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**Cueva del Ferrocarril, Mexico**



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# TEPOZTLAN, MEXICO – 2006

## 12th International Symposium on Vulcanospeleology

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### ABSTRACT

The 12th International Symposium on Vulcanospeleology was held at Tepoztlán, Mexico in July 2006. Field trips included visits to the spatter cones and vents of Los Cuescomates, Cueva del Diablo, Chimalacatepec, Iglesia Cave, Cueva del Ferrocarril, Cantona archaeological site, Alchichica Maar, El Volcancillo crater and tubes, Rio Actopan (river rafting). The author later visited some unusual volcanic caves near Colonia Moderna, northwest of Guadalajara.

### WELCOME TO MEXICO

Arriving at Mexico City airport just before midnight on 1 July, after flying from Sydney for 25 hours (with a 3 hour stop-over in Santiago de Chile), can be slightly harrowing. Then to find the last bus to Cuernavaca (fare 1,100 Peso or US\$10) departed at 11:30 pm and be confronted by a rather dubious-looking character offering a 'taxi' to take you there for US\$160, can be positively unnerving. Fortunately, with only my wallet considerably lighter, I made it to the small village of Tepoztlán, arriving at the Hospedaje Los Reyes at 1:45 am. I rested most of the next day, wandering downtown to the Axitla Restaurant for the symposium's opening banquet at 6 pm.

### THOSE ATTENDING

The symposium was ably organised by Ramón Espinasa, John & Suzy Pint and a

small band of helpers. Attendees included IUS Volcanic Caves Commission Chair Jan Paul Van Der Pas (and Bep) (Netherlands), a contingent from South Korea (Kyung Sik Woo, Kwang Choon Lee, In-Seok Son and others), a contingent from the Azores (Paulino Costa, João C. Nunes, Paulo Barcelos, João P. Constância and others), Marcus & Robin Gary, Diana Northup, Ken Ingham and Peter Ruplinger from the USA, Stephan Kempe and Horst-Volker Henschel from Germany, Ed Waters and (of course) Chris Wood from the UK, together with a number of locals.

### FIELD TRIP #1

Somewhat unusually, the meeting started with a field trip to introduce us to the Sierra Chichinautzin Volcanic Field (SCVF), located south of Mexico City, in the centre of the Transmexican Volcanic Belt (Fig. 1).

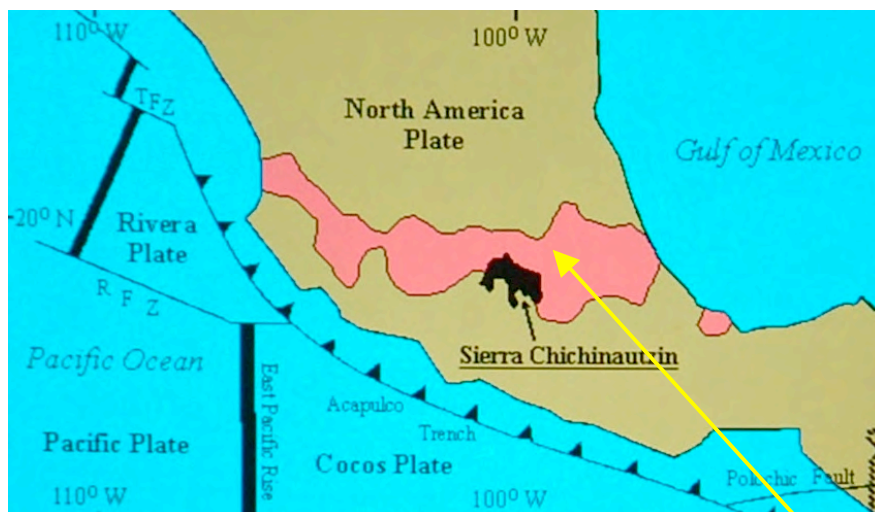


Fig. 1. Tectonic setting of the symposium and field trips, in the Transmexican Volcanic Belt.

Our first stop was to view the 3,620 m Pelado Volcano, one of the most symmetrical cones in the SCVF and which contains a rare cave in andesite, the highest mapped cave in North America. From the Morelos Memorial we walked into a pine forest to see the Los Cumescomates hornitos/ rootless vents (Fig. 2) and associated small lava tubes, formed when lava flowed over a swampy area. Local fare was enjoyed for lunch at a restaurant near the monument.

