



The Deep Mantle Volatile Cycle Revealed in Superdeep Diamonds and their Mineral Inclusions

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Diamonds crystallize in the mantle primarily as a consequence of fluid or melt metasomatism. In doing so they sample the fluid-melt-solid equilibria directly by incorporation of carbon and its isotopic flavours, and by entrapping other phases as they grow. Superdeep diamonds from the transition zone and lower mantle provide evidence for crystallization from melts derived from subducted materials [1, 2]. The presence of deeply subducted volatile components such as carbon and water are important because they lower the solidus of subducted materials. The source of carbon may ultimately be via deposition of biogenic or abiogenic carbon in subducted crust, and water may become available via dehydration of high-pressure hydrous phases in the slab (e.g. superhydrous B, Phase D) [3]. Foundering of slabs around 700 km due to density inversion and thermalization with surrounding mantle leads to the generation of low-degree, volatile-charged melts. Melts from subducted oceanic crust may be carbonated, and diamond crystallization occurs as a consequence of 'redox freezing' when the oxidized slab melts react with reducing mantle rocks [4]. Reaction of slab melts with mantle peridotite may precipitate phases such as Ca-perovskite, Mg-perovskite, majorite and ferropericlase. Here we will survey evidence from the chemistry of superdeep mineral inclusions for a record of this deep mantle reactive transport process, and speculate on the role of deep mantle volatiles.

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2. Walter, M.J., et al., Nature, 2008. 454: p. 622-U30.
3. Harte, B., Mineralogical Magazine, 2010. 74: p. 189-215.
4. Rohrbach, A. and M.W. Schmidt, Nature, 2011. 472: p. 209-212.