Understanding Fort Stanton's Snowy River

BY DONALD G. DAVIS

In 2001, a dig by members of the Fort Stanton Cave Study Project broke through the Priority 7 breakdown blockage into a previously unknown gallery east of the historic part of the cave. The most remarkable aspect of this discovery was a sinuous lining of white calcite along the lowest part of the mud-floored passage, which went out of sight in both directions from the junction. This calcite deposit, several feet to several yards wide, was immediately given the name "Snowy River," although it held no actual water.

Snowy River remained unexplored for two years while its management agency, the Bureau of Land Management, prepared a plan for handling the discovery responsibly. In 2003, exploration and survey finally began, and about two miles of passage were mapped, mostly in the sourceward direction, named Snowy River South. The calcite-lined channel continued indefinitely farther in that direction, and was, as far as we knew, the longest continuous speleothem deposit known in the world. Because of Snowy River, Fort Stanton Cave gained unprecedented media attention, and was even proposed as a Congressionally-designated National Conservation Area.

Those of us exploring it struggled from the beginning to understand what the Snowy River deposit actually *was*, and how it had developed. We had never seen or read of anything exactly like it in any other cave. I published the following comments in an article in *Rocky Mountain Caving* (Davis, 2004):

> **MYSTERIES OF THE SNOWY RIVER POOL DEPOSIT**
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> One of the most puzzling aspects of the Snowy River discovery is its namesake, the Snowy River pool deposit itself. This finely-crystalline mammillary crust clearly grew subaqueously, but it is in some ways unique in my experience. Calcite-lined cave pool basins are most often bounded by rimstone or shelfstone, but in this one, the white encrustation—which appears to be at least 2 inches thick in the deeper parts—simply thins out toward the upper margin, ending abruptly at the waterline. Calcite rafts, another relatively common pool-surface feature, are also almost absent here, despite their abundance in nearby Snowflake Passage...
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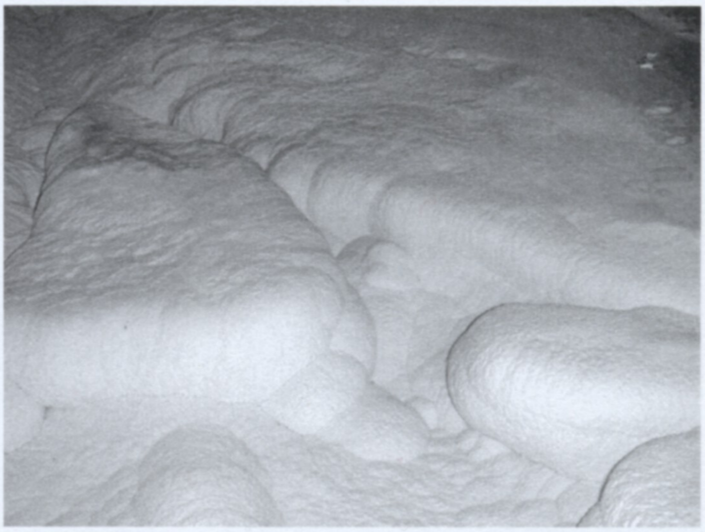
> John Corcoran [FSCSP leader] has raised another troublesome question: how can a basin that held a continuous body of water, that appears to have been so slow-flowing as to be, for practical purposes, a pool, slope at .8 degree over more than half a mile? [This was along the central section of the new survey; segments downflow and upflow plotted more nearly flat.] Systematic survey error would be one explanation, but e-mail consultation with Corcoran and [John] McLean about our techniques revealed nothing that might have caused such an error, and backsight/foresight agreement was generally within 1 degree. If the slope is genuine, it may be that in the wide, shallow sections there are subtle, gentle rises that are too inconspicuous to stand out as distinct steps. Or it is conceivable that the passage has been tilted measurably northward since it drained; if so, this would suggest an age of at least several million years. Our Suunto survey methods are too imprecise to resolve these issues. Probably the best way would be to conduct a leveling survey with something like a long plastic tube filled with water, in which the level would be identical at each end.

I included an interpretation of the sequence of events in the development of the Snowy River passage, in which the last two were these:

- Influx of very slow-moving, calcite-rich water, encrusting Snowy River pool channel.
- Drying or cutoff of calcitic-pool source, and complete abandonment by through-flowing water.

