**FIDO/APEX/ATHENA-BASED PLANS FOR CARTOGRAPHIC PRODUCTS AND ROVER LOCALIZATION ANALYSES.** R. Arvidson[1], S. Squyres[2], [1]Department of Earth and Planetary Sciences, Washington University, St. Louis, Missouri, 63130, arvidson@wunder.wustl.edu, [2]Department of Astronomy, Cornell University, Ithaca, New York, 14853.

In this abstract we preview the acquisition of stereo image data and resultant cartographic products and rover localization studies associated with the Athena Precursor Experiment (APEX) on the 2001 Mars Surveyor Lander and the Athena rover investigation on the Mars Sample Return (MSR) mission that begins in 2003 [1,2]. We also discuss ongoing experiments with the Field Integration Design and Operations (FIDO) Rover, developed by the Jet Propulsion Laboratory [3,4].

The Athena Precursor Experiment (APEX) is a suite of scientific instruments for the Mars Exploration Program 2001 Lander. It includes Pancam, a high-resolution, stereo, multispectral imager, coupled with Mini-TES, an emission spectrometer. Pancam has an angular resolution of 0.28 mrad/pixel, 16 color spectral bands from 0.4 to 1.0 μm, and a nominal SNR of 200:1 in all spectral bands. Image frame size is 1024 pixels wide by 512 pixels high. Stereo separation is 28 cm, providing good ranging accuracy to a substantial distance from the lander. Mini-TES is a raster-scanning point spectrometer with a wavelength range of 6-25 μm, spectral resolution of 10 $cm^{-1}$, and spatial resolution modes of 20 and 8 mrad/pixel. The instruments are effectively boresighted with one another, mounted on the lander deck and using a deployable mast to obtain a clear view of the terrain around the lander. In 2001, Pancam/Mini-TES will be used to perform scientific investigations of the landing site, and to help guide the mission's Sojourner-like rover.

Also on the APEX payload are an Alpha-Proton-X-Ray Spectrometer (APXS) for in-situ elemental analysis, a Mössbauer Spectrometer for in-situ determination of the mineralogy of Fe-bearing rocks and soils, and a Magnet Array that can separate magnetic soil particles from non-magnetic ones. The APXS is mounted on the Marie Curie rover, which is able to deploy the spectrometer against a range of martian soils and rocks. The Mössbauer Spectrometer is mounted on the Lander's Robotic Arm (RA), which is able to deploy the spectrometer to distances of up to ~1.5 m from the Lander.

In 2003 and 2005, Pancam/Mini-TES will fly on the Athena rover payload. The rover-based version of Pancam will be identical to the '01 Lander version, with the exception of some minor changes to the filter set. For these missions, Pancam and Mini-TES will be the key tools for remote identification of prospective targets for sampling by the rover. The '03 rover will also include lower resolution mast-mounted stereo navigation cameras, front- and rear-mounted stereo hazard-avoidance cameras, and stereo "belly cameras" to view the surface directly beneath the vehicle and monitor the sampling process. The rover's arm will include Mössbauer and Raman spectrometers, together with an APXS and a Microscopic Imager. Athena will also have a coring device and drill core caching system, together with the ability to acquire and cache soil samples and deliver cached samples to the ascent vehicle on the lander. Finally, magnet arrays will be include similar to those to be flown as part of APEX, along with various calibration targets.

FIDO is a prototype of the MSR rovers. The purpose of FIDO is to simulate, in Mars analog settings, the complex surface operations that will be required to find, characterize, obtain, cache, and return samples to the ascent vehicles on the landers. Instrumentation on FIDO is designed to simulate as closely as possible the Athena Science Payload [Table 1]. FIDO was deployed in the Silver Lake region of the Mojave Desert from April 19 to 30, 1999, acquiring just over a gigabyte of mast- and body-mounted stereo image data of local terrains [*http://wundow.wustl.edu/rover*]. In addition, a 4K by 4K pixel geometrically calibrated camera was flown at the end of the field work to simulate acquisition of descent data over the two primary areas where FIDO conducted its field work. The acquisition of the simulated descent data was conducted by Larry Matthies, JPL, and Ron Li, Ohio State University.

From cartographic and localization viewpoints, APEX, Athena, and FIDO data will be used to: (a) generate digital elevation maps for various local sites, including image overlays; and (b) improve knowledge of locations inferred from lander and rover data by intercomparisons with data derived from orbital and descent images. In addition, the image data will be used to support a variety of operations, including RA and Marie Curie activities during the '01 mission, and arm/drill/cache/cache-delivery functions during the '03/'05 missions. FIDO data acquired in April are currently being processed as prototypes of the procedures and products to be generated from Mars data. Initial results will be presented at the Mars Conference.

**Table 1. FIDO Instrumentation**

| Instrument | Purpose |
|---|---|
| **Pancam/Mast.** False color IR stereo imaging system. 15 cm stereo baseline separation. IFOV of 0.4 mrad/pixel (H) and 0.3 mrad/pixel (V). FOV of 11.1º (H) and 8.2º (V). | Color imaging and terrain model generation for areas surrounding rover for use in scientific analyses, including target selection |
| **Navcam/Mast.** Monochromatic stereo imaging system with IFOV = 1.5 mrad/pixel and FOV of 32º (V) and 43º (H). 23 cm stereo baseline separation. | For terrain model generation, traverse planning, and waypoint determination |
| **Infrared Point Spectrometer (IPS)/Mast.** Point spectrometer operating from 1.25 to 2.5 micrometers with 13 $cm^{-1}$ spectral resolution and 16 bit encoding. Boresighted with Pancam. IFOV=12 by 12 group of Pancam pixels. | Acquire reflectance spectra for selected areas identified in Pancam images, either as single point or in raster mode. Used to infer target mineralogy and physical properties. |
| **Microscopic Imager/Arm.** Color microscopic imager projected pixel size of 20 x 16 micrometers and FOV of approximately 1.5 cm. | Close-up views of targets such as rock surfaces. Images of core tips in drill to confirm core acquisition. |
| **$Fe^{57}$ Mössbauer Spectrometer/Arm.** | Iron oxidation state and mineralogy. |
| **Brush/Arm** (fall 1999) | Clean rocks before selected measurements are conducted. |
| **Raman Spectrometer/Arm** (June 2001). Red wavelength Raman Spectrometer for spectral identification of minerals. | Particularly good for identifying major rock forming minerals, aqueous minerals, and organics. |
| **Mini-Corer and Caching System.** Drill capable of coring rock. | Acquire 5 mm diameter, 1.5 cm long rock cores that can be examined with microscope imager and placed in caching tubes. |
| **Front Hazcams and Belly Cameras.** 105º FOV; 1 mrad/pixel IFOV. | Hazard avoidance (Hazcams) and examination of arm/drill activities (Belly Cameras) |

**References:**

[1] Squyres, S. W., and others (1998), *LPS XXIX*, Abstract #1101. [2] Squyres, S. W., and others (1999), *LPS XXX*, Abstract #1672. [3] Schenker, P.S., and others (1998), *Intelligent Robotics and Computer Vision XVII*, SPIE Proc. 3522. [4] Arvidson, R., and others (1999), *LPS XXX*, Abstract #1201.