

## Reaction of MgCO<sub>3</sub> high-pressure polymorph and SiO<sub>2</sub>; Origin of super-deep diamond.

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### Introduction

MgCO<sub>3</sub> magnesite is one of the stable carbonate minerals under high-pressure and high-temperature conditions [1]. The stability of MgCO<sub>3</sub> at high pressure and temperature has been studied by experiments and *ab initio* calculations [1–3]. Although these studies revealed that MgCO<sub>3</sub> might change its structure from magnesite to its high-pressure polymorph [2,3], the nature of the phase transitions of MgCO<sub>3</sub> at high-pressure and temperature is not well understood.

### Experimental

We have conducted high pressure and temperature experiments on a reaction between MgCO<sub>3</sub> and SiO<sub>2</sub> under the whole mantle conditions using a double sided-laser heated diamond anvil cell combined with the synchrotron X-ray diffraction technique. We have focused on the MgCO<sub>3</sub>-SiO<sub>2</sub> reaction which is possible to exist in slabs descending into the lower mantle and to form diamond in the lower mantle [4,5].

### Results and Discussion

The phase transition of magnesite to MgCO<sub>3</sub> phase II, a high-pressure polymorph of magnesite, was observed at around 80 GPa and 1800 K. Under the same pressure and temperature conditions, diamond was formed by the reaction of MgCO<sub>3</sub> and SiO<sub>2</sub>. We describe the phase diagram of the MgCO<sub>3</sub>-SiO<sub>2</sub> system. The phase diagram shows that MgCO<sub>3</sub> and SiO<sub>2</sub> may not react with each other down to the lowermost mantle in cold subducting slabs. The reaction occurs near the core-mantle boundary conditions and will make 'super-deep' diamond. The reaction of MgCO<sub>3</sub> and SiO<sub>2</sub> may explain diamond originating in the lowermost mantle [6,7].

- [1] Fiquet *et al.* (2002) *Am. Miner.* **87**, 1261-1265.  
[2] Isshiki *et al.* (2004) *Nature* **427**, 60-63. [3] Oganov *et al.* (2008) *Earth Planet. Sci. Lett.* **273**, 38-47. [4] Seto *et al.* (2008) *Phys. Chem. Miner.* **35**, 223-229. [5] Takafuji *et al.* (2006) *Phys. Chem. Miner.* **33**, 651-654. [6] Hayman *et al.* (2005) *Contrib. Mineral. Petrol.* **149**, 430-445. [7] Wirth *et al.* (2014) *Earth Planet. Sci. Lett.* **404**, 365-375.