Diamonds, carbonate melts and carbon-bearing aqueous fluids in eclogites

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Recent studies of diamond inclusions have proposed that eclogitic diamonds may form from either carbonate melts or by precipitation from CO_2-bearing aqueous fluids [1]. The redox conditions at which diamonds and carbonate melts are stable in eclogitic settings are still relatively uncertain with respect to temperature and pressure due to the diverse composition of these rocks. In addition, no data are available to predict the composition and carbon speciation in coexisting aqueous fluids from which diamonds might have formed.

Multianvil experiments were performed between 3 and 6 GPa and temperatures of 800-1300°C using a synthetic eclogite assemblage representative of subducted oceanic crust in the Na-Ca-Mg-Al-Si-Fe-O-C system equilibrated with Ti-bearing minerals. In this set of experiments the oxygen fugacity corresponding to the equilibrium between carbon and carbonate was measured using Ir as a redox sensor. We also investigated the carbon speciation in aqueous fluids based on a recent aqueous solution chemistry model [2]. Calculations were performed using equilibrium constants to determine the composition of C-bearing aqueous fluids in equilibrium with model eclogite in the system Na_2O-K_2O-CaO-MgO-FeO-Al_2O_3-SiO_2-H_2O-CO_2-H_2-HCl as function of the oxygen fugacity, temperature and pressure.

Preliminary results of the oxygen fugacity at which diamond and carbonate melt can coexist are relatively consistent within eclogitic assemblages with different composition. Isotopic studies on natural eclogitic diamonds showed that their $\delta^{13}C$ values extend to more negative values than diamonds from peridotites [3]. This could result from either a contribution from subducted biogenic carbon or mechanisms operating in the mantle able to fractionate carbon isotopes, possibly involving complex C-rich aqueous fluids. Results from our study allows a better understanding of these mechanisms.

[1] Taylor & Anand (2004) *Chemie der Erde-Geochemistry*, **64**, 1-74. [2] Sverjensky *et al* (2014), *GCA* (in press). [3] Cartigny (2005), *Elements*, **1**, 79-84.