FIRST RESULTS OF THE SEVEN-COLOR ASTEROID SURVEY; Beth E. Clark, Jeffrey F. Bell, Fraser P. Fanale and Paul G. Lucey, Planetary Geosciences, University of Hawaii at Manoa, 2525 Correa Road, Honolulu, Hawaii, 96822

Introduction: The new Seven-Color infrared filter system (SCAS), designed specifically to capture the essential mineralogical information present in asteroid spectra, is composed of seven broad-band filters which allow for IR observations of objects as faint as 17th magnitude (**Figure 1**). The first test of the SCAS system occurred in July, 1992. In four nights at the IRTF on Mauna Kea, Hawaii, over 67 objects were observed. Five of the observations were to test the new system for accuracy relative to previous observations with the high-resolution 52-Color Infrared Survey [1], and with the Eight -Color Asteroid Survey (ECAS) [2]. In three cases, the match to previous data is good. In two cases the match to previous observations is not so good. In addition, sixty S-Type asteroids have been newly measured with the SCAS system. Forty of those asteroids have also been observed with the ECAS system. Among the new observations is infrared data of 371 Bohemia, a mainbelt asteroid which was classified "QSV" according to its UBV colors in the taxonomic system of D.J. Tholen [3]. There are no corresponding ECAS data for 371. Q-type asteroids are of special interest as they are proposed to be the elusive parent bodies of the ordinary chondrite meteorites [4]. Most Q-types are Earth-crossing asteroids [5], and have not yet been observed in the infrared (except, perhaps, 371). Positive identification of a large mainbelt Q-type would be of major importance in the scheme of the geological structure of the asteroid belt. Without visible wavelength data, however, the classification of 371 Bohemia remains ambiguous. **Figure 2** shows an attempt to conjoin Bohemia SCAS data with ECAS data of both a typical Q-Type asteroid and an average S-Type asteroid. This figure thus illustrates the importance of visible wavelength data to the SCAS system. In other words, without ECAS data of 371 Bohemia we cannot use its spectral characteristics to identify it as a possible parent body of ordinary chondrite meteorites.

Analysis: As illustrated for the 52-Color data [6], the three parameters of albedo, continuum slope and 1-micron band depth were extracted from the new SCAS spectra combined with the ECAS data. In general, the clustering of S-type asteroids into a separate population from ordinary chondrite meteorites is preserved, despite the lower resolution and the sampling of fainter asteroids for our new SCAS data. Since only part of the new SCAS data set have corresponding ECAS data, a more general analysis technique of only the seven-color data is also presented here. Three specific color ratios of the SCAS bandpasses are plotted against eachother. The 0.91/1.05 micron ratio is an indicator of the shape of the 1-micron mafic absorption band. The 1.30/1.55 micron ratio is an indicator of the slope coming out of the 1-micron absorption, and the 2.16/2.30 micron ratio is indicative of the 2-micron pyroxene absorption band. We have used the Hapke reflectance model [7] to calculate model spectra for the end-members Cpx, Opx, Ol, and FeNi metal. These model spectra were then convolved to the SCAS bandpasses and the above color ratios were calculated for systematic increases (at the equal expense of the other components) of each component, from 0% to 100%. The vectors which arise with mineral systematics are shown in **Figure 3**. For example, as the mafic minerals causing the absorption band near 1-micron switch from more Opx-rich to more Olivine and Cpx-rich, the ratio of the 0.91 to 1.05 micron filters crosses from less than unity to greater than unity. As work progresses, these clear trends will be useful in the characterization of S-asteroid sub-classes.

Conclusion: Attempts are underway to analyze spectral data for mineralogic heterogeneity within the S-type asteroid class [8,9,10]. Combining this SCAS data set with previous 52-color observations, a total of 100 S-type objects have now been observed. This large data set presents an opportunity to search for definitive trends in the spectra which indicate mineralogical sub-classes within the S-class. It is important, however, to augment all infrared observations of asteroids with the visible wavelength data in order to unambiguously identify potential meteorite parent bodies.

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References: **[1]** Bell et al. *LPSC*, **XIX**, 57-58, 1988 **[2]** Zellner et al. *Icarus*, **61**, 355-416, 1985 **[3]** Tholen, *Asteroids II*, 1139-1150, 1989 **[4]** Bell et al., *Asteroids II*, 921-948,1989 **[5]** Tholen, D.J. *Ph.D. Dissertation*, Univ. of Ariz., 1984 **[6]** Fanale et al. *JGR, preprint*, 1992 **[7]** Hapke et al. *JGR*, **86**, 3039-3054, 1984 **[8]** Chapman, preprint,1991 **[9]** Howell et al. *Bull. Amer. Astron. Soc.*, **23**, 1140, 1992 **[10]** Gaffey et al., *preprint*, 1992.

