Diamond formation from calcite by laser-heating at elevated pressure

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Natural diamonds are generally found in kimberlites or lamproites but a new genetic type of diamond microcrystals has been found in carbonatites of the Chagatai Complex (Uzbekistan) (Divaev 1996) and in magmatic carbonatites on Fuerteventura Island (Spain) (Shumilova 2006). Hence, it now needs to be understood whether the magmatic carbonatites served as a transporter of diamonds originating from the Earth's mantle or whether the carbonatite melt was the diamond-forming source. While the formation of diamond from carbonates was first confirmed in experiments by direct synthesis of diamond from $MnCO_3$ (Lin-gun Liu et al. 2001) and from graphite in a carbonate environment (Litvin et al. 2003), no experimental evidence exists about the diamond crystallization from pure calcite up to now. In this study we clarified the mechanism of diamond crystallization from calcite and the required PT- conditions by high pressure, high temperature experiments using laser-heated diamond anvil cells. Pressures were varied between 9 and 15 GPa. Temperatures up to 3000 K were generated using a CO_2 laser heating system equipped with an optical spectrometer for temperature measurements. The quenched samples were characterized by micro-Raman spectroscopy. From the results we conclude that in a first step calcite decomposes in the whole investigated pressure range at temperatures above 2000K, forming nanocrystalline glassy-like carbon. In a second step, the carbon crystallites form aggregates. Finally, the carbon aggregates transform into diamond at P-T conditions within the diamond stability field. In summary, we have shown for the first time the formation of diamond by decarbonation of calcite.
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References

Divaev F.. (1996) Chatagai carbonatite complex – a new type of magmatic rocks in Uzbekistan. Geological journal of Uzbekistan 6: 32-41

Lin-gun Liu, Chung-Cherng Lin, Yi-Jong Yang (2001) Formation of diamond by decarbonation of $MnCO_3$. Solid State Communications 118:195-198

Litvin Yu. A., Spivak A. V., and Matveev Yu. A. (2003) Experimental Study of Diamond Formation in the Molten Carbonate–Silicate Rocks of the Kokchetav Metamorphic Complex at 5.5–7.5 GPa. Geochemistry International 41:1090

Shumilova .G. (2006) Carbonatites from Fuerteventura Island (Canary archipelago) as a special type of diamond-bearing rocks. In book: Problems of geology and mineralogy. Editor A.M.Pystin. Syktyvkar: Geoprint:248-261.

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