CliffNotes] Report on 22 Oct geologists' visit to THE Scientists' Cliffs

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For those interested in the science in our cliffs--hence the capitalized article in subject line.

Read more about our local geology in Appendix B, Scientists Cliffs Community and Context Volume II-Context. Every Cliffer has or can get a copy of these two volumes. These volumes were written and edited about a dozen years go but are for the most part still correct.

Most of my geologist visits are by students on field trips, and I use the cliffs and what is in them as a blackboard or ppt. The 22 October visit involved sampling the sediments in our cliffs for research. I had mentioned this in a Cliffnote in early October. Due to narrow beach and the vicissitudes of tide and weather, visits scheduled in advance are always a crapshoot.

. We luckily had a wide beach due to offshore winds, along with an astronomic low tide. The group comprised two scientists from US GEOLOGICAL SURVEY in Reston, three scientists from East Carolina Univ (Greenville NC, five hour drive up here) and two graduate students. The lead USGS scientist was Dr. Marci Robinson and the lead ECU scientist was Prof Steven Culver.

The research objectives are explained below. The paleoenvironments recorded by the sediments (how warm or cold, how salty, how deep etc) are no longer just a subject of academic curiosity but now relates to understanding and computer modeling of climate change. (In credibly, this term has to be eschewed for 'political ' reasons). In a word--the layers exposed in the lower part of Scientists Cliffs were deposited during a warm period of time, higher sea levels and less ice on Antarctica. This may have maxed out around 15-16 million years ago and is being studied as a possible natural analog of what mankind is doing with fossil carbon derived greenhouse gas.

Yes there are also natural ways to cause greenhouse warming--one plausible way is volcanism. Climate change computer modeling has to account for past climate change, hence the new practical interest in this middle Miocene warmth. Another such warm period happened 4 to 3 million years ago, and the ECU-USGS also sampled sediments from that time (exposed in Virginia) before they came here..

My role in this was to locate (in advance) outcrops where the layers were exposed and could be sampled from the beach.. This has become a real challenge due to the lower part of our cliffs being not only hidden below vegetation and/or slide debris (as always here and there), but now mostly also hidden behind those wire cage-gabion type toe revetments installed by Scientists Cliffs. I scouted out and photographed with iPhone potential sampling sites in the weeks prior to their visit.

Outrcops (exposures) of key layers are EXCEEDINGLY RARE on the Coastal Plain due o climate (vegetation), low relief, massive widespread development, and even along the few naturally eroding sites, ever increasing shoreline armoring by builkheads or as in SC by toe revetments.

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I invited the sampling team to collect small (volume of apple or orange) sediment samples from several of the strata (layers) exposed n the lower parts of our cliff. As I always do, I told them they were my guests and gave them visitor passes for their two vehicles. I also as always, notified the community via Cliffnotes and notified ACLT that I would be meeting them in the ACLT trailhead parking. In SC they collected samples within 50 ft north and 200 ft north of the bottom of ravine 3.

I next accompanied the group to Warrior's Rest where access had been obtained beforehand as required by DNR and ACLT..

There the team sampled layers which here in SC are below sea level. The layers sampled in Scientists Cliffs are also present along the preserved cliffs between Gate E and Parkers Creek but are too high in the unstable cliff to be safely sampled.

The team then went to a site near Plum Point with Dr Stephen Godfrey of Calvert Marine Museum as guide to sample some layers there which are below sea level even at Warrior's Rest. (The stack of Miocene layers all dip, ie are inclined down to the southeast, so the north- south Calvert Cliffs expose a tilted layer cake. Our region was mostly or entirely covered by VARIABLY shallow embayments of the Atlantic from about 18 to about 8 million years ago, the middle part of the Miocene Epoch of geologic time (23.0 to 5.3 million years ago). The part of this stack of layers exposed in our SC Cliffs ranges in age from around 15-16 million years at the very base of the cliffs at Gate E to around 11-12 million years ago near the top of our highest SC cliffs.

At the top of our highest cliffs and inland above around 100 ft elevation our sediments were not laid down by the sea but by the ancestral Potomac when it coursed straight toward the ocean, ie southeast from the area of Washington DC. These sediments called the Upland Deposits contain a variable mix of gravel, sand and clay and are very poor in fossils.

