# Kinetics of Iron-Magnesite Redox Reaction with Implication for the Genesis of Ultradeep Diamonds

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**Abstract**

The superdeep diamonds refer to diamonds originated from the sub-lithosphere depths between 250 and 2900 km. The depth distribution of the superdeep diamond indicates that two restricted zones - from deep upper mantle to top transition zone (250-450 km) and from lower transition zone to top lower mantle (600-800 km), contain the majority of these diamonds (Harte 2010). The nature of the two depth zones has not been well understood yet. Using laser-heated diamond anvil cell (LH-DAC) + synchrotron X-ray diffraction (XRD) method, we investigated the kinetics of Fe-$MgCO_3$ redox reaction, which may be the dominant mechanism of diamond formation (Palyanov et al. 2013). The results show that the reaction boundary between 12 and 40 GPa locates between the cold slab surface and interior geotherm, which allows diamond formation at slab surface and preserve the carbonate in slab interior. Furthermore, we obtained semi-quantitative constraints on the pressure and temperature effects on the reaction rate. The high temperature increases the reaction rate at a given pressure, and the high pressure decreases the reaction rate at a given temperature. Along the slab geotherms, the rate drops by more than one order of magnitude between 14.4 and 18.4 GPa, which marks the lower boundary of the first superdeep diamond zone. The second superdeep diamond zone may result from slab stagnation near 660 km, which facilitates diamond formation through slab

warming and extended reaction time.

HARTE B. 2010. Diamond formation in the deep mantle: the record of mineral inclusions and their distribution in relation to mantle dehydration zones. Mineralogical Magazine 74: 189-215.

PALYANOV YN, BATALEVA YV, SOKOL AG, BORZDOV YM, KUPRIYANOV IN, REUTSKY VN AND SOBOLEV NV. 2013. Mantle–slab interaction and redox mechanism of diamond formation. Proceedings of the National Academy of Sciences 110: 20408-20413.