Spectral Observations of a Non-Chondritic 951 Gaspra

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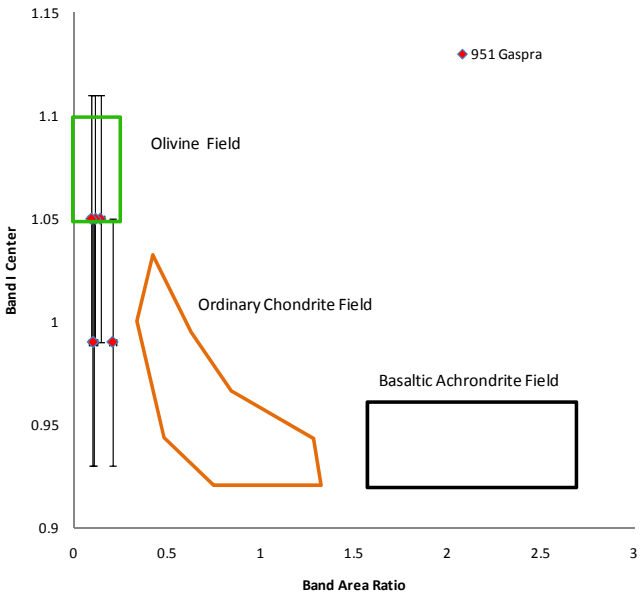
This abstract describes a re-analysis of 951 Gaspra spectral observations acquired by the NASA Galileo mission. It uses spacecraft calibration data instead of vicarious calibration sources used in earlier studies [*Granahan et al.*, 1993; *Kelley et al.*, 2000]. The Galileo spacecraft encounter on October 29, 1991 provided spatially resolved imagery and spectral data for analysis. The source of the Galileo spectra of 951 Gaspra for this abstract are images obtained by the Solid State Imaging (SSI) camera [*Belton et al.*, 1992] and the Near Infrared Mapping Spectrometer (NIMS) [*Carlson et al.*, 1992]. The SSI camera was a 800 by 800 silicon array CCD imager that used 4 filters (0.40 to 0.99 micrometers) to sample discrete visible and near infrared wavelengths. The NIMS instrument was a silicon and InSb detector spectrometer with spectral channels that range from 0.7 to 5.2 micrometers.

Figure 1: B1 Center/Band Area Ratio Plot

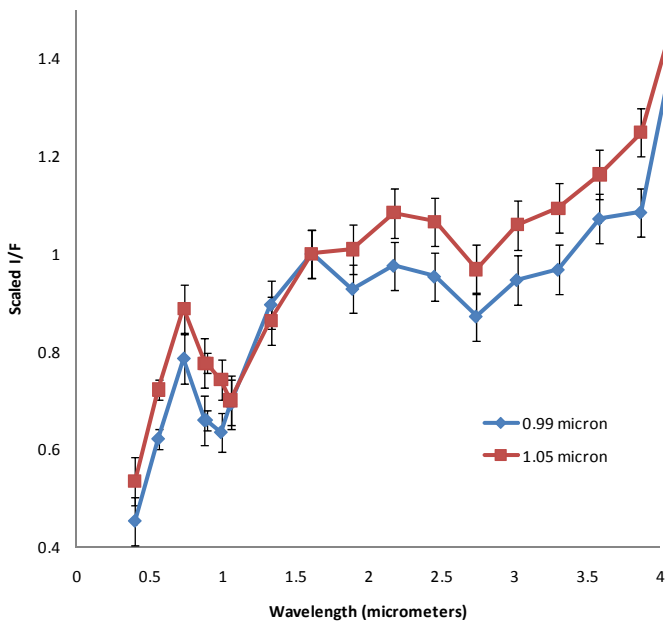


A key result of this study is that 951 Gaspra does not appear to be made of ordinary chondrite type material. **Figure 1** illustrates that it has spectral features different from those of ordinary chondrites [*Dunn et al.*, 2010; *Gaffey et al.*, 1993] . This is consistent with the earlier findings of Granahan *et al.*[1994] and Kelley *et al.* [2000] for data calibrated using vicarious calibration methods. The relative abundance of olivine (89%) with respect to orthopyroxene (11%) is different from the earlier findings. Spectral band centers and band area ratios indicate that 951 Gaspra spectra are consistent with the spectra of meteorites with monomineralic olivine as described by Gaffey *et al.* [1993]. Meteorites with monomineralic olivine include pallasites, pyroxene-poor ureilites, and pyroxene-poor brachinites. All of these meteorites have been subjected to igneous differentiation on their parent body asteroids. Hence, the spectra of 951 Gaspra indicate that it has been subjected to igneous processes.

There are also spectral variations observed on the surface of 951 Gaspra. Independent of the varying thermal emission, there are difference in the one micrometer band center positions and reflectance at two micrometers (**Figure 2**). Brighter two micrometer reflectance and absorptions with approximate 1.05 micrometer band centers are associated with craters and ridges. Darker two micrometer reflectance and absorptions with approximate band centers of 0.99 micrometers are found in the interridge regions. These spectral differences suggest some small variations in the mineral content of the surface of 951 Gaspra. The mapping of the brighter spectra with the

1.05 micrometer bandcenters with craters and ridge terrain may point to the composition of "recent" or lower regolith content surfaces. The ridges and "bright" craters may expose recently fractured or bedrock material to view. The interridge regions contain older cratered surfaces and accumulate more regolith through time. The interridge areas would then have older and meteorite "gardened" material to be observed by spacecraft. These spectral differences may be due to space weathering of the surface of 951 Gaspra. However, known asteroid space weathering spectral behavior does not alter the position of spectral absorption band centers [*Azuma et al.*, 1988; *Gaffey*, 2010; *Gradie et al.*, 1980]. Analysis of the observed thermal emissions and different rotational by NIMS may provide additional information about the observed spectral differences. Band center positions have been altered by changes in temperature for some minerals such as olivine. Such differences were observed at 433 Eros [*Lucey et al.*, 2002]. Different portions of 951 Gaspra may also have differing relative abundances of olivine and pyroxene minerals.

Figure 2: 951 Gaspra Spectra



951 Gaspra was also found to be a SI [*Gaffey et al.*, 1993] S-type subclass and a Sa class [*DeMeo et al.*, 2009] asteroid. This indicates that this asteroid has spectra that are distinct from most S-type asteroids.

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