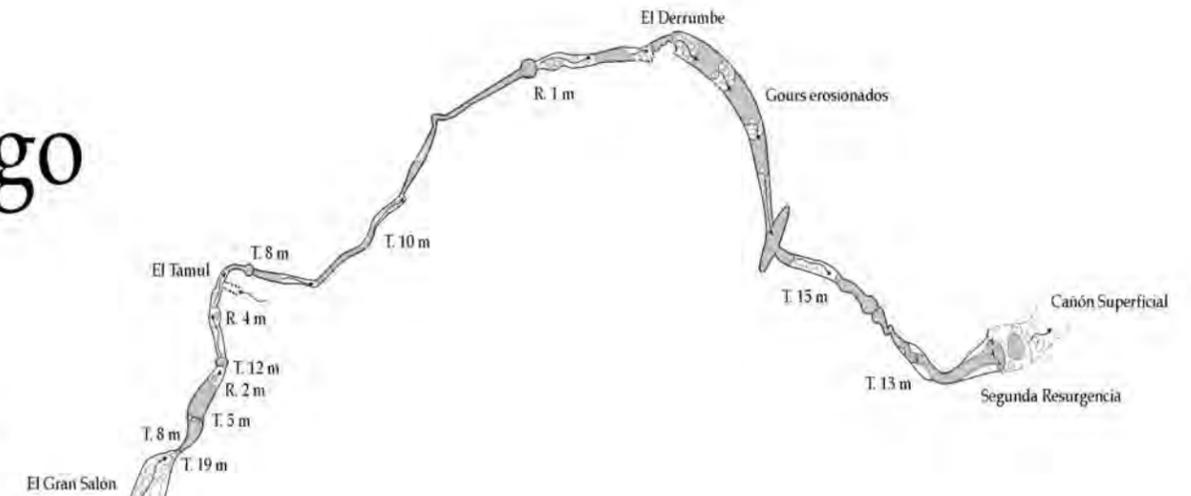
Longitud: 705 m

Desnivel: 42 m

Metros
Difíciles

Resumideros del Río Mixtlancingo

Coaxtlahuacán, Guerrero



Cañón del Cristo

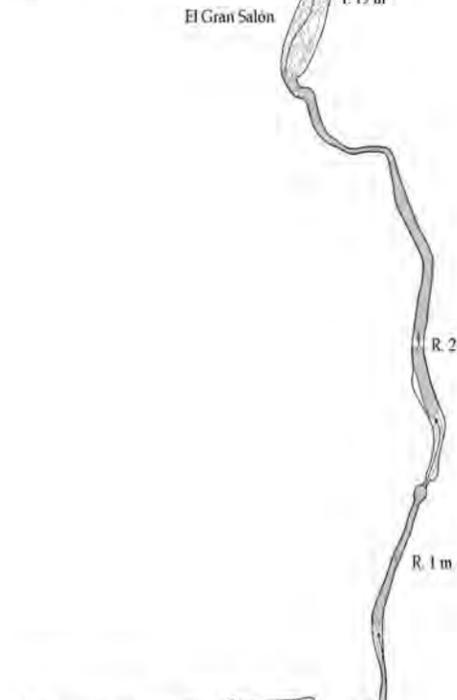
Longitud: 341 m

Desnivel: 39 m

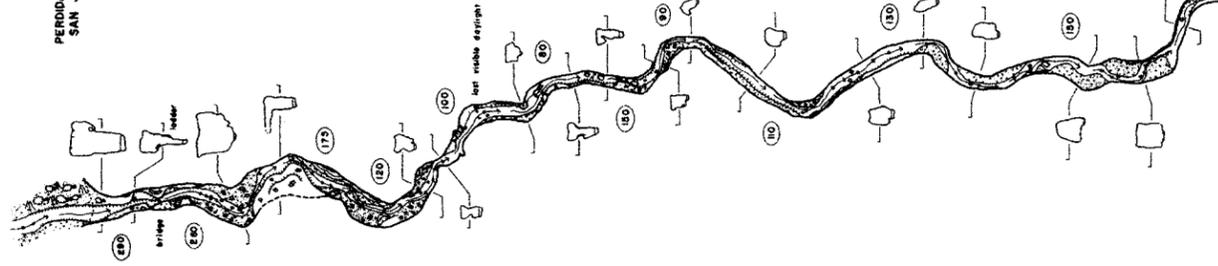
Segundo Resumidero

Longitud: 1,746 m

Desnivel: 143 m



PERDIDA DEL RIO
SAN JERONIMO



LAS GRUTAS DE LOS RIOS SAN JERONIMO AND CHONTALCOATLAN

QUERRERO, MEXICO
APRIL 1973 and MARCH 1974
Suunto Compass and Tape Survey

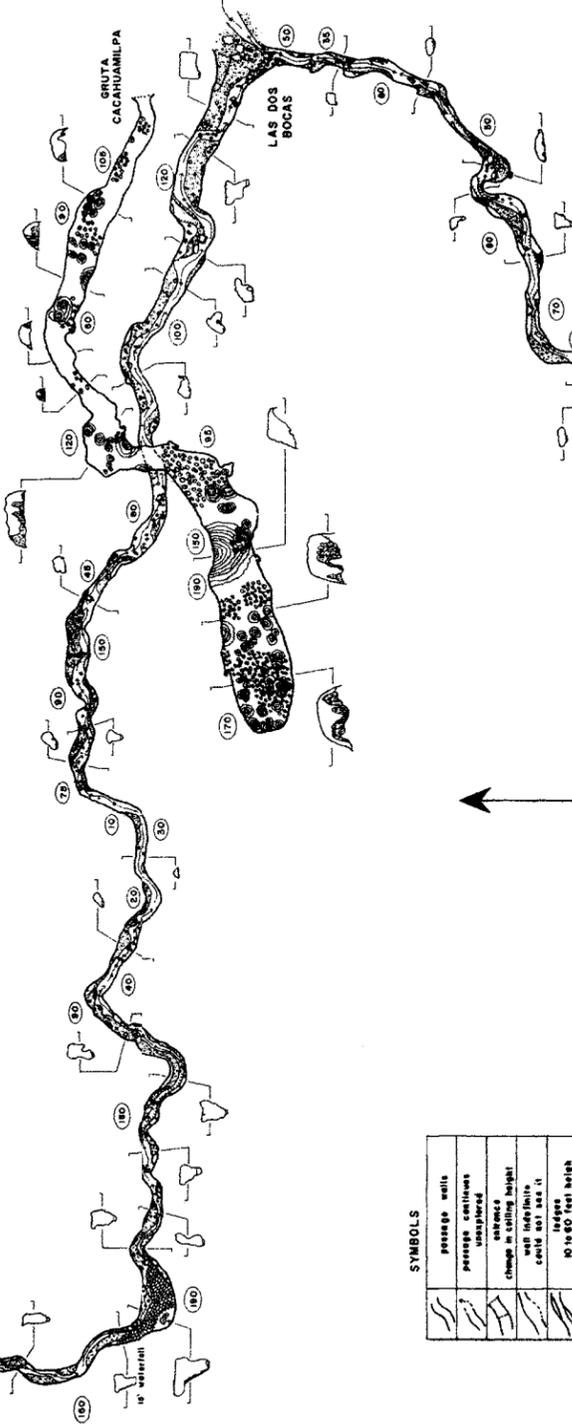
by

T. ALBERT E. FORRY
M. ASHES A. JORDAN
P. ARNES R. LOUGHEED
C. BITTINGER A. LUGAS
S. BITTINGER M. MOORE
D. COONS T. SATYRER

GRUTA CACAHUAMILPA

Adapted From A Map By
THE MEXICAN GEOLOGIC INSTITUTE,
SECRETARY OF INDUSTRY, COMMERCE, AND WORK,
AND SECRETARY OF AGRICULTURE
1921

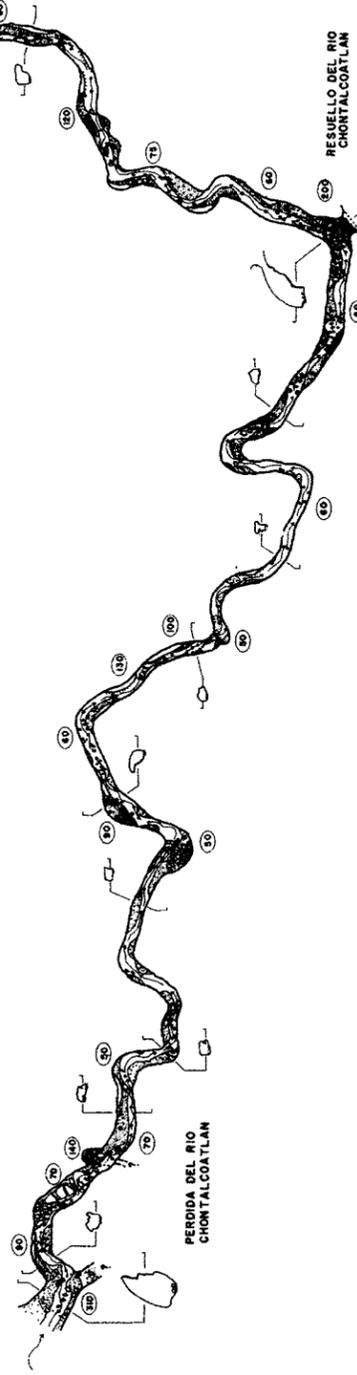
Drafted By:
D. COONS
S. BITTINGER
C. BITTINGER



SYMBOLS	
	passage walls
	passage cuttings
	unsphered boulders
	change in falling height
	wall height in feet
	wall height in meters
	ledges
	stream
	rapids
	stream rounded cobble
	sand
	breakdown
	limestone
	limestone debris
	stactolites, strogmites
	slope
	lines where damplings
	trees
	path
	ladder or bridge as indicated
	cross or chapel



scaling heights in feet
meters heights in meters



PERDIDA DEL RIO
CHONTALCOATLAN

RESUELLO DEL RIO
CHONTALCOATLAN

LAS GRUTAS DE LOS RÍOS SAN JERONIMO AND CHONTALCUATLAN

Chris Lloyd

Just 30 kilometers from the famous historic silver district of Taxco and 100 kilometers southwest of Mexico City lies the Doc Bocas System, the dry, fossil tourist cave of Cacahuamilpa situated above the active river caves San Jeronimo and Chontalcoatlán. The river caves are two independent caves, each almost 6 kilometers long, that have lower entrances within 100 meters of each other—the Dos Bocas—and can be done as separate through trips. All three caves feature enormous passages through their whole lengths, and they truly make up one of the most impressive cave systems in Mexico and some of the classic through trips in the world. And what other cave in the world has had a lahar flow through it?

A lahar is a cold volcanic flow produced when there is a cataclysmic eruption of a volcano that has glaciers on it. The hot, particle-laden cloud emitted from the volcanic vent first rises, but then collapses, sending the hot cloud down the flank of the volcano past the glaciers, which quickly melt from the heat. The cool mixture of water, ash, sand, and rock rushes down the slope, sweeping away anything in its path and incorporating it into the flow. The resulting lahar can travel many tens or even hundreds of kilometers. In the case of the caves of the Dos Bocas System, which have remains of it plastered on their

The foldout map is reprinted from the *Canadian Caver*, volume 8 number 1, May 1976.

walls all the way to the roof, a lahar flowed 50 kilometers from its source, through the caves, and then some 30 kilometers more downstream. The best guess of the age of this flow is twenty-eight thousand years. It certainly would not have been a good day to be caving.

Gruta de Cacahuamilpa has been known for hundreds of years and a tourist cave since the nineteenth century. It was first mapped in the 1920s and is essentially a level, 2-kilometer-long passage of borehole dimensions, averaging about 40 meters wide by at least that high. It is extremely well decorated, with floor-to-ceiling flowstone or columns in places. Having it lit for the tourist trip is really the only way to appreciate it. [A description of a trip to the cave in 1848 is printed in *AMCS Activities Newsletter 23*, along with comments on the geology of the Doc Bocas by J Harlen Bretz.] For active cavers, though, it is the lower caves that hold the real attraction, for both have kilometers of sporting river passage that averages 30 or 40 meters high and wide.

To get to the entrance of San Jeronimo, you can hire a local truck for a dollar a person to drive you from the tourist cave over the mountain to where you can walk down 200 vertical meters into a dry valley that takes you to the course of the very active river, which is so large that the cave is generally not passable from the beginning of the rainy season in late May until about New Years. Numerous people have died trying it at the wrong time of

year, as all the crosses near the entrance attest. (The combined flow of the rivers below the two caves is paddleable all year around, with nice class-3 whitewater.) If it is December or January, many people suit up with wetsuits before entering the river, as the source of the river is meltwater from the snow on Volcán Toluca 50 kilometers upstream. Most sane people just wait until a little later in the year, when the water levels go down and the temperature goes up, so they can do it in shorts and tee shirts. My first visit was timed to catch as much high water as I thought our group could handle, but happened to correspond to a late-January snowfall on Toluca. Most of our group of twenty did have wetsuits, and even those who didn't did not complain of the cold, not even the seventy-two-year-old aunt of the trip leader.

You can't even see the actual entrance from where you must enter the river, due to the narrowness of the canyon, which is about 10 meters wide by at least 40 meters high and which forces you to swim shortly after entering the frigid water. After about 100 meters, you can wade again, and you can see the true ceiling of the entrance high above you, though it is still another 200 meters before the canyon opens up into wide cave passage. Here you are overwhelmed by the size, 60 meters wide by 70 meters high, still well lit by the entrance. In fact, it is at least another 500 meters before the light from the entrance finally disappears and you are left to

guess where the walls are, unless you have enough people and lights. An advantage of a large group, especially if you are the last in line, is that the long string of lights enables you to actually see the whole outline of the enormous passage.

The route depends on what you consider the line of least resistance. In places it is definitely easiest to walk along the sandy embankments, while in others wading in the smooth-bottomed river is preferable. But where there are slippery rocks hiding beneath the surface, as is more common, and there is no flat, sandy beach, it is necessary to scramble over boulder piles, some of which can take you up to 30 meters above the river. Because it is a large and powerful river, last year's easy bypass to a cascade may this year be a slide down a large ramp of boulders and a plunge into the pool below. Numerous swims are necessary, though none is as long as the one outside the entrance. Occasionally there are some large masses of gour (rimstone) pools, which are well worth a scramble up to check out. The largest one stretches at least 100 meters along one wall and at least 50 meters vertically up it at about the half-way point. It is a good place to stop for a snack or lunch.

About two-thirds of the way through, the ceiling finally comes down to where you can easily see it 10 or 20 meters above you, and you start to notice the draft. The wind

becomes strong enough to blow out a ceiling-burner carbide light at a point 5 meters high and 25 meters wide; there can't be many cave passages like that. Claustrophobic types need not worry, for it opens back up again to its more normal dimensions.

The lower entrance is just as impressive as the upper one; here too there are at least 500 meters of gradually increasing light before you can see blue sky again. The swifts that have been all day watching tourists hike down from the show cave to see the entrances no doubt get a surprise when the occasional group of light-bearing figures comes out of the darkness below them.

The normal time for Mexican *excursionistas* to traverse the cave is about eight hours. Our group of twenty, who ranged in age from nine to seventy-two, made it in seven. It has been done in as little as two hours, but they didn't see any of the nicer formations. It's worth the time to go slowly and savor it all.

It was a year later when we got around to organizing a trip to Chontalcoatlán, and we decided to photograph it, as there are very few known photos, and those are very old. Rumors of an unexplored big

room off a side passage at the entrance to Chonta added to the appeal of the trip. We hiked up and over to the entrance Saturday morning.

Knowing you are going to a big cave does not prepare you for the size of the entrance. The 50-meter-wide opening is located at the bottom of what must be a close to 600-meter-high vertical wall. The side passage, which is best viewed from the opposite cliff while climbing down, makes the entrance look even bigger. Without doubt the scariest part of the trip is climbing down a fixed, overhanging ladder held together by baling wire. Sensible school groups belay the students down this part.

As everything in this area is big, we should have realized that the climb up into the entrance to the side passage wouldn't just be a scramble. It turned out to be a 25-meter-high 5.8 climb, sporting an overhang near the bottom and a



Above: Large gour's midway through the upstream section of Chontalcoatlán. *Left:* Big river passage in Chonta. The large flowstone and gour's that appear in the distance are in the photo above. *Chris Lloyd.*



vertical section of moss-covered flowstone at the top, all with little protection. We had not brought harnesses and climbing shoes, and the person Ramón Espinasa had expected to lead the climb had canceled out the previous afternoon. Fortunately, I had invited Dave Jones along, and he quickly got up it, despite being equally unequipped. While Dave, Ramón, and Francisco “Curro” Ruiz went ahead to survey, Kirk Stafford and I photographed our way in. The passage’s name, Pilars, is quite appropriate, as beautiful white columns, some well over 15 meters high, grace the entrance sections. There are also some nice gour dams, dry that time of year. The nice part ends quickly, though, forcing one into a nasty

Above: The climb to the lead at the upper entrance to Chonta.

Right: Curro at the skylight entrance about halfway through Chonta. Three people may be barely visible at the left edge of the gours about halfway up.

Chris Lloyd.

crawlway, not the nice flat, sandy-floored one I had been looking forward to, but a tight, contorting, sweat-producing one, punctuated by the occasional pile of putrid vampire guano that you have to try to pass without smearing it onto yourself. We caught up with the surveyors after about 150 meters when they were paused at a duckunder. Nobody was very keen to get his only clothes wet, especially as it seemed that somebody had surveyed at least this far before. Kirk decided to go for it, and he coaxed Ramón and Curro to continue on to where they did finally find the fabled big room, along with names and 1950s dates marked on the wall—somewhat anticlimactic, though the passage did continue on the other side of the room as a similar crawlway that looked unenter-

tered. As this Pilars Passage looks like it was a major route before being largely plugged by the lahar, this crawl has good potential. Perhaps another time.

Bivying in the entrance meant that we were well positioned for a good start on a through trip on Sunday morning, but it also meant that

we had to listen to the nearly continuous parade of groups starting in. For some reason, Mexican *excursionistas* like to enter the cave about dusk and leave it about midnight. This weekend, though, happened to be one of the few long weekends Mexicans get, and they were out in force, with a new party passing us every hour all night long, whooping and hollering as they hit the cold water. This in turn woke up the swifts nesting high above us, who added their racket to give us a restless night.

We did manage to get going before the crack of noon, just, and thoroughly enjoyed strolling along the huge passage. There is another lead not far in, at least 10 meters in size and some 10 meters up an overhanging wall, that was found, on a subsequent trip, to be just an alcove. It seems to me that Chonta is a bit smaller than San Jeronimo, but is it very consistent in its 30-meter width and height. It is also a lot easier, having more sandy beaches to walk on and fewer boulder piles to climb over. Occasional large gour pools have formed below inlets, creating perfect places for the Mexicans to spray-paint their names. Almost exactly halfway through, the cave passes beneath the Clara-boya entrance, which has a very impressive flowstone and gour-pool cascade 60 meters high, down



which water flows during every rainy season. The lower section went by quickly, as we weren't taking photos, partly because the marble band here is not as pretty as that in San Jeronimo. The original explorers here in the 1930s had gotten to about 600 meters from the bottom entrance and had turned back one corner from the sight of daylight.

We got out in time to savor that daylight, and we tromped back up to the cars with considerably more energy than we had had after the previous year's trip though San Jeronimo. If you are ever visiting Mexico, I highly recommend a trip through at least one of these caves. The best times for the river caves are from about Christmas until about May. Trying them during the rainy season or for three months afterward is likely to result in loss of life.

Las Grutas de los Ríos San Jeronimo and Chontalcoatlan

Las cuevas de Dos Bocas son dos resurgencias de grandes ríos subterráneos bajo la Gruta de Cacahuamilpa. Ambas son muy populares entre los excursionistas, pero solo pueden visitarse con seguridad entre Navidad y el mes de mayo, cuando el caudal de los ríos es bajo. Se describen viajes a través de ambos ríos subterráneos. Antes del viaje a través del Chonta, se visitó el pasaje superior fosil en la entrada superior. El mapa fue publicado en el *Canadian Caver* en 1976.

