GALILEO MAGNETIC FIELD SIGNATURE: NO EVIDENCE THAT GASPRA IS DIFFERENTIATED; Lon L. Hood and Charles P. Sonett, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721.

As summarized in ref. 1, the asteroid 951 Gaspra is a relatively small, elongated body with a mean radius of about 7 km orbiting near the inner edge of the main asteroid belt (2.2 a.u.). Gaspra has spectral properties that put it in the S taxonomic class with an inferred surface composition of olivine, pyroxene, and iron-nickel metal. The major unresolved issue relating to S-type asteroids is whether they are parent bodies of ordinary chondrite meteorites or of the stony-iron meteorites. In the former case, they are undifferentiated and have relatively little metal while in the latter case they have been differentiated into metal and silicate components during an early heating event. Ground-based spectra of Gaspra show it to be unusually red and olivine-rich suggesting that it may be differentiated.

The Galileo flyby of Gaspra occurred on October 29, 1991 at a distance of 1600 km (200 - 300 Gaspra "radii"). Analyses of the resulting images suggest that it is a fragment or combination of fragments from the collisional disruption of one or more precursor asteroids and is covered with regolith (1,2). But the question remains of whether its composition is more like that of the ordinary chondrites or like that of stony-iron meteorites. Unfortunately, an accurate determination of Gaspra's mass (and hence density) was not possible due to the distance of the flyby. However, as described by Kivelson et al. (3), the Galileo magnetometer did detect a change in direction of the interplanetary magnetic field near the time of closest approach to Gaspra. The magnetic field apparently rotated toward Gaspra beginning one minute before closest approach and rotated back toward its original orientation two minutes after closest approach. According to the analysis by Kivelson et al., the field signature can be interpreted as evidence for "draping" of the solar wind magnetic field around a "magnetospheric" obstacle. Under this interpretation, Kivelson et al. estimate a magnetic dipole moment for Gaspra of between 6×10^{15} and 2×10^{17} Gauss-cm^3. Assuming a mass density of 4 gm cm^{-3}, the corresponding limits on the magnetic dipole moment per unit mass are 0.001 and 0.03 G-cm^3 gm^{-1}.

Accepting the above estimated limits on the magnetic dipole moment of Gaspra and assuming that the moment is due to intrinsic bulk magnetization, one may compare the inferred magnetization levels to those characteristic of ordinary chondrites and stony iron meteorites. Kivelson et al. (3) have concluded that the inferred magnetization limits are "in the range observed for iron meteorites and highly magnetized chondrites." Such a conclusion would suggest a stony iron composition. However, this result is based on a comparison with a relatively small sample of meteorite magnetization intensities (4) (see Figure 4 of ref. 3). Here, we compare the inferred magnetization limits of Kivelson et al. with a sample of 200 natural magnetic remanence (NRM) values previously studied by Sonett (5) and compiled from original measurements by Russian investigators, primarily Gus'kova, Pochtarev, and Gorshkov (6). The sample population contains 8 achondrites, 70 L ordinary chondrites, 35 H chondrites, 11 stony-irons (pallasites and mesosiderites), and 76 iron meteorites excluding the anomalous irons. As seen in Figure 1, the bulk magnetization limit estimates of Kivelson et al. tend to bracket the measured values for H and L ordinary chondrites. Only 2 of 11 stony-iron samples have measured NRM values within the inferred range for Gaspra. Only 21 of 76 iron meteorites have measured

NRM values within the inferred range. Thus, while a stony-iron composition may not be excluded, the inferred magnetization limits are most consistent with an ordinary chondrite composition.

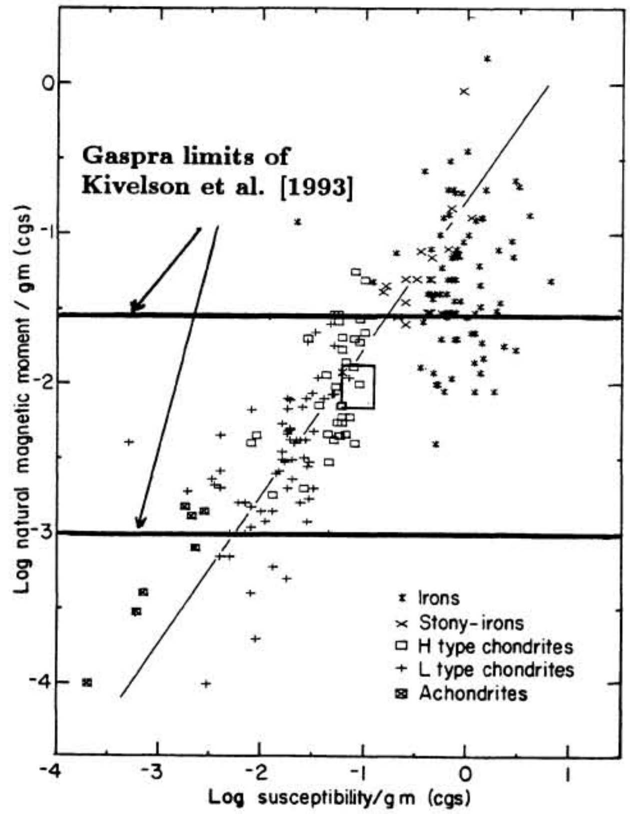

Figure 1. Comparison of meteorite NRM data from Sonett (5) with limits on Gaspra's magnetic moment per unit mass from Kivelson et al. (3). The meteorite NRM data are plotted versus magnetic susceptibility. The rectangular box indicates one-sigma values for 38 subsamples of the meteorite Pultusk.

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