I was guessing then (as I think all of those caving there did) that it had been a long time—a few thousand years, at least—since water had flowed through Snowy River, and that it was now extinct (though we did wonder at times why there was almost no breakdown or fallen mud and manganese on the clean calcite surface). That assumption of considerable age was demolished by a startling e-mail sent to John Corcoran by cave-dating expert Victor Polyak in September 2003, in which Polyak stated that a small sample collected by Mike Spilde from the uppermost part of the Snowy River deposit had been uranium-series dated at 152 ±61 yrs before present. This "very very young" date could mean that the channel was dormant but not abandoned. In my next publication of the sequence of events in



Snowy River floor with deep and shallow places, shown when dry in the spring of 2008.

Photograph by Roger Harris.

Snowy River, for the New Mexico Geological Society (Davis, 2006), I revised the last event as follows:

- Intermittent smaller-scale influx of very slow-moving, nearly clastic-free, calcite-rich water, encrusted the Snowy River pool channel.

And I suggested that (contrary to earlier assumptions) "...the Snowy River calcite-deposition process is not extinct; the channel is probably only temporarily dry and could refill during the next sufficiently wet climatic period." I had no clear idea how soon that wet period might arrive.

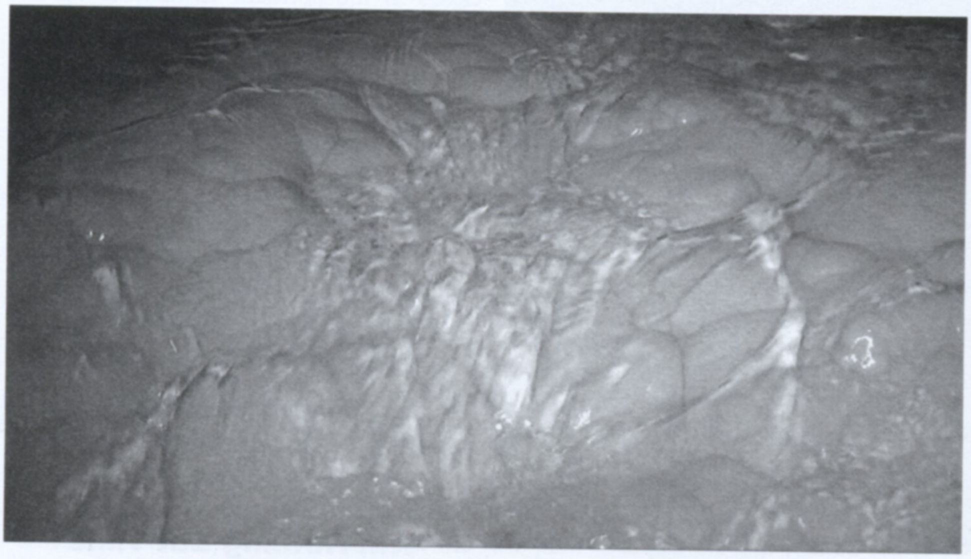
Meanwhile, after the October 2003 expedition, BLM again suspended exploration in Snowy River until Priority 7 could be bypassed by a safer, shorter route dug into the Mud Turtle side passage of Snowy River. A radiolocation trip was allowed in 2005, when Snowy River was found to be still dry.

During this exploration hiatus, it was still unclear how we should properly describe the Snowy River channel. With less than 1° of surveyed slope, was it essentially a single, extremely elongated pool basin, with its high-water margin controlled by a master spillover point near the downflow end, or a low-gradient stream channel with many subtle steps unidentifiable simply by looking at the calcite? No leveling survey had been attempted.

Unusually rainy weather had set in during the latter half of 2006, and by April 2007, flow had returned to the Main Corridor in the original cave for the first time in at least 15 years. Finally the Mud Turtle connection dig broke through, and on July 1, 2007, we returned to Snowy River—to find that, for the first time anyone had seen, the channel was indeed full and flowing. The water was moving slowly and silently along the roughly foot-deep section at Turtle Junction (about four inches per second), but the keener-eared among the cavers could hear faint rippling noise upstream and downstream. To forestall possible microbial contamination, we were not allowed to step into the water, so could not investigate further.