ACCIDENT REPORT

RESUMIDERO LA JOYA, GUERRERO

Ramón Espinasa-Pereña

Resumidero La Joya is located near the town of Gavilanes on the Cacahuamilpa-Taxco road. It was first explored by Asociación Mexicana de Espeleología in the seventies to a sump beyond three interior pitches. In the late seventies, José Montiel of Base Draco passed the sump, which is really a crawlway about a meter long with 5 to 10 centimeters of airspace, and found a long continuation, with two more pitches to a room with a final sump at a depth of 236 meters. The main passage is about 3 kilometers long and contains flowing water almost from the beginning. The entrance pitch is 5 meters, the second is 15 meters, and then, beyond several squeezes, the third pitch is 10 meters. Following the fourth pitch, also 10 meters, a long horizontal passage containing the sump leads to the fifth pitch, of 11 meters. The sixth pitch, 45 meters, follows immediately. Passage size is ample, but not roomy, about 1 to 2 meters wide and 0.5 to more than 20 meters high, with many meanders and lots of small pools. No swimming is necessary, but you do get almost entirely wet. There are many small climbs. No convenient map exists, but Base Draco published one in more than a dozen segments in *Draco* numbers 2, 3, 4, and 5 over the period 1983 to 1989.

Since its discovery and exploration, La Joya has become a popular

This is the author's personal report and analysis of the rescue, based on personal knowledge, the official Espeleo Rescate México report, and a report by Javier Vargas.

cave, and it is used by most Mexico City cavers as a training and tourist trip considered "semi-serious" by most people. Round-trip times to the bottom range from 5 hours, if the cave is rigged, to over 20 hours during some courses that include rigging and derigging.

After the rescue of Alain Goupil in the Sierra Negra of Puebla in 1999 [see *AMCS Activities Newsletter* 24], many of the Mexican cavers involved felt the need for training in cave-rescue techniques. Juan Montaña organized a rescue seminar in November and December 2000, after the national caving congress, with the help of members of Spéléo Secours Français, the French cave-rescue group, and Resumidero La Joya was used for the practices. Those who attended the course then organized Espeleo Rescate México. [See article elsewhere in this issue.]

I do not know the details of the accident, but the following is made up from things told to me and the official report of the ERM. Cavers from Grupo de Espeleología del Institute Politécnico Nacional entered La Joya at 11 A.M. Saturday, May 26, 2001. The group was composed of thirteen beginners led by four instructors. They entered in two different teams, each with two of the instructors. At about 9:30 P.M., one of the instructors in the second group, Martín Alvarado Ibarra, age 23, started his descent of the last pitch, 45 meters deep. He apparently got through a rebelay 10 meters down okay, but then lost control of his speed. He was using a Dressler descender, possibly

without an extra control carabiner, and a shunt for safety that was attached to his harness with a 1-meter sling of half-inch tape. He had been caving for three or four years. When he lost control, he let go of the shunt, but the webbing broke, and he continued his fall, still attached to the Dressler but unable to brake, hitting once against the wall before landing on the bottom sitting down. He probably fell for about 25 meters. Those present stabilized the victim and diagnosed a broken ankle, fractured pelvis, and possibly several broken ribs. Three cavers were sent to the surface to report the accident, reaching it at 2:30 A.M. on Sunday. After reporting to the local authorities, they managed to call Ricardo Arias, leader of the Politécnico group, in Mexico City. Then the three reentered the cave, leaving nobody on the surface.

At about 3:00 A.M. Sunday, Ricardo Arias called José Montiel of Base Draco and Sergio Santana, the Operations Coordinator of Espeleo Rescate México. While Montiel contacted Arturo Montero of the Mexican Red Cross, who passed word of the accident to the Red Cross in Taxco, Santana talked with Juan Montaña, the ERM Coordinator, who then proceeded to contact all members of ERM and some other cavers. At about 5 A.M., Manuel Casanova, the ERM Instruction Coordinator, and Dr. Beatriz Álvarez left Mexico City, followed about an hour later by Sergio Santana with two members of his group Unión de Rescate e Investigación en Oquedades

Naturales and four members of the Red Cross. About 7:00 A.M., Juan Montaña left Mexico City with two members of Grupo Espeleológico Universitario, after making sure that other cavers were getting ready. This first contingent of twelve rescuers arrived at La Joya between 7:30 and 9:00 A.M. and found the entrance area deserted, with nobody to answer their questions. A couple of cavers were sent in to investigate, followed soon by Casanova escorting Dr. Álvarez and a group from the Red Cross carrying a litter. They made contact with Martín and the other sixteen Politécnico cavers at the base of the 45-meter pitch, 2 kilometers into the cave, at around 12:30 P.M., fifteen hours after the accident. The patient was stabilized and put on the stretcher, and preparations to haul him up the pitch were started. Santana went back out to inform those on the surface, while Casanova, with the aid of the Red Cross members, rigged the last two pitches for stretcher hauling. The Politécnico cavers were reluctant to leave their friend, but most were finally persuaded to head back to the surface, reaching it at various times that afternoon.

Meanwhile back in Mexico City, several other groups of cavers were organized to go help with the rescue. By midday on Sunday, Ramón Espinasa and four other members of Sociedad Mexicana de Exploraciones Subterráneas left for the cave. Arturo Robles and four other Grupo Espeleológico Universitario cavers were experiencing car troubles, and finally left in another car about an hour later. These two groups arrived at La Joya between 3 and 5 P.M. During the rest of the day, several other groups headed toward the cave.

Everyone was expecting a very long carry, and estimates of the time needed to carry Martín out varied up to forty-eight hours. Therefore it was arranged that groups of five to eight people would enter the cave every six to eight hours to carry the stretcher. Santana reentered the cave at 5 P.M. with seven Politécnico cavers carrying UNAM's stretcher, a French model that it was felt

would be better in the squeezes between the second and third pitches. At about this same time, Casanova's team had finished hauling Martín up the last two pitches and was carrying the stretcher toward the "sump" crawlway. There, since the largest space underwater was not right at the small airspace, a hose was given to Martín to help him breathe while the stretcher was maneuvered underwater. Fortunately, he was conscious and able to help.

At 5:30 P.M., without further news from inside, five GEU and two SMES cavers entered the cave with all the gear needed to rig the first four pitches for hauling. When they reached the top of the fourth, they met two Politécnico cavers on the way out, who informed them that Martín was already being hauled though the sump. They decided to split up into three groups to have all the pitches rigged and ready when the stretcher arrived.

On the surface, things were getting out of control. At least seven different Red Cross ambulances, coming from Taxco, Cuernavaca, and as far as Orizaba, were parked near the local football field, and a group of nine members of Cuernavaca's mountain rescue unit of the Red Cross had arrived. But they had no caving experience, so they were persuaded to remain on the surface. Local police and Civil Protection officials arrived with metal ladders, which were placed at the short entrance pitch, but they too had to be persuaded not to continue into the cave. Montiel and the Red Cross were meanwhile discussing with Civil Protection the possibility of building latrines and arranging food for the rescuers. Luckily, Montaña, as surface coordinator, managed to stay on top of all this.

At midnight, no word had come out of the cave, so I and four other SMES members went in. At the second pitch we found a few Politécnico cavers on their way out, and they told us that Martín was already past the sump, so we hurried onward, passing the GEU cavers stationed at each pitch, and found Martín halfway between the sump and the fourth pitch. While Dr. Álvarez was

checking the patient, I talked with Casanova about the need to open up the squeeze known as the Paso de los Noventas, and while we took charge of the actual carrying, he and the rest of the GEU cavers went up to make sure the third and fourth pitches were ready and to start hammering the squeeze. The rest of the Politécnico cavers were somewhere behind, too tired to move faster than the stretcher was being carried.

The fourth and third pitches were easily passed, hauling the stretcher with the counterweight of another caver, and we soon reached the base of the climb leading to the Noventas squeeze. By this time, Casanova had already chipped off some 10 centimeters of flowstone, and it was deemed wide enough for Martín and the stretcher. A rig point was found so the stretcher could be hauled up to the level of the squeeze and held there by the people below, while two people maneuvered it into the squeeze and two others received it on the other side. When Martín had passed the squeeze, everyone sagged with relief, knowing the rest would be comparatively easy.

Two GEU cavers then headed out to ask for all the people available to make the carrying easier. By 5 A.M. we had reached the base of the second pitch, and Martín was immediately hauled up. While those still below climbed, members of the Red Cross carried the stretcher the final stretch to the surface, which it reached at 7:30 A.M. on Monday, thirty-four hours after the accident.

Most of the Red Cross ambulances present either had mechanical problems or were stuck in the mud on the road, so after his wet clothes were changed and he was given another checkup, Martín was placed in a Socorro Alpino ambulance and taken to a hospital in Mexico City. There, a fracture of the right ankle and two cracks in the pelvis were confirmed, and he had to be taken to intensive care for respiratory problems caused by *Histoplasma capsulatum* and pulmonary embolism. Fortunately, he recovered satisfactorily and is now out of danger, though facing months of recovery.

The rescue went extremely well, considering all the factors and the people present. It was very fortunate that the rescue course had practiced in the same cave only six months earlier, because all the pitches had previously been rigged for stretcher hauling and most of the difficult spots had already been recognized and considered, which saved a lot of time. As always, there were many people who did not help at all, but only gave trouble, but Montaña did a good job of

keeping them at bay. Most of the actual rescue was carried out by Santana, Casanova, and the Grupo Espeleológico Universitario, with some help from us of the Sociedad Mexicana de Exploraciones Subterráneas. A few others were also very helpful. If I had been in charge of surface operations, I would have kept a more constant check on what was happening underground by sending messengers in, but maybe Montaña was right in saving the able cavers to make up hauling

groups, as everyone thought it would take a lot longer to get him out. In general, I was pleased that caving in Mexico has advanced enough that a rescue operation like this was carried out so efficiently, but wonder what would have happened in a much more technical cave, one that would have filtered out many of the people who carried the stretcher part of the way, leaving the whole rescue in the hands of the real cavers.

El sábado 26 de mayo, un grupo del Instituto Politécnico Nacional formado por 13 espeleólogos novatos guiados por 4 instructores entró al Resumidero La Joya, una cavidad activa muy popular, en las cercanías de la famosa Gruta de Cacahuamilpa. Esta cueva contiene varios tiros y dos estrecheces severas. En el último tiro, de 45 metros, Martín Alvarado Ibarra, uno de los instructores, perdió el control de su descensor y cayó casi en caída libre desde unos 25 metros de altura, fracturándose un tobillo y golpeándose fuertemente la pelvis. El rescate, que involucró a decenas de espeleólogos de casi todos los grupos basados en la Ciudad de México, tomó 34 horas.

ZACATÓN UPDATE

Marcus Gary

Two recent expeditions have collected data that will be used to interpret the geologic and hydrologic processes that formed the sinkholes in the large karst system that includes water-filled El Zacatón, plumbed to 329 meters deep.

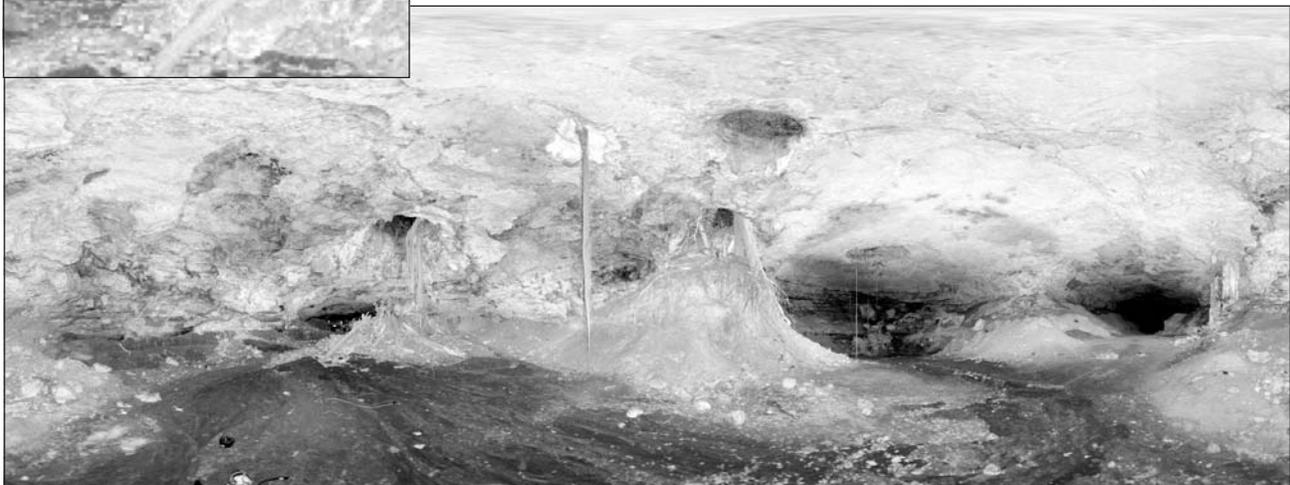
In January 2002, Marcus Gary, Robin Havens, Bill Stone, Jim Bowden, Ann Kristovich, Jack Sharp, and Mark Helper spent two weeks working on Rancho La Azufrosa, the cattle ranch where Zacatón is located. Robin, Jim, and Ann spent much of the time working on cave-diving techniques and training. Marcus, Bill, Jack, and Mark spent the entire time conducting a detailed survey of the topography

around the pozas on the ranch (see *AMCS Activities Newsletter 24*). The goal of this survey is to produce a high-resolution three-dimensional image of the area, both above and, eventually, below water level.

In order to create images of the pozas above the water level, a laser radar, or LADAR, was used to scan the walls and surroundings. The first step was to clear the dense Tamau-

lipan thorn forest from several areas around the edge of the poza to give the LADAR a clear view. Once areas were cleared, benchmarks were drilled into bedrock, and a surveyor's total station was used to tie their locations together. Finally, each poza was scanned with the LADAR instrument from the several clearings in order to obtain data from enough angles to make a

This is an image of a room in Cavernas Cuarteles at a junction of three horizontal passages and several skylights. It represents a LADAR scan 360 degrees around (the left and right edges of the picture match up) and vertically from straight up to 45 degrees below horizontal. The data set consists of 750 points for each of 2000 vertical scan lines, giving a total of one and a half million data points. At each point, the instrument recorded both range, to plus or minus 15 millimeters, and the intensity of the reflection. The picture is made from the intensity data, which most closely imitates what a flash photo would look like. It is possible to drive 150 meters into the cave, and a truck is visible in the left-most passage. The small picture shows a blowup of the truck, demonstrating the resolution of the data. *Bill Stone.*

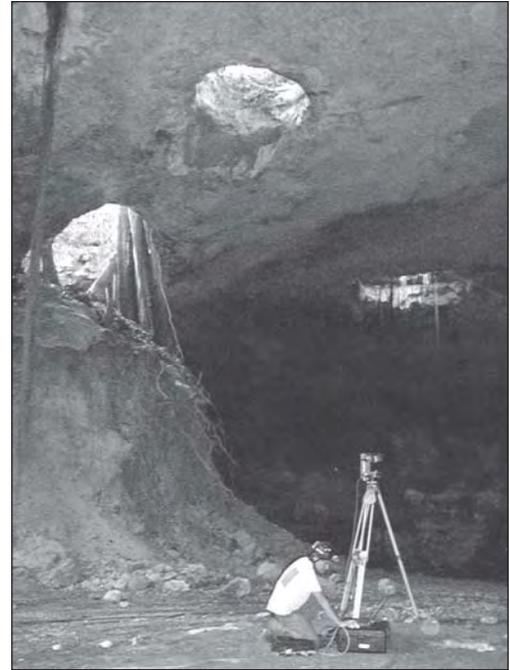


complete three-dimensional image. For each scan, a generator, power cords, the LADAR device, two tripods, and a laptop computer had to be hauled through the brush. Heat and rain caused some difficulties with the electronics; the computer had to be placed on an ice chest to keep it from overheating. El Zacatón, Poza Caracol, Poza La Pilita, and La Azufrosa were scanned during the expedition. We did not have time for Poza Verde because of the amount of chopping that would have been required.

We also completed a scan of a room in Cavernas Cuarteles, a dry cave. This produced a file of over a million and a half points that can be used to produce an extremely

high resolution cave map.

In March, a second expedition collected water samples from pozas in the area and explored previously unvisited sinkholes. Marcus Gary, Robin Havens, Jim Bowden, Ann Kristovich, Karen Hohle, and Alan Riggs spent a week diving and collecting data. The large Poza Tule was reached by much chopping through high reeds, only to discover that the water there is only 1 meter deep. We identified many other locations that need further study.



Marcus Gary with the laser scanner in place in Cuarteles. The large root at left, the rubble heap below a skylight, and the skylight at center are conspicuous in the middle of the panorama. *Bill Stone.*

Se reportan los últimos estudios realizados en los cenotes del Rancho La Azufrosa, Tamaulipas. Se utilizó un radar laser (LADAR) para elaborar un mapa tridimensional detallado de las porciones no sumergidas de varios de los cenotes, así como de un salón en la Cueva Cuarteles. La figura muestra un panorama del salón en Cuarteles, basado en la intensidad del eco del rayo laser a 1.5 millones de puntos. Se tomaron datos de química de las aguas y muestras de las cubiertas de algas que cubren las paredes de algunos de los cenotes. También se alcanzó por tierra la Poza Tule, que parecía muy prometedor desde el aire, pero la profundidad máxima del agua no fue superior a 1 metro.

CAVE-RESCUE COURSES IN MEXICO

Antonio Aguirre Álvarez
with a contribution by John Pint

Bernard Tourte and Jean-Marc Gibelin of the Spéléo Secours Français of the Fédération Française de Spéléologie taught a cave-rescue course in Mexico during November and December 2000. Mexican cavers who had participated in the rescue of the Canadian Caver in Puebla in December 1999 were invited to attend. [See *AMCS Activities Newsletter* 24.] Twenty-six cavers, mainly from Mexico City, participated, including cavers from the cave rescue team of the Mexican Red Cross, the Grupo Espeleológico Universitario, Grupo de Espeleorescate del Socorro Alpino de México (GER-SAM), and the Unión

Underground practice during the first rescue course. *Courtesy of ERM.*



de Rescate e Investigación en Oquedades Naturales (URION). There were twelve days of training, six in Mexico City and six in the Taxco, Guerrero, area, where practice was done in Resumidero La Joya and Zacatecolotla.

After the course, members formed Espeleo Rescate México, a national cave-rescue organization. It has already done a rescue from La Joya [see article elsewhere in this issue]. The first leader was Juan Montaña from the GEU.

A second course was held in San Luis Potosí on December 15–24, 2001. In addition to ten cavers who had taken the previous course,

there were thirty new students, twenty-nine from Mexico and one from Brazil. The same two instructors from France were there, and one new one from France and one from Spain. Seven days were spent working on the surface and three days in caves. Because of the large group, three caves were used for practice: Sótano de Carbonera, Sótano de Pablo Alderete, and Sótano del Encino. On the ninth day, cavers were derigging in Sótano del Encino when a climber made a mistake trying to change ropes and became detached from both ropes. By gripping both ropes, he was able to stop his fall 1 meter above the floor. He could not climb because of burns on his hands, but the team had him on the surface in 15 minutes,

where he was able to walk to an ambulance. He is caving again now.

There is going to be a third course in November 2002. This course will be in Chiapas, so we will have had courses in central, northern, and southern Mexico. We hope to attract students from Veracruz and Oaxaca.

Before this training, there were many groups in Mexico interested in cave rescues. Those who have taken the courses are now the fifty-six members of Espeleo Rescate México, which is an organization of individuals, not groups, although individual members have access to the equipment of groups they belong to, such as the Red Cross. This is the first real cave-rescue organization in Mexico. Each state will have a coordinator. There are now members of ERM from Mexico City, Michoacán, Chiapas, San Luis Potosí, Guerrero, Nuevo Leon, and Jalisco. Members in each area have local practices, but we plan to also have national practice and training sessions around the country. There was one on March 15–17 at Sótano de los Hernández in Querétaro. Cave-rescue seminars will train and recruit additional members. We also hope to train in cooperation with Italian, Spanish, and Belgian groups, with the Federación Espeleológica de America Latina y el Caribe (FEALC), and of course with the National Cave Rescue Commission of the NSS. We are working hard to form a reliable national cave-rescue organization for Mexico. Our emergency contact email address is EspeleoRescateMexico@yahoogrupos.com.mx.