We then drove back through Tepoztlán and down to Cueva del Diablo. What for most of us was our first Mexican lava tube cave is 2,020 m long and is still used by locals for religious rituals honouring the devil, involving the sacrifice of chickens.

This anastomosing tube system (a minor one compared to what was to come), is the lowest in the Suchiooc lava flow. The cave features canyons and multiple superimposed passages; climbing between them can be difficult (Fig. 3).

#### PRESENTATIONS

Tuesday 4 July was devoted to presentations at the Symposium venue – an ancient convent in the middle of town. Papers were given on Mexican lava caves: Lava tubes of the Suchiooc Volcano by Ramón (detailed descriptions, including most important and complex Ferrocarril system – 14 entrances – archaeological values, problems with rubbish dumping); Surveyed lava tubes of Jalisco, Mexico by John Pint et al. (small but only tubes in region); Cueva Chinacamoztoc, Puebla (cave of bats, first recorded 1851, 15 m high entrance now filled with sediment) by Ramón; Cueva Chapuzon in lithic tuff, Jalisco by Chris Lloyd and the Pints (water-eroded); Limestone dissolution driven by volcanic activity, Sistema Zacatón, Mexico by Marcus Gary et al. (spectacular El Zacatón is the deepest phreatic sinkhole in the world – Fig. 4.) Later sessions were devoted to lava caves of the world, including the potential of Korea's Jeju Island caves for World Heritage inscription (Prof. Woo); the recently discovered calcite-decorated Yongchon Cave on Jeju Island and its structural characteristics (Profs Lee & Woo and Dr In-Seok Son); Recent contributions to Icelandic cave exploration by Shepton Mallet Caving Club, UK by Ed Waters; Lava-cave

studies in Harrat Khaybar, Saudi Arabia by John Pint; Al-Fahde Cave, Jordan, longest lava cave on Arabian Peninsula, and Lava cave research in Jordan by Stephan Kempe et al.

Further presentations on 6 July related to Gruta das Torres visitor centre, Pico I., Azores by Manuel P. Costa et al.; what is known about Thurston Lava Tube, Hawaii (the most visited lava tube in the world?) by Kempe and Henschel; Geology and genesis of Kamakalepo Cave system in Mauna Loa lavas, Hawaii and Archaeology of the Kamakalepo/ Waipouli/ Stonehenge area, underground fortresses, living quarters and petroglyph fields by Kempe et al.; Comparison of microbial mats in Pahoehoe and Four Windows caves, El Malpais NM, New Mexico by Diana Northup et al. (are they impacting on the basalt?); Use of Atlantis Terra 2 in mapping biodiversity of caves in Azores by Paulo Borges et al.; Cueva del Diablo: a batcave in Tepoztlán by Gabriela Segurajáuregui; Troglóbites from lava tubes in Sierra de Chichinautzin challenge the exclusion principle by Luis Espinasa & Adriana Fisher; Uranium in caves by Juan Bernal; Development of a Karst Information Portal to advance research and education in global karst science by Northup et al.; A database for the most outstanding volcanic caves in the world by João Constância et al.; Morphogenesis of lava tube caves: a review by Chris Wood. In addition, there were at least 10 poster presentations ranging from local caves to a number on lava caves in the Azores islands.

#### #2 – SISTEMA CHIMALACATEPEC

On 5th it was back to the field. After breakfast at our hotels we met downtown and took taxis up to the village of San Juan Tlacotenco. (Under this village lie 12 caves that form the Sistema Tlacotenco, the longest and most complex lava tubes in Continental America – but more on them later.)

We climbed up a steep path from the village to the lowest entrance to the Sistema Chimalacatepec, Cueva de Iztaxiatla. This 1,390 m cave system is the deepest lava tube in Continental America, with a vertical extent of 201 m. (see Fig. 5).

