Environment of diamond formation in UHPM rocks from the Greek Rhodope: A Raman study of inclusions in zircon

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The Rhodope Massif in northern Greece is a newly established ultrahigh-pressure metamorphic (UHPM) province in the world (Mposkos and Kostopoulos, 2001).

Microscopic observations on zircons separated from a garnet gneiss revealed a simple zoned structure consisting of a somewhat rounded detrital core and a metamorphic overgrowth rim. Numerous mineral and fluid inclusions were found in the metamorphic rim especially near the interface of the two domains.

We carried out a detailed laser µ-Raman spectroscopic study of the inclusions and their zircon host in both domains. Quartz and monazite were identified in the detrital core whereas diamond, albite, phengite, hematite, rutile and CO_2 gas were identified in the rim. Interestingly, albite occurs always in pockets with phengite and diamond whereas the latter two phases can occur independently. We interpret these pockets as precipitates from a melt phase at high pressures.

The microdiamonds were probably formed by dissociation of CO_2; the thus liberated oxygen was combined with iron available from the fluid / melt phase to precipitate hematite. Importantly, there is clear-cut distinction in the Raman spectra of detrital and rim zircon, with the latter being additionally characterised by a broad band at ~1332 cm^{-1}. What is more significant is that by approaching the included diamonds the above band in zircon increases dramatically in intensity. This can either be assigned to carbon occupying interstitial sites in zircon and in all probability reflects a luminescence band or to enhanced carbon solubility in zircon (Shcheka *et al*., 2006), with the diamonds reflecting sites locally supersaturated in carbon.

We favour the former explanation since similar bands, often associated with CO_2 peaks, were also observed in inclusions in garnet for which C solubility is negligible.

References

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An experimental basis for eco-safe geoconservation of radioactive nuclides in aluminosilicate matrixes based on fusible bentonites

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The most important requirements to matrixes for burring of radioactive wastes are recognized characteristics of absorption of radiation by substance with its warming up and tension relaxations, and also admissible levels of saturation by radioactive nuclides of bonding skeletons.

The authors suggest the creation of cheap silica-alumina matrixes based on fusible bentonitic cation-exchange clays. Using these clays it is possible to develop almost “pure” technologies for production of silica-alumina matrixes separately for products of nuclear fission (PNF) and separately for transuranium elements (TUE). At a “wet” (exchange) stage of charge preparation it is possible to separate radioisotope cations from anions of strong inorganic acids at once. As the exchange capacity of clays is insignificant, the demanded level of saturation of an initial material can be reached by addition of absorbing radioactive nuclides of humus substances. At the subsequent thermal treatment the organic compounds will burn out completely with formation of dense glass ceramic shard of lithoidal structure. The nearest natural analogues of such silica-alumina matrixes are high-temperature metamorphic rocks and volcanic glasses, which have been stable in watered systems for millions years.

Experiments at different temperature modes with modeling nitrate raffinates of PNF containing stable Cs, Ce and Sr have confirmed that they active replace exchange cations of clays - Ca, Na and K. Moreover, the cation exchange capacity achieves 190 mq/100g. Fast saturation of clays by PNF simulators within the first hour was established. This gives necessary information for a substantiation of wet technology processes at low temperatures. During sorption from modelling solution within 6-7 hours up to 80 mass. % of Ce, up to 50 mass. % of Cs and up to 30 mass. % of Sr pass into clays. Mechanisms of the thermal sintering of silica alumina matrixes were determined. With the purpose of definition of the maximal concentration of organic substances (peats), which possible to enter into bentonite matrix with preservation of its integrity after baking and without critical increase in porosity, a 40 experiments series was carried out. The results show that bentonites are perspective materials for production of glasses and ceramics, which strongly immobilize not only highly radioactive isotopes of alkaline, alkaline-earth elements and lanthanoids but also actinoids and other metals forming at nuclear fission and neutron activation.

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