Many of the individuals in ERM



Practicing pick-offs during the first training course.

Courtesy of ERM.

have twenty years of experience in caving and rescue. Some of them plan to visit all of the 1000-meter-deep caves in Mexico with all-Mexican teams, starting with Sótano de Ocotempa and Sistema Cheve in 2003.

En diciembre de 2000, espeleorescatistas franceses impartieron un curso de rescate en cavernas a espeleólogos mexicanos en la Ciudad de México y cuevas de Guerrero. Un segundo curso se llevó a cabo en San Luis Potosí en diciembre del 2001. Quienes participaron en dichos cursos fundaron Espeleo Rescate México, como una organización nacional de rescate en cavernas. La dirección de Internet para emergencias es EspeleoRescateMexico@yahoogrupos.com.mx.

Another Rescue Course

On August 4, 2001, Susy and I were in Mexico City for a weekend course on cave rescue given by an expert on the subject, Sergio Santana, founder of URION. We left the big city, took to the expressways, and were soon cruising among pine-covered mountains, the weather cool and fresh. After a few hours, we arrived at Zacatecolotla, a cave at a small ranch near Taxco, Guerrero. Only when you approach closely in the undergrowth can you see that this is a vertical cave, with less than half a meter of floor before a pitch of about 5 meters. We were going to learn to get an injured person up and out of this hole. We would start with two fundamental techniques for pulling heavy weights.

Both systems require secure anchors for the ropes. There were two expansion bolts in the wall. Sergio pointed out that both had been driven in too far—by a famous French rescue expert, no less. The rock had been chipped away around one hole to make the bolt flush with

the wall, and Sergio did the same to the other. Then he had me drill a hole for a third bolt. It took me about half an hour to put in the anchor. I'd rather not think how long it might take to accomplish the same thing while hanging beneath an icy waterfall. Sergio then attached a loop of 11-millimeter rope to these anchors, and we attached a Z-rig pulley system that can be used to pull up an accident victim.

What I found most interesting was the way he connected a pulley to a Petzl jammer to form a smooth-operating auto-lock system that requires no attention. The secret is in the pulley's construction: the sides are straight and parallel, so that after inserting a biner crosswise through the holes, you can insert a second biner into the gap between the sides. A jammer clipped onto this second biner is in a perfect position to feed rope smoothly into the pulley. In our practice session, the Z-rig was positioned not to haul the victim from the bottom of the pit, but only to get him up over the edge.

To raise the victim up to the surface

level, we used an ingenious counterweight system. The weight of a caver is used to raise the victim, with no hauling required. We practiced this suspended from a tree branch, but in a cave the system works like this. The counterweight person rappels down to the victim on a doubled rope that is attached to a pulley very near the lip, if possible. He attaches one end of the rope to the victim and then prepares to prusik up the other. Meanwhile a coordinator clips in to the point where the pulley is anchored. The CW person climbs up his side of the rope, reaches for the other rope, and gently pulls the victim up, while he, of course, goes back down. One of the coordinator's jobs is to stop the movement of the rope, whenever necessary, by simply grasping both sides of it below the pulley. Once the victim reaches the pulley, the CW person changes over to rappel and, sitting at the bottom of the pit, feeds rope through his rack as the victim is pulled up and over the lip with the Z-rig.—*John Pint*

THE YUCATAN DEEP SPELEOLOGICAL DIVE TEAM

Andreas W. Matthes

Looking for new places to dive or new underwater caves to explore is an addiction one can have. The Swiss-cheese-like limestone rock of the Yucatan Peninsula of Mexico is one of the prime areas for underwater cave formation. The state of Yucatán is an area full of unexplored cenotes and only a few people interested in exploring them. The Ecology Department of Yucatán lists over 1700 cenotes. A lifetime of exploration is waiting here. The difference between the caves in Quintana Roo and those in Yucatán is that the caves are deeper in Yucatán, but much shorter in length.

The Yucatan Deep Speleological Dive Team was formed in March 1997 as a small and dedicated group of cave and technical divers to find, explore, map, and preserve the deep sinkholes and cave systems of the Yucatan Peninsula. Deep cenotes and cave systems are a link to understanding the geology and the formation of the cave systems before and during the last ice ages. They are natural sources of fresh water and also natural monuments to be preserved for coming generations. We stress the importance of good landowner relations, and with the permission of these landowners we publish our findings and maps to educate the public. We are well aware that there are other groups and individuals with similar goals, and the Yucatan Deep Speleological Team stresses the importance of good relations and cooperation.

This article appeared in somewhat different form in *Underwater Speleology*, volume 20 number 1, 2000.

The team for our November 1999 project consisted of Andrew Pitkin from the United Kingdom, Doug Chapman from the United States, and Andreas "Matt" Matthes from Germany but living in Mexico. The one-week project was privately funded by the three divers, who had logistics help from Agustín García and Roberto Hashimoto, both Mexican nationals living in Mérida. At Cenote Sabak-Ha, the team was helped by our trustworthy sherpas, Dionicio and Pedro, both residents of the *poblado* of Mucuyche. During our dive at X-Kol Aak, we were helped by the Mérida Fire Department, who sent a truck and three firemen with us. At Cenote Ucil we were helped by three baseball players and a very friendly policeman from Cenotillo. All oxygen and helium was organized and stored in Roberto Hashimoto's warehouse, and we were invited by Agustín García to stay with him with all our gear.

During our diving operations, we used double steel 104-cubic-foot tanks in conjunction with 80-cf stage bottles. Dives to a depth of 55 meters were conducted on air. On deeper dives we used trimix 10/52 or 10/60 (10 percent oxygen, 60 percent helium, and the rest nitrogen). Horizontal penetrations at a depth of 60 meters were done with 16/24 trimix. A total of fifteen dives were conducted, eleven on mixed gas and four on air. Decompression tables were computed with Adept and Proplanner software. As our standard travel gas we opted for air or, on one dive, trimix 14/33. Our intermediate decompression gas was EAN 40 (air enriched to 40

percent oxygen), and our shallow decompression gas was pure oxygen. For each dive, three down-lines were placed. All decompression gases and extra tanks were staged on a weighted line that went to 55 meters and had metal rings on it every 3 meters. A second down-line had two sets of double 95-cf steel tanks attached to it, EAN 40 at 21 meters and oxygen at 6 meters. The third line was a #24 braided line deployed from our primary dive reels that went all the way to the bottom and provided a reference during ascent and descent. No support divers were used; we felt we had enough safety margin in the extra tanks on the lines. In addition to the computed decompression stops, we did extended 5-meter stops and surface decompression of between five and fifteen minutes breathing pure oxygen. Post-dive exertion was kept to a minimum, which was an easy task because of our excellent surface support crews. All gas blending had to be done at night, after our drive back to Mérida. There is only one air-fill station in Mérida, and we had to schedule time late at night to fill or top off our tanks in order to let the trimix sit for eight to ten hours before the next dive to insure that the components had fully mixed.

The cenotes we explored during this project were Sabak-Ha, Ucil, and X-Kol Aak. All of these cenotes are in the state of Yucatán between 55 and 120 kilometers from Mérida. After exploring Sabak-Ha, we saw the need to do comparison dives in the other deep cenotes to see if the others also had horizontal

passages around the 60-meter and 150-meter levels. Tom Iliffe had asked us if the cave passages in Yucatán are formed along faults that follow the Chicxulub crater rings. From the few maps on hand, it looks like there is a correlation between the direction and orientation of passages and the rings of the meteor crater, but the caves we have seen do not look like they are formed on faults or fracture lines like the ones in Bermuda. More systems will have to be explored and surveyed to prove the theory.

While on a scouting trip to Yucatán the year before, we came across a huge water-filled depression some 55 kilometers south of Mérida named Sabak-Ha (turbid water), and that is what it looks like. The surface is a pool of green, uninviting water about 60 by 40 meters in size. The drop from ground level to the water is about 8 meters, typical of the area. On descent, the green algal bloom gives way to crystal-clear water below 15 meters. The huge size of the sinkhole impressed me quite a bit; I felt like an ant in a huge bowl. At -65 meters, a hydrogen-sulfide layer with about 6-meter visibility is trapped at the halocline, the interface between fresh water above and brackish water below. At -87 meters is the top of a talus cone, the breakdown that

was once the ceiling of this large dome. At -65 meters, the diameter of the pit is about 75 meters. On November 16 and 17, 1998, Kashi de Cleer and I returned to Sabak-Ha for a closer look at the walls. We came across a horizontal cave passage heading west at a depth of 55 to 60 meters for 129 meters to a terminal breakdown. A cloud of millions of little cave shrimps greeted us at the entrance, and farther into this passage we found one of the largest populations of blind cave fish we have ever seen at that depth. We counted thirteen with one sweep of the eye, and we named the passage the Blind Cave Fish Cafe. On May 20, 1999, Ronald Rumm and I returned to see what the bottom did. We descended to a depth of 111 meters (365 feet), where I tied the end of our exploration line to the wall.

On August 16, a new cave passage was found on the east side, opposite the entrance to the Blind Cave Fish Cafe, at a depth of 65 meters. It extends 123 meters into the bedrock, and the shallowest point, at -57 meters, is right at the end, where the passage splits into two small leads. Close to the end, there is a side passage that will be passable only with side-mount gear. The main passage here is the Passage de Sacrificios, due to the fact that

after the dive one complete stage-bottle setup, including the regulator, was lost down the pit. It remained at 87 meters for three months before being retrieved. There is a small side passage off the Passage de Sacrificios near its entrance called the Bone Step and Orange Walk.

Before the November project, I made a bounce dive in Sabak-Ha on November 1, collecting water chemistry data with Tom Iliffe's Hydro-lab to a depth of 122 meters. Then on November 13, during a 60-meter acclimating dive for Andrew and Doug, we collected the missing survey data to link the east and west cave passages together in order to produce a basic map. We also measured the circumference at this depth. To my knowledge this is the only deep sinkhole in Yucatán that has significant horizontal passages. At -15 meters we found a bedding plane that discharges cooler fresh water at a very slow rate. I think this can be seen in the Hydro-lab data, too. One place at the bedding plane looks big enough to be penetrated with sidemount gear.

On November 14, Andrew, Doug, and I went for a dive to a planned depth of 137 meters. During the descent, Andrew had a problem with a sticking inflator and had to abort at -97 meters. Doug and I continued to a depth of 120 meters, where we penetrated around 150 meters into a large cave passage that opened up even larger as we went. I tied the exploration line off at a depth of 147 meters (483 feet). Visibility was excellent, over 30 meters, and there was no apparent flow. At this point, we were in a deep, horizontal passage with no walls, ceiling, or bottom to be seen. Weightless in a black void is true inner-space travel. After finishing our 3.5-hour decompression, we could hardly find words to describe it. We estimate the bottom to be at least 170 meters deep.

On November 15, Andrew did a dive on the other side of the talus cone to a depth of 140 meters (459

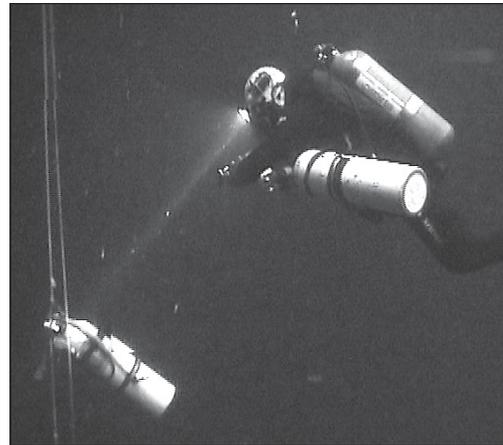


Matt Matthes checking stage bottles for a dive at Sabak-Ha. Andrew Pitkin.

feet) and reported the same huge void Doug and I had experienced the day before. Joking around about what we would tell people we had found, we decided on nothing, a lot of nothing.

Sheck Exley did a dive in X-Kol SAak on July 6, 1989, with Paul de Loach and Hilario Hiler as support. He reported a depth of 120 meters. There is a story that a Coca Cola truck fell into it twenty years ago. We joked about having a soda at -120 meters, but we were concerned about the dehydrating effect of caffeinated beverages. (Dehydration increases risk of the bends.) On November 17, the whole team went to X-Kol Aak, some 84 kilometers from Mérida, past the beautiful town of Izamal. With the superb help of the *bomberos*, we got all our tanks down to the water, which is around 8 meters below ground level. The surface water is bright green, but the surface conditions did not hold us back, as we looked forward to the crystal-clear water

that should be waiting for us below. What we found was an extremely strong hydrogen sulfide layer that started at -45 meters and went all the way down to the bottom on a heavily silted talus cone at -121 meters (397 feet). Visibility at this depth was around 3 meters, and it took only a glance at each other to get the thumbs-up sign to get out of there. On the way up, we had to switch from our bottom gas to our travel air in the upper levels of that H₂S layer, which was not comforting, to say the least. When we were finally above the acid bath, we had to wash our burning faces with fresh water. Andrew could not see with his burning eyes for the better part of his decompression, and I had numb lips for three days. Needless to say, we didn't find the Coca Cola truck. After the dive, all our brass had turned completely black, and the once light gray cord on my pri-

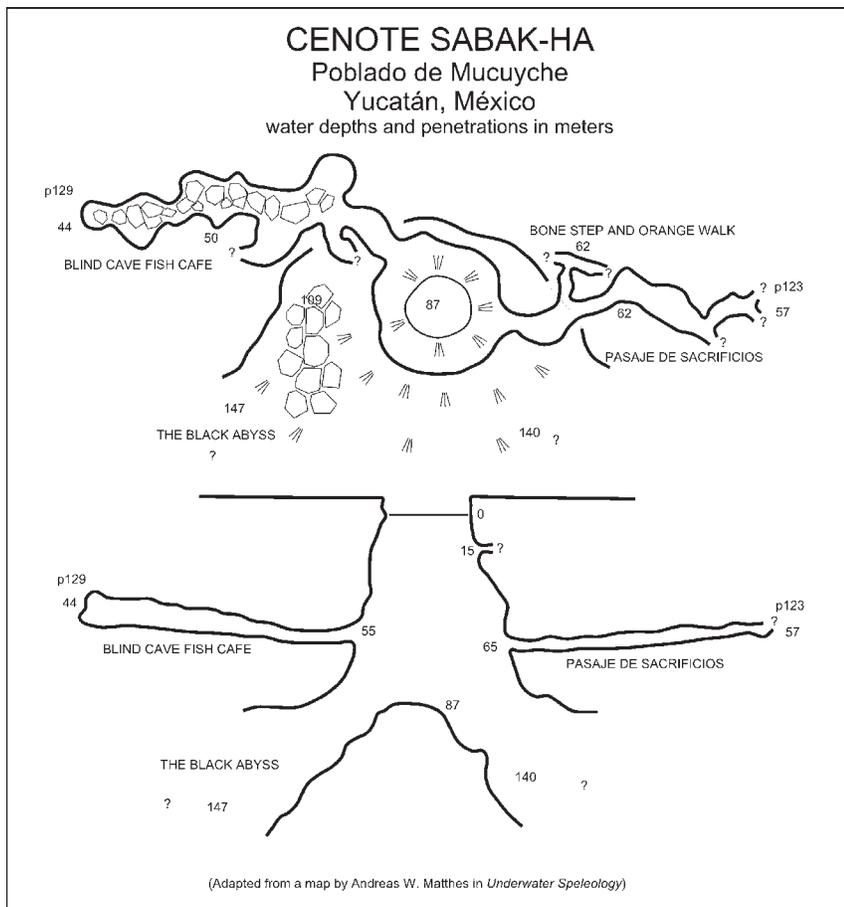


Matt Matthes checks decompression tanks at the start of a deep dive into Sabak-Ha. *Andrew Pitkin.*

mary light was dark gray, almost black.

About 120 kilometers east of Mérida lies the little town of Cenotillo. The *presidente* of the municipality told me about an American who went down to the bottom of Cenote Ucil many years ago. This turned out to have been Sheck Exley with support from Paul de Loach and Hilario Hiler, on July 5, 1989. Other divers who have explored this cenote are Oliver Knab in the spring of 1989 [see *AMCS Activities Newsletter* 19, pp. 59-61, which includes a map of the cenote], and Jim Coke with Jochen and Anne Warner on December 4, 1990. On subsequent dives, Jim Coke, Lorie Conlin, and Tom Young compiled a survey of the upper dry cave and the cenote itself to a depth of 60 meters. The opening to a large and dry underground chamber is about 1 kilometer from the little town. Inside the dome-like chamber, sunbeams from a hole in the ceiling hit the water, and trees are growing close to the crystal-clear, deep-blue water. It is just beautiful.

On November 18, our sherpas helped us get all the tanks, gear, and ropes down to a little platform at the water's edge. It took about an hour to get all the lines and tanks in. While descending, for most of the dive we could see the circular walls of the chimney-like sinkhole. At -67 meters we encountered a hydrogen sulfide layer and



halocline. We were relieved to find that the layer was very weak, and we passed through it to clear salt-water below. We reached the top of the talus cone at -91 meters, where we switched from our travel gas 14/33 to bottom mix 10/52. While laying our guideline, we swam to one of the walls and found the bottom to be 118 meters (387 feet) deep, with visibility around 30 meters. The diameter at the bottom is around 60 meters, and at a depth of 50 meters, about 30 meters. During our long and slow ascent, we circled the walls and found old fresh-water ducts, where a long time ago rain water was discharged into the then-dry pit. At a depth of 8 meters I found a little passage with a distinct but slow discharge of fresh water.

Equipo de Buceo Espeleológico Profundo de Yucatán

A diferencia de las cavernas subacuáticas de Quintana Roo, que suelen ser largas y poco profundas, los Cenotes de Yucatán son frecuentemente profundos, aunque rara vez presentan prolongaciones importantes. Durante 1999, los buzos del equipo exploraron varios de estos cenotes. En el Cenote Sabak-Ha se alcanzó la cumbre de una montaña de derrumbe a -87 m. Grandes túneles, a profundidades de hasta -140 metros, rodean a la montaña. También hay pasajes pequeños a -60 metros. El 17 de noviembre se buceó en el cenote X-Kol Aak. Una fuerte concentración de ácido sulfhídrico se detectó desde los -45 metros hasta el fondo, a -121 metros. En el Cenote Usil también se detectó ácido sulfhídrico, en concentraciones menores, en la interfase entre agua dulce y agua de mar, a -67 metros. En este cenote la cumbre de la montaña de derrumbe que ocupa su fondo está a -91 metros, y la profundidad máxima alcanzada en una de sus paredes es de 118 metros.

SOME QUINTANA ROO DIVING ADVENTURES

Fred Devos and Christophe Le Maillot

A paved parking lot behind the tennis courts of the Puerto Aventuras resort is a unique dive site. In the fall of 1997, a new cave system was found with some help from the automobile and construction industries. The weight of cars and relentless pounding at the site of a future condominium contributed to a collapse in the parking lot that revealed a tube full of clear water flowing toward the sea. (Or maybe it was caused the Mayan gods battling the onslaught of modernization.) First to dive below the 1.5-by-2.5-meter opening were Luis Fernando Martínez and Alejandro Elizondo. Kate Lewis, Yair Azubel, Bernd Birnbach, and I made additional exploration and mapping dives.

Because of its proximity to the sea, flow and visibility vary greatly with the tides. Various sponges and clams decorate the walls, while lobsters, octopuses, and bristle worms sneak through the brackish tunnels. Finds include bones believed to be of a young crocodile and more than one empty Coke can. The contrast between nature and civilization continued when Kate and I surfaced at a second entrance in a part of the marina now being used as a dolphin enclosure.

The map showed passages in Sistema Valet up to 8 meters wide running 6 meters below three restaurants, two streets, and several shops and apartments. Our downstream line ended below the front

Adapted from material at www.aquaexploration.com/English/News. ©Aqua Exploration.

lobby of an expensive hotel, while the upstream end tapered off beneath the first tee on a golf course. To our dismay, the hole in the parking lot was closed, and it once again catered to cars, not cavers. However, the hole temporarily opened again in August 1999, and Yair and I made two dives and discovered 600 more meters of passage in a new upstream section, the Vintner.