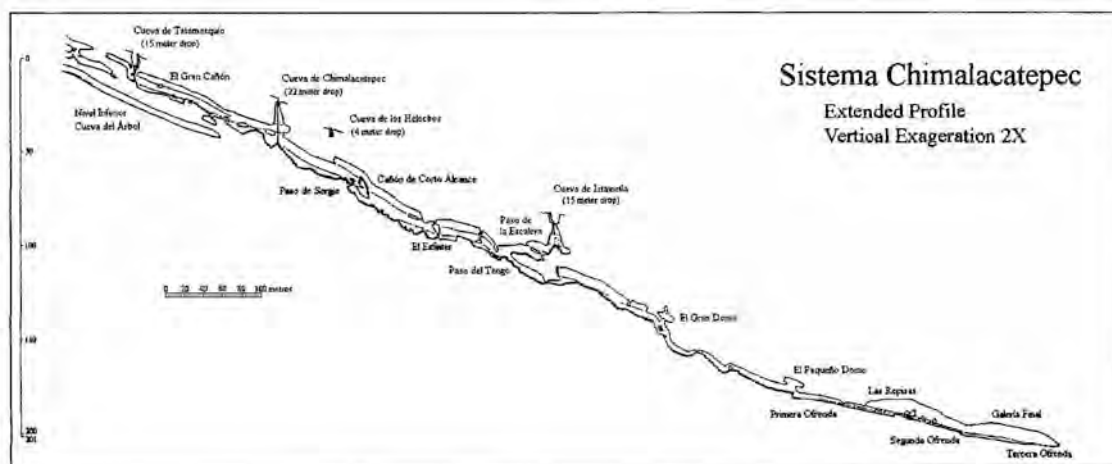


Fig. 5. Profile of Sistema Chimalcatepec showing entrances, etc. [from Espinasa 2006]

The organisers rigged two abseiling ropes, plus a wire ladder for those without SRT gear, and we descended the 15 m entrance shaft into Cueva de Iztaxiatla (Fig. 6). A scramble down a sloping passage brought us to a wire ladder down a further 2-3 m drop. From there it was a gradual descent with only one short crawl to the terminal lava seal or sump. The passage is generally a few metres high – e.g. the *Las Repisas* section (Fig. 7). The cave was found to contain archaeological remains at three distinct sites, comprising incense burning pots, earthenware bowls, 50 figurines carved from jadeite and fireplaces. Dating indicates a post-colonisation age for this material. On our visit, Ramón found some small pieces of coloured stone at the furthest site and Jan Paul found a quartz crystal at the penultimate site. Diana was happy as she found plenty of cave slime.

After a few hours we returned to San Juan for a traditional meal comprising prickly pear ‘leaves’ with cheese in an egg batter, a tomato sauce, beans and rice, washed down with guava juice. Australia might never have needed the *Cactoblastis* caterpillar if we had just developed a taste for prickly pear!

A local bus took us back down to Tepoztlán.

#### COMMISSION MEETING

The IUS Commission on Volcanic Caves met on 6 July at the Ex-convento de Nuestra Señora de la Natividad, Tepoztlán. A matter of concern has been the publication of the proceedings of the previous 3 symposia. The Catania (1999) proceedings appeared on CD in 2005 and the Azores (2004) proceedings have also been published on CD. Only the

abstracts were published for the Iceland (2002) symposium. Proceedings of this symposium will be published by the Assoc. for Mexican Cave Studies, which is willing to include previously presented, but unpublished, papers.

A proposal to hold the next symposium in Jeju Island, South Korea, in 2008 presented by Dr In-Seok Son was unanimously accepted. The author foreshadowed the likelihood of a bid by Australia to host a symposium in 2010.

Dr Kempe raised the matter of problems of access to caves on State land on Hawaii. It was agreed that the authorities should be urged not to hinder speleological research.

A proposal from the Azores to prepare a world catalogue of significant lava caves was accepted in principle, with a group being designated to examine the criteria, etc, on behalf of the Commission.

#### FIELD TRIP #3 – CUEVA DE LA IGLESIA – MINA SUPERIOR

We returned to San Juan Tlacotenco on 7 July to visit a small part of the Sistema Tlacotenco: the 6 km long Cueva de la Iglesia – Mina Superior; second longest lava tube in Continental America (see Fig. 8).

