3605
199463V632 43/630

POSSIBLE SPINEL ABSORPTION BANDS IN S-ASTEROID VISIBLE REFLECTANCE SPECTRA: T. Hiroi and F. Vilas, SN3, NASA Johnson Space Center, Houston, TX 77058; J. M. Sunshine, SETS Technology, Inc., 300 Kahelu Avenue., Mililani, HI 96789.

Minor absorption bands in the 0.55-0.7 μm wavelength range of reflectance spectra of 10 S asteroids [1] have been found and compared with those of spinel-group minerals using the Modified Gaussian Model [2]. Most of these S asteroids are consistently shown to have two absorption bands around 0.6 and 0.67 μm. Of the spinel-group minerals examined in this study, the 0.6 and 0.67 μm bands are most consistent with those seen in chromite. Recently, the existence of spinels has also been detected from the absorption-band features around 1 and 2 μm of two S-asteroid reflectance spectra [3], and chromite has been found in a primitive achondrite as its major phase [4]. These new findings suggest a possible common existence of spinel-group minerals in the solar system.

Reflectance spectra of the 10 S asteroids were measured using a CCD spectrograph [1]. Reflectance spectra of spinel-group minerals were measured using the RELAB bidirectional spectrometer at 30° incidence and 0° emergence angles [5]. A spectrum of chromite (<25 μm) from Nye, Montana was measured at every 1 nm from 0.4 to 1.1 μm [6]. A spectrum of spinel-rich CAI in the Allende meteorite was measured at every 10 nm from 0.35 to 2.6 μm by [3,7]. An absorbance spectrum of a spinel ($Mg_{0.82}$ $Fe_{0.22}$ $Cr_{0.92}$ $Al_{1.05}$ O_4) from Lesotho was taken from [8] and digitized at every 5 nm.

Each measured reflectance spectrum was converted to the approximate absorbance spectrum by taking its natural logarithm, which was then deconvolved into a background (linear to energy) and a series of modified Gaussians according to the Modified Gaussian Model [2]. Two parameters of the background and three parameters (band center, half width, and strength) of each absorption band were optimized for the best fit with each asteroid spectrum. For this study, the initial values of the background parameters were chosen so that the background is in contact with the measured spectrum at as many data points as possible. After deconvolving each asteroid spectrum, artificial random noise was added to the solution spectrum as a simulation of the noise introduced during asteroid observations. These simulated spectra were then deconvolved to estimate the error ranges for the band parameters.

Some of the results of the deconvolutions of reflectance spectra of the S asteroids and spinel-group minerals are shown in Fig. 1. The measured spectrum, background, fitted spectrum, and the residual errors are shown for each plot in Fig. 1. These asteroids have two broad bands and one small, narrow band in the 0.55-0.7 μm region. The small and narrow bands are, however, well within the noise and are thus deemed to be unreliable. The spinel-group minerals have three absorptions in the 0.55-0.7 μm region, which have similarities to those found in the S asteroids. However, both the Nye chromite and the Allende CAI spectra have a strong absorption band around 0.75 μm which is absent in the S asteroids. In a noisy asteroid spectrum, the 0.75 μm absorption in the Nye chromite may not be detectable, but instead be merged with the 0.66 and 0.68 μm bands to form a single absorption band around 0.68 μm. The 0.75 μm band in the Allende CAI, if present in asteroid spectra, is however, expected to be distinguishable from the 0.65 μm band.

The band centers and half widths of the major absorptions in the S asteroids and spinel-group minerals are plotted in Fig. 2. The S asteroid points are shown as filled squares with the estimated standard deviations as error bars. Points for spinel-group minerals are shown as three different markers. The uncertainty of the points for spinel-group minerals should be much smaller than the asteroid points. Asteroid 483 Seppina has no absorption bands and was well fit using only the background continuum. This suggests that a linearly tangent background is appropriate for modeling S asteroids in the 0.55-0.7 μm region. Reflectance spectra of 692 Hippodamia and 1368 Numidia are so noisy that existence of their absorption bands is highly unreliable. The absorption bands of 152 Atala overlap significantly making their band parameters uncertain. However, the band parameters of the other two absorption bands are very consistent among the asteroids and are likely to be reliable. If the 0.6 and 0.67 μm bands in the asteroid spectra are due to a single mineral phase, Nye chromite (open circle) may be a good analogue. However, further study is necessary to better confine the mineral candidates responsible for these two absorptions.

ACKNOWLEDGMENTS: We thank Drs. C. M. Pieters and M. J. Gaffey for reflectance spectra of Nye chromite and Allende spinel-rich CAI, respectively. We thank S. F. Pratt for the measurements. RELAB is a multiuser facility operated under NASA grant NAGW-748. F. V. was a visiting astronomer, CTIO, NOAO. T. H. and F. V.

are supported by NASA Planetary Astronomy Program. This work was done while T. H. held a National Research Council-NASA/JSC Research Associateship.