—Fred Devos

Only the mosquitoes and ticks seemed to enjoy the 100-percent humidity in early April 1998. Bernd Birnbach and I wished we were as well adapted to the environment. A forty-five minute hike through the damp jungle took us to Cenote Kop, the main entrance to Sistema Actun Chen, 7 kilometers south of Akumal. Entry is made difficult by the fact that all equipment and tanks must be lowered 8 meters through a narrow crevice to reach the pool of crystal-clear water.

After 250 meters of diving, we found ourselves in small passages in unstable limestone, where visibility quickly turned to zero. Several restrictions are navigable only with side-mount equipment, but hopes for larger passage kept us squeezing forward against the steady current. Continuing northeast, the cave widens, but has few of the beautiful formations so abundant in nearby systems. Some hundred meters farther, the walls suddenly disappeared, and we found ourselves in an enormous 60-meter-wide room, later named La Mancha. There, the cave splits, and we each decided to take a tunnel.

My side varied in direction from northeast to northwest, and it was not long before I had emptied my reel, tying off in large, unending tunnel. A 4-meter stalagmite dividing the passage more than made up for the lack of other decorations. At the same time, Bernie was pushing east and struggling through several small and nasty areas. But persistence paid off. After spilling 500 meters of line, he also found passage worth returning to.

Actun Chen was soon surveyed to more than 5700 meters of passage. A halocline is at -12 meters and a less pronounced one at -7 meters. The average depth is 12 meters and the maximum 22 meters. Most sections are very large, but some major restrictions pose challenges. Although eight other cenote entrances have been discovered, the trek to Cenote Kop remained the easiest access during exploration. A road to one entrance has subsequently been made.

—Christophe Le Maillot

In early May 1998 I finally found the traces of an old trail rumored to lead to a little-known swimming hole. My usual dive partners were working, so I had to play alone that day. Ten minutes of swinging a machete took me to the twin cenotes, which were later named Dos Pies. Green surface water didn't hint at what lay deeper as I pushed my reel through a narrow crack. A passage seemed to be leading me east, and within a few minutes I had passed the dim light of a third small cenote entrance. A dark hole coaxed me northwest, and I picked up the

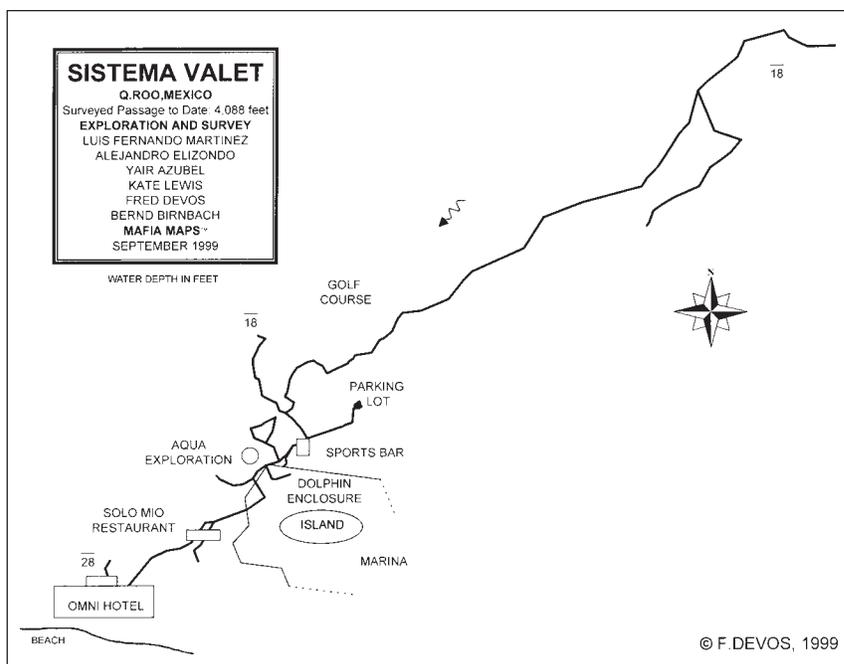
pace. I'm not certain who was more startled when my fifty-watt light picked up the silvery scales of a twenty-pound tarpon. Seeing a large fish is not anticipated during a cave dive, and I'm sure that evolution had not prepared the tarpon for a close encounter with a cave diver. Knocking the light from my hand, the fish bounced heavily off my shoulder before finding a way past.

Catching my breath, I continued northwest, spilling line in ever-widening passage. Limits on air turned the dive, and I had to leave further discoveries for the future. Surveying out, I envisioned the possibilities. The immense Sistema Dos Ojos had downstream lines heading in this direction, and slightly to the west lay Sistema Nohoch Nah Chich, at the time the world's longest underwater cave. During the previous ten years, divers from all over the world had attempted to connect these two huge systems, and now I was pushing my way directly between them. It was not difficult to muster the motivation to return.

Kate Lewis and Daniel Riordan each joined me for a dive, and by July we had managed to discover over 3300 meters of passage. The farther upstream we went, the larger the passage seemed to be, with some bedding-plane ceilings stretching unsupported 50 meters in every direction. Cars and trucks on Highway 307 pass some 12 meters above.

On July 19, I hauled three tanks to the water and, with side mounting, proceeded to push through downstream restrictions. Larger passage lured me on, but I periodically paused to make sure I would be able to swim out against the mounting current. Before the dive, I had loaded my reel with almost 500 meters of line, and soon the line remaining would take me only a few more meters. But luck was with me, as coconut shells on the floor and a dim light in the distance foreshadowed a surprise. It wasn't until my head broke the surface that I understood where I was. Dos Pies

Yair Ozubel in the parking lot entrance to Valet. *Fred Devos.*



was only the second Mexican underwater cave known to have a divable connection to the sea.

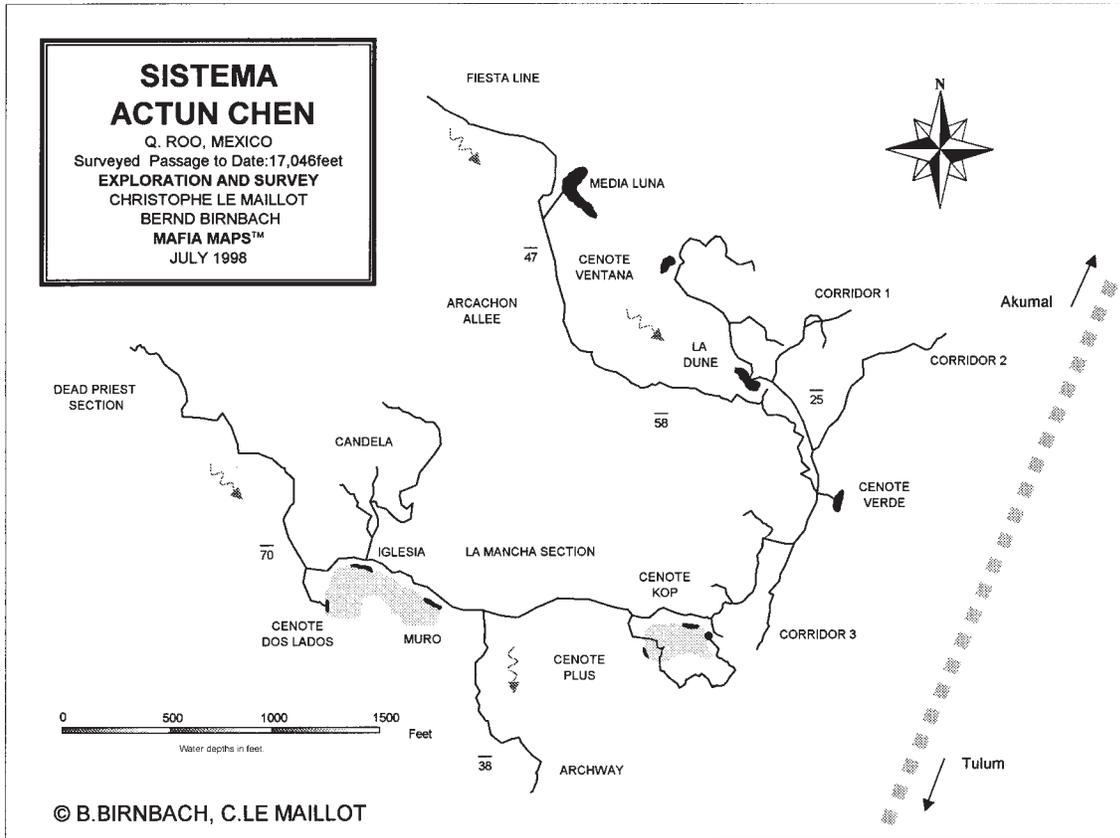
Dos Pies now holds 3500 meters of exploration line, connecting six entrances. Most passages lack formations, and although the average size is large, several restrictions limit back-mount divers. A significant flow comes from sources farther inland, but a connection to Dos Ojos or Nohoch Nah Chich remains a dream. —*Fred Devos*

We knew from their big smiles on the rainy November 1998 day that Daniel Riordan and Bernd

Birnbach had just kicked ass. It had taken them slightly more than two hours to add 500 meters of line to the 90 meters already there from a previous French-Portuguese expedition. Sistema Minotauro, as it is now known, is located 5 kilometers south of Puerto Aventuras on the land of Don Inocencio. It is nestled between Sistema Taj Mahal to the south and Sistema Actun Koh to the north.

The following day, Bernie, Kate Lewis, and I bounced along the rough road in hopes of further exploration. The steep collapse entrance and an unfinished ladder



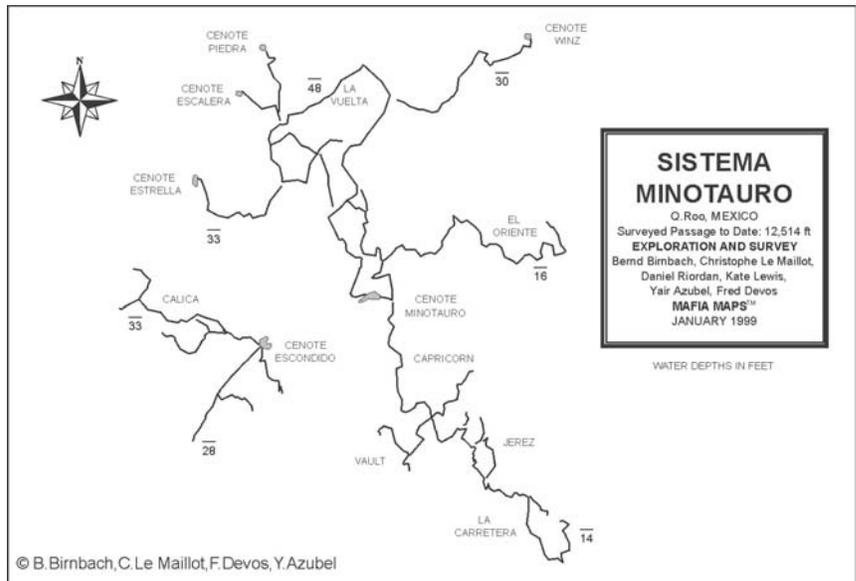
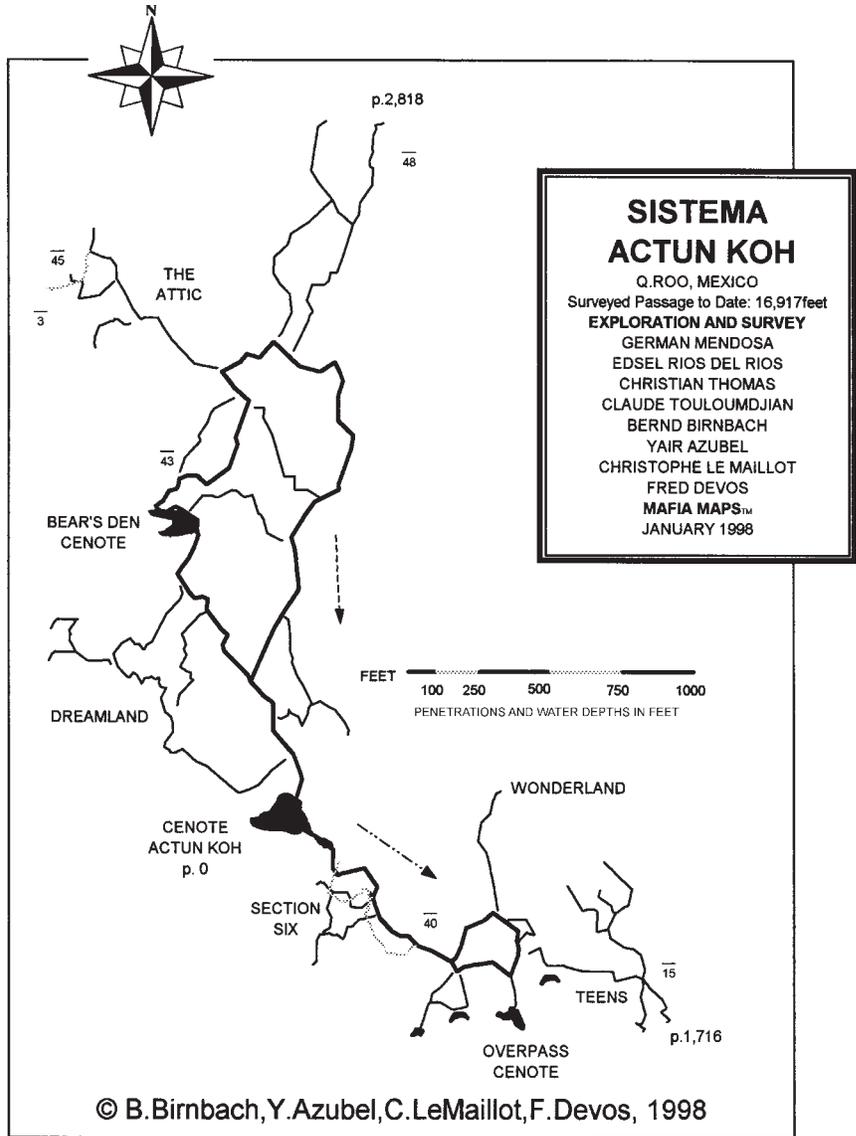


made our entry slow and precarious. The fifteen minutes following our immersion were spent battling the numerous restrictions in the beginning of the main upstream passage. Fine silt was pushed quickly behind us by the rapid flow in this narrow part of the cave. From a shallow 3 meters, the passage dropped to 10 meters and became wide. With Kate and Bernie leading, we quickly found what we were looking for, a colorful clothespin left on the line the previous day to indicate a lead. We headed southwest through virgin cave, and the tunnel now opened up into a small, decorated room that was made grander by knowing it was being unveiled for the first time. This larger passage ended, and once again we found ourselves inching through restrictions. Bellies rubbing, we were careful not to damage fragile formations on the ceiling. Farther northwest, we found an opening later named Cenote Estrella. Hitting thirds, we began to survey back along the 500 meters of new line.

A week later, Bernie and I headed north down another promising passage. We reached -9 meters, swimming now in a well-defined halocline where we could see fresh water flowing steadily over the heavier salt water. White walls emphasized the effect. This section ended in a room measuring over 30 meters across. A northeast passage originating here was later found to connect to the main upstream line, forming a popular loop called La Vuelta.

We picked up our passage on the other side of the room and continued north. Another 180 meters took us to a large collapse, Cenote Escalera. Numerous attempts have failed to find a way through this mass of unstable rock. Having explored about 500 meters, we surveyed out.

Most of the downstream part of Sistema Minotauro is severely restricted, and only side-mounts will pass. Bernd Birnbach completed most of the work in this area, following earlier dives by Bil Phillips and Sam Meacham. Attempts to connect to Minotauro have added



600 meters in Cenote Escondido, barely 150 meters from Minotauro's main entrance, and 200 meters in Taj Mahal, but tiny leads and loose rocks never seemed to yield connections. Sistema Minotauro is 4200 meters long. —*Christophe Le Maillot*

Sistema Actun Koh was initially explored in 1996 by German Mendoza and a group of French divers that included Christian Thomas, Claude Touloumdjian, and Edsel Rios. The cave lay dormant until the spring of 1997, when

Christophe Le Maillot, Bernd Birnbach, Kate Lewis, Yair Azubel, and I began diving the system. A couple thousand meters of unknotted line was removed and replaced with surveyed knotted line. Dental floss used by the French for mapping littered the floor of the cave, and many frustrating hours were spent removing it. During the following eight months, we doubled the size of the system, to about 5300 meters.

Large passages averaging 11 meters in depth connect four cenotes, Actun Koh, Dear's Den, Overpass,

and Fox Hole. Airbells and limestone daggers adorn the ceilings, while a shimmering halocline hovers at -12 meters. Both the upstream and downstream lines form loops. An upstream area known as The Attic tests divers' buoyancy control where depths rise to less than 2 meters in low passage. Wonderland, off the downstream loop, meanders through grand arrays of colorful pillars, flowstone, and ancient waterfalls. Many think Actun Koh is the best cave dive north of Akumal. —*Fred Devos*

Se describen brevemente una serie de exploraciones de espeleobuceo realizadas a fines de los noventa en la Riviera Maya, una porción de la Península de Yucatán en la costa del mar Caribe. El sistema Valet se descubrió merced a un colapso que ocurrió en un estacionamiento del hotel de Puerto Aventuras.

PROYECTO ESPELEOLÓGICO SIERRA OXMOLÓN



Proyecto Espeleologico
Sierra Oxmolon

Jerry Fant

The Sierra Oxmolón area has been intriguing for many years. The potential shown by the density of caves south of the area and the vast dolines on the topographic map led to the creation of the Proyecto Espeleológico Sierra Oxmolón. Discussions with Terry Raines, Peter Sprouse, William Russell, Joe Ivy, and others indicated that little was known about the area. The project area in San Luis Potosí includes the villages of Tonzozob, La Reforma, La Cruz de Guadalupe, La Cuchilla, San Benito, Oxmolón, Xopoy, Los Charcas, El Otate, La Cueva, Tanquizul, Tanchopal, La Brecha, and Aguacate. Until recently, there were no roads, but now roads have reached La Cuchilla, La Brecha, Aguacate, and Tanquizul, opening up the southern, eastern, and western fringes of the area. The El Abra limestone in the area gives depth potentials of 300 to 1000 meters. The area is characterized by deep dolines and weathered karst, covered by lush tropical hardwood jungle.

The goals of the project are to explore and survey the caves of the Sierra Oxmolón, to study the hydrology and cave biology of the area, and to promote cultural exchange with the local people.

Thanksgiving week 2001 was one year after the last visit to the La Brecha area. Some old faces were along, and there were some new ones. On Sunday, November 18, Enora and Jerry Fant set up camp at the old site in a *llano* and found a cave just 10 meters from the path to camp, down in a sink. It is

hard to believe that it had been missed before, but the entrance is heavily vegetated and very easy to pass by without noticing. Later that day, Jerry and Enora started out for a large sink shown on the topo map. Several minor sinks were entered. All were plugged with clay or breakdown. The large sink was never reached; it seemed to keep getting farther away.

That evening Peter Sprouse, Terri Whitfield, James Lopez, Dale Barnard, and Denise Pendergast arrived. The team also got the news that the *llano* could not be used for camping this time. So they moved to Carlos and Señor Perez's house in the village. The new camp was literally in their front yard, and the use of their corn bin for base camp, dry and warm with cement walls and lanterns burning into the late night hours, was welcome during the rainy first three days. But their rooster was in charge of waking up all of La Brecha at 4:00 A.M., 5:00 A.M., and 6:00 A.M. No one was exempt from the alarms.

That evening Peter, James, Terri, Jerry, and Enora mapped the first cave of the trip. The cave was named Cueva No Se after someone who was asked the name replied, "I don't know." The cave is short, with one upper-level crawl into a vampire-bat roost. Some excitement was caused when James found remains that might be human. Later in the trip they realized that the molars in the fragment of rear jaw were really those of a javelina.

Monday it was decided to finish up the caves on the hill beside Cueva Pisos Falsos. Peter, Terri,

Dale, and Denise began to survey Cueva del Hoyo Inclinado, Sótano del Grito, which had been found but not explored in 2000, and Sótano del Rayo de Luz, just found on this trip. Cueva del Hoyo Inclinado was hard to find again, because clear-cutting had left it in the middle of a corn field. Meanwhile, James, Jerry, and Enora went up to Sótano del Rayo de Luz and began to map the route down to the flowstone bridge. A battery-powered drill was handy for setting up four rebelayes. James was the first to descend the last stretch, which landed on a ledge overlooking another drop. Deciding it would be better to wait until the others could join in, it was left until a survey trip. A good climbing lead was seen.

