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РОССИЙСКАЯ АКАДЕМИЯ НАУК СИБИРСКОЕ ОТДЕЛЕНИЕ
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Тезисы докладов Международной конференции,
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академика Владимира Степановича Соболева

THE PROBLEMS OF MAGMATIC AND METAMORPHIC PETROLOGY, GEODYNAMICS AND GENESIS OF DIAMONDS

Abstracts of International Conference
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Vladimir Stepanovich Sobolev

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LARGE-SCALE CARBON TRANSFER BETWEEN CRUST AND MANTLE DURING SUPERCONTINENT AMALGAMATION AND DISRUPTION

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Early Cambrian (Pan-African orogeny, ca. 600 Ma) amalgamation of the Gondwana supercontinent through linear hot orogenic belts occurred in Africa and Southern India. These orogenic belts are characterized by ultrahigh temperature (UHT, >1000°C) metamorphic events, which have played a fundamental role in the development and stabilisation of the continents. Granulite and UHT-metamorphism are linked to major episodes of supercontinent amalgamation at least since the late Archean, traces of which having been found in virtually all known supercontinents so far [1]. Depending on the geodynamic setting (continent collision or basin-inversion after lithospheric thinning), the duration of these UHT-episodes is variable, from less than 15 Ma in the recent granulites from Hokkaido (Japan) or Seram (Indonesia) to more than 100 Ma in the long-lived and slowly-cooled Napier complex (Antarctica) [2]. But whatever their age or geodynamic settings, minerals of all UHT-granulites worldwide contain a great quantity of primary fluid inclusions, containing dense or superdense (> 1.1 g/cm^3) mantle-derived CO_2. It shows that, during UHT events, large quantities of mantle-derived CO_2 were injected into the continental lower crust [3]. The occurrence of these syn-metamorphic CO_2 fluids is so systematic in UHT granulites, that it can be assumed that they played a critical role in the genesis of the extremely high temperatures reached during this metamorphism. In addition to CO_2 another fluid is present, namely high-salinity aqueous brines, the source of which can be the sedimentary protolith, the mantle, or both [4]. Both fluids were immiscible at peak metamorphic conditions, but they became miscible and mutually reactive at decreasing pressure and temperature.

The amalgamation of the Gondwana supercontinent lasted for more than 400 Ma, starting about 1000 Ma ago in the Trivandrum bloc, India and ending in Eocambrian times (ca. 600 Ma) during the Pan-African orogeny, which affected Africa, Madagascar, Sri-Lanka and Southern India. At this time, the large fluid influx in the lower crust caused instability, leading to breakup and disruption of the supercontinent immediately after its final amalgamation [4]. Elimination of the UHT-granulite fluids occurred rapidly during post-metamorphic uplift, with important consequences for both at local and regional scales. Local scale (10 to 100's m.) effects are due to the intergranular migration of brines, resulting in the formation of granulite mineral assemblages at the periphery of the main granulite complex (incipient charnockites, granulite "islands"). Less mobile CO_2 fluids can only migrate through crustal-scale (10 to 100 km) shear zones, probably caused by major earthquakes. CO_2 fluids can either be reduced, resulting in graphite veins [5], or oxidized, resulting in the quartz-carbonate shear zones found in the vicinity of many granulite terranes [6].

References:

1. Brown, M. (2007) Metamorphic conditions in orogenic belts: a record of secular change. Int. Geol. Rev. V. 49, P. 193-234.
2. Harley, S. (2016) A matter of time: The importance of the duration of UHT metamorphism. J. Mineral. Petrol. Sci. V. 111, P. 50-72.
3. Santosh H.M., Omori, S. (2008): CO_2 flushing: A plate tectonic perspective. Gondwana Res. V. 13. P. 86-102.
4. Touret J.L.R., Santosh, H.M., Huizenga, J.M. (2016). High-temperature granulites and supercontinents. Geosci. Front. V. 7. P. 101-113.
5. Touret, J.L.R., Huizenga, J.M., Kehelpannala, W., Piccoli, F. (2018) Vein-type graphite deposits in Sri-Lanka, the ultimate fate of granulite fluids. Chem. Geol., in press (ECROFI 2017 issue).
6. Newton, R.C., Manning, C.E. (2002) Experimental determination of calcite solubility in H_2O-NaCl solutions at deep crust/upper mantle pressures and temperatures: Implication for metasomatic processes in shear zones. Am. Min. V. 87, P. 1401-1409.