Insights into Juina super-deep diamonds

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Inclusions in diamonds may provide direct samples from the otherwise inaccessible Earth's lower mantle, as was first suggested almost thirty years ago. Nevertheless, it is only in the last two decades that diamonds of a deeper origin have been identified as minor components from a number of kimberlitic and alluvial diamond deposits worldwide [1, and references therein]. These so-called super-deep diamonds may originate between 300 and 800 km depth and thus provide important natural evidence on phases and phase compositions that allow unique insights into the processes and states in the extreme depths of our planet. They mainly contain ferropericlase, enstatite (believed to be derived from MgSi-perovskite) and $CaSiO_3$-walstromite (believed to be derived from $CaSiO_3$-perovskite).

In order to obtain some information on their depth of origin, two alluvial diamonds coming from São Luiz (Juina, Brazil) were investigated both by *in-situ* microRaman spectroscopy and *in-situ* single-crystal X-ray diffraction. In total we analyzed more than sixty inclusions and we found evidence of $CaSiO_3$-walstromite, larnite, $CaSi_2O_5$-titanite, perovskite, orthoenstatite, siderite, phase EGG and probably ferropericlase; other phases are present but they still need to be identified. In particular, at least one inclusion showed the coexistence of $CaSiO_3$-walstromite, larnite and $CaSi_2O_5$-titanite, indicating that $CaSiO_3$-walstromite can effectively form in sublithospheric conditions from the back transformation of larnite + $CaSi_2O_5$-titanite. Our preliminary thermodynamic calculations, however, suggested us that single inclusions of $CaSiO_3$-walstromite cannot derive from $CaSiO_3$-perovskite. This is due to the high volume change from the high-pressure to the low-pressure polymorph, that would require ~30% of expansion in the host. Further analyses are in progress in order to determine the unit-cell of ferropericlase and phase EGG.

[1] Kaminsky (2008) *Earth Sc Rev* **110,** 127-147.