Tuesday started out drizzly, spoiling the enthusiasm of everyone. Getting up was hard, except for the rooster. Carlos and Señor Perez were ready for a short hike to show everyone two caves. Dale, Denise, James, Jerry, and Enora put on their rain gear and packs to follow the guides into the jungle. After dodging mud puddles on the road for 1.5 kilometers toward La Linja, they took a trail to the east. Not far off the road was a small, inconspicuous entrance. It didn't look like much, but James, Jerry, and Enora peeked inside to see passage that kept going. They scooped about 100 meters in Paxal Ita Te to a 17-meter drop that looked good. Outside, the weather had not changed, and everyone was eager to continue. Back across the road on the jungle trail, everyone trudged along trying to guess where the guides had gotten

to ahead. The terrain was up and down over weathered karst. Small sinks were everywhere, and a fissure was passed but left for another time. The guides stopped, themselves confused in the jungle, but they were soon on the trail to another cave, Cueva Calavera del Jabalí. It has a large entrance, and everyone stayed dry while poking around. A complete skull of a javelina was found near the end of the cave, and this identified the past owner of the teeth and jaw found earlier. Once the GPS units had gotten their bearings, it was off again into the rain. Nobody wanted to check out a small hole filled with mud that was seen in a coffee field. Over a ridge and down into another sink, James climbed down into a hole. He climbed out to report a chamber over 30 meters across and 10 meters tall, with no leads. So on into the jungle, which, though it had quit raining, was becoming quite steamy. After about another half-kilometer, up out of one large sink and down into another, a small entrance was pointed out. James and Jerry quickly scrambled into the entrance and disappeared down a short climb. They explored about 30 meters to a small room with two pots catching drips from the ceiling. After another 60 meters, the cave was still going, so they returned, lest they be called scoopers. A short distance farther into the jungle a small pit was found. The hike was starting to take its toll, so everyone decided to head back to camp. The

return by another trail yielded more dolines and two more pits, very small, among coffee and bananas. Back in camp, Peter and Terri eagerly heard about the ten new caves, some with good potential.

Everyone except Peter and Terri was worn out from the 4.5 kilometers of hiking up and down dolines. After lunch, though, virgin passage in Paxal Ita Te was waiting. Peter, Terri, and Enora began the survey from the entrance, while James and Jerry rigged the pit and began to survey from there. Two bolts were used to rig the 17-meter pit, which led to a small canyon that ended after 15 meters of tight passage. When they returned from surveying that area, no one was at the entrance, but the others' gear was still there. They had found a small room above the pit, with a passage leading out of it up high. Following this, James and Jerry soon went down some short climbs into a large room, where there was still no sign of Peter's group, except for survey flagging that kept going in passage that kept getting bigger, still trending down short climbs. Several hundred meters of passage had been surveyed by the time James and Jerry caught up with them. Then the passage led to a large drop into a dark canyon, and, having no rope, they all decided to call it a day.

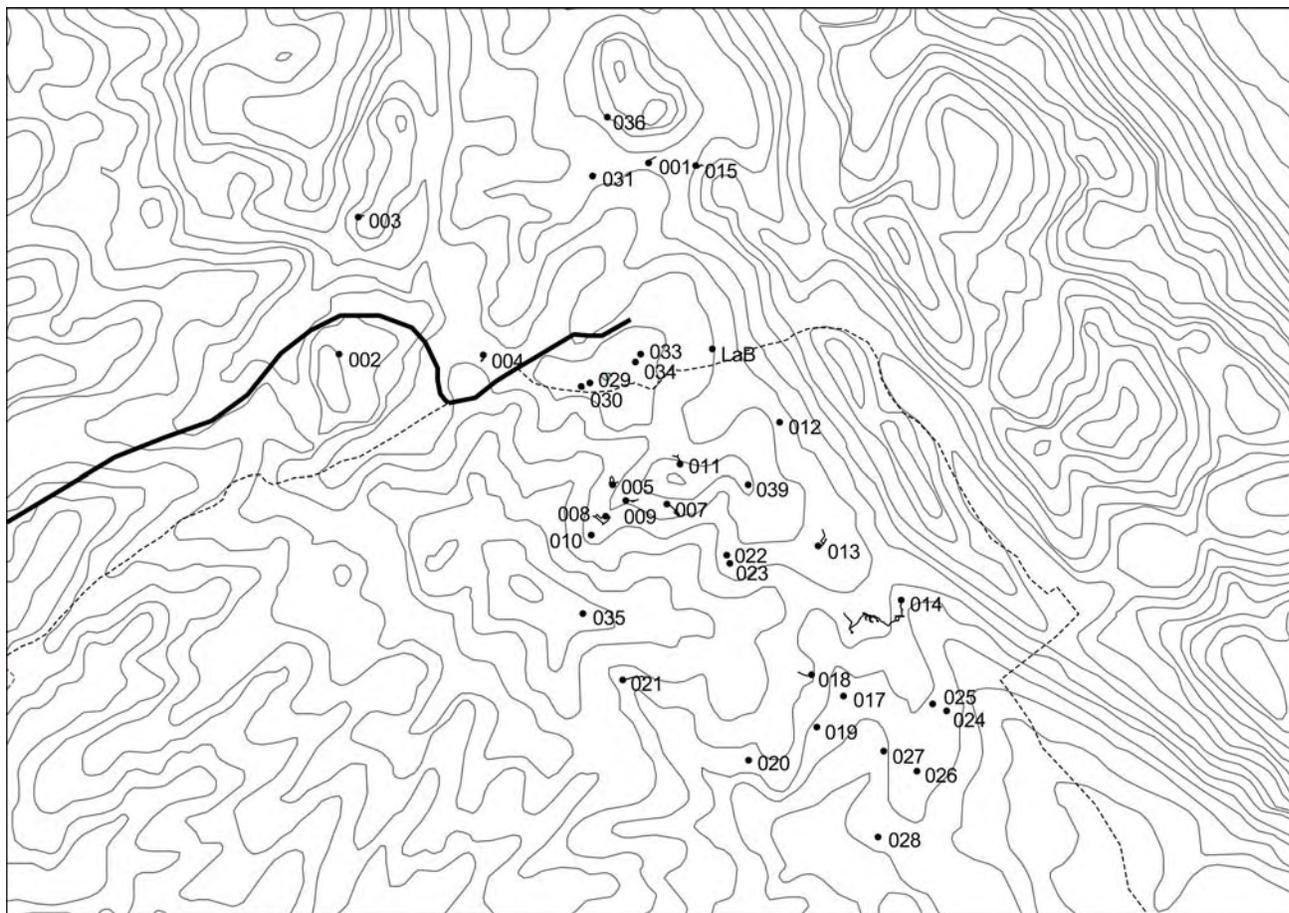


James Lopez in the entrance to Sótano del Rayo de Luz. *Jerry Fant.*

Waking early to the rooster on Wednesday, everyone's thoughts were on a cave that was going big, with one team going to push the flowstone bridge in Sótano del Rayo de Luz and the second going to continue in Paxal Ita Te. James, Dale, and Jerry went into Rayo de Luz in perfect weather. There they started the survey and worked their way down to the last rebelay, planning to check out the lead seen earlier. James descended farther to a flowstone ledge, got off rope, and waited for the others to join him. Jerry descended next, discovering that they had passed the lead and were only 25 meters above the bottom of the cave. The survey was taken on down to the bottom, 90 meters deep. On the way out, the route into the promising canyon, an easy climb from a ledge, was spotted. They did not have the drill with them, so the 60-degree slope up 18 meters will have to wait until another trip. On the surface, a huge

The Perez family, hosts in La Brecha, with Peter Sprouse, Terri Whitfield, Denise Prendergast, Dale Barnard, Enora Fant, Jerry Fant, and James Lopez; Thanksgiving 2001. *Jerry Fant.*



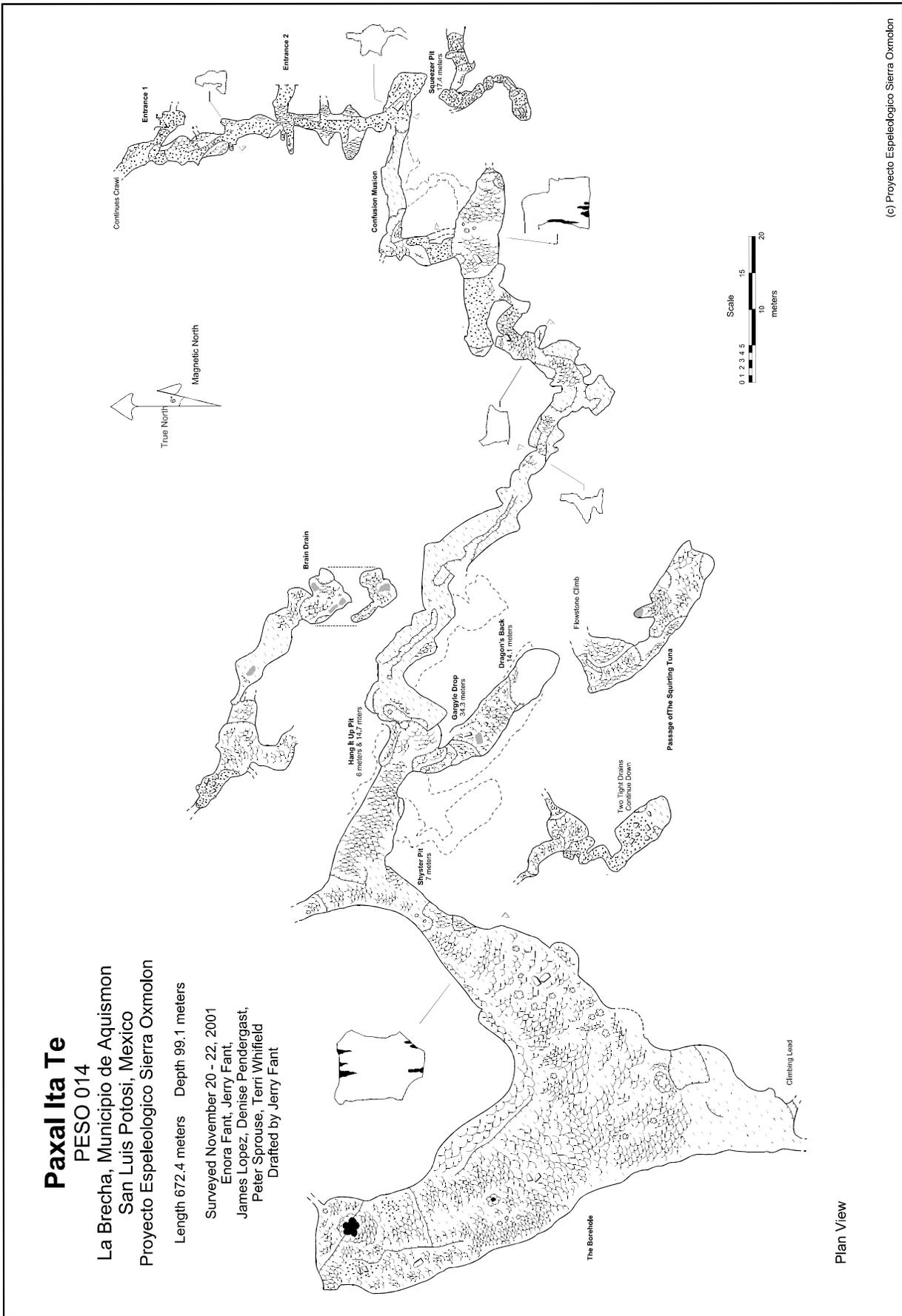


CAVES IN THE LA BRECHA AREA

thunderstorm awaited the crew as they made their way up past the rebelay. The rope was left rigged at the pit to avoid dodging lightning any longer than necessary, and the dash for camp was made over a flooded trail. How much water had the other party seen? Ita Te seemed to take a lot of water, judging by the clean-washed rocks in the entrance sections.

After eight hours in Ita Te, that team made their way back to camp to tell tales of more pits and huge rooms. They had not noticed the rain while they were in the cave. They had surveyed down the big drop, which was actually two drops, of 6 and 15 meters. Thwy led to another drop of about 30 meters, which Terri descended to still another drop that needed another rope. Back up in the canyon, a 7-meter drop was located but not descended. The canyon continued and soon led to a passage off to the south. They pushed on, and the south branch began to descend into a huge chamber they called The

- | | |
|----------------------------------|--|
| 001 Sótano del Rayo de Luz | 021 Paxal Pach Ja |
| 002 Cueva del Cielo Enciendiendo | 022 sink lead |
| 003 Sótano Cerca Talabja | 023 Sótano de Plátanos |
| 004 Cueva No Se | 024 sink lead |
| 005 Cueva Tres Raices | 025 sink lead |
| 007 Cueva Pisos Falsos | 026 Sótano de los Espeleólogos Perdidos (or Jol Quili) |
| 008 Sótano del Cañón Barba | 027 Sótano de Huasteca (or Jol Quele) |
| 009 Cueva del Hoyo Inclinado | 028 Sótano de La Linja (or Sigui Jol) |
| 010 Sótano de Chuchumbex | 029 Sotanito del Baño |
| 011 Sótano del Grito | 030 Sotanito de la Rota Botella |
| 012 Cueva al Brate | 031 Sótano de la Araña Blanca |
| 013 Cueva del Agua | 033 Cueva de Casa |
| 014 Paxal Ita Te | 034 Cueva de La Brecha |
| 015 Sótano del Grieta Chica | 035 Sotanito de Nada |
| 017 Sótano del Camino | 036 Cueva del Pato |
| 018 Cueva Calavera del Jabalí | 039 Cueva del Camino |
| 019 Cueva de la Sala Grande | |
| 020 unexplored cave | |



Paxal Ita Te

PESO 014

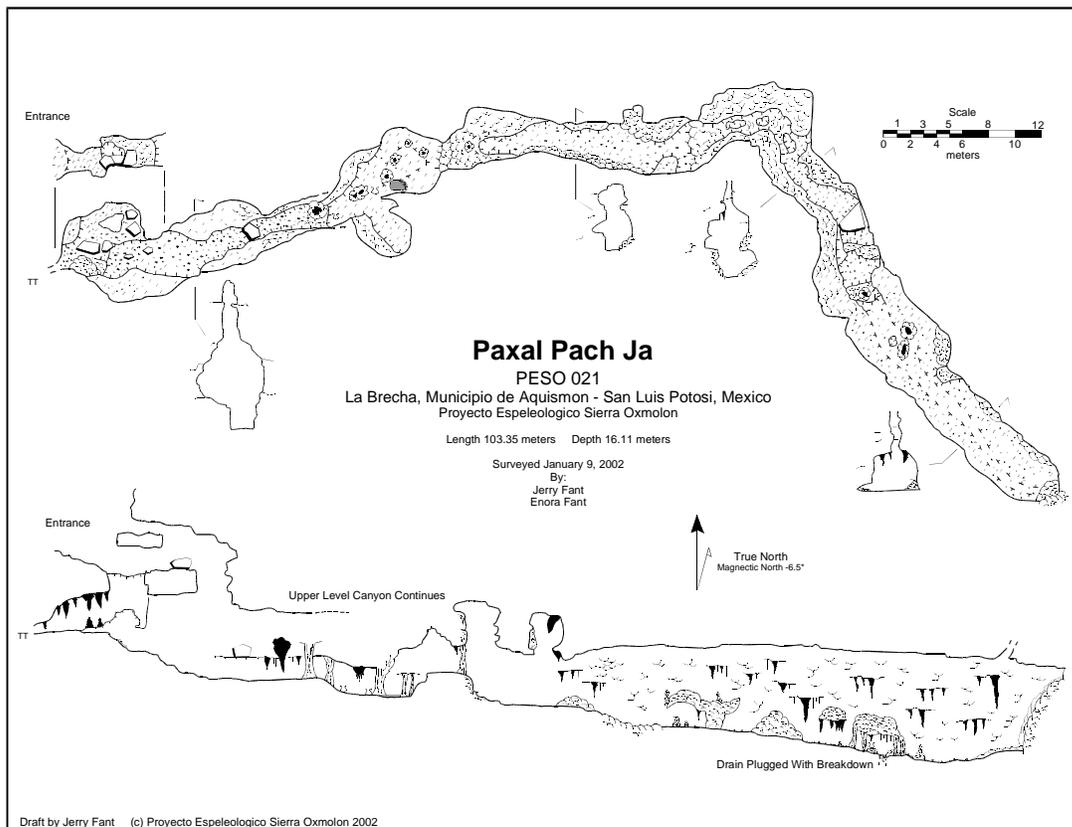
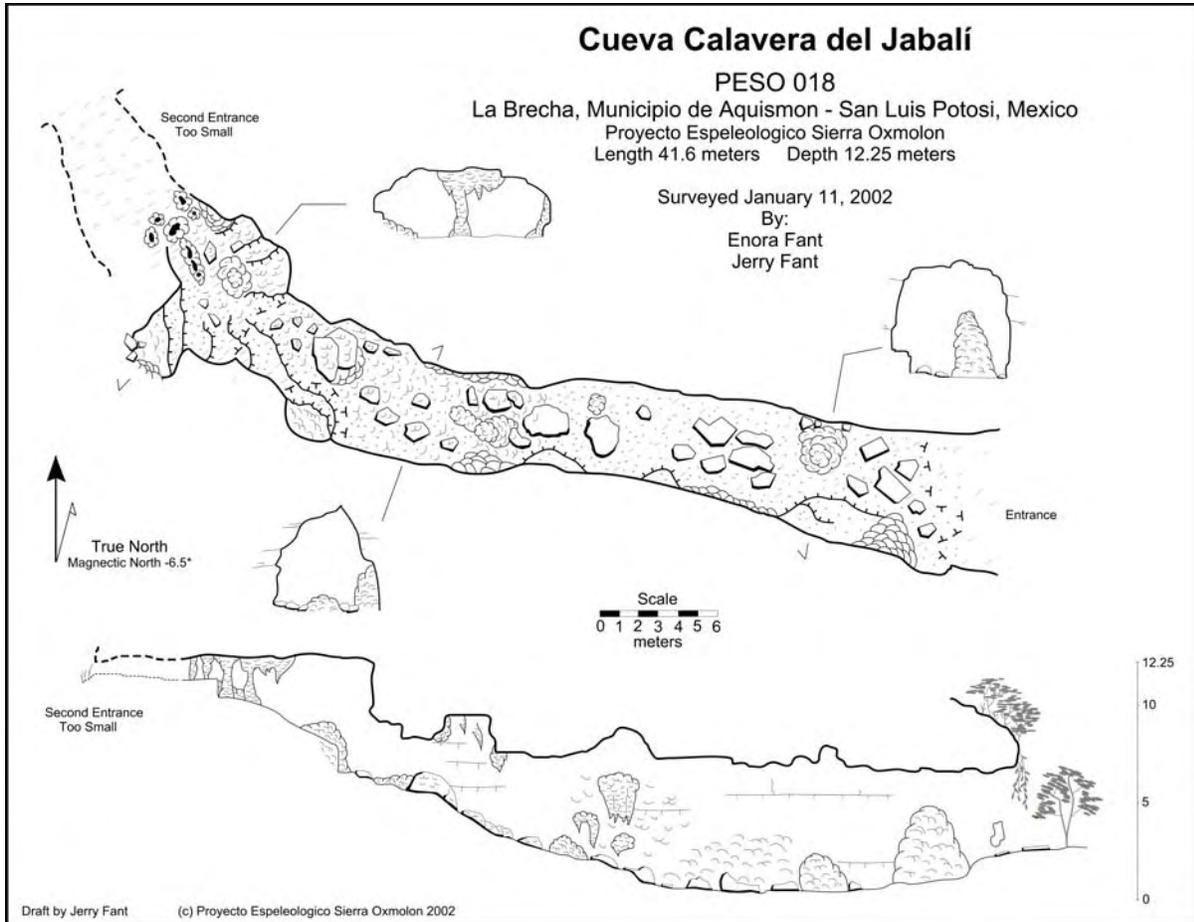
La Brecha, Municipio de Aquismón
San Luis Potosí, Mexico
Proyecto Espeleológico Sierra Oxmolón

