ASTEROID 951 GASPRA'S THREE MICROMETER REGION SPECTRAL FEATURES. J. C. Granahan[1], [1]Leidos (10932 Blake Lane, Bealeton, VA 22712. E-mail: james.c.granahan@leidos.com).

Introduction: Infrared spectra of Asteroid 951 Gaspra possesses absorption features in the vicinity of 2.8 and 3.4 μm (micrometers) in wavelength. The 951 Gaspra data are from Galileo spacecraft Near Infrared Mapping Spectrometer (NIMS) observations obtained on October 29, 1991.[1] These spectral absorption features vary in strength with respect to both position and in time. The 2.8 μm feature was found to decrease in depth with the increase of observation phase angle. It is consistent with the presence of structural hydroxyl (OH) on the surface of the asteroid. These properties are analogous to those observed for OH as observed on the Moon [2], suggesting that this volatile is the product of solar wind interactions with mineral surfaces.

Abstract: This investigation is the product of processing uncalibrated NIMS data archived in the NASA Planetary Data System. The NIMS imaging spectrometer possessed two silicon and 15 indium antimonide detectors that acquired spectra ranging from 0.7 to 5.2 μm.[3] The sensor had a grating that could move into 24 different positions. Different sequences of grating positions produced 17, 102, and 408 spectral channel observations of Asteroid 951 Gaspra. Six observations were radiometrically calibrated by an application of NIMS calibration factors that were calculated for the first Earth/ Moon encounter of the Galileo mission. The NIMS sensor used a solar illuminated aluminum plate and a blackbody radiation source inflight to determine sensitivity values for radiance calibration.[3] Three 17 channel, two 102 channel, and one 408 channel observations were processed from raw data values into reflectance spectra. They were acquired as the Galileo spacecraft approached Asteroid 951 Gaspra. The reflectance spectra were created by ratioing the radiance data with Solar radiance values and by modeling thermal emission with the standard thermal model. [4]

A three μm spectral feature was first detected on Asteroid 951 Gaspra as a 2.7 μm minimum in the incidence/flux spectra from the NIMS closest approach observation. [5] ***Figure 1*** is a band depth map of this spectral feature created from the 17 channel reflectance spectra from the same observation. The NIMS data has a spatial resolution of 1.48 km/pixel. The band depth map of ***Figure 1*** is overlain on top of a 54 m/ pixel image of Asteroid 951 Gaspra acquired by the Solid State Imager. [6] The deepest band depths were detected in the vicinity of the Sun illuminated ridges of this asteroid.

Figure 2 compares spectra from a 408 channel observation (gap015) to a 17 channel (gap016) observation by the NIMS sensor of Asteroid 951 Gaspra. Lines are drawn in this figure to illustrate the position of local minimum values detected in the 408 channel spectrum. They were identified by finding the local minimum value present in the spectrum and in a multi-polynomial fit to the same spectrum segment. Band centers at 1.04, 1.98, 2.82, 3.39, and 4.47 μm were detected. The 1.04 and 1.98 μm band centers can be attributed to the presence of the minerals olivine and pyroxene. These correspond to the 1.05 and 1.89 μm minima present in the 17 channel spectrum. The 2.82 and 3.39 μm features correspond to those detected in materials with structural OH (e.g. Murchison [7]). They correspond to minima detected at 2.73 and 3.30 μm minima found in the 17 channel spectrum. The 4.47 μm feature does not have a corresponding minima in the 17 channel data.

The 2.82 and 3.39 μm features were found in all six of the processed NIMS observations of Asteroid 951 Gaspra. They were represented by minima at 2.73 and 3.30 μm in all 17 channel observations. They had the same band centers in the 102 channel observations. The offset minima measurement in the 17 channel data is most likely due to the fact that those channels were the closest in wavelength value to the features found in the higher spectral resolution. The relative band depth of the 2.82 μm feature ranged from 0.03 to 0.149. The band depth changed from 0.149 to 0.09 in a specific region as the phase angle ranged from 37 to 49 degrees. These variations, band positions, band depth, and the albedo value of Asteroid 951 Gaspra suggest that the three μm features are due to the solar wind implantation of protons into minerals such as olivine. This process has been documented for similar time varying structural OH features found on the Moon. [8]

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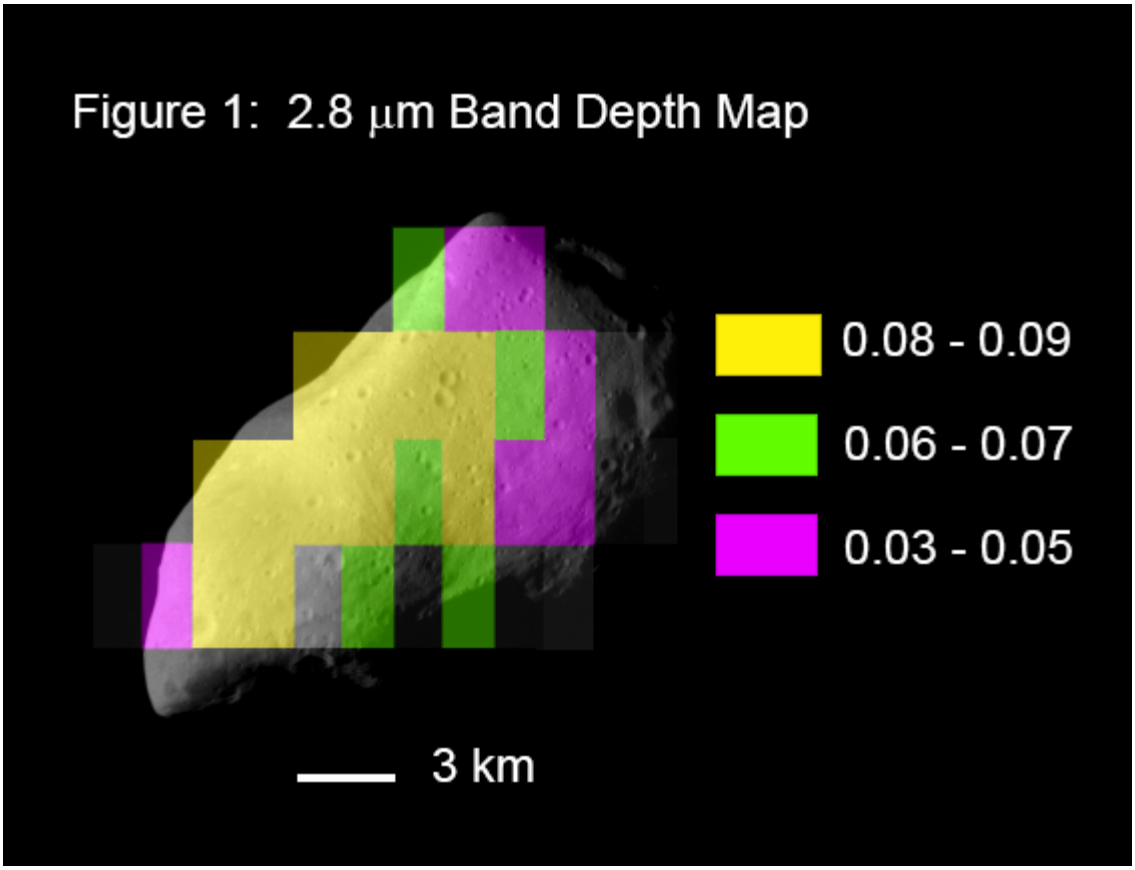

Figure 2: 951 Gaspra Spectral Bands