The guidebook (Espinasa 2006) describes Iglesia as “a complex network of anastomosing passages” – as is demonstrated by the plan (Fig. 8). We were very impressed when Ramón conducted us through much of this cave with barely a glance at the map.

Our party entered via the only accessible entrance (5 others have been blocked), in the SE of the town, and were immediately crawling – in mud even!

A short distance inside we noted pottery fragments, indicating the cave was used in by the native people. The cave demonstrates many lava tube features, such as benches along the walls, lava falls, lava balls (Fig. 9), flaking linings, syngenetic breakdown, shark-tooth lavacicles and secondary speleothems, possibly of silica (Fig. 10). We even found some excellent microgours, probably also formed of silica (Fig. 11). Despite some low sections, most of the passages are walkable (Fig. 12).

That evening we all returned to the Axitla Restaurant for the excellent closing banquet.

#### POST-SYMP. FIELD TRIP A – CUEVA DEL FERROCARRIL – MINA INFERIOR

At 6538 m, this is the longest lava tube in Continental America and has a vertical extent of 90 m. It could be a lot longer; it comes within 20 m of Cueva de la Iglesia-Mina Superior and 15 m of Cueva de la Tuberia; it has been cut off from Cueva de Capulin by the railway cutting (see Fig. 8).

This is a remarkably complex lava tube; there is no clear 'master' tube; the passages form a complex anastomosing labyrinth.

On this trip a slightly hung-over Ramón led the hard-core group of Chris, Ed, Stephan, Horst-Volker, Jessica, Jorge and Curro (3 local cavers) and the author on about a four-and-a half hour wander through this labyrinth (see route shown on Fig. 8).

We started at an entrance created by the railway cutting which presumably gave the cave its name. The labyrinth contains an impressive array of passage forms with multiple levels, complex junctions (Fig. 13) and evidence of the pirating of lava flows, together with obvious flow features (Figs. 14, 15, cover).

#### FIELD TRIP B – CUEVA DEL ARBOL

The second post-symposium field trip, on 9 July, went to Cueva del Arbol, a cave directly above, though extending under – and arguably part of – Sistema Chimalacatepec.

The notes say "The entrance to this cave is probably the most impressive in the Suchiooc lava flow" (Espinasa 2006) and I can thoroughly endorse this (Fig. 16). The large skylight gives access, over massive breakdown, to a large (10-15 m high) downward-trending passage. Before proceeding down we investigated a large side

passage on the left, notable for its red a'la lava. There were a few bats and we managed to catch one to photograph (Fig. 17). Here, while taking a photo, Ed slipped and gashed his hand badly. First aid soon staunched the flow of blood but Ed was badly shaken.

The main passage descended to the 10 m pitch known as El Embudo which had to be clambered around to get to the next drop, La Cascada. Some of the party continued on down while some returned to the surface.

Cueva del Arbol has a total length of 1480 m and a vertical extent of 118 m. "Since it allows access to a master tube with clearly formed canyon shaped passages, separating into superposed levels, and also gives access to smaller anastomosing overflow tubelets, it is safe to say that it is one of the most instructive lava tubes of the area, from the geomorphologic and genetic point of view" (Espinasa 2006).

#### FIELD TRIP C – EASTERN END OF TRANSMEXICAN VOLCANIC BELT

On 10 July we left Tepoztlán by minibus, failed to see Popocatepetl stratovolcano due to low cloud but did catch sight of Malinche stratovolcano. We stopped at Alchichica Maar to observe its phreatomagmatic tuff cone, bedded tephra deposits with volcanic bombs and unusual ring of 'white caliche-like deposits' (Fig. 18) which formed as stromatalites (and may still be growing). The latter were too much for our Germanic compatriots (Stephan & Horst-Volker) who proceeded, over the next few hours, to measure, sample, document and record every conceivable aspect of the billowing white material, huge samples of which were trucked off to the lab for still further analysis. There being little of the day left, we retired to a hotel at Perote.

Next day we visited the recently excavated and partly restored archaeological site at Cantona, a bewildering maze of pathways, stairs, walls, platforms, ball-courts and pyramids. At 12 sq. km., it is the largest urban centre yet discovered in Mesoamerica and flourished between 600 and 1000 AD. After a couple of hours we drove on to the small village of Francisco I. Madero and out into fields of broadbeans and maize. From there we walked into the 'scrub' of cactus and pines, soon reaching the upper entrance to Cueva de Chinacamoztoc.