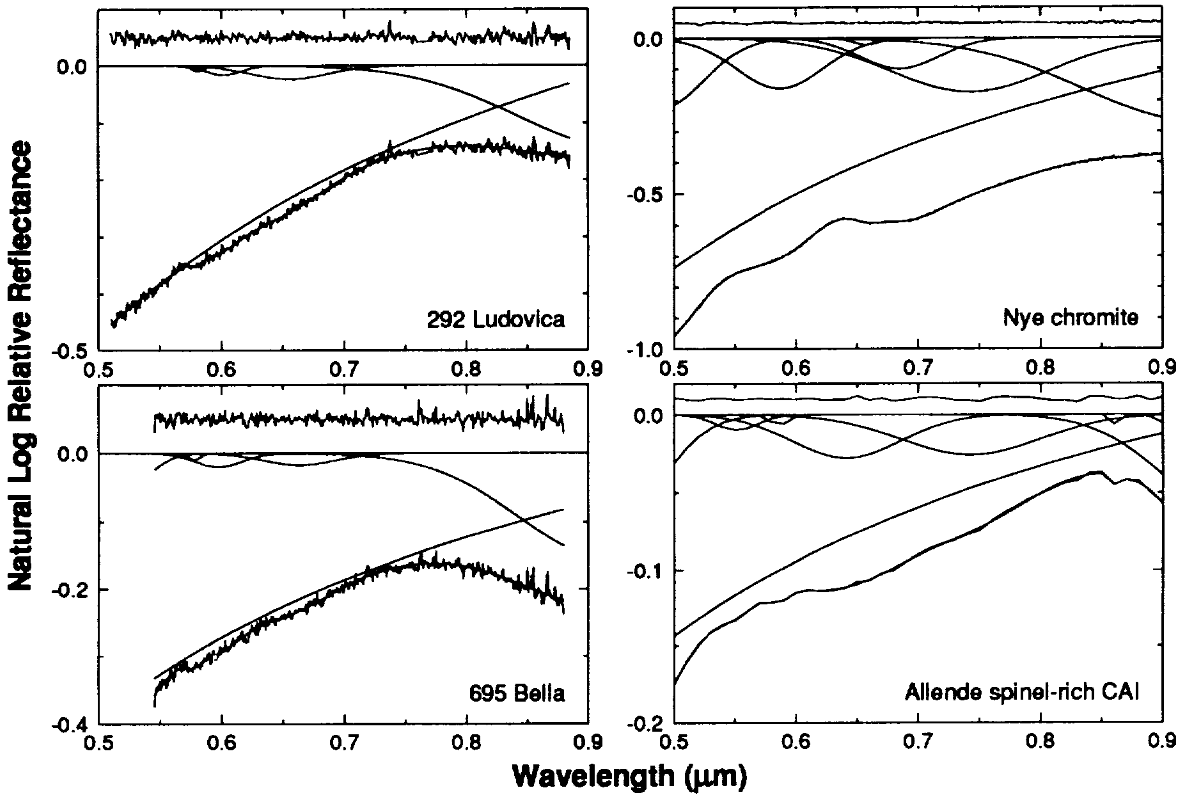

Fig. 1. Modified Gaussian Model [2] deconvolutions of reflectance spectra of two S asteroids and spinel-group minerals. The residual errors are offset for clarity.

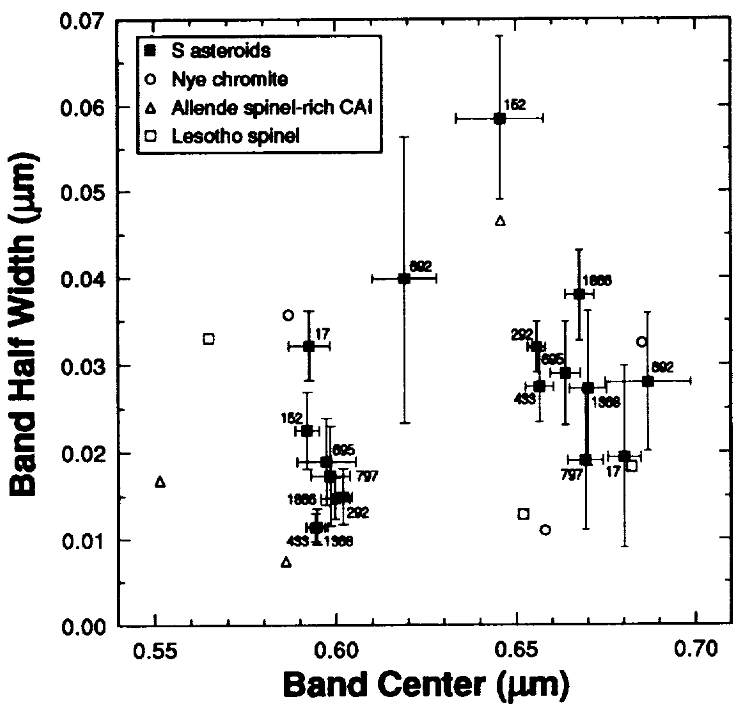

Fig. 2. A plot of the major absorption band centers and half widths of the S asteroids and spinel-group minerals.

REFERENCES: [1] Vilas F. and Smith B. A. (1985) *Icarus, 64,* 503; Vilas F. and McFadden L. A. (1992) *Icarus, 100,* 85. [2] Sunshine J. M. et al. (1990) *JGR, 95,* 6955. [3] Burbine T. H. et al. (1992) *Meteoritics, 27,* 424. [4] Takeda H. et al. (1993) *Lunar Planet. Sci., 24,* 1395. [5] Pieters C. M. (1983) *JGR, 88,* 9534. [6] Pieters C. M. (1993) Personal communications. [7] Gaffey M. J. (1993) Personal communications. [8] Mao H. K. and Bell P. M. (1974) *Carnegie Inst. Washington Yearbook, 73,* 332.