Diamond dissolution and morphological change in silicate and carbonate melts

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Natural diamonds display a wide range of morphological variation, which could be largely attributed to results of dissolution into their host magmas. We carried out a series of experiments in the diamond-kimberlite and the diamond-lamproite systems at high pressures (1.0-2.5 GPa) and temperatures (1300-1500 degree Celsius) with a piston cylinder apparatus with 34 mm bore hole, and examined dissolution mechanism and morphological change of diamond in silicate and carbonate melts. Natural octahedral diamond (1 mm in diameter) was placed at a center of solvent powder then they were loaded into a Pt capsule (4 mm in diameter). The double capsule method with the I-W buffer was used to control oxygen fugacity. After experiment, morphological change of the seed diamonds was examined with optical microscope and SEM. We measured weight change of the seed diamonds before and after the experiments.

Increasing run duration led to higher dissolution of the seed diamond, and the diamond gradually changed from original octahedron through hex-octahedral and tri-octahedral to finally football- or ball-shaped smaller crystal. The area of {111} face gradually reduced and finally disappeared. Negative trigons grew on the {111} face of dissolved octahedral diamond. With increasing dissolution, morphology of trigon changed from smaller flat-bottomed to larger V-shape-bottomed shape. The diamonds with highly dissolved morphology contain smaller number of trigon and finally no trigon was observed on the seed crystals when {111} face disappeared. At 2.5 GPa, dissolution rate (radius/hr) is 0.026mm/hr at 1500 degree Celsius and 0.007mm/hr at 1300 degree Celsius in the kimberlite melt. At 1.0 GPa and 1300 degree Celsius, diamond dissolved into the kimberlite melt at a rate of 0.014 mm/hr and into the lamproitic melt at a rate 0.0026 mm/hr. The data indicate that the dissolution rate into kimberlite melt is strongly suppressed by addition of water or carbonate into the melt.

The present experiments well represent the morphological changes observed in natural diamonds. Dissolution of diamond highly depends on temperature and chemical composition of host magma.