A COMPARISON OF PYROXENE VERSUS OLIVINE RICH INTERPLANETARY DUST PARTICLES (IDPs) IN THIN-SECTION; J.P. Bradley and M.S. Germani, McCrone Associates, Inc., Westmont, IL 60559; D.E. Brownlee, Dept. of Astronomy, University of Washington, Seattle, WA 98195.

Infrared (IR) spectral transmission measurements indicate that most chondritic IDPs fall into hydrated (layer silicate) and anhydrous categories [1]. The anhydrous group subdivide into "olivine" and "pyroxene" classes after the minerals that provide the best match for the observed IR spectral features. Analytical electron microscopy (AEM) has confirmed that olivine is indeed the dominant silicate within IDPs from the "olivine" IR class [2]. To date there has been no corresponding IR/AEM examination of particles from the "pyroxene" IR class. Using thin-sectioned particles it is possible to compare mineralogical and petrographic features in detail, and the purpose of this study was to make such comparisons between particles from the "pyroxene" and "olivine" classes.

Nine anhydrous particles were selected for this study (U219C2, U222B28, U222B42, U220SP66, U220A19, r72-M2-3A (Viburnum), W7028C2, U2-13-M10#4 (Marvel), U2-23-M4 #9 (Cannonball). Three of them (Viburnum, Marvel, and Cannonball) had previously been classified as "olivines" by IR spectroscopy [1,3-4] The particles were sectioned using the procedure described by Bradley, 1988 [5], and several hundred x-ray spectra were collected from each thin-section on a two dimensional grid. For rapid identification of the major silicates present (olivine or pyroxene) the data were plotted on Mg-Si-Fe ternary diagrams (Figure 1) followed by nine-element cluster analysis [6].

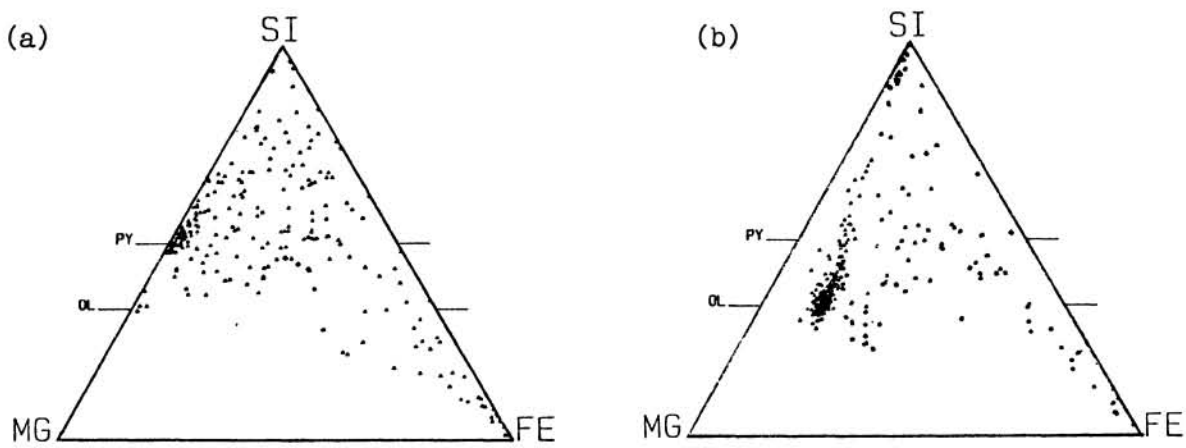

Figure 1. Ternary Mg-Si-Fe diagrams from quantitative thin-film analyses of two anhydrous chrondritic IDPs. (a) Pyroxene-rich particle U222B28 (266 data points - 37% fall within the enstatite cluster). (b) Olivine-rich particle U220SP66 (354 data points - 63% fall within the olivine (Fo_{80}) cluster.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

Particles U219C2, U222B28 (Fig. 1a), U222B42, and U220A19 are clearly "pyroxene" IDPs because (Mg-rich) pyroxene was the dominant silicate within the thin-sections. All four are extremely fine-grained aggregates of mineral grains (enstatite, Fe-sulfides, forsterite), glass, and disordered carbonaceous material. U220SP66 (Fig. 1b) is much coarser grained and olivine ($\sim Fo_{80}$) is the dominant component: iron-rich sulfides are common as well as carbonaceous material and alumino-silicate glass.

Viburnum (r72-M2-3A) is a very unusual particle. Like U220SP66 it is relatively coarse grained, but it consists of a population of enstatite, forsterite, and spherical Fe-sulfides embedded within an alumino-silicate glass matrix. The glass content is much higher than that of any other IDPs so far thin-sectioned. Although r72-M2-3A best fits the "olivine" IR class [4] enstatite appears to be more abundant than forsterite.

Particles U2-13-M10 #4 (Marvel) and U2-23-M4 #9 (Cannonball) are portions of IDPs that initially had been crushed between quartz slides and pressed into KBr crystals for IR measurements. The crushed material was recovered from the KBr and transferred to epoxy mounts for thin-sectioning. Olivine is the dominant component of the sections, thus confirming their classification as belonging to the "olivine" IR class. However specific aspects of their overall mineralogy suggest that these particles are unlike the other seven IDPs described above. It is possible that transfer of the fragments from KBr has in some way influenced our observations.

The nine IDPs studied here exhibit a range of pyroxene and olivine contents, and at least one particle (W7028C2) contains similar amounts of each. However, there are important differences between the end members. In particular, the olivine-rich particles (U220SP66, r72-M2-3A, U2-13-M10 #4, U2-23-M4 #9) are much coarser grained, glass-rich, and do not contain solar flare tracks. (Tracks were prominent in all of the pyroxene-rich particles (U219C2, U222B28, U222B42, U220A19)). The olivine-rich particles are also depleted in sulfur (relative to the "pyroxenes"), and the textures of some of them (e.g. r72-M2-3A) are reminiscent of shock melting or strong heating, possibly as a result of particle-particle collisions in space or pulse heating during atmospheric entry.

REFERENCES

[1] S.A. Sandford and R.M. Walker (1985) Astrophys. J., 291, 838; [2] R. Christoffersen and P.R. Buseck (1986) Earth Planet. Sci. Lett., 78, 53; [3] K.D. McKeegan (1987) PhD Thesis, Washington Univ., St. Louis; [4] W. Carey, R.M. Walker, and J.P. Bradley (1988) Abs. 50th Met. Soc. (1987), Newcastle, England, Meteoritics, in press; [5] J.P. Bradley (1988) Geochim. Cosmochim. Acta, in press; [6] M.S. Germani and J.P. Bradley (1988) abstract this volume.

Acknowledgements

Samples were provided by M. Zolensky and W. Kloch (JSC), and B. Wopenka (Washington Univ.). This research was supported by NASA grants NAS 9-17749 and NSG 9052.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System