Fig. 2. On the rim of one of the numerous Los Cumescomates hornitos. photo: Kwang Choon Lee



Fig. 3. Prof. Woo climbs between levels in Cueva del Diable. >

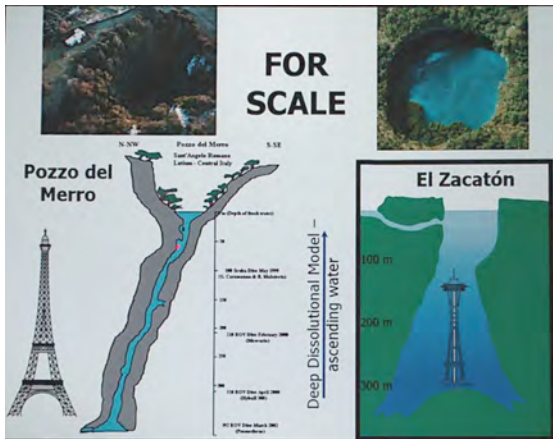


Fig. 4. Comparison of El Zacatón with Pozzo del Merro, Italy, world's deepest underwater cave.



Fig. 6. The 15 m entrance pitch into Cueva de Iztaxiatla. photo: Kwang Choon Lee



Fig. 7. In Las Repisas passage, Iztaxiatla. Wall levees indicate the tube was filled and drained.



Fig. 9. Chairman Jan Paul crawls past a wedged lava ball in Cueva de la Iglesia.

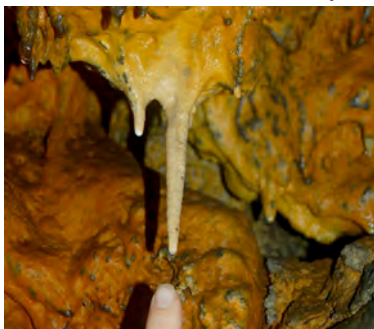


Fig. 10. Who says lava caves don't have good 'tites'? Example from Cueva de la Iglesia



Fig. 11. Chris examines microgours in Cueva de la Iglesia





Fig. 12. Typical tube passage in Cueva de la Iglesia. In the distance it splits into two.



Fig. 13. Ferrocarril passage junction; Jessica and Curro. photos ^>: Ed Waters



Fig. 14. Chris and striking flowlines, Ferrocarril.>



Fig. 15. The author on a small lava fall, Ferrocarril. photo: Ed Waters

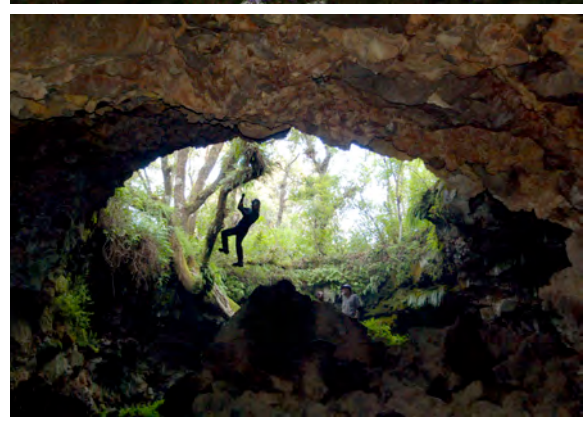


Fig. 16. Curro descends the 15 m entrance pitch into Cueva del Arbol (note big trees).



