Ultradeep diamond genesis at Redox conditions of slab-mantle boundary

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Diamond genesis is an intriguing issue for diamond resources and Earth Carbon Cycle. Besides kimberlitic diamonds, many characteristic ultradeep diamonds hosting inclusions with phase assemblages with a sublithospheric origin have been exploited throughout the world. Ultradeep diamonds with their chemical and inclusion compositions not only record a history of oceanic lithosphere subduction and upward transport at a depth of >250 km to 660 km or deeper, but also indicate their genesis pertinent to mantle-carbonate melts in a Fe^0-bufferred reduced condition. In our pilot experiment, the formation of diamonds from $MgCO_3$-Fe^0 system was evidenced in a diamond anvil cell device at ~25 GPa and ~1800 K, the conditions of the depth of ~660 km in the mantle. A detailed study of redox mechanism of $MgCO_3$-Fe^0 coupling has been conducted using large volume press along the oceanic lithosphere subduction paths in the pressure-temperature range of 6-25 GPa and 1200-2000 K, covering the formation region of most ultradeep diamonds. The clear reaction boundaries around Fe^0-foil in contact with $MgCO_3$ strongly support the redox reaction between carbonatitic slab and Fe^0-bearing metals under mantle conditions. Our study experimentally documents the possibility of ultradeep diamond genesis at Redox conditions of carbonateitic slab and Fe^0-bearing metals. Furthermore, we will discuss the rates of diamond formation as a function of pressure-temperature conditions.