Asteroid (354) Eleonora: Plucking an Odd Duck

By

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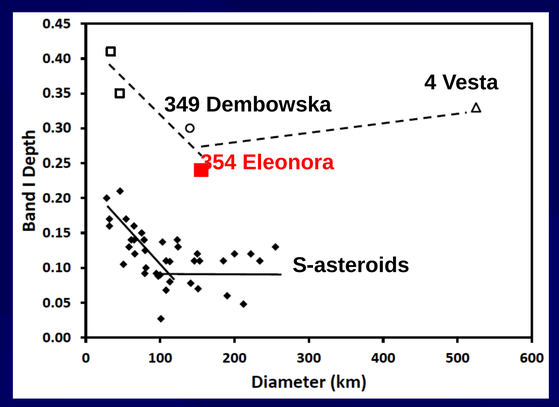
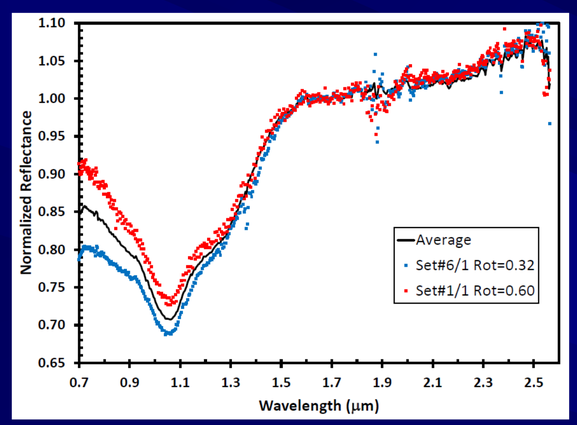
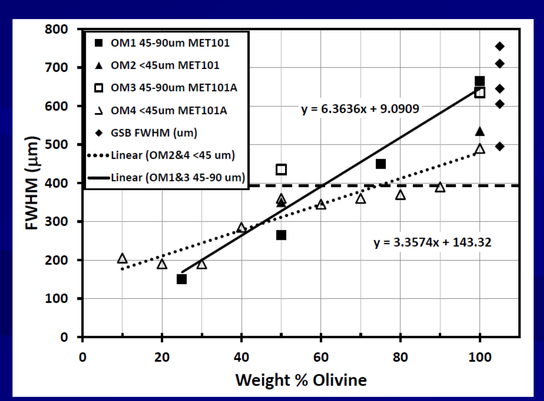


In the S-asteroid survey (Gaffey *et al*. (1993), S-asteroid 345 Eleonora was identified as having a 1 μm band feature more than twice as strong as any other S-asteroid of comparable size.



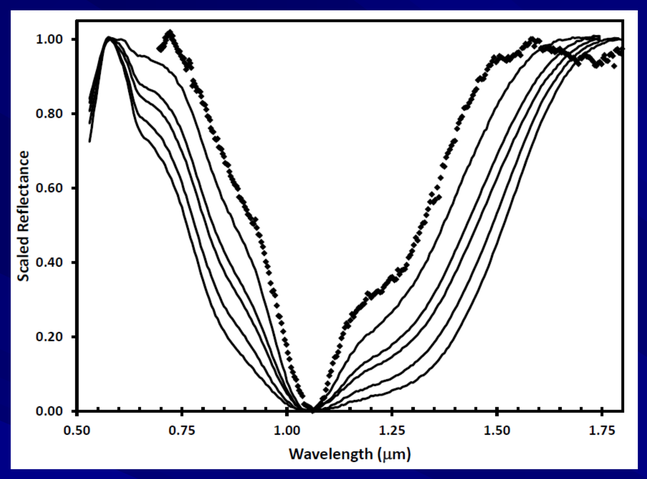
The Eleonora spectrum showed a strong broad 1 μm olivine feature and a possible weak 2 μm pyroxene feature. The intensity and position of the features did not vary with rotation, but the slope across the 1 μm feature varied significantly.



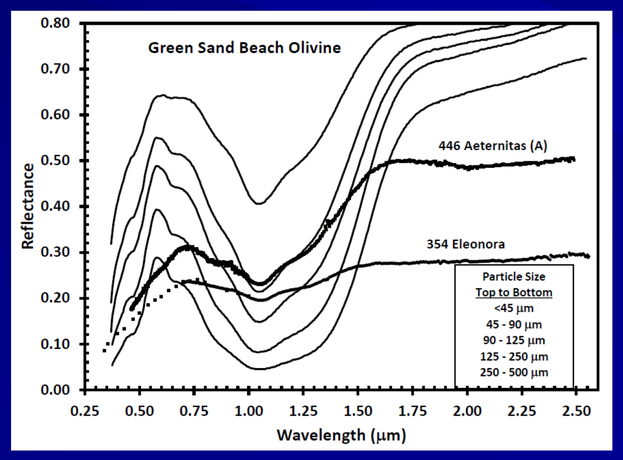
Width of 1 μm feature in fine grained mixtures of olivine and meteoritic metal.