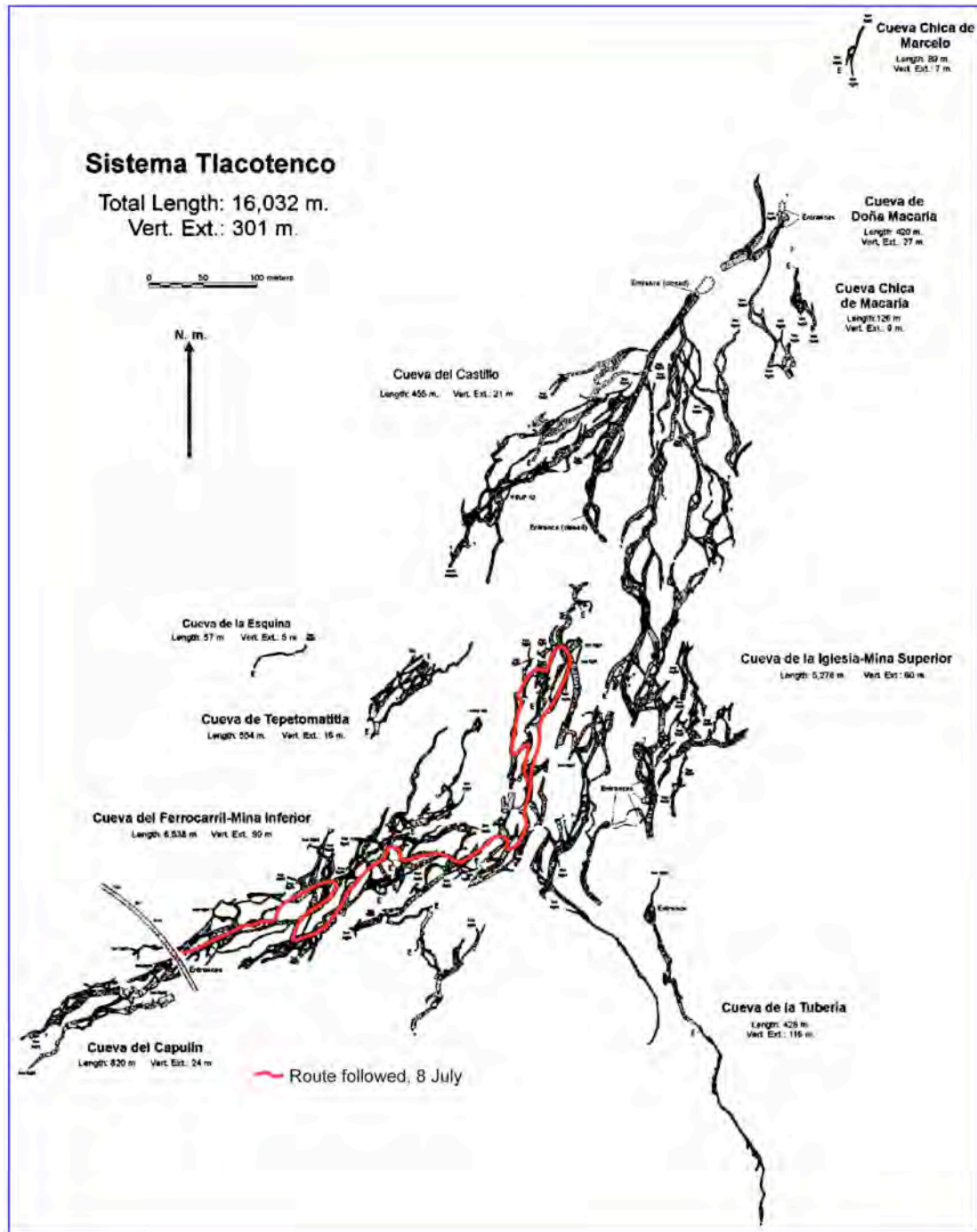


Fig. 8. Plan of most of the caves comprising the Sistema Tlacotenco (Cueva de Marcelo (1286 m), to the northeast, has been omitted).

The route through Cueva del Ferrocarril followed on 8 July 2006 is overlain. [from Espinasa 2006]

We passed into a comfortable walking tube and went mauka to The Wall (an anthropogenic structure probably put in to prevent the silting up of the lower part of the cave). A hole in The Wall (Fig. 19) allowed access to a short section of the upper cave (first reported in 1865), since completely silted up. Proceeding makai, we passed through a tube up to 30 m wide and often over 10 m high with frequent breakdown

blocks or bare a'a floors. Frequently skylights are passed or the tube is completely collapsed and one crosses an open rubble-filled depression, carefully avoiding the ferocious bees and dozing rattlesnakes. In one of the later openings we disturbed 3 large owls which flew in and out, but were difficult to photograph. Under a large dome with a small, high, skylight (Fig. 20) we noticed a raised mound of rocks.



