Geophysical Research Abstracts, Vol. 7, 04318, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04318

Experimental study of rock permeability at high temperature and pressure: implication to the continental crust

A.V.Zharikov (1), V.M.Shmonov (2) and V.M.Vitovtova (2)

(1) Institute of Geology of Ore Deposits, Moscow, Russia (vil@igem.ru /Fax +7 095 2302179)

(2) Institute of Experimental Mineralogy, Chernogolovka, Russia,

Permeability of 50 samples of different type of crustal rocks; granite, granodiorite, diorite, basalt, gneisse, amphibolite, serpentenite, marble, limestone, aleurolites, dolomite and sandstone was measured at temperature up to 600^{o}C and effective pressure up to 200 MPa. The main tendencies of rock permeability behavior at high temperature and pressure were found. Pressure increase always leads to permeability decrease. At temperature increase permeability may increase or decrease within the entire temperature range or to undergo inversions. At first permeability decreases, reaches a minimum and increases with subsequent heating. It was found that such permeability behavior is governed by rock microstructure transformations due to competitive effect of temperature and pressure.

The experiments at simultaneous temperature and pressure elevation, simulating in situ conditions of the deep continental crust were also carried out. Effective pressure in the experiments altered as $P_{eff}=P_{lith} - \alpha P_{fl}$. P_{lith} and P_{fl} were calculated using the data on rock and water mean density, α was assumed to be 0.85. Temperature was elevated according to the thermal gradients typical to platforms - 9^{o}C/km, or shields - 18^{o}C/km, or orogenic belts - 26^{o}C/km.

The common tendency is the permeability decrease with depth increase. However, the trend gradients are different and may be inconstant. Hence, the deep seat rocks can vary greatly in permeability and against the common background of permeability decrease with depth; local deep aquifers may occur.

The universal trend for the continental crust was also obtained on the basis of statistical

processing of the experimental data. Permeability (k, m^2) depends on depth (H, km), as log k = a + bH^c, where a= -12.55, b = -3.289 and c = 0.2192. The mean permeability values range from $2.82\times10^{-13\pm1.5}$ m^2 near the Earth's surface to $1.17\times10^{-20\pm1.5}m^2$ at the depth of 40 km.