

nature of astrobiology; by building and leading their team's work, they become ideal candidates for communicating the broad topics of astrobiology to students of all levels. Each NAI PI identifies unique E/PO and training opportunities and includes their team members in these efforts. The result is an amalgamated program reaching the full spectrum of K-Postdoctoral students receiving information and opportunities in astrobiology. Research is embedded throughout the NAI's E/PO program with the ultimate goal of seeding future researchers and their discoveries of life in the universe. URL: <http://nai.arc.nasa.gov>

ED41A-07 0930h

Field/Lab Training Workshops in Planetary Geology and Astrobiology for Secondary School Teachers

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Thematic field-lab-classroom workshops can be successful in training secondary teachers in planetary geology and astrobiology, from the LP's 4 years experience. A typical workshop includes ~4 days of field study and ~3 days of related classroom/lab lectures and exercises. Up to 30 teachers have participated at once, and the staff averages 5 researchers and educators. The 2003 workshop, The Great Desert, focused on geology and life in the Colorado Plateau as analogs for Mars. Specific emphases were on geologic processes exemplified in the Grand Canyon, Sunset Crater and Meteor Crater, and on biotic communities in desert soils and hot springs. The classroom portion, hosted by UNM, included lectures, lab work, and teaching exercises keyed to the field experience and its extensions to Mars. Formal followups: non-directive exit questionnaires; email list-serves for participants; web-sites with images, presentations, and exercises from the workshop, and links to related materials (e.g. <http://www.lpi.usra.edu/education/EPO/yellowstone2002/index.html>); and interviews for six-month retrospective. Graduate and continuing education credit are available. Past workshops, all relevant to Mars, have targeted: geology and extremophiles of Yellowstone NP, geology of the Cascade volcanoes; and giant floods and lava flows of central Washington. The greatest benefit of this workshop format is the teachers' intense, deep experience, emphasizing scientific content. They learn from field, classroom, and laboratory perspectives, and work with PhD level researchers who contribute their excitement, demonstrate and teach critical thought processes, and provide authoritative background and answers. The small group size permits personal interactions (among teachers and presenters) that complement each other's understanding and appreciation of the subject. They log ~65 contact hours with the staff, in small groups or one-on-one. Teachers return to the classroom with personal experiences, with heightened appreciation, excited, and energetic. The teachers are asked to share their knowledge in their districts (in one case, saving the district thousands of dollars). For the presenters, the workshop format allows personal interactions with the teachers, leading to enhanced appreciation of their perspectives and needs. This year, teacher input assisted with an NSF-sponsored National Park education initiative. And in one case, a meaningful research collaboration has come from these workshops. Logistics is the greatest challenge of this workshop format. Hosts and teaching/lab venues need to be arranged early in sites dictated by science content, not convenience. Travel and lodging must be arranged for teachers and presenters at several sites, usually all distant from the organizing institution. Logistics also dictates that each workshop cannot serve more than about 30 teachers. The depth of knowledge imparted and its long-term effects on the teachers and their districts offsets the small number of teachers reached per year. Authors here are the 2003 organizers and presenters. Many others have organized and presented at past workshops - especially Dr. A.J. Irving of U. Wash. We are grateful for past support from NASA Broker/Facilitator, and now from Sandia National Laboratory and NASA OSS/EPO.

URL: <http://www.lpi.usra.edu/education/EPO/yellowstone2002/index.html>

ED41B MCC: Level 2 Thursday 0830h

Undergraduate Research in Geoscience Posters (joint with OS, P, C, PA)

Presiding: I Dexas, University of Colorado; G White, American Institute of Physics; K McCall, University of Nevada, Reno

ED41B-1159 0830h POSTER

A Preliminary Geophysical Study Involving Remote Sensing at the Archaeological Site Trincheria Cave, Colorado

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Resistivity, magnetic, seismic, and geodetic surveys were performed at Trincheria cave, an archaeological site ~50 km east of Trinidad, Colorado, in order to locate the foundation walls of an ancient jacal structure. This structure, a shelter built during the Apishapa phase (earlier than 750 years before present), was reported - and backfilled - during a 1974 excavation; recent excavations have failed to again find it. The cave is a ~8 m high overhang, the bottom of which marks the contact between the Dakota formation (yellowish-brown, fine-grained sandstone) and the underlying Furgatone formation (bedded, organic-rich shale). The foundation was reported to be made of blocks of sandstone surrounded by cave fill/soil that is estimated to be 1.5 m thick in the cave. A total station survey mapped the topography beneath the overhang (the cave, ~30 by 8 m) and within the adjacent creek. This part of the study should be useful to tie together future archaeological and geophysical work. Our magnetic map of the area is inconclusive due to the presence of metallic pipes left at the site by previous excavations and because of the overhang. Seismic refraction tests yielded varying thicknesses of the cave fill (0.7-2.3 m); however we experienced problems with the equipment in the field and realized that a 1-D model is insufficient to explain the data. A future reflection experiment might produce more useful seismic data. Our most reliable results were obtained by resistivity profiling. They show a more resistive structure in the SW part of the cave, about 1 m from the overhang and at a model depth of 2 m. We interpret this as the 'lost' foundation.