Inside the ring of rocks was a circular depression and beyond it, a ring of breakdown rubble – surely this is a religious site of some kind. The Lower Entrance, from which we emerged, required a slightly tricky climb up the side of the pit followed by an easy hike back to the village.

Next morning we drove to the new park at Volcancillo where we were kindly offered a lift to the top in a truck. Unfortunately it didn't quite make it so we had a steep climb up the last part to the rim of a deep, vertical-sided, spectacular caldera. Unusually, a cave opens high on the wall of the caldera and runs steeply down, breaking out on the outer face of the small volcano. In parts of the steep 50 m tube, upper levels were evident and above the lowest exit were stacked three higher openings (Fig. 21). Scrambling over breakdown, we descended to the lower, main, part of the Cueva de Volcancillo. We descended this colourful tube for about 350 m, including some bits of climbing (Fig. 22), to a steep drop (Fig. 23) below a small skylight before retracing our steps. As we got back to our vehicle we remembered the Cueva del Arco. Despite the onset of a heavy downpour, Ramon led us part-way back up the peak and across to see this dramatic arch (Fig. 24). The structure is about 35 m in total height; about 20 m to the top of the opening – certainly the most spectacular arch in lava the author has seen.

We then drove via Xalapa to El Descabezadero where the Actopan River suddenly rises from beneath the bottom end of the Volcancillo lava (about 50 km from its origin). In a nearby village we were accommodated at the headquarters of “Diversion en Rio” and on our final day were treated to a white-water rafting trip by this company down about 15 km of the almost continuous rapids of the river (Fig. 25) right to the village of Actopan (stopping at a riverside bar on the way).

This most enjoyable and enlightening excursion ended that evening in the historical heart of Mexico City. Many thanks to Ramón for a great trip.

#### TO GUADALAJARA

With a few more days to spend in Mexico, the author took a look at the historic highlights of old Mexico City and then flew

to Guadalajara to visit John and Suzy Pint at El Rancho Pint, Zapopan.

A highlight of that visit was a day trip with John, Chris Lloyd (a Canadian-Mexican caver/geologist) and Sonia (a local caver) to the northwest of Guadalajara (towards the coast). First stop was below Ceboruco Volcano where we inspected a 19th century lava flow, which is still only barely vegetated. We then drove on to the small village of Colonia Moderna, located among the lava flows of Volcan Sanganguey, southeast of Tepic, where Chris and John spoke to various locals about caves.

Eighty-seven year old Don Eduardo agreed to show us a cave he knew; it turned out he hadn't revisited it in 50 years! Anyway, we found it with little trouble in an outcrop of what Chris identified as a rhyolitic tuff. I followed Chris in through a low scramble which led to a wide chamber 1.5 to 2 m high and about 20 m long. Chris pointed out some black deposits on the floor which indicated the presence of vampire bats! These caused us no trouble; indeed, they withdrew into cracks when one tried to photograph them (Fig. 26). Here I also encountered my first “tindrapos” or “vinagrillos” as Chris called them – so-called “whip-tailed scorpions” (which don't have whip-tails and don't look much like scorpions)(Fig. 27); some were as big as a dinner plate. There were a few low crawls leading off the main chamber but no real prospect of extensions. The cave seemed to have been formed by erosion of a relatively soft layer in a (volcanic) rhyolitic tuff.

Back on the surface we rejoined our elderly guide and decided to name the cave after him: Cueva Don Eduardo (the ‘don’ being a term of respect). We drove him back to town and after John and Chris chatted to an earlier informant, José, we drove to another cave shown by him to John and Chris in May 2005 – La Cueva del Zurdo (the Cave of the Left-Handed Man - after José's father)(see Pint 2006a).

Chris quickly relocated the cave on the edge of a sugarcane field but as it was by then 3:30 pm we paused for lunch. This cave was also in rhyolitic tuff. A low entrance opened into a broad, low chamber. Chris immediately headed for a small passage leading from the lowest part of the chamber



*Fig. 17. Microchiroptera encountered in Cueva del Arbol.*



*Fig. 18. The phreatomagmatic tuff cone, lake and stromatalites of Alchichica Maar. photo: S. Kempe*



*Fig. 19. Laura at the hole in The Wall, Cueva de Chinacanoztoc.*



*Fig. 20. Large dome with ring of stones beneath – apparent religious site - in Cueva de Chinacanoztoc.*



*< Fig. 21. Stacked lower entrances to Cueva del Volcancillo.*





Fig. 22. Chris determined to chimney his way up a tricky bit; "OK, but where to from here?"



