Chromite: Accessory mineral tracing pallasite parent body differentiation

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Pallasite meteorites are mixtures of olivine and metal [1, 2] with numerous accessory phases such as chromite [3]. Most originated in a single early planetesimal [4] formed in the early history of the Solar System, but this type of parent body may be the default end-product of silicate melt extraction [as indicated by the presence of other pallasite parent bodies, e.g. 5]. Like the geochemically similar IIIAB iron meteorites [6], pallasite meteorites contain chromite, which mostly crystallised from metal vi 4a early oxidation of Cr by oxygen acting as an incompatible trace element [7]. However, unlike IIIAB irons that contain nearly pure end-member $FeCr_2O_4$, pallasite chromites contain variable Mg and Al contents [8]. In chromite, these two components trace the effects of metamorphism by equilibration with olivine, and the presence of silicate magma during earlier, higher temperature differentiation [e.g. according to their respective diffusivities in chromite: 9, 10].

The early identification of two types of chromite in pallasites [8] have become clearer with the collection and collation of more data [e.g. 3, 11], with: 1) a common cluster characterised by a correlation between Fe# (Fe/[Fe+Mg]) and Cr# (Cr/[Cr+Al]), and 2) e 4ffectively Al-free chromites with a range of Fe# in the low-Mn pallasites Brenham and Molong. These represent silicate-present and silicate-free conditions respectively, in stark contrast to expectations from phosphate mineralogy [12]. The two trends converge near Fe# 80 and Cr# 100, which seems to be a kind of parental chromite. This composition is also shared by chromites from some more conspicuous pallasi 4tes, including: Brahin (homogeneous chromite and low-Mn olivine), Pavlodar (ultra-refractory?) and Phillips County and Zaisho (FeO-rich), reflecting early planetary-scale differentiation.

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