This variablility of fluvial (river or stream deposited) sediments help explain why some SC lots perk wonderfully (sand0 while nearby lots don't perk (clay). Walk along land trust streams and note the variability.

This 'icing on the geological cake' was deposited from about 8 to maybe 2 or 3 million years ago-- whenever the Potomac shifted its course to the southwest upon laving the Piedmont (an event which triggered formation of the Patuxent River). It was a geologist named John Schlee (who spent some of his childhood in Scientists Cliffs) who unraveled the story of the Upland Deposits in the 1950s.

In the early 20th century MD State Geologist George Shattuck assigned numbers to the layers. With some minor changed, his numbering system is so convenient that it is still used today. If you stand on the beach and look up at any recent slide scar, you will note a layer with fossil shells about one third of the way up and a higher similar shelly layer near the top. These are

Shattuck's layers 17 and 19. Along the Gate A cliffs near beach level, where not obscured by the toe revetments or slide debris, you can see layer 14. Unlike 17 and 19, #14 is clearly subdivided into layers with more shells and layers with few or no shells. At present the time between these sublayers is very very poorly known--tens, hundreds or thousands of years??

Back to the USGS-ECU sampling:: Sediment samples were collected at or near the bottom of Ravine 3 from layers 14, 15, 16A, 16B and in the Lipphold slide scar (formed May 18) also 17. Dividing layer 16 into A and B had to be done because Shattuck missed an important feature--a channel carved ito the existing seabed during Miocene times, and later filled again.

The channel fill is called 16A and extends from around Governors Run to or just past the north end of Scientists Cliffs.

This channel has been called the Governors Run Channel but has nothing at all to do with modern Governor's Run stream. The fossil channel is nearly devoid of fossils, although some sea urchins have been found at the bottom of the buried channel, on exhibit in Chestnut Cabin. The channel is not easy to recognize, and our own Lincoln Dryden, who first noticed it, later changed his mind.. It was confirmed by Prof Susan Kidwell when she did her thesis work in the early 1980s. Our cliffs only show the ancient buried channel only in profile. It's layout (trend) remains unknown.

The USGS-ECU sampling focused on the tests (calcium carbonate, aka lime) of tiny marine animals called foraminifera (forams). Various species have evolved and become extinct, so foram tests separated from the clay-silt-sand in the samples provide age information. There are both planktic (sea surface) forams which upon dying settle to the sea floor, and benthic forams which live on the sea bed. The mix of species also depends on water temperature and salinity, very important to know for climate modeling. The job of separationg out the forams and identifying the species etc will be part of an ECU thesis--the grad student who will spend endless hours peering through a microscope trying to identify the species (by their shape, largely) came along.

The calcium in the foram tests is sometimes replaced by magnesium, and the ratio of these two elements turns out to record temperature. What was the temperature of the sea that covered our area back then? Pretty relevant to climate! Vertebrate fossils of eg crocodilians and baldcypress pollen suggest climates warmer than today, but this is not very quantitative.

In addition, USGS scientists will analyze the sediments for an organic chemical called alkenone (a long chain of carbon atoms) which records paleotemperature (log on to learn more). These alkenones are produced by tiny planktonic algae (Phytoplankton) for reasons only the algae know. NB geosciences are like many other fields divided into many specialties. I had NEVER HEARD of 'alkenone paleothermometry' until educated by Marci Robinson.

How the layers were sampled can still be seen if you look especially below the Wilcox (now Gates) cabin. Trowels are used to clear off the outcrop surface, removing algae, moss, stuff slid down from above etc. Small holes are excavated and the sediment placed in numbered bags. Three samples are collected along a distance of a few tens to 100s. Triplicate sampling is

important in case of any mix-ups etc. Careful notes are taken plus photos of the numbered bags place in the holes with the tag number showing. In a few months the small sampling holes will disappear due to normal processes of cliff erosion etc.

Without the metadata, the bags of sediment are just dirtbags! instead they are encyclopedias waiting to be read..

This entire study will take a couple years and will be the first really major advance over what was done back in the 70s.

I hope some of you goet something out of this verbose email! If you don't understand anything, let me know and I will elaborate or ask experts.

Peter