TRACE-ELEMENT ANALYSES OF PYROXENE AND PLAGIOCLASE IN THREE HED METEORITES.

A. Ruzicka and T.J. Schepker. Cascadia Meteorite Laboratory, Dept. of Geology, Portland State University, 1721 SW Broadway, Portland, OR 97207. E-mail: ruzickaa@pdx.edu.

Introduction: We obtained trace-element compositions of pyroxene (px) and plagioclase (plag) in HED meteorites using the technique of LA-ICP-MS. HED meteorites of different classes and metamorphic grades were analyzed: Pasamonte, an unequilibrated (weakly metamorphosed) Main Group eucrite that contains zoned pigeonite and augite grains; Juvinas, an equilibrated (metamorphosed) Main Group eucrite that contains inverted pigeonite; and a new howardite from Northwest Africa (NWA 4858) which contains pyroxene with a wide dispersion of major-element compositions, ranging from Mg-diogenite ($Wo_{0.7}En_{78}$), to Fe-diogenite ($Wo_{3.1}En_{57.9}$), to pigeonite ($Wo_{8}En_{56}$), to augite ($Wo_{31}En_{14}$). Our data permit a preliminary assessment of the role that igneous and metamorphic processes played for these three contrasting sample types.

Pasamonte: We confirm earlier suggestions that mineral trace-element compositions in Pasamonte mainly record igneous processes [1,2]. For incompatible elements, we measured a factor of ~10x variation in px and a factor of ~1.5-2.5x variation in plag. A noteworthy feature is the different behavior in px of Al compared to other elements, with Al content first dropping as crystallization progresses (i.e., as incompatible elements such as Y increase), then rising. We interpret this to indicate the rapid onset of plagioclase crystallization during pigeonite crystallization. Pasamonte appears to sample one evolving magma type.

Juvinas: Juvinas shows the effects of metamorphic redistribution [1,2], but mainly for px [2] and only for some elements, notably those that concentrate in plag (Al, Sr) and chromite (Cr, V). We suggest that these elements diffused out of px and into the other phases during subsolidus metamorphism. Low but relatively constant values of Ti/Y and Zr/Y in Juvinas px compared to Pasamonte px suggests that Ti and Zr had been previously depleted in the magma by ilmenite crystallization.

NWA 4858: Not unexpectedly, the trace-element composition of px in the howardite extends over a much larger range than in Pasamonte and Juvinas although compositions overlap the other meteorites. Abundances of incompatible elements (e.g., Ti, Y) in px vary by over 3 orders of magnitude, being lowest in Mg-diogenite and highest in augite, whereas Ba content in plag varies by 1 order of magnitude. Pyroxene appears to have crystallized from multiple magmatic systems. However, none of the px compositions in the howardite match for all elements those found in Pasamonte.

Conclusions: Our data suggest that studies of mineral trace-element compositions in HED meteorites can provide important information. For example, it appears that a magmatic signature in Juvinas px was incompletely erased by metamorphism, and that the signature of co-crystallizing or prior-crystallizing phases can be identified in Pasamonte and Juvinas. Analysis of clasts in howardites can yield a more comprehensive understanding of the diversity of igneous rock types and their genetic relationships than otherwise possible. Further work is needed to more definitively assess the genetic relationship of diogenites and eucrites.

References: [1] Pun A. and Papike J.J. (1996*) American Mineralogist* 81: 1438-1451. [2] Hsu W. and Crozaz G. (1996) *Geochimica et Cosmochimica Acta* 60: 4571-4591.