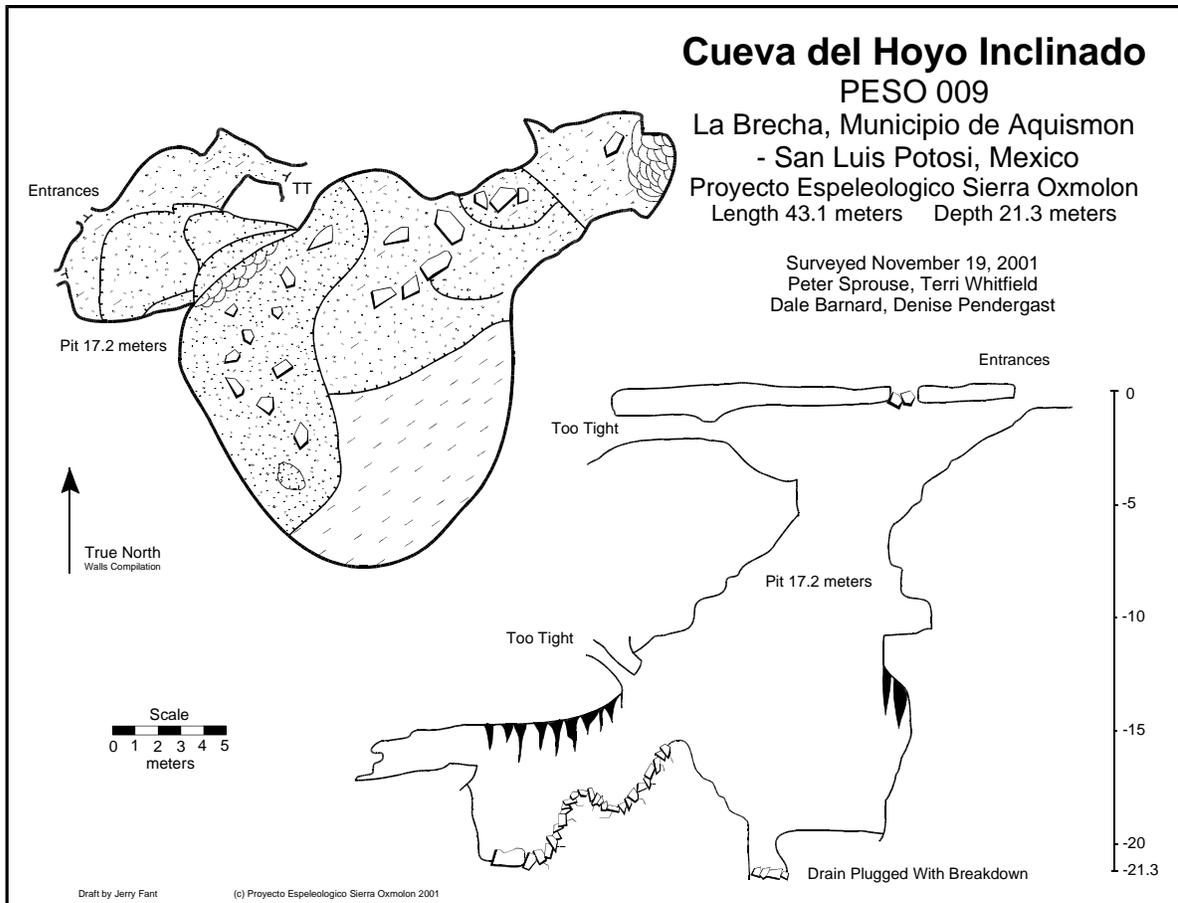
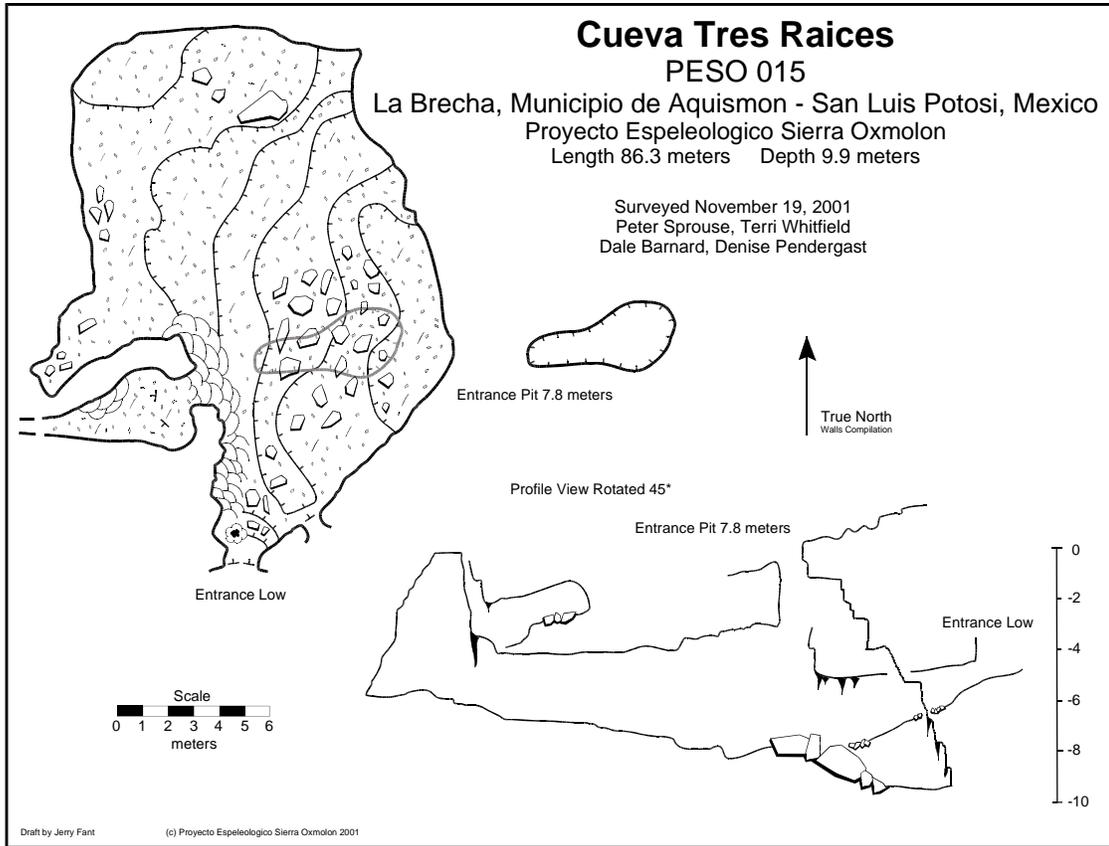
Length 672.4 meters Depth 99.1 meters

Surveyed November 20 - 22, 2001
Enora Fant, Jerry Fant,
James Lopez, Denise Pendergast,
Peter Sprouse, Terri Whiffeld
Drafted by Jerry Fant

Plan View

(c) Proyecto Espeleológico Sierra Oxmolón





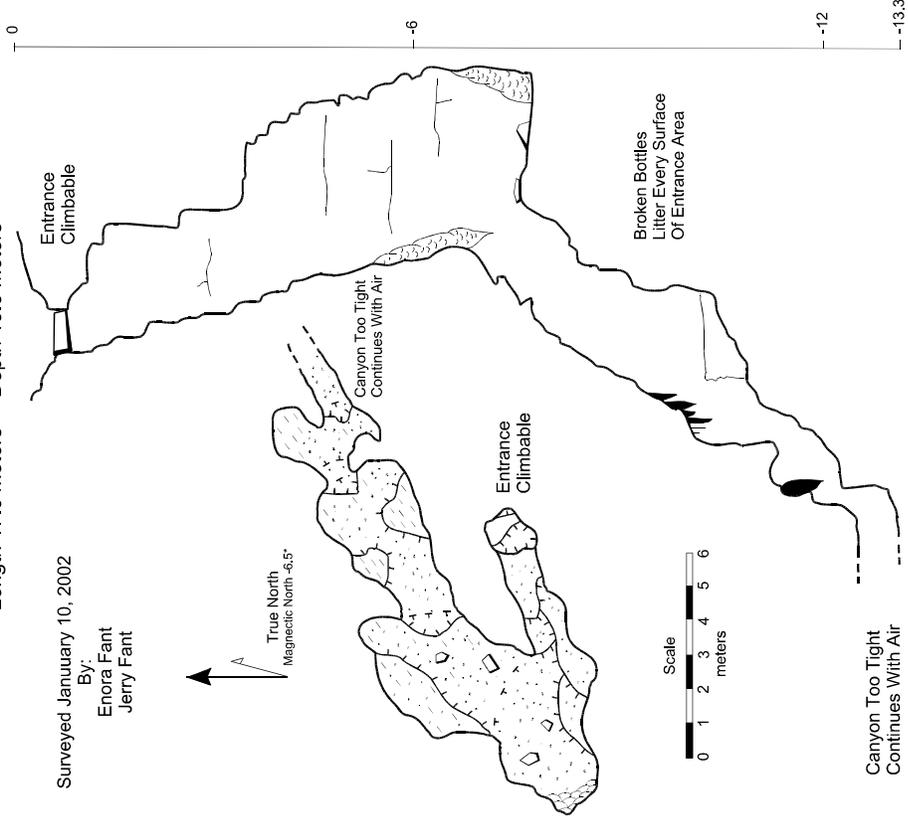
Sotanita de la Roto Botella

PESO 030

La Brecha, Municipio de Aquismon - San Luis Potosi, Mexico
 Proyecto Espeleológico Sierra Oxmolon
 Length 17.6 meters Depth 13.3 meters

Surveyed January 10, 2002

By:
 Enora Fant
 Jerry Fant



Draft by Jerry Fant (c) Proyecto Espeleológico Sierra Oxmolon 2002

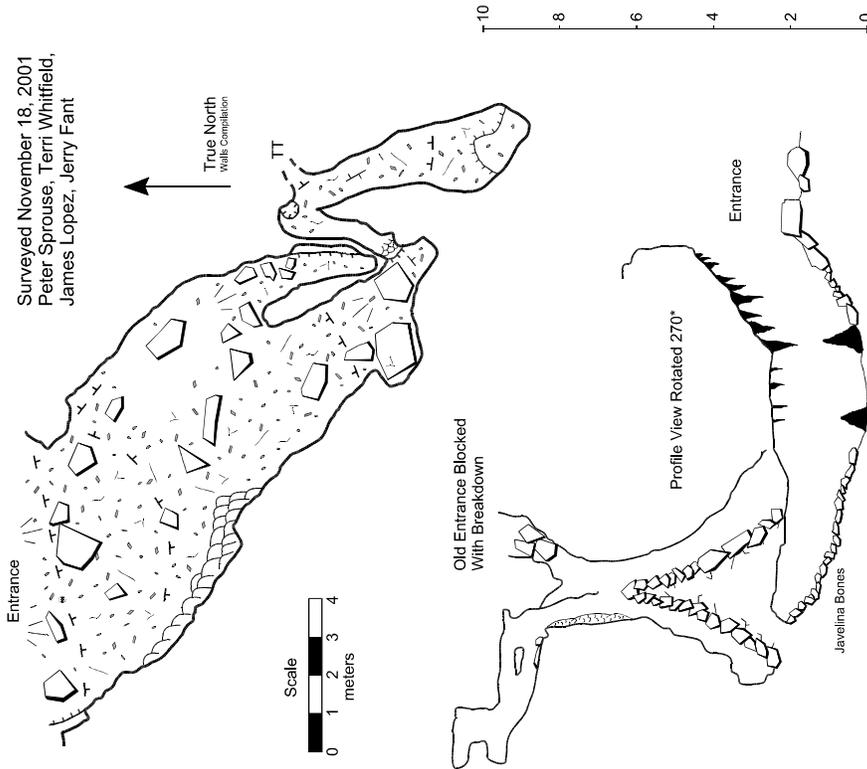
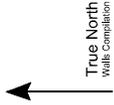
Cueva No Se

PESO 004

La Brecha, Municipio de Aquismon - San Luis Potosi, Mexico
 Proyecto Espeleológico Sierra Oxmolon

Length 33.7 meters Depth 8.5 meters

Surveyed November 18, 2001
 Peter Sprouse, Terri Whitfield,
 James Lopez, Jerry Fant



Draft By: Jerry Fant (c) Proyecto Espeleológico Sierra Oxmolon 2001

Borehole.

On Thursday, Peter, Terri, James, and Jerry went deep into Ita Te, surveying their way down the 30-meter drop. Jerry rigged the following drop, the 14-meter Dragon's Back, with flowstone cascades most of the way down. The passage at the bottom goes a short distance before ending in a drain filled with breakdown. Back above that drop, the survey went around several corners in a passage off the 30-meter drop, to be stopped this time by flowstone. After the lower part of the cave was derigged, attention turned to the 7-meter drop seen the day before; maybe a way on could be found there. It led to a small room with an even smaller passage leading out of it. After 15 meters, this crawl opened up into a room filled with breakdown. Two drains were impassable, but water could be heard running below. An upper lead could be seen, but reaching it will require bolting. All the easy leads in Paxal Ita Te had been surveyed, and it was time to head back to camp.

Meanwhile, Dale, Denise, and Enora went to derig Rayo de Luz and survey a small pit Enora had

found near there on Monday. Dale finished sketching the big pit and lugged the 100-meter rope over to Sótano del Grieta Chica. This proved to be 10 meters deep, into a small room with two bolting leads, one at each end. Both have flowstone cascading out of them, and both are very near the surface. The cave is 13 meters deep and over 30 meters long.

After almost everyone had packed up and headed home on Friday, Enora and Jerry tried to survey a small passage near the entrance of Ita Te, but the instruments were found to be fogged up. The passage was pushed for about 100 meters to where it was blocked by flowstone. After taking some pictures of the entrance, they went ridgewalking between La Brecha and La Linja. Several karsty areas were located that will need thorough investigation, and two small pits were found. Before they drove away from La Brecha, they were told about three more pits that would have to wait until the January trip.

January 6, 2002, found Enora and Jerry Fant back at La Brecha. Ita Te was 672 meters long and 100 meters deep, and hopes were high for making it longer and deeper. Several others were to join them on Monday to help with that cave and others found in November. On the way out from Aquismón, a stop was made at the *lanim* (*nacimiento*) to see if it was still full of water. It was, only 8 meters lower than during a visit in 2000. This is a major access into the river that drains the mountains, and locals have said it is 2 kilometers long. Several of the people given rides on the road reported many more caves and pits. Camp was very cold, but dry.

Monday the Fants went into Aquismón for needed permissions, a change from earlier visits. Carlos Perez helped with the authorities, and they got permission for the project. The expected

cavers had not shown up. Later, back at La Brecha, a short ridgewalk found another small pit, Sótano de la Araña Blanca, and a small shelter cave behind Sótano del Rayo de Luz. Before dark, Carlos showed them three more caves near or right in the village. One by the road was full of trash and needs to be cleaned out before it is entered. One pit in the sink across from Carlos's house was only 7 meters deep and led to a small room and a very small passage that soon dropped another 6 meters to a mud block. The pit had human feces at the surface and down the drop, so it was named Sotanito del Baño.

The next morning it was cold at 5:00 A.M. They drove in the dark to La Cuchilla, where Señor Perez was working and wanted to show them a big cave before work. The cave is located in a huge sink and has a short climb down into a large room. The drain from this room is blocked, but by climbing over the flowstone, another passage is reached that has a 7-meter pit, supposedly to lots of cave. Back at camp, Carlos and Jerry spent two hours digging open a small cave there, but it went only 5 meters before pinching in flowstone and mud. Later in the long day, Enora and Jerry went to Sótano de la Araña Blanca to push and map this cave. They needed to clear some vegetation from the entrance. The first pitch landed 6 meters down on a sloping breakdown floor. A rebelay was needed for the second drop, 9 meters. Several small climbs led down to a bottom where the passage becomes too small to follow, although slight air-flow was felt.

On Wednesday, a new route to Paxal Pach Ja was found, eliminating 3 kilometers of hiking. The survey progressed rapidly into the canyon that James Lopez and Jerry Fant had left in November. Four hours were spent surveying. That night was spent back in Aquismón eating dinner with Mike Walsh and Ben Kim and talking about Walsh's recent flight over the area looking for new caves.

On Thursday, Carlos accompanied Enora and Jerry to Paxal Pach Ja, where the survey was completed

Guide Carlos Perez, Jerry Fant, and James Lopez hike through banana trees. *Enora Fant.*

