Final Report of Accomplishments
NASA Planetary Geology and Geophysics Program Grant NAGW-1358
Title: Paleoclimatic and Tectonic History of the Eastern Desert, Egypt and Surroundings
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Period Covered: 5/1/88-6/30/97

Report:
This report covers work done from Oct 1989 until June 1997 for the Planetary Geology and Geophysics Program, specifically:
a. Scientific Research
   Research accomplished under Grant NAGW-1358 has focused on three areas: analysis of the tectonics and paleoclimatic conditions in north eastern Africa, analysis of surficial geology and damage associated with the 1993 Missouri River floods and rates of lava flow degradation at Lunar Crater volcanic field in Nevada. Work has resulted in several dozen abstracts, several dissertations and a number of papers. The papers and dissertations are as follows, with available copies attached to this document:


Sultan, M., I.J. Duncan, R.E. Arvidson, R.J. Stern, and B. El Kaliouby, 1990, Reply—Extension of the Najd Shear System from Saudi Arabia to the central Eastern Desert of Egypt based on integrated field and Landsat observations, Tectonics, 9, 539-543.

Rivard, B., 1990, Lithologic Mapping in the Southwestern Greenland and Nubian Shields Using Field, Laboratory, and Landsat Thematic Mapper Data, A Ph.D. dissertation presented to the Graduate School of Arts and Sciences, Washington University in St. Louis


Mohammed Sultan finished leading a number of studies of the tectonics of opening the Red Sea Rift. Additionally, Arvidson was responsible for planning and implementing a field expedition to the Kukur Oasis in the Western Desert of Egypt. Travertines were mapped and samples were collected for analytical analyses. U-Th ages and carbon and oxygen isotopes were obtained using the Argonne National Laboratory facilities. We concluded from the observations and data that wet periods over the past several hundred thousand years have been driven by Milankovitch cycles. During peak insolation periods, monsoons from the Atlantic Ocean increased moisture and reactivated springs that produced travertines.

Three papers were published (see above) from this research. Later in 1996, Sultan completed studies of work in the Egyptian desert including acquisition of pristine travertine samples and fossil ground water in areas in the western desert. These samples are to be used to better define the timing of pluvial epochs and confirm our hypothesis.
c. Damage Assessment associated with the 1993 Missouri River floods
Under this task, Arvidson spearheaded the working group that acquired AIRSAR and TOPSPAR data over Jameson Island bottoms/Arrow Rock bottoms flood plains that were severely damaged during the 1993 Missouri River floods. We conducted extensive analysis of the data, completed several field trips, modeling and laboratory analyses. This work was published in a paper by Noam Izenberg and part of the Ph.D thesis work by Mary Katherine Crombie.

d. Lava Flow degradation, Lunar Crater Volcanic Field
We used remote sensing and cosmogenic exposure age dating to understand lava flow degradation processes and rates at the lunar Crater Volcanic Field in Nevada. The work included use of Al-26, Cl-36, and Be-10 to date the Black Rock Flow and to determine mechanisms of desert pavement formation on an old flow south of the Black Rock Flow. We found that desert pavement occurs by a rapid accumulation of aeolian mantle, with basalt clasts remaining on the surface and riding on the mantle as it builds. This work was published in a paper by Mike Shepard who also did his Ph.D. thesis on this topic.