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FIGURE 1
The new seven-color infrared filter system, designed to capture the essential mineralogical information present in asteroids spectra.

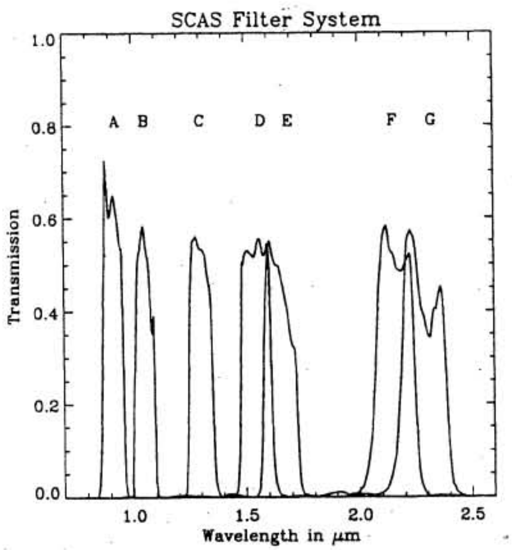
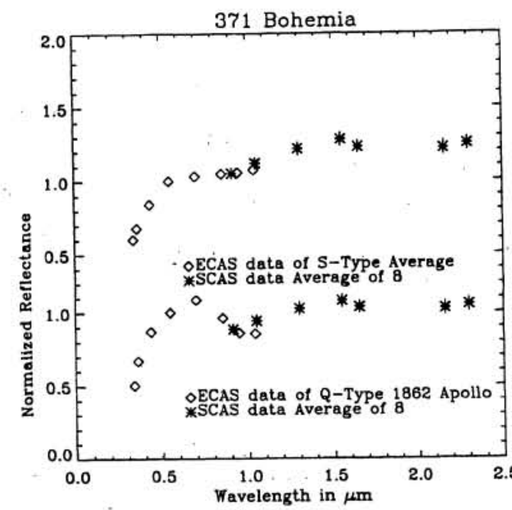


FIGURE 2
Attempts to conjoin asteroid 371 Bohemia with ECAS data of both a typical Q and a typical S-type spectrum. This figure illustrates the fact that ECAS wavelength data is necessary to the SCAS system.



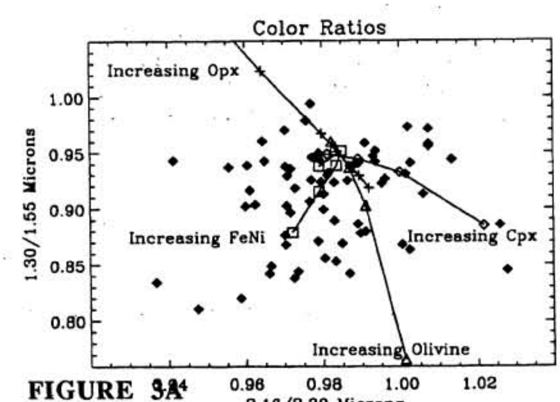


FIGURE 3A
S-Type asteroid SCAS color ratios are plotted with filled diamonds and compared with color ratio trends found by calculating Hapke model systematic mineral component variations, from equal mixtures to pure end-members as indicated.

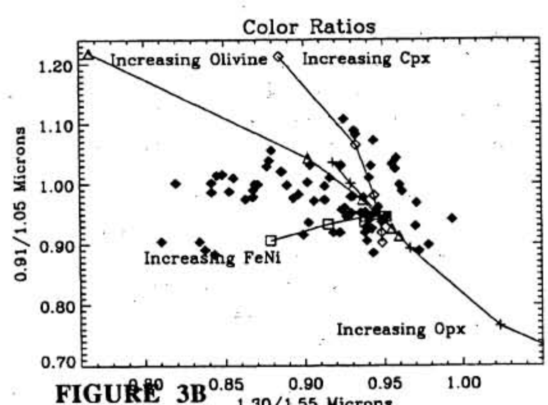


FIGURE 3B
Same as in Figure 3A. Note that the 0.91/1.05 color ratio is a sensitive indicator of mafic mineral composition, and can distinguish between olv/cpx-rich and opx-rich asteroid surface assemblages.