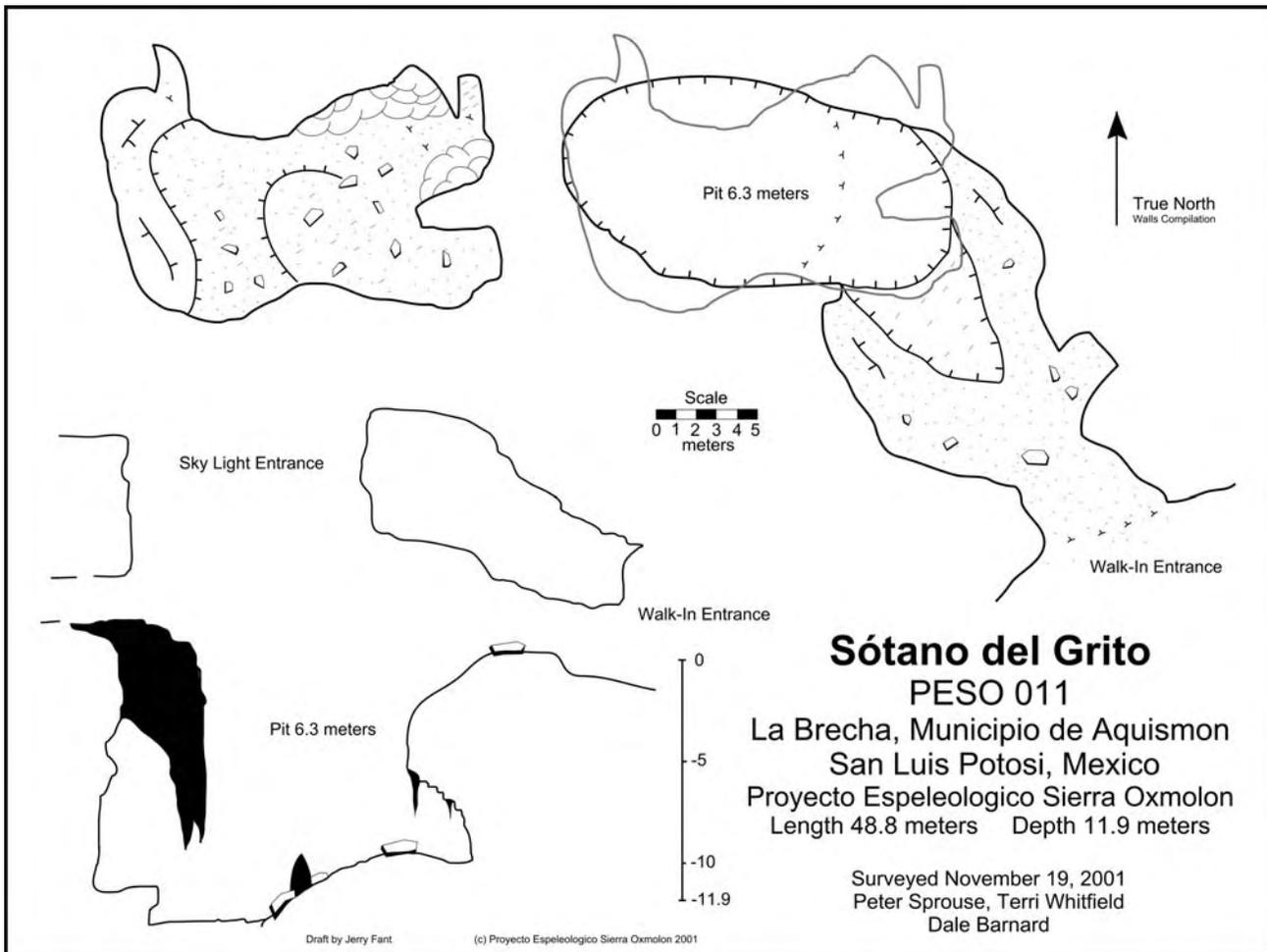


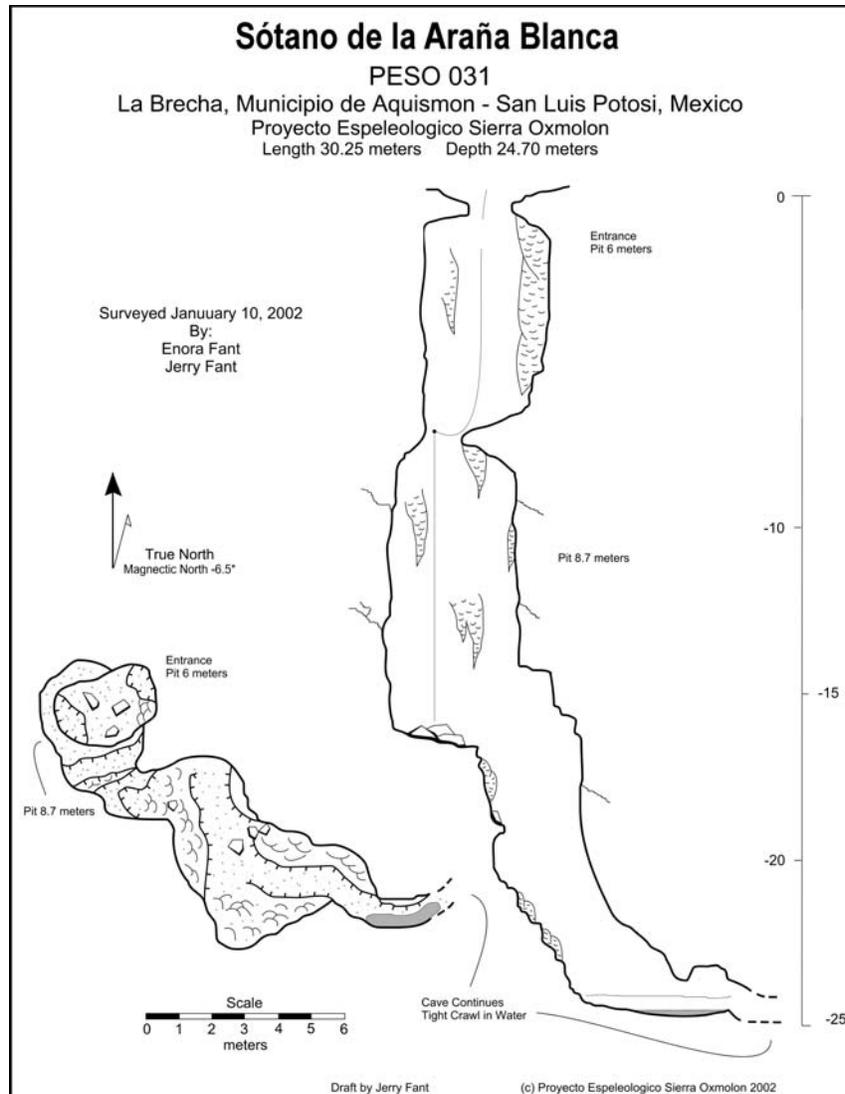
and Carlos found a pot full of water near the end. The cave ends after 103 meters in flowstone fill, with roots coming in from the surface. On the hike back to camp, several sinks were looked into. One sink just below the trail yielded Sotanito de Nada, which had a horizontal entrance to a 7.4-meter drop into a small room that Enora, who dropped into it with the tape, found didn't go. After dinner they made the short walk to the sink across the road to Cueva de la Rota Botella to begin the survey. The entrance was found to be climbable, over crumbly walls and broken glass. It dropped 7 meters into a small room with flowstone-covered walls and more broken glass. A small squeeze opens up into another small room with more broken glass and vials for veterinary medicine. A tiny drain was pushed into small passage that soon became too small. Lots of water flows through here

during the rainy season. Botella surveyed out to 17 meters long and 13 deep. On the climb to the surface, a large rock collapsed and hit Jerry in the leg.

The last day, Friday, things got off to a slow start. Finally a hike was made to Sótano del Camino to survey and push. This entrance was located but not entered during the long hike in November. Things must have looked different in the rain, because it turned out to be only an open fissure 4 meters deep. It was a short hike over to Cueva Calavera del Jabalí. The large, impressive entrance to this cave measures 6 meters wide and 6 meters high. Ten meters inside, a large flowstone mass rises 5 meters from the floor. The cave soon trends upward into a large room blocked by flowstone. During the Thanksgiving trip, a strong breeze was felt going through the flowstone here. After they finished the survey, Jerry

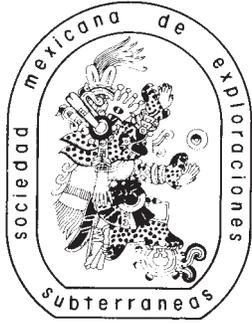
squeezed through and entered a crawlway that soon led to another entrance. So much for the strong breeze. Later, after the truck was packed, Carlos offered to show them another cave, near his father-in-law's house in La Laja. His father-in-law carries water quite a ways and wanted help locating a new source close to home. The cave ended up being closer to San Miguel than La Laja, and it has a nice walk-in entrance. It continued 50 meters to the window of another entrance, and after another 50 meters flowstone almost blocked progress. Several climbs up and down for another 100 meters led to a 5-meter pit. Rope and vertical gear had been left at the entrance and were easily retrieved. At the bottom of the pit were two drains that did not go. Beyond was big canyon to several hundred meters more passage. But Carlos and his family were waiting in the rain, so the cave was left going.





Proyecto Espeleológico Sierra Oxmolón

Los nuevos caminos han hecho accesibles las montañas al oeste de Aquismón, San Luis Potosí. Algunas cuevas, en su mayoría pequeñas, se descubrieron cerca del poblado de La Brecha.



FILO DE CABALLO, GUERRERO

Ramón Espinasa-Pereña

Located to the west of Chilpancingo, the capital of the state of Guerrero, the Filo de Caballo area first attracted my attention in the early days of 1986, during an expedition with Italian cavers, when I saw it from the Huacalapan-Omiltemi plateau, site of the longest cave in Guerrero, Cueva del Borrego, and the unfinished Sumidero de Xocomanetlán. Unfortunately, many other projects prevented us from visiting this area until 1998.

After getting aerial photographs of the area, we made four scouting trips and located many good-looking entrances over a two-year period. The area consists of three main limestone plateaus separated by valleys excavated down into other rocks. On the first scouting trip, which was mainly to get to know the roads in the area, we met Don Florentino Merino in the small village of Corralitos, in the center of the middle plateau, who has been very helpful both in showing us entrances and obtaining access to all the cave areas. The second scouting trip was to the southern plateau, where locals at Filo de Caballo took us on an overgrown road to Cueva de la Majada, which has a very nice entrance that was taking a small stream, and they also mentioned a sinking stream and many other caves at a place called Los Otates. We then followed the main road across the plateau and down to the town of Yextla, where Don Flor had told us there was a large cave. This turned out to be Yextla's main water supply, a large, enterable resurgence. Majada, Los Otates, and other deep dolines 1400 meters

higher gave us hope for a very deep cave in the plateau.

The third trip was ridgewalking on the northern plateau, where we had seen a huge depression on aerial photos. The depression had formed, we later found out, in the core of a granite intrusion onto the limestone. Ignoring for the time being the many large dolines near Puerto Fresno, where we had parked my truck, Ruthy Diamant, Sergio Nuño, and I walked along the limestone-intrusive contact to the bottom of the depression. We were impressed by a headwall over 70 meters high, but very disappointed when we found that the three large streams that drain over 3 square kilometers disappear in a huge mud-choked plain at the base of the wall. There was not even a tiny hole in the limestone. The depression is over 300 meters deep and 3 kilometers long, and three hours of uphill struggling took us back to the Puerto Fresno area. About a hundred meters from the truck, the path we were following passed by the side of a tiny doline in the bottom of a ravine. Though we were very tired, we decided to give it a look, just to be thorough. Sergio went down, and his yells of excitement made Ruthy and me follow. Although the entrance at the bottom is not large, it immediately drops down a vertical pitch. Rocks thrown down fell free for 3.5 seconds and then rattled on out of hearing, making us calculate a depth of at least 70 meters. A few bats, disturbed by the noise, flew out of the pit.

After we got back to the truck, we discovered that Rancho de Puerto

Fresno, a small (well, tiny) village of about four houses, is about 200 meters farther down the road. The locals were quite friendly and immediately showed us their local garbage-dump sótanos, which looked okay, except for all the trash that had been thrown into them. We will leave those for the time when Filo de Caballo has its own caving club.

We camped by the road, and the following day we woke up early to go check a series of large dolines seen on the aerial photos in a place we later found out is called Agua de la Golondrina. We drove through a gorgeous forest among tens of small and large dolines until we reached the main depression. We walked down a ravine and were soon walking on the bottom, where three small arroyos that carry intermittent streams join. Around a corner we came to the entrance of Sumidero de Agua de la Golondrina, a good 20 meters high by 10 meters wide. Sergio and I immediately turned on our lights and entered. A few tens of meters in, we came to a series of downclimbs that eventually took us to the edge of a 15-meter pitch. At the bottom, a large stream could be heard, and the cave was sucking air hard.

In the summer of 2000, a fourth recce trip was organized. Gustavo Vela, a Grupo Espeleológico Universitario caver recently transferred to the Sociedad Mexicana de Exploraciones Subterráneas, and the SMES core, Ruthy and I, were the team. We spent all the first day checking the high area on the middle plateau, where every surface is either a doline slope or a

doline edge. We found a few small holes, two cave remnants, and at least three old poppy fields. Apparently no large-scale logging has occurred in many years, but there are quite a few logging roads. We camped by one of them, cooking under a large yellow tarp, since it continued to rain, as it had been most of the day. The next morning, a Wednesday, I went for a walk while Ruthy and Gustavo slept, and I found that we had camped about 100 meters from the largest flowering field I've ever seen, at least 100 by 50 meters. We decided to go back to Corralitos, where Don Flor lives. We managed to get the truck stuck in the first available drainage ditch by the side of the road and spent most of the day getting it unstuck, eventually, with the help of a manual winch that was loaned, together with a guy to operate it, by Don Flor after I had walked down to town in search of help. That night, Don Flor introduced us to the field's owners and explained to them that we are only looking for caves and sótanos and therefore they should not shoot us if we met at the field.

Thursday morning Don Flor arranged for a guide to take us to a resurgence about 300 meters below Corralitos. The actual resurgence was sumped, although the guide insisted you can get through in dry times, when no water flows; he himself had entered it, getting wet only to the chest. Above that, Cueva de las Bailadoras is a nice fossil

resurgence with 5-by-10-meter passage that ends in a silt fill after about 200 meters. The guide insisted that he had seen a very narrow crawlway at the end that leads to water, but we never saw it. Of course, this was a ridgewalking trip, so we only had two flashlights, and we might have missed a narrow crawlway. On our way back toward Corralitos we went through what we called The Valley of Ten Thousand Dolines, and that is about the number of depressions we checked. Most are plugged with silt or just too narrow, but a few have going cave. One is the entrance to a large chamber, maybe 20 meters in diameter, but it ended in collapse. Nearby, a stream-sink was found that would take ladder or rope to check thoroughly, but, considering the size of the stream entering it, is definitely worth returning to. Still, we had not found anything very exciting.

We were rained on fairly steadily, except for short intervals of fog and drizzle and the occasional cloud-burst. With the weather as it was, nobody felt like going up to the southern plateau, so we decided to check on a lead given to us on our first recce trip. El Resumidero is located at the bottom of a very deep *barranca* east of the main part of the southern plateau and just southeast of the town of Carrizal de Bravo. The water supposedly passes 1 kilometer on a straight line and about 300 meters vertically through the hill to come out of Cueva de la Mano, near the town of Pasclar and

famous in the whole region. We found a logging road going to the ridge above the actual *sumidero*, where some locals told us about a path going down toward the sink. The owner of the whole area was there, and he said nobody ever goes beyond a field right at the edge of the gorge. He said he had never seen a cave there and had followed the water to where it disappears among boulders, but we were doubtful.

Friday was actually a clear day, so taking advantage of the sun we decided on a little bit of canyoneering. When we reached the river it was swollen from the previous days' rains, so we went back up to the ridge for a different approach. Taking the old path, we reached a col, probably the ancient surface course of the river, at the field above the sink point, and at the bottom of the field we were at the edge of the gorge. To our right, a large headwall loomed, but vegetation prevented us from seeing our surroundings clearly. Curiously, no river could be heard below. Carefully, as the gorge's edge was very loose, we moved toward the headwall, and when we reached it, we suddenly burst out of the undergrowth to find ourselves in front of an awesome sight. We had come out at a ledge on the gorge, already under the dripline of a truly majestic entrance at least 100 meters high and some 80 meters wide. By a series of traverses we managed to reach the bottom of the gorge at a point already at least 150 meters beyond the dripline, where the entire cave funneled down to 40 meters wide, with a "low" ceiling about 15 meters high. That is as far as natural light goes. Although no water was flowing in the gorge, going upstream in it would surely would have taken us to the actual river sink. It is obvious from the vegetation and dust that this entrance has not been used by the stream for centuries. Proceeding into the cave below the low ceiling, which lasted for some 50 meters, we came into a room 100 meters in diameter. To our right we



Landscape in the Filo de Caballo area. *Ramón Espinasa.*

could hear the water, but we first went left, thinking of going around the perimeter. At the high end of the room to the left we found a large and very beautiful skylight and an upstream canyon passage that was not pursued. Continuing our perimeter walk, we found another lead at the very top of the breakdown chamber. Ruthy and Gustavo followed it to the river, appearing and disappearing in the breakdown. Finally, we headed down to the bottom of the room. The roar of water was very impressive as we neared the end of the breakdown pile, where the river emerged from the boulders to flow into a passage at least 30 or 40 meters tall and about 20 meters wide. Very noticeable airflow followed the water. Though very excited about this discovery, we stopped at the first pool that required immersion, worried about what the weather might be doing outside. Two flashlights for three people in that size of passage can be scary.

We drove, in gathering fog, toward Puerto Hondo, on the southern plateau. On the way we stopped near a marble quarry to check a large doline belonging, I think, to the drainage of Yextla and therefore having at least 1200 meters of depth potential. Like most large dolines in the area, this one contained what at first seemed to be three smaller dolines at its bottom. The highest one looked good, taking surface drainage to what looked like a collapsed entrance. The way in above the collapse was too narrow, but by following the stream Ruthy found a small, inconspicuous entrance, about 1 meter high by 2 meters wide, taking air and water, and she followed it to where she would have needed to get seriously wet to continue. The second doline also had a stream, which we followed until it disappeared under a dolomite headwall. While Gustavo followed a dry, earthy channel to a partially filled but enterable sink with water noises inside, I took a closer look at the base of the headwall and noticed that the wall was actually a narrow ridge about 2 meters wide separating the second doline from the third. The stream

went through a natural bridge to emerge at the bottom of the third doline, crossed it, and sank again at the other end. Mist and vegetation prevented a clear view until we were right at that sink. The water went into a nice passage about 3 meters wide by 7 meters high. With the batteries of my flashlight dying out and thunder starting to be heard outside, I took only a quick look at the stream passage, which soon degenerated to a series of narrow, parallel joints and crawlways. Some airflow could be felt in places, but I could not trace it to a particular crawl. All in all, a worthwhile entrance, particularly considering the depth potential. We continued to our campsite at Puerto Hondo in the gathering rain, cooked our supper under the tarp in the rain, put up our soggy tents in the rain, and then got rained on all night.

Saturday dawned with partially clear skies. Near the campsite, at a viewpoint right at the edge of the cliffs that limit the southern plateau on the south, we saw range after range of mountains to where a very fine horizontal line marked the horizon, the Pacific Ocean, about 70 kilometers away in a straight line. Unfortunately, this view lasted for about five minutes, before we were surrounded again by mist rising from the valley bottom. As we cooked breakfast, it started raining again, damping any intentions we might have had about proceeding to the highest areas of the plateau. As the truck had not been functioning perfectly since the ditch episode and we were tired of being wet all the time, we decided to abort further prospecting and return to Mexico City early.

CUEVA DE LA MANO EXPEDITION. On November 1, 2000, a group of ten cavers from SMES and GEU established a campsite for a Cueva de la Mano expedition on the ridge above El Resumidero and made plans for the coming exploration. The following day we started surveying. While my team made a perimeter survey of the entrance chamber found on the recce trip, Gustavo's team surveyed downstream into a huge canyon-shaped

passage going steeply downward, with the stream cascading among large boulders. We caught up with them when they reached the edge of a 25-meter pitch with the full force of the water going down it. The ceiling had abruptly come down, and the airflow in this section was awesome. A side passage provided an easier option than the thunder of the main pitch, and we were soon in the passage below. We leapfrogged ahead through a much more horizontal passage, still following the stream and air. Passing a few side leads, we eventually came to the edge of a pool in a marvelous clean-washed and perfectly circular tube 15 meters in diameter. A near-swim followed, and we were soon admiring some gorgeous flowstone coming in from the right, just before an unclimbable pitch into a deep pool. A high ledge got us into a series of side passages that connected to the stream passage higher up and also led to a higher ledge farther downstream, from which we could see a giant passage heading off into the darkness. Our two teams had surveyed a total of over a kilometer, and we decided to head out. After an interminable hike on which we gained over 250 meters of elevation, more than half of that in the cave, we reached the campsite.

November 3 saw Humberto "Tachi" Tachiquin and Gustavo leading two teams into the cave early. From the previous end, one team continued the survey, and the other carried on rigging. The large tunnel seen from above turned out to be very big, with passage dimensions up to 30 meters wide and usually that high or higher. A second round, polished tube was found, 15 meters in diameter, and then the tunnel opened up again to massive proportions, over 40 meters wide. Up above, a series of ledges could be seen on the right. A sudden narrowing of the main passage preceded a series of two short pitches, which were rigged out the water, although some of the team members elected to jump into the deep pools waiting below. Again the passage opened up, and two apparent boreholes could be seen

high above on the right. A long, straight tunnel continued ahead and ended in a large room. Although a huge passage was plainly visible on the left, the light from the bottom entrance could be seen to the right. The surveyors caught up with the riggers as they were descending a short drop. This was followed by a last one, which was not rigged because a side passage to the left allowed an exit without swimming the last pool. Here they found flagging that had been left by Ruthy and Sergio, who had reached this point a few hours earlier on a surface trip from the campsite. Following the flagging, the two teams of cavers were able to locate the path and the road, and, after a gain in altitude of over 300 meters in less than 2 kilometers horizontal distance, they got back to the campsite on the ridge.

The following day my team, lured by the description of the cave, decided to do the reverse through trip, derigging on the way and surveying a few of the side leads. One of the two main inlets near the bottom was followed up a series of cascades to a sump. The huge passage seen to the left when approaching the bottom entrance was followed, but not surveyed, to an incredibly large wood and debris pile, beyond which a small stream was found to originate and disappear at sumps. The two high boreholes near the Second Tube were basically large ledges, although one of them included many gorgeous formations. Also near the Second Tube, another

inlet was followed to a complex area where several leads were not pursued to ends.

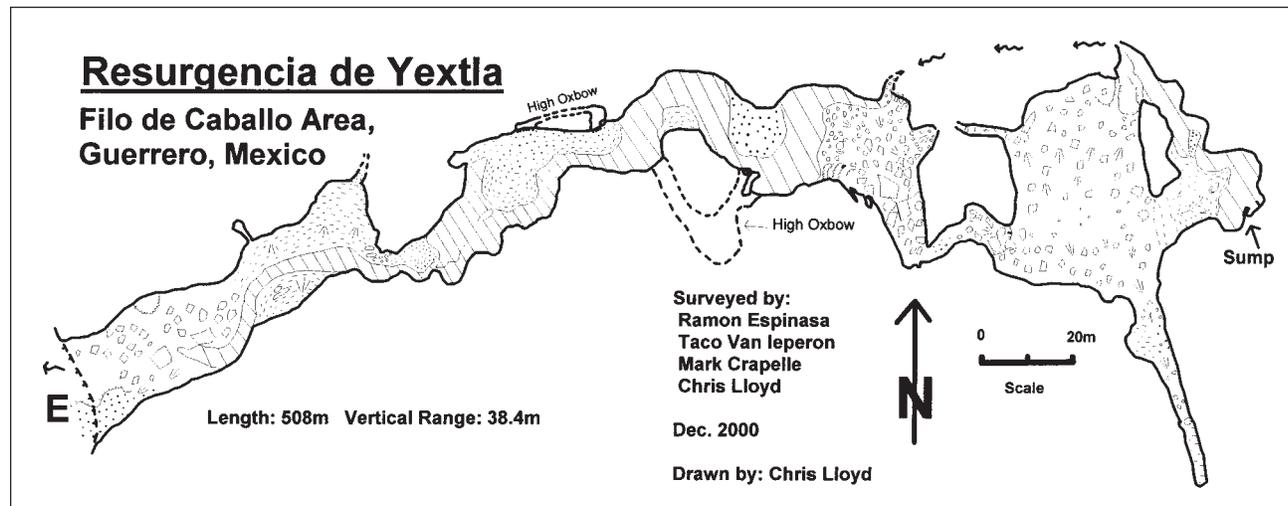
The final surveyed length of Cueva de la Mano is 2786 meters, with a total depth of 238 meters. There are still quite a few leads, and the through trip is quite exhilarating.

