METAL-SILICATE SEGREGATION IN ASTEROIDAL METEORITES. J. S. Herrin and D. W. Mittlefehldt, NASA/Johnson Space Center, Houston, TX, USA (jason.s.herrin1@jsc.nasa.gov).

Introduction: A fundamental process of planetary differentiation is the segregation of metal-sulfide and silicate phases, leading eventually to the formation of a metallic core. Asteroidal meteorites provide a glimpse of this process frozen in time from the early solar system. While chondrites represent starting materials, iron meteorites provide an end product where metal has been completely concentrated in a region of the parent asteroid. A complimentary end product is seen in metal-poor achondrites that have undergone significant igneous processing, such as angrites, HED’s and the majority of aubrites. Metal-rich achondrites such as acapulcoite/lodranites, winonaites, ureilites, and metal-rich aubrites may represent intermediate stages in the metal segregation process. Among these, acapulcoite-lodranites and ureilites are examples of primary metal-bearing mantle restites, and therefore provide an opportunity to observe the metal segregation process that was captured in progress. In this study we use bulk trace element compositions of acapulcoite-lodranites and ureilites for this purpose.

Discussion: For a given starting mass, metal-silicate segregation occurs in three stages each brought about by an increase in temperature: (1) textural coarsening of silicate and metal grains, (2) formation and migration of metal-sulfide partial melts, and (3) migration of refractory metal en masse. Silicate melting and melt migration accompanies, and may facilitate, this stage. The first stage can be observed in the metamorphic stages (3-6) of ordinary chondrites which experienced an increase in mean grain size and mineral equilibrium with progressive metamorphism at subsolidus temperatures. During this stage, siderophile elements remain unfractionated in the bulk mass. The second stage begins as temperatures exceed the Fe-Ni-S cotectic (~980°C). Sulfur-
Figure 2. Processes of silicate partial melt extraction, indicated by decreasing Na/Sc, and extent of metal loss, indicated by Co concentration, for acapulcoite-lodranites and monomict ureilites. GRA 98028 is the most texturally primitive acapulcoite [1] and represents a logical starting composition on the figure. MAC 88177 is a lodranite which has lost much or all of its original metal. LEW 86220 is an acapulcoite enriched with a basaltic melt [2,1]. Data compiled from numerous sources.

Conclusions: The acapulcoite-lodranite clan and ureilites are unique in that they preserve a depleted asteroidal mantle sequence that retains refractory primary metal in silicate matrix. In acapulcoite-lodranites, metal segregation is largely limited to extraction of metallic partial melts (stage 2), while ureilites appear to have experienced the removal of some of their refractory metal component (stage 3). This difference could be rooted in the larger size of the ureilite parent body. In the future, as more meteorites are recovered and more data is obtained on existing meteorites, other more underrepresented groups of stony asteroidal achondrites might yield similar sequences of refractory metals.