GENESIS OF DIAMONDS AND DIAMONDIFEROUS ROCKS FROM THE SAXONIAN ERZGEBIRGE, CENTRAL EUROPE

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Since the discovery of microdiamond in the Gneiss-Eclogite Unit of the central Saxonian Erzgebirge, an exposed basement unit of the NE Variscan orogen, in 1997 (MASSONNE, 1999), this mineral and the hosting and surrounding quartzofeldspathic rocks have been investigated by several analytical methods involving EMP, SEM, XRF, ICP-MS, and other mass spectrometric methods. The results of the corresponding studies have led to the subsequent genesis model for the Saxonian diamonds and the Variscan crust in which the microdiamonds were found.

The protoliths of the diamondiferous rocks were pelitic rocks not older than 395 Ma. These rocks probably contained biogenic carbon which crystallized to diamonds during an ultrahigh pressure (UHP) event according to the $\delta\ ^{13}C$(PDB) values of diamond around -28 ‰. The earliest (close to 340 Ma) metamorphic stage of the diamondiferous rocks is recorded by inclusions in cores of garnet and zircon, among them is jadeitic pyroxene, pointing to P-T conditions of about 18 kbar and 600 °C. These conditions can be related to the base of a thickened continental crust. Crustal thickening resulted from the collision of Gondwana and Laurussia which might have started already in Devonian times. It is believed that after extended crustal thickening portions from the lower continental crust were involved in delamination of the underlying continental lithosphere (MASSONNE, 2005) sinking deep into the mantle. Thus, the diamondiferous rocks were buried possibly to depths of 200 km or more due to the find of a nanocrystal of TiO_2 with α-PbO_2 structure (HWANG et al., 2000). During burial, these rocks were partially molten by heating to ≥ 1100 °C. Afterwards, they quickly ascended and intruded the continental crust 336 Ma ago. During rise and cooling, garnet, kyanite, and zircon crystallized early enclosing microdiamonds which had formed from the partial melt as well (MASSONNE, 2003). In addition, melt was included in garnet to crystallize to microdiamond, quartz, feldspars and various micas (STÖCKHERT et al., 2001). Final crystallization of the diamondiferous rocks occurred at about 15 kbar and 750 °C leading to abundant muscovite and some K-feldspar as late magmatic phases. In the lower continental crust these massive igneous rocks formed little homogeneous bodies and remained undeformed even after subsequent exhumation. The surrounding rocks, garnet-bearing HP gneisses, are richer in SiO_2 and show different trace element signatures compared to the diamondiferous rocks. Thus, these gneisses cannot be derived from the diamond-bearing rocks due to tectonic processes. Relatively SiO_2-rich eclogite boudins in the vicinity of the diamondiferous rocks show, in fact, features similar to these rocks but it is not clear yet if they have experienced a similar P-T evolution.

References

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