Depth of formation of ferropericlase included in super-deep diamonds

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Super-deep diamonds are believed to have formed at depths of at least 300 km depth (Harte, 2010). A common mineral inclusion in these diamonds is ferropericlase, (Mg,Fe)O (see Kaminsky, 2012 and references therein). Ferropericlase (fPer) is the second most abundant mineral in the lower mantle, comprising approximately 16–20 wt% (660 to 2900 km depth), and inclusions of fPer in diamond are often considered to indicate a lower-mantle origin (Harte et al., 1999). Samples from São Luiz/Juina, Brazil, are noteworthy for containing nanometer-sized magnesioferrite (Harte et al., 1999; Wirth et al., 2014; Kaminsky et al., 2015; Palot et al., 2016). Based upon a phase diagram valid for 1 atm, such exsolutions would place the origin of this assemblage in the uppermost part of the lower mantle. However, a newly reported phase diagram for magnesioferrite demonstrates that the latter is not stable at such pressures and, thus, it cannot exsolve directly from fPer at lower-mantle conditions (Uenver-Thiele et al., 2017).

Here we report the investigation of two fPer inclusions, extracted from a single São Luiz diamond, by single-crystal X-ray diffraction and field emission scanning electron microscopy. Both techniques showed micrometer-sized exsolutions of magnesioferrite within the two fPers. We also completed elastic geobarometry (see Angel et al., 2015), which determined an estimate for the depth of entrapment of the two ferropericlase – diamond pairs. In the temperature range between 1273 and 1773 K, pressures varied between 9.88 and 12.34 GPa (325-410 km depth) for one inclusion and between 10.69 and 13.16 GPa (350-440 km depth) for the other one. These results strengthen the hypothesis that solitary fPer inclusions might not be reliable markers for a lower-mantle provenance.

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Angel, R.J., et al. (2015) *Russ Geol Geophys*, **56**, 211-220; Harte, B. (2010) *Mineral Mag*, **74**, 189-215; Harte, B., et al. (1999) *The Geochemical Society, Special Publication*, **6**, 125-153; Kaminsky, F. (2012) *Earth-Sci Rev*, **110**, 127-147; Kaminsky, F., et al. (2015) *Earth Planet Sci Lett*, **417**, 49-56; Palot, M., et al. (2016) *Lithos*, **265**, 237-243; Uenver-Thiele, L., et al. (2017) *Am Mineral*, **102**, 632-642; Wirth, R., et al. (2014) *Earth Planet Sci Lett*, **404**, 365-375.