Drier weather ensued, and in early October, 2007, flow had ceased, but water was still standing at Turtle Junction, about two inches below the high level. A reconnaissance trip at the end of October found the Snowy River channel once again dry at Turtle Junction, though the Main Corridor flow had not gone down. The closure of the cave for bat hibernation prevented further visits in the winter.

In late April, 2008, the Snowy River channel was still dry, the Main Corridor had drained again, and exploration finally resumed. In six long survey trips during expeditions in April/May and June/July, the Snowy River passage was extended more than two miles farther SSW into the ridge, reaching more than four miles in length, and still going on upstream unexplored. No residual standing water was found in this direction, despite the route passing through a drained sump that would have been about 15 feet deep when flowing. (There were still remnant ponds downstream in Snowy River North.) Rapid calcite deposition during the previous flood was indicated by semi-opaque crust developed on plastic flagging and sheeting that had been left in the channel in 2003.



Fast water flowing through shallow riffle in Snowy River South during high flow, summer 2008.

Photograph by Jim Cox (extracted from video footage).

Late in July, the final pulse of a hurricane pushed into southern New Mexico, and several inches of rain fell July 27 in the Ruidoso area and on the east flank of the northern Sacramento Mountains, in the general region toward which the upstream Snowy River passage trends. On August 1, Government Spring (the outlet for Snowy River) was seen to be gushing. On August 3, we reached Turtle Junction once more, and confirmed that Snowy River was running strongly again (though no water had returned to the Main Corridor). Snowy River was still flowing in early October, delaying further exploration.

However, we had at last been allowed to walk into the water for a short distance, and were finally able to see what the flow pattern looked like out of sight of Turtle Junction. We found that the rippling sounds previously heard were coming from knobby shallows about 100 feet from Turtle Junction in each direction, where shallow, braided, fairly rapid flow was moving between deeper, pooled sections, dropping an inch or two within a few yards.

This answered some of the questions that had been hanging since 2001. Snowy River is definitely not a miles-long, uninterrupted lake. It is a series of many elongated ponded segments, more or less separated by shallow low-slope riffles. If the flow were slower, steadier, more uninterrupted seepage than it is, these shallows would probably grow into rimstone dams, as in other caves. But here it is too episodic, turning on and off quickly and flowing rather strongly in between, creating conditions too energetic and unstable for growth of well-developed rimstone dams or even cave rafts. Calcite rafts must be rare along Snowy River because they cannot float quietly and grow large; incipient rafts may start to grow in sheltered eddies, but are eventually likely to drift downstream and be sunk and/or broken up by being swept through the turbulent riffles between ponded sections. And we can now see that, as was theorized earlier, the lack of shelfstone is in fact because the water does not stay long at a stable margin level.

Dr. Lewis Land, of the New Mexico Bureau of Geology, has taken several core samples showing that the deposit, beyond the thin margin, ranges from 1½ to 3½ inches thick on top of the underlying mud, and has a distinct lamination pattern that is recognizable in all cores. Dating of these cores is in progress. Most calcite deposition probably occurs as the flow slows and stops, and the level drops, so that the deposit thickens downward across a given cross-section. However, the cores show that the thickest calcite is not in the deepest hollows, but along the shallow riffle sections. These are where agitation would speed CO^2 loss, thus enhancing calcite precipitation. This is, in fact, the basic mechanism that develops rimstone dams, but in the Snowy River case, the "dams" are so stretched out and attenuated that they do not build up into clearly recognizable walls.

The Snowy River passage has been following the explorers' best-case scenario: multi-mile "borehole" extension, still going bigger than ever. But the Snowy River stream still presents many unanswered questions. The Snowy River water and the Main Corridor water presumably have different sources (or at least different routes from a faraway source), since their flows start and stop months out of phase. Although unexplored upper-level leads have been seen above inner Snowy River, these appear to be abandoned "fossil" passages, and the stream has intersected no feeder tributaries in all 4+ miles yet explored. Where does the calcite-depositing water come from? The gallery is going upstream toward Fort Stanton Mesa and the Little Creek/Eagle Creek region to the southwest, but surface reconnaissance trips there have not located any losing-stream insurgences or closed basins that can be regarded with any confidence as probable significant inputs for Snowy River. A new geologic map shows a fault, bisecting Fort Stanton Mesa along its SW/NE axis, that is in line with the going Snowy River South passage—will this prove to be a collector and a control on the passage location?

