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Two generations of ferropericlase inclusions in diamond indicate heterogeneity of the Earth's lower mantle

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Bridgmanite, CaSi-perovskite, ferropericlase and stishovite are major minerals of the Earth's lower mantle (LM). Ferropericlase (fPer) is the most enigmatic among them because of its very wide compositional variations. Although theoretically it should have magnesium index *mg* = Mg/(Mg + Fe)$_{at.}$ = 0.73-0.88, geological samples occupy a much wider range in FeO content (*mg* = 0.36–0.90) [1].

Recently we analyzed 37 fPer grains from Rio Soriso placer diamonds, Juina area, Brazil. They vary in their iron content and magnesium index *mg* = 0.48–0.84. They form two generations with *mg* maxima at 0.60 (variations from 0.48 to 0.72) and 0.79 (variations from 0.76 to 0.84). The first, high-Fe group contains 600-3,050 ppm Ni, while high-Mg group contains 8,270-10,660 ppm Ni. Diamonds hosting the two groups of fPer differ in the carbon isotopic compositions.

We demonstrated before that Fe-containing minerals (bridgmanite and ferropericlase), in which iron acts as a dilutant of Ni dissolved in metal, become with depth more iron-rich than at the top of the LM [2]. Experimental data demonstrated that metallic content in the LM may be estimated at 1 wt% (10 000 ppm) before the release of metallic alloy forming the core [3]. This implies that the fPer grains with high Ni (and low Fe) concentrations were formed in media that did not contain metallic alloy (or its quantity was extremely small), suggesting these originated within the uppermost lower mantle, while the low-Ni (and high-Fe) fPer grains were formed in the presence of metallic alloy within lower parts of the LM. This conclusion may be applied to the results of this study. Low-Fe – high Ni fPer varieties may be considered as belonging to the upper levels of the LM, and high-Fe – low-Ni group represent deeper parts of the LM.

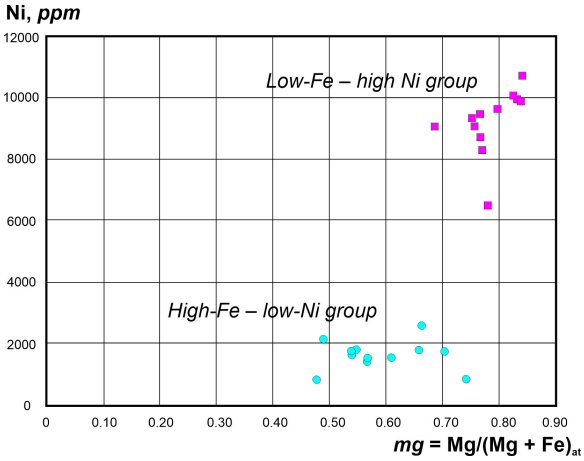

Fig. 1. Concentrations of Ni and Mg (as mg = = Mg/(Mg + Fe)$_{at.}$) in ferropericlase from Rio Soriso.

References:

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