A UNIQUE OUTSIDE NEUTRON AND GAMMA RAY INSTRUMENTATION DEVELOPMENT TEST FACILITY AT NASA's GODDARD SPACE FLIGHT CENTER.

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Introduction: An outside neutron and gamma ray instrumentation test facility has been constructed at NASA's Goddard Space Flight Center (GSFC) to evaluate conceptual designs of gamma ray and neutron systems that we intend to propose for future planetary lander and rover missions. We will describe this test facility and its current capabilities for operation of planetary *in situ* instrumentation, utilizing a 14 MeV pulsed neutron generator as the gamma ray excitation source with gamma ray and neutron detectors, in an open field with the ability to remotely monitor and operate experiments from a safe distance at an on-site building. The advantage of a permanent test facility with the ability to operate a neutron generator outside and the flexibility to modify testing configurations is essential for efficient testing of this type of technology. Until now, there have been no outdoor test facilities for realistically testing neutron and gamma ray instruments planned for solar system exploration.

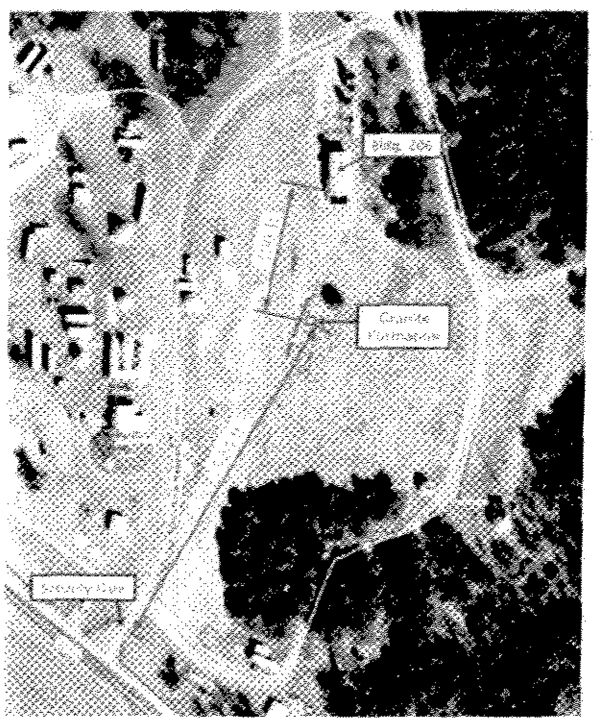

Figure 1: Areal photograph, courtesy of Google Maps, of our test facility. We operate remotely from Building 206 labeled in this photograph.

Description of the Neutron and Gamma Ray Instrumentation Development Test Facility: The test facility at GSFC, shown in Fig. 1, consists of a 2 x 2 x 1 meter structure of granite in the middle of an open field with a 50-meter radius radiation safety parameter. We remotely operate the Pulsed Neutron Generator - Gamma Ray And Neutron Detectors (PNG-GRAND) on a known sample, minimizing background signals from neutron and gamma ray interactions with nearby structures. The facility is equipped with an operations building that provides power and communications to the granite monument, so users can operate and monitor their systems at a safe distance from the PNG. The radiation safety perimeter is visually monitored during operation, and we are currently installing a video and motion sensor surveillance system.

The current 2 x 2 x 1 meter granite structure, shown in Fig. 2, was selected due to its uniform elemental composition, its density and the ability to control water content outdoors due to its low porosity. In addition, the size and placement of the granite in an open field was selected to insure that the neutrons from the PNG were only interacting with the granite itself. We are currently in the process of selecting a similarly sized planetary analog sample that we plan to install at the site in the near future.

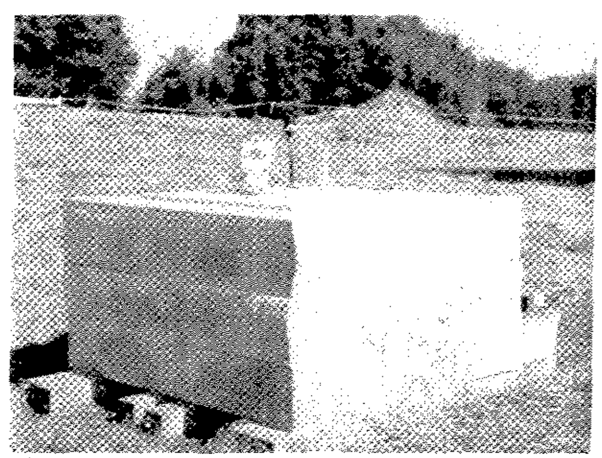

Figure 2: PNG-GRAND experimental configuration with our PNG and a $LaBr_3$ gamma ray spectrometer on top of our granite formation topped with a layer of polyethylene tiles and granite pavers at our test facility.

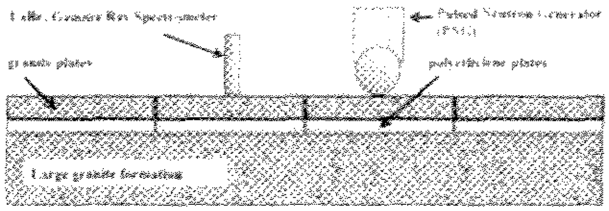

Figure 3: Example of how we can simulate a water/ice layer below the surface using polyethylene tiles and granite pavers.

A unique feature of our test facility is the ability to perform layering studies using granite pavers and high-density polyethylene tiles to simulate layers of water ice. We have purchased enough granite pavers and polyethylene tiles for three complete layers each of both granite and polyethylene on top of the granite monument. These materials can be stacked to simulate a variety of layering scenarios, shown in Fig. 3, such as simulating the side of a crater. Additional, we can introduce other materials to test sensitivities of numerous elements. Our large quantity of granite pavers and polyethylene tiles and the ability to use various other layering materials affords us great flexibility in constructing numerous configurations to simulate a wide variety of planetary surfaces, geological features and environments.

References:

Parsons *et al.*, "Subsurface Planetary Geochemistry Through Active Gamma Ray and Neutron Instrumentation", LPSC 2010.