

## ORDER-DISORDER REACTION IN OLIVINES FROM PALLASITES: A PROXY FOR THERMAL HISTORY STUDY.

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Pallasites are stony iron meteorites that contain nearly equal amounts of iron-nickel metal and olivine. Taking into account silicate mineralogy, O-isotopic composition and metal composition, pallasites can be subdivided into four subgroups: Pallasite Main Group (PMG), Pallasite Eagle Station (PES), Pyroxene-Pallasite Grouplet and Ungrouped Pallasite [1,2]. There are two proposals for explanation of pallasites origin. The first one argues that pallasites formed during an impact event involving an intrusion of metal into an olivine cumulate [3]. The second view argues that pallasites formed at the core-mantle boundary of a planetesimal. If this were the case, uniform cooling rates should be expected for pallasites. However, this view is at variance with the diverse cooling rates exhibited by the pallasites [4]. Despite the controversial origin of pallasites, it should be pointed out that the mechanism for olivine-silicate mixing remains a complex issue.

In this work, a preliminary study concerning the intracrystalline Fe-Mg distribution in olivines extracted from pallasites is used to infer the thermal history of representative samples from Pallasites Main Group, aiming to gain insights concerning the origin of this group. Although olivine is not established as a geospeedometer, like the orthopyroxene system, cooling rate retrieved from cation ordering studies in olivines could yield reasonable results [5].

Olivine crystals were extracted from four pallasite samples, namely: Imilac, Quijingue, Brenham and Krasnojarsk. According to the Meteoritical Bulletin Database, Imilac and Brenham belong to the Pallasite Main Group (PMG). On the other hand, Quijingue and Krasnojarsk are classified as anomalous Pallasite Main Group (PMG-an), since they exhibit certain properties that are distinctive from other members of PMG. The separation of olivine from pallasites metallic matrix was done in several thin slices, as described in [6]. Following, the olivine crystals were analyzed by means of electron microprobe, X-ray diffraction (XRD) and <sup>57</sup>Fe Mössbauer spectroscopy (<sup>57</sup>Fe-MS).

Polished thick sections of pallasites were prepared. Under an optical microscope olivine crystals were selected for chemical analysis with an JEOL EPMA JXA-8230 Superprobe (WDS). Natural and synthetic standards were used for calibration and ZAF correction was applied. Powder olivine samples were prepared for XRD and <sup>57</sup>Fe-MS analysis. The X-ray diffraction was done with a D8-Discover, Bruker, using Bragg-Brentano geometry, from 10° to 90°, 0.02° 2Theta step, copper tube, LynxEye detector, nickel filter. <sup>57</sup>Fe Mössbauer spectroscopy, in standard transmission geometry using a 25 mCi <sup>57</sup>Co/Rh radioactive source in sinusoidal mode, was performed at room temperature (RT). Spectra were recorded for 24h in a 512 channel spectrometer and the calibration was taken at RT with an alpha-Fe foil. The error in source velocity is less than 1% and the isomer shift are given relative to alpha-Fe. The Normos code was used for the analysis.

Microprobe results indicate that fayalite (Fa) content for all olivine samples ranges from 12 to 16%. The XRD data for all samples showed only two phases: olivine and taenite. The amount of taenite is residual and the error of its quantitative amount (mass%) is very large. The olivine was described by a continuous solid solution between Fe and Mg. The molar fraction of iron in the metal sites ranged from 0.12 to 0.22, in agreement with microprobe results. Room temperature Mössbauer spectra for all olivine samples were fitted with two doublets associated to Fe<sup>2+</sup> at M1 and M2 sites. In order to increase the accuracy of Mössbauer area for cation distribution as well as cooling rate calculation, Mössbauer measurements at low temperatures are in progress.

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**References:** [1] Zucchini A. et al. (2018) *Meteoritics & Planetary Science* 53:268–283. [2] Dottin J. W. et al. (2018) *Geochimica et Cosmochimica Acta* 224:276–281. Author E. F. et al. (1997) *Meteoritics & Planetary Science* 32:A74. [3] Scott E. R. D. (1977) *Geochimica et Cosmochimica Acta* 41:693–710. [4] Yang J. et al. (2010) *Geochimica et Cosmochimica Acta* 74:4471–4492. [5] Heinemann R. et al. (2007) *European Journal of Mineralogy* 19:15–27. [6] Dos Santos et al. (2014) *Hyperfine Interactions* 224:251–256.