PRELIMINARY INVESTIGATIONS INTO THE TOMOGRAPHY OF PALLASITES: IMPLICATIONS FOR PALLASITE FORMATION

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Introduction: Pallasites consist almost entirely of coarse olivine ($(Mg,Fe)_2SiO_4$) and FeNi metal. They are traditionally thought to have formed at the core-mantle boundary of a differentiated parent body [1], where the olivine from the mantle would mix with molten metal in the core. However, there are several problems with this theory. The cooling rate of pallasites is much slower than that of any irons [2]. The density difference between the olivine and metal is so great that one would expect to find only a small volume of pallasites, as the zone of mixing would be very limited in a core-mantle formation [3]. However, for every 12 iron meteorites, we have roughly one pallasite [4].

Other formation models theorize that pallasites could have formed i) near the center [5, 6], ii) near the surface [7, 8], or iii) at contact zones between an olivine mantle and isolated metallic pools [9]. Model (i) states that pallasites formed close to the center of the parent body, which essentially negates the problem with density difference. Model (ii) requires an external heat source, which would melt the surface of the chondritic parent body, causing differentiation. Model (iii) proposed that partial crystallization of a melt yielded the olivine, and the remaining melt was forced out by liquid metal pools.

Here we present the preliminary results of a tomographical study of pallasite. The goal of this study is to examine the relationship between the olivine and the metal in terms of models for pallasite petrogenesis.

Methods: Pallasites are usually sliced thinly to allow light to shine through the olivine crystals. In order to see the 3D relationship between the olivine and the metal in pallasites, it is important that we use samples that are still in 'block' form. For the purposes of this preliminary work, we analyzed the sample Fukang from the Monnig Meteorites Collection at TCU. The tomography scans were taken at the High Resolution X-Ray CT Facility at the University of Texas at Austin using a BIR ACTIS scanner. The scans are to be analyzed using the program Blob3D. Characteristics that we will be looking at include the interconnectivity of the olivine and metal, along with the grain size, shape, and orientation of the olivine.

Future Work: We are currently researching other meteorite collections to find more suitable pallasite samples for tomographic analysis. We plan to scan and analyze samples from the main group and Eagle Station pallasites. These two groups are suggested to derive from different parent bodies [10]. We will use tomography to assess any differences between the formations.

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