Fig. 23. Last drop before the bottom of Cueva del Volcancillo.

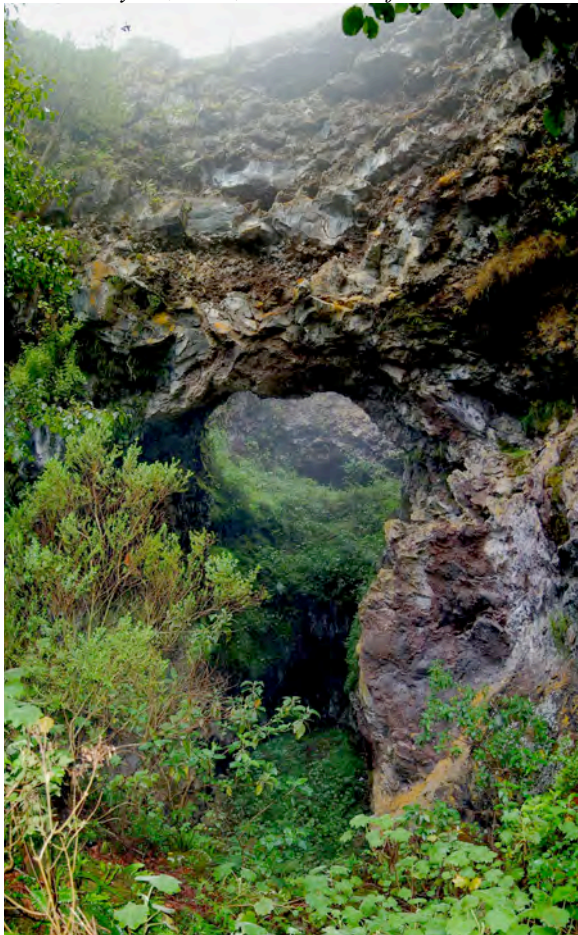


Fig. 24. The spectacular El Arco; the arch is 20 m high, the whole structure, c. 35 m.



Fig. 25. The "Volcanic Rafter" in action on the Rio Actopan.



Fig. 26. Vampire bats in Cueva de Don Eduardo retreated into roof cracks.



Fig. 27. A "tindarapo" or whip-tailed scorpion.



Fig. 28. John in the pumice connecting passage, Cueva de Zurdo.



Fig. 29. Chris below the obsidian ceiling of part of Cueva de Zurdo.

where he had noticed a strong draught on their first visit. The small passage soon enlarged and after a couple of bends opened into a round chamber, 2 m high except for a central blind shaft obviously frequented by vampires. A low passage (Fig. 28) continued on to a wide, but still low chamber with many bats flitting about and more “tindarapos”. Of most interest, however, was the fact that the cave appeared to have been eroded out of a bed of rock formed from consolidated pumice pieces in an ash matrix. Chris also noted that further in the ceiling was composed of a thin band of obsidian pieces (Fig. 29) which appeared to have been intruded in between the upper tuff and the lower pumice layers, now largely removed – a very unusual formation. The black glassy chunks of obsidian sparkled in our torch lights. As Chris explored more passages leading off the main chamber, he declared this to be a highly unusual and significant

volcanic cave. He also stirred up large numbers of (mainly insectivorous) bats. We decided to leave surveying of the cave to another day (or perhaps night, when the bats will be out feeding) and drove back to Zapopan.

In the following days I visited the Rio Caliente in the Parque Ejidal La Primavera with John, the nearby oak and pine forest with Chris and the local markets with Suzy. All in all, a most enjoyable conclusion to my stay in Mexico. My sincere thanks to the Pints and Chris Lloyd.

Photos by the author except where indicated otherwise.

For other reports on the symposium see Pint (2006b) and, for a British view, Waters (2006). The author also reported on the post-symposium field trips to NSS (Middleton 2006).

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