Experimental study of melting, texture, and phase relations of basalt (eclogite)-peridotite-fluid system at sub- and supercritical P-T

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Fluids have an effective influence on the phase relations and melting of the mantle. Depending on the P-T conditions fluid-bearing silicate systems can be in the subcritical and supercritical conditions. Melting, textures, phase relations at sub - and supercritical P-T are studied experimentally in the system basalt (eclogite)-peridotite-H_2O, H_2O+(Na, $K)_2CO_3$ fluid.

Experiments were carried out in piston-cylinder and anvil-with-hole apparatus by a quenching technique in the range P=2-4 GPa, T=1100-1400°C. Different texture and phase relations of quenched samples served as test that the system goes into a supercritical state. Two experimental techniques were used: Pt-Pt-peridotite ampoules at T=1350-1400ºC and direct melting peridotite in Au and Au-Pd ampoules at T=1100-1200ºC.

At subcritical P-T conditions quenching samples have a massive texture, due to the fact that the massive silicate glass cements solid liquidus phases. At supercritical P-T conditions observed full miscibility between melt and fluid, and in the second critical end point – between minerals, melts, and fluid. The disintegration of the experimental samples observed during quenching supercritical phase. Samples characterized by clastic-like or fragmental-like textures regardless of the composition and technique of experiments. They consist of a mixture of fritted, rolled-like relicts of Ol, Opx from peridotite, reactionary minerals, and products quenching of supercritical phase - microlits of silicate minerals and their joints needle- or dendrite-like forms, microglobules Al-Si glasses, carbonates. Separate fragments remind of “breccia”-relicts of Ol, Opx cement of reactionary Grt, Cpx. Solubility of minerals peridotite, reactionary relation between relict and neogenic reactionary minerals testify to high reactionary ability supercritical phase.

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Intra-plate tectonics and magmatisim as a consequence of mantle lithosphere delamination

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Most of intra-plate melting is associated with interaction of deep mantle plume with mantle lithosphere. Vast amount of mafic/felsic intra-plate intrusions are located along post-collisional lines, where for longer periods time regional tectonic conditions are more likely to be (weakly) compressional to transpressional, and more rarely extensional. Arrival of the asthenosphere-derived plume would suggest initiation of extension along the weak/post-collision zone (craton boundary). Alternatively, in compressional regime a surprisingly large range of instabilities can develop that lead to melting of the lower crust and mantle lithosphere. Unexpected structural complexity arises which is quite sensitive to the geometry and rheological properties. This has dramatic effects on melting and devolatilisation within the lithosphere and hence in the localisation of and melt emplacement. Melts extracted in theses circumstances lead to emplacement of all variety of melts: mafic, intermediate and felsic, from wide range of PT conditions.

In order to investigate theses intra-plate sites of deformation, melt production and crustal growth in relation to cratonic post-collisional contacts we performed a series of 2D numerical experiments by using a coupled petrological–thermomechanical numerical model. The model includes, stable mineralogy, aqueous fluid transport, partial melting, melt extraction and melt emplacement in form of extrusive volcanics and intrusive plutons.

As a case studdy we will present Musgrave Orogeny in Central Australia.

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