Report on Use of FRAC Funds for Arizona Field Work
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In March 2004 I spent several days conducting geological field research on the Ward Terrace, north of Flagstaff and east of Cameron, Arizona, on Navajo Nation land. This report provides a summary of the work done and the interim results of the work, which remains in progress.

Purpose, Personnel, and Time

The focus of my work was on the Owl Rock Member of the Chinle Formation, and specifically I was preparing a measured section of the strata from the Little Mexican Springs Wash exposures. Previous trips to the area in 2000 and 2001 alerted me to the wonderful outcrops that occur in that canyon. I was in the field from March 13 to March 18. During that time, I was joined by Professor Timothy Demko from the University of Minnesota, Duluth Campus, and four of his undergraduate and graduate students for two days.

Methods

I used standard measuring technique (Jacob staff) to determine the thicknesses of units within the Owl Rock strata. The lowest part of the section that I measured was at the confluence of Tohachi Wash and Little Mexican Springs Wash. The true base of the section is not easily accessible in the time I had available, however I have that information from my previous work in Badger Wash. I worked up the section by measuring, describing, photographing, and collecting a few samples from the strata. The important aspects I focused on were the rock types, sedimentary structures (e.g. crossbedding) where visible, trace fossils, paleosols, and unusual bedding surfaces.

The two days spent with Tim Demko were exceptionally helpful. He provided me with additional information about regional geology, and with interpretations and strategies for studying the paleosol fabrics, paleo-groundwater features, and paleontologic specimens. I am incorporating his interpretations into the final measured section that I am preparing.

Preliminary Results

The total thickness of the Owl Rock strata that I measured is 102 meters (340 feet). There are approximately 10 feet of additional strata at the base, below the confluence of Tohachi and Little Mexican Springs Wash that brings the grand total to 350 feet, which means this section is comparable to the thickest sections that have been measured for the Owl Rock in the Four Corners region.

The stratigraphic section may be divided into a lower and upper section, based on lithology, sedimentary bed thickness, and associated aspects of trace fossils and paleosol development. The lower 180 feet are dominated by sets of beds that are 5 to 15 feet thick, separated by prominent surfaces of paleosol development and intense bioturbation, suggesting lengthy exposure at the land surface and non-deposition. The lithologies include calcareous siltstone and silty limestone. At least two resistant limestone units occur in this part of the section. These units comprise the plateau-forming sedimentary beds on the Ward Terrace.

Fossil evidence indicates that these strata were deposited in water, most likely in lakes and the environment immediately surrounding lake shorelines. Freshwater thin-shelled unionid bivalves and high-spired gastropods, a phytosaur tooth, and abundant crayfish burrows are evidence for a lacustrine environment, likely dominated by shallow standing bodies of water. Plant

roots, burrowing by small invertebrates (including insects) as well as vertebrates, and groundwater processes modified the sediments following times of lake desiccation.

The uppermost resistant limestone marks a dramatic change in sedimentation. The upper 160 feet of the Owl Rock which overlie that limestone are dominated by fluvial sediments. Channels and muddy to locally sandy sets of beds that accumulated on point bars in river channels, in addition to nonresistant, poorly exposed horizontal siltstone, comprise units that range up to about 5 feet thick. Half a dozen thin, locally-discontinuous limestone beds form slightly more resistant units. These limestones are likely predominantly calcareous paleosols, although the uppermost limestones are more continuous and may be lacustrine in origin. One sample from equivalent strata about 4 miles away in Tohachi Wash contains ostracods, strongly suggesting lacustrine sedimentation. The top of the Owl Rock Member is a gently-inclined, sharp unconformity with the overlying Moenave Formation.

A wide array of trace fossils occurs in this Owl Rock section. One spectacular burrow is exposed at about 45 feet above the base of the section, and is on a cliff about 18 feet off the ground. It is a partial burrow with an exposed length of about 6 feet, and a rounded-off square cross section with a lateral dimension of a little less than one foot. It is slightly inclined from horizontal, and gently curved. It is weathering out in relief on this cliff face. The bottom and one side are visible, and are marked by diagonal to elliptical grooves and impressions. This exceptional burrow was likely made by a vertebrate of some type. Locally, the base of the sedimentary unit that hosts this trace fossil is heavily burrowed by some other type of vertebrate. These burrows are near-vertical and terminate downward in bulbous chambers. They are about 1½ - 2 feet long, and about a foot in diameter.

Ongoing work

The large subhorizontal burrow, and accompanying burrowed horizon, will be the subject of a paper that will be submitted for publication. The large burrow may be named as a new ichnofossil, pending a more thorough literature search to determine whether other similar burrows have been described elsewhere. Tim Demko has informed me that he subsequently found a compacted, deformed similar burrow in Petrified Forest Park strata, but he and I are not aware of other references to such burrows. If it is a newly-identified ichnofossil, the Little Mexican Springs Wash occurrence will be designated its type locality.

The measured section of Owl Rock strata will also constitute the focus of a publication. Some additional field work is required to determine the extent of the units across the Ward Terrace, and comparison with other published sections will place the section into regional context. I anticipate doing the bulk of that work in May and June this summer.

I deeply appreciate the support that FRAC has provided me for field work. I have ideas for undergraduate research projects that I hope will attract geology majors to do some work with me on these rocks in the coming years, and this type of opportunity will be made possible from the information I have gathered from the FRAC-supported work.