Reports *from Albert and Alice Weeks Postdoctoral Fellows*

Gwen Daley

Some of the most interesting paleontological research of the last decade has examined the phenomenon known as “coordinated stasis.” The debate surrounding the apparent stasis in multiple lineages of organisms over millions of years has yielded dozens of papers about the possible relationship between evolutionary and paleoecologic control on the persistence of species, and the maintenance of morphologic stasis.

It has also raised fundamental questions about what factors control morphology in living organisms, and thus what causes the differences in morphology seen in the fossil record: evolution (genetic change) or ecology (ecophenotypic variation). By combining paleoecological and morphological analyses it should be possible to tease apart these two causes of morphological change within lineages.

In order to test this, I collected samples from the Caloosa Shell Quarry in Ruskin, Florida. The locality is an active quarry working several mixed clastic-carbonate shallow water marine facies of the Pleistocene Fort Thompson Formation. I collected from the “Upper Shell Bed” which is composed of a quartz sand with a plethora of mostly molluscan fossils forming a dense shell bed.

Since my arrival at the University of Wisconsin, I have been busily processing samples from that locality. The initial processing effort turned several hundred pounds of sediment into a delightfully large pile of shells composed of approximately 27,000 individual specimens belonging to 87 species of bivalves and gastropods. The initial paleoecological analysis indicates there are two well-defined paleocommunities present in the sampled interval, both of which developed on a substrate composed of dirty shell rubble in a shallow marine environment. The lower paleocommunity is composed primarily of species that lived epifaunally while the upper paleocommunity contains primarily burrowers (Figure 1). Many species are common in both paleocommunities which will allow me to examine how the morphology of these species differs under different paleoenvironmental conditions.

An analysis of the Southern Quahog clam *Mercenaria campechiensis* from this locality by my colleague Andrew Bush at Harvard indicates that collections of *M. campechiensis* from one paleocommunity differ from those found in the other paleocommunity. That analysis is a part of a paper that is currently in review, and will hopefully be published sometime in the coming year. It will be very interesting to see in the coming months whether this pattern is repeated in other clams or in snails.

In addition to the main thrust of the research, Dr. Dana Geary and I are developing several smaller research projects based on the paleoecological collections. These research efforts will examine morphologic patterns in other bivalve lineages, paleoecological interactions among Fort Thompson species, and paleoenvironmental reconstruction using isotopic and sedimentological analyses. Several students have expressed interest in performing these analyses.

I would like to express my gratitude to the Weeks Post-Doctoral committee for the opportunity to come to the University of Wisconsin and perform what is turning out to be a very interesting research project.

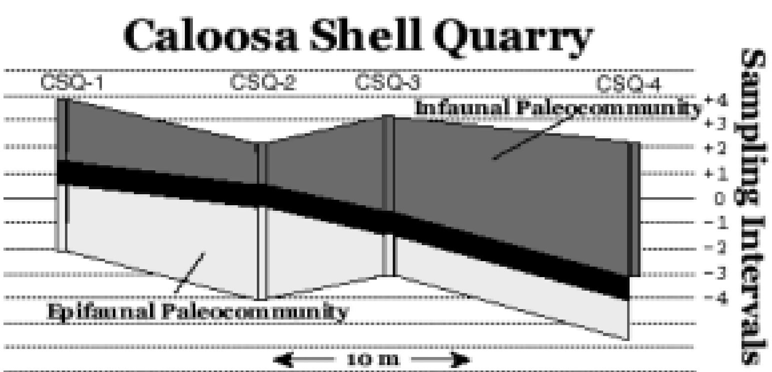

Figure 1. Cross-section of Caloosa Shell Quarry outcrop of the Fort Thompson Formation, with distribution of major paleocommunities. The black-shaded zone between the two paleocommunities contains a mixture of both.

Michael Kaplan

I arrived in Madison as a Weeks Postdoctoral Fellow in the fall semester, 2000. Prior to my arrival, I obtained a PhD (1999) at the University of Colorado. While in Colorado, I studied the geometry and dynamics of the northeastern Laurentide Ice Sheet, which covered most of eastern Arctic Canada, and the Holocene paleoenvironmental history of southern Greenland.

My research project at the University of Wisconsin concerns the glacial and climate history of mid-latitude South America. Despite over a century of research, we still have a limited knowledge of the ice-age world during the Late Quaternary Period. The Milankovitch theory, first put forth about 75 years ago, explains that variations in the amount and distribution of solar radiation are the "pacemaker" of the ice ages, specifically the timing of glacial cycles in the northern hemisphere. However, there are still major problems that need to be addressed before we can fully understand the Earth's ice-age climate. For example, although orbital parameters dictate that over time the flux of solar energy varies antithetically between Earth's polar hemispheres (e.g., the seasons are out of phase), preliminary information indicates that past global climates appear to have been, at least in part, modulated largely by growth and melting of northern hemisphere ice sheets. Understanding to what extent, and why, the northern hemisphere dominated the entire Earth's climate during glacial periods requires adequate global spatial coverage of well-dated geologic records; a fundamental spatial gap in data coverage is in the Southern Hemisphere.

