EVOLUTION OF THE INNER ASTEROID BELT: PARADIGMS AND PARADOXES FROM SPECTRAL STUDIES. Michael J. Gaffey, Department of Geology, West Hall, Rensselaer Polytechnic Institute, Troy, New York 12180-3590.

Recent years have witnessed a significant increase in the sophistication of asteroidal surface material characterizations derived from spectral data. An extensive data base of moderate to high spectral resolution, visible and near-infrared (~0.35-2.5μm) asteroid spectra is now available (1-4). Interpretive methodologies and calibrations have been developed to determine phase abundance and composition in olivine-pyroxene assemblages and to estimate NiFe metal abundance from such spectra (5-7). A modified version of the asteroid classification system more closely parallels the mineralogic variations of the major inner belt asteroid types (8). These improvements permit several general conclusions to be drawn concerning the nature of inner belt objects; their history, and that of the inner solar system; and the relationship between the asteroids and meteorites.

Essentially all large inner belt asteroids have - or are fragments of parent bodies which have - undergone strong post-accretionary heating, varying degrees of melting and magmatic differentiation, and subsequent collisional disruption. The surfaces of the dominant S-type asteroids appear mostly to be the exposed metal-rich internal layers of differentiated or partially differentiated parent planetesimals (7,9). The shift from an S-type dominated inner belt population to a C-type dominated outer belt population (10) appears to be primarily the result of post-accretionary heating of the inner belt and not the signature of a radial compositional gradient in the original solar nebula. The S-type asteroids are predominantly olivine-metal assemblages with a relatively minor pyroxene component [ol/px$\gtrsim$2.5] (3,9), but exhibit a significant range of variation. These asteroids show a systematic, but not yet well characterized, mineralogic variation with semi-major axis. Large S-type family asteroids exhibit greater lightcurve amplitudes in general than large non-family S-objects, and the mineralogic range among members of the S-families is much smaller than the range in the background S-type population. This suggests that the S-type asteroid families represent relatively recent ($\lesssim$4byr) collisions onto the cores of previously disrupted parent bodies. A variety of additional constraints (heating requirements for small bodies, rarity of pure olivine mantle fragments, meteorite heating ages) suggest that the thermal evolution of the inner belt occurred very early, followed quickly by disruption during single collision events with an intruding flux of large planetesimals, similar to those invoked to abort the growth of Mars (11).

REFERENCES: (1) Chapman, C.R. and Gaffey, M.J. (1979) in Asteroids (T. Gehrels and M.S. Matthews, Eds.), U. Arizona Press, pp. 655-687. (2) Zellner, B., Tholen, D.J., and Tedesco, E.F. (1985) Icarus 61, 355-416. (3) Feierberg, M.A., Larson, H.P., and Chapman, C.R. (1982) Astrophys. J. 257, 361-372. (4) Bell, J.F., Hawke, B.R., Owensby, P.D., and Gaffey, M.J. (1985) Bull. Am. Astron. Soc. 17, 729. (5) Adams, J.B. (1974) J. Geophys. Res. 79, 4829-4836. (6) Cloutis, E.A., Gaffey, M.J., Jackowski, T.L., and Reed, K.L. (1986) J. Geophys. Res., submitted. (7) Gaffey, M.J. (1986) Icarus, in press. (8) Tholen, D.J. (1984) Ph.D. Diss., U. Arizona, Tucson. (9) Gaffey, M.J. (1984) Icarus 60, 83-114. (10) Gradie, J., and Tedesco, E. (1982) Science 216, 1405-1407. (11) Weidenschilling, S.J. (1975) Icarus 26, 361-366.
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