How much older than the calcite deposit is the Snowy River passage itself? Is the presently ongoing Snowy River calcite deposition a unique event, or are there one or more earlier calcite deposits buried out of sight below? Why is the stream supersaturated with calcite? What limits Snowy River's apparent maximum flow to the approximately 1½ cubic feet per second we observe, and why is the water almost entirely free of transported clay? Is it filtered near the source(s)? Is the channel so long that sediment settles out, or is there some sort of ponded storage in the system? Why does Snowy River seem to rise so quickly in response to heavy rain—do flashy sink-point sources provide the starting surge? Does more diffuse input from uplands—perhaps stored in and filtered through a blanket of Tertiary sand and gravel alluvium on Fort Stanton Mesa?—then keep it flowing for months afterward?

FSCSP hydrologist John McLean offers the following idea: "John Corcoran's latest maps showing the relation between south Snowy River and the water table under Ft. Stanton Mesa indicates that Snowy River probably acts as an intermittent ground-water drain. During wet periods the water table rises and intersects the passage, providing saturated or supersaturated water which can then lose CO^2 to the cave atmosphere in the SR passage, initiating calcite deposition. This mechanism is supported by the general absence of drips, and the sparse stalactites in SRS. This suggests that, if we were to do precise titration in the cave, we would find that the stream is only slightly supersaturated, and that the relatively rapid rate of deposition is due to the large flow volume, rather than greater supersaturation." This interpretation could plausibly explain the scarcity of detrital sediment in the calcite.

Does Snowy River turn off completely (rather than declining to a low permanent base flow) because it is an overflow loop for the permanent Crystal Creek spring that appears near the north end of the Snowy River passage? Other questions could be posed—including some, no doubt, that we don't yet know enough to ask. Further exploration and study, I suspect, will yield interesting—perhaps surprising—answers.

REFERENCES

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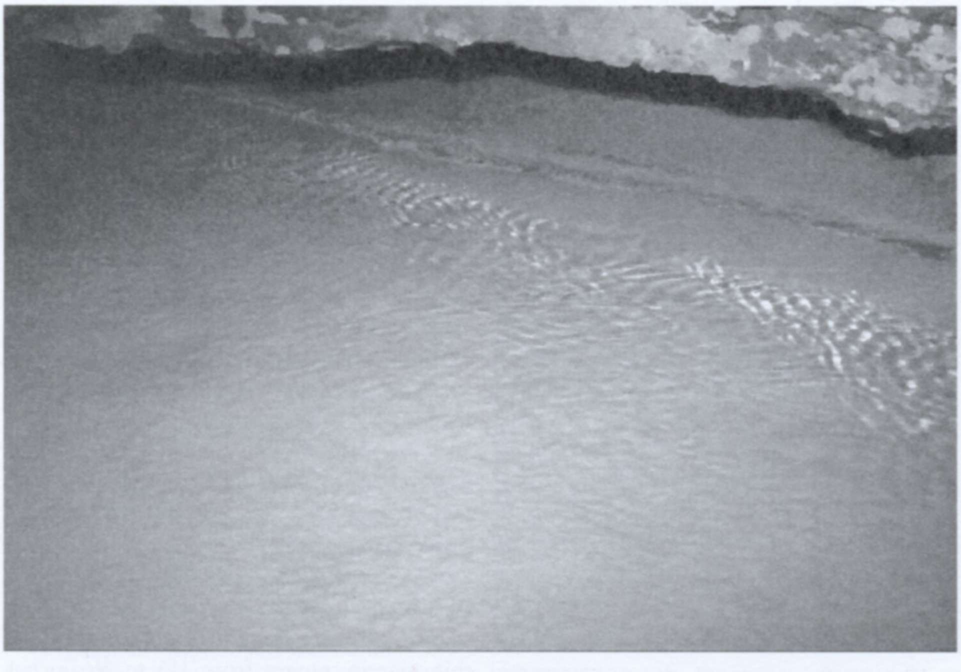

Gentle flow in Snowy River South in relatively wide and deep segment; note small standing ripples along margin.

Photo by Jim Cox (extracted from video frame).

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