ICS Pre-congress Field Trip: H$_2$S Caves in Central Italy

Louise D. Hose

“It feels like you’re descending through the Gates of Hell,” Art Palmer told us in reference to the deepest parts of Grotta Nuova. Jennifer (Jenn) Macalady, (geomicrobiologist from Pennsylvania State University), her undergraduate field assistant Lindsey Albertson, Amos Frumkin (Hebrew University of Jerusalem), Andres Wildberger (Switzerland), Michael Queen (USA), Patricia (Trish) Beddows (MacMaster University, Canada), and I (National Cave and Karst Research Institute, USA) made up the second wave of foreign cave scientists headed for the bottom of this active, hypogenic, sulfur cave in central Italy. Art and Peggy Palmer, with their Italian guides, were already heading out of the cave after a very brief exploration at the bottom. We soon learned why they hastened their retreat.

Local geologist/speleologist Sandro Galdenzi had offered this field trip, “H$_2$S Caves in Central Italy,” as a pre-14th International Congress of Speleology event. We individually found our way to the delightful youth hostel in Galdenzi’s hometown of Jesi, our base of operations. The first day was spent exploring the local geology, including a historic paleokarst iron mine and Frasassi Gorge with its active sulfidic springs. The second day took us into Grotta Grande del Vento, the beautiful commercial part of the Frasassi caves [ed: also see NSS News, July 2004 for a feature article and photos of this impressive show cave]. Overcast weather on this day during the biggest holiday week of the year had driven many tourists inland from the beach resort and the tours were packed. Although we strove to pass the tour groups and clamber off-trail as discretely as possible, our visit had to be a disruption for the commercial operation, which serves 300,000+ visitors a year.

The claims that Grotta Grande rivals Carlsbad Cavern rang true in many ways. A huge (estimated to be ~1 million cubic meters) main room lacked streams or lakes. There are extensive displays of calcite speleothems, especially giant, mitten stalagmites, and massive deposits of gypsum, both reminiscent of features in Carlsbad’s Big Room. Even the air temperatures are similar (−13°C). The most notable differences derive from their individual histories of development. Grotta Grande was well protected and controlled prior to commercialization with exploration limited to experienced cavers. Carlsbad was originally mined for guano under private ownership and uncontrolled tours. Grotta Grande, developed in the 1990s with modern sensibilities and relatively easy access, placed all concessions and eating establishments in a staging area about one kilometer from the cave. Early tours into Carlsbad Cavern required all-day visits before the elevator was built and an underground restaurant made sense to the early developers, a legacy that has been modified but still remains in the Big Room. The Frasassi development has placed plexiglass shields around speleothems adjacent to the trail in an effort to prevent the loss and/or breakage of tens of thousands of stalactites that Carlsbad has experienced over the last 100 years.

The third and fourth days of the field trip brought the most fascinating venues. First, we visited the lower, active passages in the Frasassi system. Many of the characteristics that we now consider “standard” for active, sulfidic caves were noted. Atmospheric gas levels were low, nearly as low as Lower Kane Cave, Wyoming. After some focused looking, we found a few, tiny (<5 mm long) mucoliti (snotites).

The next day found us in Acquasanta Termine, a spa-resort town based around a thermal (and sulfur-rich) karst spring. Our focus for the day was a trip into Grotta Nuova del Rio Garrafo. We were joined by Macalady, who has been working in the Frasassi caves for the last few years, her student, and several local cavers. While the trip announcement had stated that everyone must have basic vertical gear and competence, I don’t think most of the scientists were expecting this multiple pitch, multiple traverse, re-directional rigged adventure. However, our guides from the local Associazione Speleologica Acquasantana quickly and proficiently moved the group through the cave.

The upper parts of the cave were relatively featureless (save some prominent clusters of apparent actinomyces on the walls of one room). The cave impressed me as more interesting for its modest physical adventure than a place for a scientist to travel around the globe to see. That was, until we reached a sloping pit and a slight fog rolling up the pit walls. At first I assumed the fog was generated by the hard-working Art and Peggy Palmer on their way out of the cave. While the air temperature was only about 10°C, Art was soaked in perspiration. Upon greeting him as he emerged from the pit, he told us, “You aren’t going to believe it down there. It feels like you’re descending through the Gates of Hell.”

We carried on, descending the pit, traversing midway down, prusiking back up the far wall of the pit, then descending another drop. The room was about 8 m in diameter and lined with small selenite (gypsum) crystals. Tiny (<5 mm long) mucoliti hung
from nearly every selenite needle. pH paper confirmed that strong acid (presumably, sulfuric acid) dripped from each tip. But, the most imposing feature of the room was the 2 m x 1 m opening at the bottom of the sloping floor: Palmer’s “Gates of Hell.” Dense, hot fog billowed out with a strong sulfur odor. Thin, microbial curtains on the wall above the opening waved in the convective breeze rising through the hole. As we descended through the hole and down the short slope, the power of the place hit each one of us. The air temperature changed from the very low teens to the high 30s (over 100°F) over only a few meters distance. The acrid odor of sulfur dioxide caused each of us to start coughing. I had to stop and reassess my willingness to continue on. I immediately regretted not bringing along my gas mask and monitor. I knew that Frasassi never reported high gas levels and it had not occurred to me that we might visit other, much more aggressive systems. I decided to stick it out but remain on high alert to the first sign of a problem in myself or my companions. Macalady also stayed, placing her faith in our trip leader Giampaolo Filipponi’s judgment as she was more familiar with his widely respected reputation.

At the bottom of the slope was a small, 40°C stream entering the room. The hot water flowing into the cool cave air caused the condensing fog that filled the room. Taking quality photographs seemed impossible and I was delighted to end up with a few documentary snapshots. While most of the group made a very hasty tour and headed up and out of the room, Macalady, Filipponi, and I stayed long enough to snap a few photos and grab a few air and water measurements/samples. The conditions were truly brutal.

Retreating to the next higher room and out of the worst of the steamy air and SO₂ gases, Macalady and I examined a previously unreported microbial feature on the ceiling above “The Gates of Hell”—Snot Balloons. Several spherical, gas-filled microbial “bubbles” ~1 cm in diameter protruded from the wall near “snot” curtains and snottites. Under internal pressure, the gentlest of touch caused one to burst and “evaporate” like a soap bubble. (We assume that the snot balloons are ephemeral, growing and disappearing within days, like snottites.) After Macalady took further samples, we left the cave with the satisfaction of discovering another fascinating feature in an active, sulfidic, hypogenic cave.

The value of the sort of field excursion organized by Galdenzi should not be underestimated. The trip provided a wonderful forum for scientists to exchange ideas and information based on their diverse experiences throughout the world. This particular trip brought together researchers with experience in most of the well-known, active sulfidic caves in the world (U.S.’s Lower Kane Cave; Mexico’s Cueva de Villa Luz and Cueva Luna Azufre; Italy’s Frasassi and Rio Garrafo caves) as well as knowledgeable researchers in important inactive, sulfidic sites (U.S.’s Guadalupe Mountains and Upper Kane Cave; Italy’s upper Frasassi Gorge caves) to one site to compare and contrast their observations. I hope we will offer similar opportunities in North America when the world comes to visit the United States for the 15th International Congress of Speleology in 2009.