1st International Conference on Subduction, Volcanism and the Evolution of Oceanic and Continental Crust (SVOCC 2014)
10-16 February 2014, Nadi, Fiji
Abstract Volume
IAGR Conference Series No. 17, pp. 37

INTERNATIONAL ASSOCIATION FOR GONDWANA RESEARCH
IAGR
Conference Series 17

The formation of micro diamonds in decompression cracks out of equilibrium controlled by the C:O:H ratio in the kimberlitic melt

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Diamonds are supposed to be formed in the diamond window under high-pressure conditions due to the polymorph graphite/diamond phase transition. In this study we present for the first time, that natural diamonds can be formed by C:O:H bearing volatiles during the uplift of the kimberlitic melt in eclogites from the Roberts Victor mine, South Africa. Our results give evidence that the kimberlitic melt acts like a catalyst, and therefore the C:O:H ratio in the kimberlite changes through the uplift of the kimberlite permanently, caused by the formation of hydrous and carbonatitic minerals within the kimberlitic melt. This catalytic process leads to the growth of light carbon bearing molecules and under favorable thermodynamic, stoichiometric and kinetic conditions micro diamonds can be formed, even under lower pressure conditions outside of the diamond window. High-spatial-resolution synchrotron based FT-IR has been used to detect C:O:H-bearing volatiles around planar defect structures in garnet. In micro diamond bearing planar defect structures, a correlation between C:O:H-bearing volatiles could be identified whereas in micro diamond free planar defect structures no correlation of the different C:O:H containing volatiles is visible. The conclusions from our study proves that C:O:H-bearing volatiles, and their distribution pattern around the studied micro cracks, are suggestive of the formation of micro diamonds in natural eclogites.

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