Towards this end, our project will develop a precise late-Pleistocene record of glacial events in mid-latitude South America. This project also involves Assistant Professor Dr. Brad Singer and PhD student Daniel Douglass. We are collaborating with scientists at the Woods Hole Oceanographic Institution (WHOI) and Professor Jorge Rabasssa in Argentina. Glaciers advance at times of decreased temperature or increased precipitation, leaving behind moraines that mark cold periods in the area. This past January (2001), we studied at least 17 remote, well-preserved moraines deposited sequentially east of Lago Buenos Aires, Argentina (71° W 46° S). On the basis of $^{40}Ar/^{39}Ar$ radioisotopic ages on interbedded basaltic lava flows, in part obtained in the new Rare Gas Laboratory by Singer, we know that the moraines range in age from 15 thousand to >1 million years old. This exceptionally long archive of oscillatory climate is among the most complete in South America and in the world. Determining the age of glacial moraines is usually difficult because they may be older than the working range of radiocarbon dating (>40,000 years old), or lack datable organic matter altogether. A relatively new method is the use of in-situ produced cosmogenic nuclides to determine the time since rocks comprising moraines became exposed to the atmosphere. Exposed rock surfaces are continuously bombarded by cosmic rays, producing a variety of cosmogenic nuclides in mineral lattices including ^{26}Al, ^{10}Be, and ^{3}He. The time of exposure is determined by simply measuring the number of cosmogenic nuclides that have accumulated in minerals and dividing by reasonably well constrained production rates. Last fall, I set up a facility in the Department of Geology and Geophysics for extracting ^{10}Be and ^{26}Al from rock samples that we collected from morainal boulders around Lago Buenos Aires. Subsequent to chemical isolation of the desired cosmogenic nuclides, we measure their concentration using an accelerator mass spectrometer (AMS), only a few of which exist in the world for such analyses.

Our findings will provide new information on the Late Quaternary waxing and waning of the Patagonian mountain icecap and thus a mid-latitude South American climate model for at least the past several hundred thousand years. Comparison of our chronology to that preserved in sediments from the North Atlantic Ocean, Arctic and Antarctic ice cores, plus the limited terrestrial chronology from New Zealand and more northerly central Chile, will provide tests of hemispheric and global synchroneity in the Late Quaternary Period. In turn, our record may preclude or permit specific pathways within the climate system that cause the Northern Hemisphere to, at least in part, dominate the global climate during glacial periods. Finally, such studies, of the past climate system, provide the best context in which to compare any recent and future environmental changes, such as the human-induced global warming

Yaron Katzir

I began my second year in Weeks Hall by finishing a manuscript that concerns a project carried out here with **John Valley** during 2000: Tracking fluid flow during mid-crustal anatexis (Naxos, Greece). By studying ultramafic horizons associated with migmatites in the core of Naxos dome, we were able to decipher the timing and scope of fluid-flow and the pathways of fluids during in-situ genesis of granitic magma. Peridotites of two ultramafic horizons on Naxos (MUH and the AUH) were metamorphosed together with their host felsic gneisses at high-amphibolite facies conditions. However, the resulting assemblages, the mode and intensity of deformation, and the oxygen isotope compositions of the MUH and AUH are surprisingly different. Petrologic and structural analyses and oxygen isotope thermometry (Fig.1) show that the MUH meta-peridotite assemblages developed at peak metamorphic temperatures (~700˚C) and deformation. They retain mantle-like chemical and oxygen isotope compositions and thus require no infiltration of fluids from the host rocks. Moreover, in some of these peridotites, pre-metamorphic mantle assemblages and oxygen-isotope fractionations are preserved (Fig. 1). Unlike the MUH, the AUH mottled peridotites crystallized at retrograde (~600˚C), almost static conditions during infiltration of silica-bearing high $\delta^{18}O$ aqueous fluids. Probable sources for these fluids are aplitic and pegmatitic dikes emanating from the migmatitic core of Naxos and intruding the AUH.

We thus conclude that at peak metamorphic temperatures and during partial anatexis of gneisses, Water/Rock ratios were low and fluid-composition was locally buffered in the deeper part of the Naxos section. Crystallization of melts within the migmatitic core released siliceous fluids and initiated an episode of retrograde hydrous metamorphism in the overlying sequences, as observed in the AUH.

The conclusion that a principal phase of fluid-flow occurred on Naxos during post-peak, retrograde conditions changes our understanding of the role of fluids in areas of partial crustal anatexis in general. It suggests that granitic melts are a temporary sink for volatiles: at the onset of melting they dissolve liquids just to release them later, while crystallizing. It follows that fluids could not have played a major role in enhancing the extreme syn-metamorphic extensional deformation observed on Naxos and on other migmatite-bearing core-complexes. Fluids were significant, however, in heat and mass-transport to upper levels of the continental crust during cooling and uplift.