LLANO DE OTATES EXPEDITION. The following Christmas, my ranting and raving about the great potential of the area above the Yextla resurgence resulted in a rather large group, by SMES standards. Three cavers from Canada, two Brits, and ten Mexicans participated for varying lengths of time. We established base camp at Llano de los Otates, after having quite an epic time trying to locate it the previous night. The little stream by the campsite sank at the bottom of the doline less than a hundred meters away, and the two Brits, still thinking they were back home, immediately started a digging project and by afternoon had already excavated a 3-meter-deep cave. Meanwhile the rest of us started walking around, as no previous trips had checked this area. Unfortunately, although many sites were looked at and some started out really promisingly, almost all our finds were quickly choked by logging debris.

Cueva de los Mármoles, a promising stream-sink back near the marble quarry along the main road, got our adrenaline going for a couple of days, but ended rather disappointingly at a sump at 64

meters depth after only 350 meters of nice streamway, the rest of its 846-meter length being upper-level, fossil passages that were pushed hard in a failed attempt to get past the sump. Cueva de la Majada, in spite of its large entrance, ended rapidly in a too-tight meander, as did another small cave nearby, Tomatillas de Taco. Some long scouting trips to the upper part of the plateau resulted only in finding lots of flat-floored dolines.

Finally, on the ridge immediately above Yextla, a large cave entrance taking a stream was found. Since it also had lots of air flow, we really got excited, so much so that we actually spent a whole day cutting old trees out of the nearest logging road in an attempt to shorten the walk in. Finally, a group left camp with the intention of pushing this Cueva de la Ortiga. Knowing that the only available resurgence, Yextla, was over 1100 meters lower and only 4 kilometers away made us feel confident. A nice, steeply sloping entrance almost 20 meters wide soon degenerated into a narrow meander that soon ended abruptly against a gravel fill. A desperate climb above this reached a low crawl, and soon we could hear the stream again. We popped out at the top end of a larger passage, and a few meters ahead a large breakdown could be seen. Fortunately we easily passed through the boulders to a continuing stream passage, but, unfortunately, after crashing down over some very nice gours, the stream entered a very narrow and immature crawl



Cueva de la Mano

Carrizal de Bravo, Gro.

Longitud: 2,786 metros

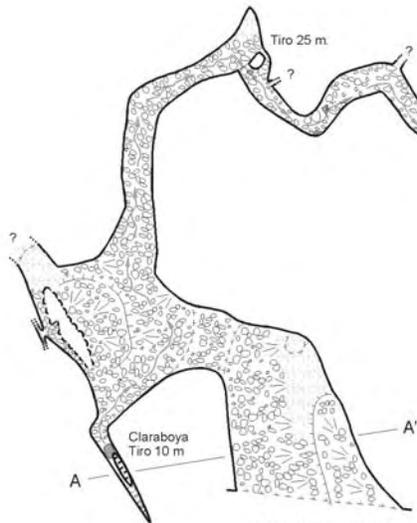
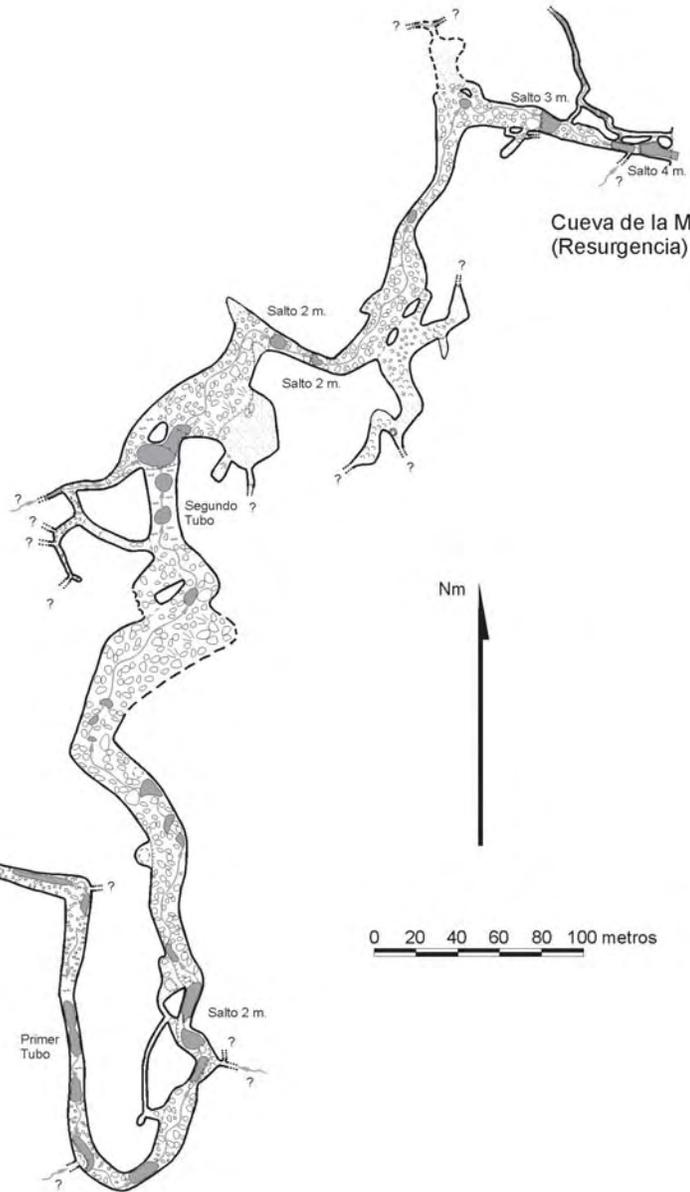
Desnivel: 238 metros

Topografía realizada en noviembre 2000 por:

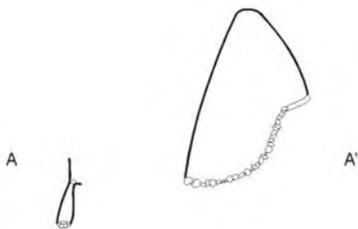
Ramón Espinasa Pereña	Gustavo Vela
Ruth Diamant	Diana Aguilar
Sergio Nuño	Victor Chavez
Humberto Tachiúin	Susana Balderas
Jesus Reyes	Erik Molino

Dibujo realizado por:

Ramón Espinasa Pereña y Ruth Diamant



El Resumidero



that is plugged to the ceiling. The dig looked so bad that not even the Brits cared to contemplate it. A series of crawls made a short loop, but only reached the base of a dome. Back at the breakdown, a way was found up into a large room floored in huge blocks and covered with a thick layer of bat guano. A short climb above this gained us an obvious passage right above the streamway. This ended at a pitch, but unfortunately this happened to be the dome we'd seen in the crawls below. More searching in the breakdown and crawlways didn't produce a going lead, so after surveying only 336 meters of cave we returned to base camp very disappointed. More searching in the dolines on this ridge produced a few other spectacular entrances, but all of them silted shut still in twilight.

We now decided to attempt to get into the plateau from below, through the Yextla resurgence. After the long and steep drive down, we parked the truck in front of the cave and, while getting proper clothes on, engaged in conversation with the passing locals. We were pleased to be told how nice and beautiful the cave is. When we entered it, we all thought this was what we wanted: large, walking stream passage that just kept on going. After 300 meters of this, we came to a breakdown choke. The stream issues from a very narrow passage on the left, but we elected to carry on in the large passage above the breakdown. We came out in the side of a very large chamber at least 40 meters wide, and we could see leads at both ends, as well as on the other side of the chamber, where a small mudslide took us back down to the stream. Unfortunately, the water was issuing from a sump pool. The other leads just produced some more breakdown, so the total length is only 508 meters.

On the next to last day of the expedition we couldn't try our planned Cueva de la Mano through trip because of car troubles that required a trip to Chilpancingo. We did the through trip on the last day. A few of the side leads were cursorily looked at and found to be promising, but no new surveying

was done. Everybody cursed the cave gods for not allowing us to find another cave like that during this expedition, and all enjoyed the through trip very much.

SCOUTING THE NORTHERN PLATEAU. Although previous scouting trips had shown that the northern plateau indeed had good-looking entrances, we did not want to spend another winter expedition in Filo de Caballo unless we were sure there would be enough caves to keep everyone happy, so Gustavo, Ruthy, and I decided to spend a week in August 2001 scouting the whole northern plateau. After our experience the previous year, this time we were prepared for rain, with a large tarp, watertight luggage for our clothing, and large ponchos. By this time we had made contact with "the lone gringo," an American caver who, according to the locals, had explored quite a few caves in the area by himself, and we had established that although he had indeed spent some time in the area and explored at least one cave to nearly 200 meters in depth, he had done no surveying and had no plans to return and properly document his finds. His deep cave was Sumidero de Agua de la Golondrina, which we had found on our second scouting trip and where we had decided to establish our base camp. Our days were all spent ridgewalking, and each and every day we found some very nice entrances. On the last day, we took the truck down to the town of La Ciénega and followed a guide into Tlaxitine Canyon, where, above some beautiful travertine cascades, he showed us the entrance to Cueva del Agua, a very interesting resurgence cave that could not be entered due to the high flow. A search in the jungle above failed to find the reputed second and larger entrance to this resurgence, which has been entered by the locals "for a very long way, to a window." There were rumors in La Ciénega about robbers in the area, and they were supported by the sudden appearance and as sudden disappearance of a truck loaded with police, so we went back up the road to our campsite at Agua de la

Golondrina. We returned to Mexico City the next day.

PUENTE DE DIOS. Views of the large Huacalapan-Omiltemi plateau during the previous scouting trip inspired us to go have a look at a large depression above the town of Chichihualco, at the northwest end of that plateau. Trying to reach the large doline, which is shown on maps, from the towns of Iyotla and Tepozonalco, we were told that a road went up to the large Puente de Dios cave entrance up there, and that we had better approach the doline from that side. We were told that the road had been made to install a water pipe to take water to Chichihualco. Having found the correct road, we followed it until it disappeared against the hillside. We could actually see the depression we were seeking above us, and quickly found a large path taking us there. The views were magnificent as we climbed steeply to the edge of the plateau. After considerable elevation gain, we crossed a col and were looking into a huge doline at least half a kilometer in diameter and 250 meters deep. On the opposite side, a deep gorge ran down the doline, and we could hear a river crashing down a series of cascades on its way to the bottom. A path into the doline was quickly found and followed. We were in for a surprise.

Reaching the river, we found a series of small dams channeling most of the flow into a water pipe that followed the stream-channel downward into a most impressive entrance at least 100 meters high and 40 meters wide. The screeching of *vencejos* (the same birds that live in Sótano de las Golondrinas) filled the air, and we could see into a large passage of the same dimensions with a floor made up of large breakdown blocks covered with bird guano, reminiscent of the bottom room in Hoya de Guaguas. The stream made its way among the boulders, as did the water pipe. We later learned that the pipe had been placed there by the town of Chichihualco to provide it with water uncontaminated by the guano.

Surveying was made easy by the

huge dimensions and the ample light streaming in from the entrance. After 150 meters, the cave made a slight turn, and we entered a huge chamber nearly 100 meters wide. Way below we could see another beam of light, the lower exit of this short, but very impressive stream cave. A few small side leads extended the cave to 555 meters in length, 420 of which are the main passage. The depth is 93 meters. A short but very impressive through trip; strange that it had not been documented previously.

Once out the other side, we attempted to follow the water pipe, but were soon trying to make our way across the jungle to follow the stream instead. We quickly found a path going in the right direction, and after a short uphill walk we were back at the truck.

AGU A DE LA GOLONDRINA EXPEDITION. On our expedition to Sumidero de Agua de la Golondrina, there were three Italians, two Brits and a Canadian, and a grand total of thirteen Mexicans plus three visitors, for varying lengths of time. This was one of the largest SMES expeditions ever.

Our first objective, Agua de la Golondrina, was right by the campsite. Although we had a tackle list provided by the lone gringo, this was rather useless, as he had apparently rigged American style, with

things like, "10-meter pitch, used 50-meter rope, rigged to large natural. Used same rope for the following two pitches." Since we were using 9- and 8-millimeter ropes, we opted for a more European rigging approach. Unfortunately, the Italian and British teams engaged in a contest to see who could produce the most awkward and difficult-to-cross rebelay, thus making the cave a bit too sporting. A first breakdown choke was easily passed, but after fifteen short pitches the large terminal breakdown room was encountered. Although most members of the expedition visited this room, no way on could be found, despite the tremendous airflow just a couple of pitches above it. The survey showed Agua de la Golondrina to be 730 meters long and 193 meters deep. We were really impressed by what the lone gringo achieved all by himself.

The following few days were a bit disappointing, as again most entrances were soon silted up or choked by logging debris. Sumidero de Árboles Caídos, one of our best finds on the previous scouting trip, ended disappointingly after only 187 meters of stream-washed passage, and two of our best-looking leads choked after only one pitch. After a couple days' efforts, Agua del Mosquito was found by Ruthy. Even with the aid of GPS, this cave was not found again until a third

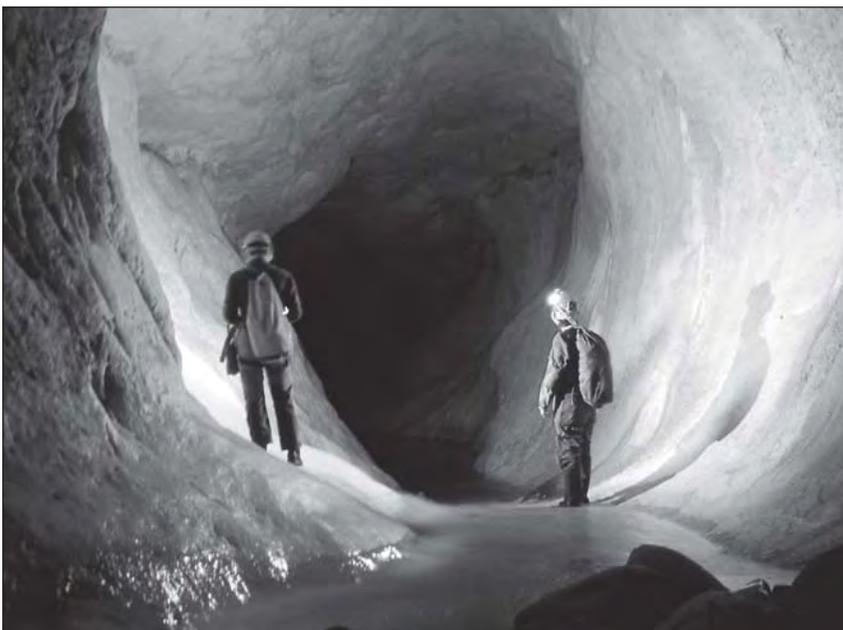
attempt. Unfortunately, two mapping trips found that the large entrance passage degenerated to a very narrow rift that ended the cave.

We decided to make the long walk toward Puerto Fresno, where we had known of a big pit since the third scouting trip. Two of the Italians and Sergio won the first-descent rights and returned to camp late that night full of stories about the very deep entrance pitch, but sad that the only continuation was small and ended quickly. The survey showed that Sótano de Puerto Fresno has an entrance pitch of 99 meters, third deepest in Guerrero, and a total depth of 117 meters. Total surveyed length is only 163 meters.

While they were doing this, a rather large contingent went for a long walk to a large doline at the edge of the main granite intrusion. When we reached its bottom, we found Sumidero de Agua del Carpintero, named after the small woodpeckers nesting near the very good looking entrance, which takes a small stream. The only drawback was the two- to three-hour uphill walk back to base camp. The final days of the expedition were dedicated to exploring this cave and digging efforts in Agua del Pipistrello, a very interesting sink between the road and the campsite, where a very large hading rift eventually took us to several narrow squeezes. These were finally passed by Luciano after getting proper digging tools made by a local, prompting many jokes about him seeking the Timavo River, which he had found, thanks to huge digging efforts, in Lazaro Jerko Cave, back in his native Italy. Unfortunately, no return was made to this cave, because the breakthrough happened on the last available day.

Agua del Carpintero starts very nicely as a narrow, winding canyon excavated in beautiful white limestone. After a few downclimbs, a short pitch of 7 meters took us past a very polished meander to the edge of a bigger pitch of 20 meters,

One of the tubes in Cueva de la Mano. *Gustavo Vela.*



rigged from some stals on the left that provided a perfect free-hang. A large chamber at the bottom appears blocked by a flowstone curtain, but a small duckunder leads to a narrow continuation. A few meters farther, a very short pitch of 2 meters took us to an active streamway coming from the flowstone above. At the pitch that followed, cultural differences emerged, as the Italians rigged a dodgy and awkward traverse to drop the pitch beyond a standing pool of water at its base, while I suggested an easier rig straight down to the water, which was, as it turned out, only knee deep. The Brits who followed a couple of days later rerigged this section, actually making it a lot harder to traverse, in their desire to always use Y-hangs.

A couple of short pitches later,

the cave enters a narrow meander. The Italians again followed a difficult route, a very narrow and tight overpass, to avoid a small drip in the lower, walking-size passage. Italian cave water is very cold, as Paolo used to remind us every time we got dressed for caving, saying in his strange Italian accent, "In Italy, with this, you die," but really this was excessive. The continuation of the meander is somewhat tight and has quite a few short and exposed climbs, and then we hit a squeeze. Paolo took the lead, and we started hearing quite a bit of the finest Italian language when he became partially stuck, and then again when he managed to get to the other side and discovered he was hanging from some tiny handholds above a very dark and very deep abyss. After he returned and we had

the thing rigged, we all proceeded through and down. This pitch, which turned out to be 94 meters, was named Pozo Chiquín. Unfortunately, the bottom of Pozo Chiquín is a breakdown chaos, and although a strong air current could be felt going into the breakdown, no obvious passage could be found. Although only 396 meters long, Sumidero de Agua del Carpintero became the deepest cave found on the expedition, at 210 meters total depth, and is among the ten deepest caves in the state of Guerrero.

Although we haven't yet found the deepest or longest cave in Guerrero there, it is obvious that the region is promising, and it has produced some astoundingly great caves. We intend to continue exploring this beautiful mountain range.

Filo de Caballo, Guerrero

Desde 1998 la SMES ha realizado varios viajes de prospección y tres expediciones al área de Filo de Caballos, en el estado de Guerrero. En la primera expedición se exploró y mapeó la Cueva de la Mano, una travesía de 2.8 km de largo y 238 metros de desnivel. La segunda expedición mapeó la Cueva de los Mármoles, de 846 metros de largo, y la resurgencia de Yextla, de 508 metros, entre muchos otros descubrimientos menores. El Puente de Dios fue cartografiado en un viaje corto, y resultó ser otra travesía corta (420 metros) pero muy espectacular por sus pasajes de mas de 80 metros de altura. La última expedición descubrió el Resumidero del Agua de la Golondrina, de 730 metros de largo y 193 metros de profundidad, el Sótano de Puerto Fresno, con un tiro de entrada de 99 metros y una profundidad total de 117, y el Resumidero de Agua del Carpintero, que aunque sólo alcanzó 396 metros de largo, contiene un tiro interno de 94 metros, y su profundidad total de 210 metros lo situa entre las diez mas profundas cavidades del estado de Guerrero.