Suggested that Eleonora was either a metal-poor surface or had not experienced significant space weathering

Observations of 354 Eleonora were carried out on June 1 & 2, 2011 using the SpeX instrument remotely on the NASA IRTF at Mauna Kea Observatory. A total of 226 usable spectra were obtained.



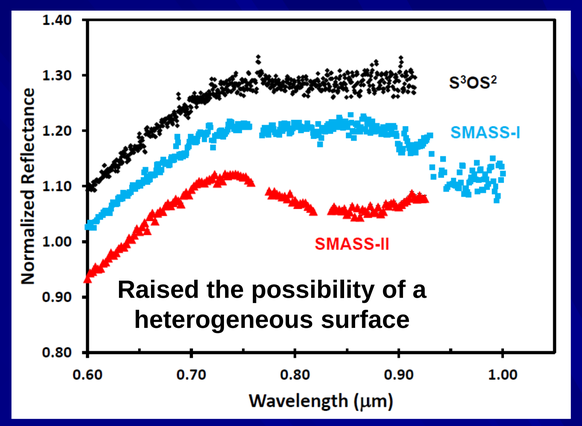
The 1 μm feature in the Eleonora spectrum is too narrow to result from a fine surface particle size (see above), mineral composition or the low surface temperature.



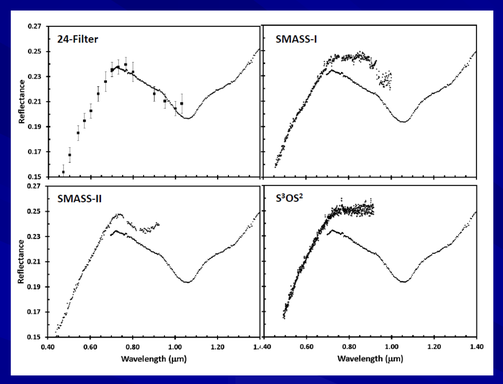
The low albedo and reduced spectral contrast of Eleonora compared to olivine powders and the A-type asteroid 446 Aeternitas indicates an additional spectrally featureless phase in the surface assemblage.

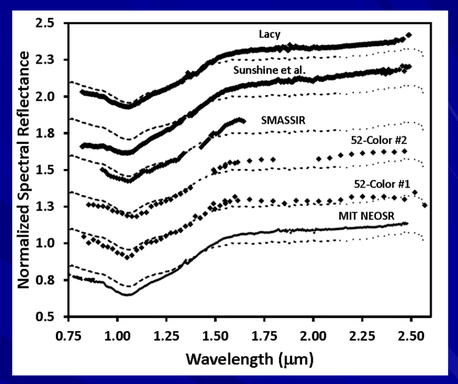
The narrow 1 μm absorption feature, the lower albedo and spectral contrast are consistent with a surface composed of an intimate mixture of fine grained olivine (~$Fa_{30\pm10}$) mixed with 30-40% NiFe metal. The assemblage may also contain few percent of igneous pyroxene (~$Fs_{50}Wo_{10}$)

As the investigation got underway, it was realized that the visible wavelength spectral survey data (SMASS-I, SMASS-II, S^3OS^2) for Eleonora did not agree and taken at face value the spectra would imply different surface assemblages



A series of tests ruled out spectral variability and instead indicated that the spectral data on 354 Eleonora in the three surveys were erroneous and could not be reconciled with the near IR data. By contrast near IR spectra from several observers were consistent.





Above Left: Visible region spectra (24-filter, SMASS-I, SMASS-II & S^3OS^2) overlapped with NIR spectrum from new IRTF SpeX observations.

Above Right: NIR spectra of Eleonora from six different observers compared to our recent IRTF SpeX spectrum (dashed line). Slope differences between the spectra are attributed to difference in standard stars.

Conclusion: The surface assemblage of 354 Eleonora is consistent with that expected near the core-mantle boundary in a differentiated body with a low Ni core (to allow embrittlement of the metal at reduced temperatures).

No ducks were harmed in this work!