ED41B-1160 0830h POSTER

Preliminary Geophysical Investigations of the Ship Rock Diatreme, Navajo Nation, New Mexico

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Magnetic and gravity data were collected at the Ship Rock minette neck and dikes, part of the Navajo volcanic field in the central Colorado Plateau, to investigate their subsurface structure. The deep root system of Ship Rock, an exhumed Oligocene maar-diatreme complex, has not been resolved. The diatreme is largely composed of minette tuff-breccia with a large wallrock fraction, whereas the dikes are composed of hypabyssal minette. The country rock is the Upper Cretaceous Mancos Shale. Density and magnetic contrasts between the igneous rock and surrounding shale suggest that the buried structure of Ship Rock can be imaged. Preliminary geophysical investigations were carried out in order to test this hypothesis. We collected magnetic and gravitational data along four lines selected to transect the major south and northeast dikes and to partly encircle the diatreme. Modeling differently

sized, oriented and shaped intrusions, we created theoretical Free Air anomaly curves to try to match the two clearest anomalies. Modeling necessitates (i) that the major north-south dike dips west and (ii) the presence of a high-density, deep body near the diatreme. The Free Air anomaly curves show that smaller dikes might not be detected from gravity data; however, they are necessary to determine the presence of large, dense bodies. Although not modeled, the magnetics curves show that smaller dikes can easily be detected. Our study results are promising, and we plan a more thorough investigation in the future which will produce a magnetic map to determine if further buried dikes exist in the vicinity, and measure gravity along additional profiles to better constrain the location of the dense body at depth.

ED41B-1161 0830h POSTER

A COARSE Receiver Function Survey of the Southern Arizona Lithosphere

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Project COARSE (CONsortium for Arizona Reconnaissance Seismic Experiment) operates a temporary network of broadband seismic stations in southern Arizona. The goal of the project is to investigate the crustal and deep structure across the transition from the Southern Basin and Range to the southern Colorado Plateau. Southern Arizona is a region of notable undersampling in tomographic and receiver function studies of the lithospheric-scale structure of the western United States. In addition, these data will provide unique first-order constraints on crust and upper mantle structure beneath the region in preparation for more focused efforts as EarthScope and USarray pass through the region. We are currently operating eight broadband seismographs recording continuously at 25 samples/sec in an approximate SW-NE swath across southeastern Arizona. When combined with the two permanent broadband stations in the state (TUC and WUAZ), the array will provide the requisite data to delineate the first-order structure of the lithosphere and sublithospheric mantle, as well as improve imaging capabilities for deep Earth structure in adjacent regions. One key question we are addressing is the nature of extension in the Southern Basin and Range, and how this extension is accommodated at greater depths. The current study therefore focuses on data collected at stations located at astronomical observatories on mountain summits associated with metamorphic core complexes. From SW to NE the seismic stations are located at 1) Kitt Peak (KIT), 2) Mt. Lemmon (LEMM) and the nearby GSN station TUC, and 3) Mt. Graham (SQR). Analyses of receiver functions from teleseismic events at each station indicate a gradual SW to NE increase in crustal thickness from 29 km at KIT, to 30 km at LEMM, and 32 km at SQR. This crustal thickness increase correlates with the increase in summit elevations from 2100m at KIT, to 2800m at LEMM, and 3050m at SQR. Among these stations, only the TUC station has a clear Moho multiple from which we can estimate the bulk crustal Vp/Vs value of 1.74. The receiver functions from stations KIT and SQR have prominent arrivals from the top of a crustal low-velocity zone at depths of 17 km and 14 km, respectively. Inter-crustal arrivals in this region possibly mark shallowly dipping shear zones that have played a role in accommodating extension during core complex formation. We hope to characterize how crustal thickness, anisotropy, extension, and shear within the crust are related in southern Arizona.

ED41B-1162 0830h POSTER

Modeling of Geodetic Crustal Motion Velocities in Southern California: Undergraduate Research

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