Review of Science article on the magnetostratigraphic pattern of sediments in Mammoth Cave National Park


This classic cave research article shows that the magnetic orientation of sediments deposited in Mammoth Cave can be used to date cave formation and river incision by correlation with regional reconstructions of magnetic polarity reversals.

Schmidt introduces his research by briefly describing both the problems with cave dating and some of the previous magnetostratigraphic studies of cave sediments. He points out that other methods of dating have serious limitations. Faunal correlations are of limited value because sediments become palaeontologically sterile the farther they are from the entrance and uranium isotope methods only yield dates back to 350,000 years. Schmidt goes on to say that most of the previous magnetostratigraphic studies have not dated past 20,000 years.

Schmidt provided a solid and concise introduction of the problem, however, I felt that he should have made a smoother transition between the previous work and problems and the new approach to dating.

After some brief history on the timeline of his research in Mammoth Cave he launches into a description of the methods used in collection and analysis. Of importance to note is the reporting of the methods for establishing the elevation of each sample taken.
from their cave passages. This was done with survey altimeters and tied into USGS
benchmarks within the cave system. This is rather important because the elevation of the
sediment samples can be related to the water table.

Schmidt didn’t give us much of a feel for how the sediments were processed or
analyzed. I’m assuming this has more to do with the style of Science articles than a
reflection on his reporting abilities.

Schmidt’s purpose in determining the exact elevation of each sediment sample
was to relate the deposit with the level of the Green river at the time of deposition.
Schmidt explains that cave passages are formed around the level of the current water
table. As the river incises, the water table lowers and eventually leaves the passages
above the flood zone. Sediment can no longer be deposited within the cave passage.
Therefore, the higher the cave passage in relation to the river elevation the older the
sediment deposited within. Schmidt reminds us that normal laws of superposition still
apply within the individual cave levels (sediment on top is younger than sediment on the
bottom). I found this to be an excellent description of how Stratigraphy works in caves.
By correlating the magnetic orientation of the sampled sediment to regional polarity reversal graphs Schmidt produced a timeline for river incision and cave formation. He interpreted the polarity change at 550 feet elevation as the Brunhes-Matuyana reversal. Above this elevation the interpretation was more difficult. Schmidt proposes two possibilities. The first has the Brunhes-Matuyana reversal spread out over 550 to 590 feet due to flooding with the next normal representing the Jaramillo. This
would put the sediments in the highest caves at around 1 million years of age. The second has the Jaramillo normal and the Brunhes-Matuyana contained between the elevations of 550 to 590 and the zones of mixed polarity from 650 to 710 defining the Olduvai and Reunion normal intervals. This scenario would put the oldest sediments at around 2 million years of age.

Schmidt reports that further work was being carried out and that preliminary results showed a normal-to-reverse transition within the 550 to 580 foot elevation range which would mark the end of the Jaramillo normal interval. Schmidt believes this to be likely because it would mean a slower rate of incision for the Green river and it would support other chronologies done in the area.

I found the ideas in this section harder to grasp. This could be because of his writing style (and lack of space to fully explain his position) or my misreading and misunderstanding. After reading it a few times I was able to figure out exactly what he was trying to say.

Schmidt concludes that the sediments at 550 feet were deposited 730,000 years ago and the sediment from the highest caves are at least about a million years old and probably closer to two.

I looked specifically for this paper because it was referenced in almost every other article on this subject. The publishing of this research appears to be a watershed moment in cave research. The method in this paper looks like a valuable dating technique, one
which I will surely use in my future research. I also like the historical grounding that reading this paper gave me. When I read this reference in the future, I will know exactly what is being referred to.