INFLUENCE OF ACID AND NEUTRAL FLUIDS ON THE ELASTIC PROPERTIES, DENSITY, POROSITY AND PERMEABILITY OF SANDSTONE AT HIGH PRESSURE AND TEMPERATURE (SILICIFICATION)

E.B.Lebedev, . B.N.Ryzhenko, A.M.Dorfman, S.R.Zebrin, N.T.Sokolova, N.Kononkova *(Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Russia)*; **A.V.Zharikov** *(IGEM RAS)*; **V.M.Shmonov** *(IEM RAS)*; **G.T.Ostapenko** *(IMAG NANU)*; **H. Burkhardt** (*Institute of Applied Geosciences, Technical University Berlin, Ackerstr. 71-76, D-13355 Berlin, Germany)*

Experimentaly data show an increase of elastic wave velocity (p-wave) of about 0,3-0,5 km/s under pressure (of 300 MPa) in neutral and acid fluids H_2O, (H_2CO_3 , HCl, 1M) in temperature range 400-640^oC.

This increase of elastic wave velocity is explained by silicification. These reactions are a typical reactions of acidic leaching , expressed by the following equation:

$Al_2[Si_20_5](OH)_4$?$Al_2[Si_4O_{10}](OH)_2$?Al_2SiO_5 + $nSiO_2$(am)
Kaolinite Pyrophyllite Andalusite Amorphous silica
350^oC 525^oC 590^oC

There are two reasons of silicification: a decrease of temperature and an increase of acidity of solution. Porosity and permeability dependencies in quenched sandstone samples in presence of neutral and acid fluids H_2O, (H_2CO_3, 1M) and P=300 MPa were measured at different temperatures. Elastic wave velocities (V_p) have a positive correlation with density of rock: the maximum of velocity correlating with the maximum of density. There is however also a positive correlation of elastic wave velocity with porosity and permeability: when elastic wave velocities increase, porosity and permeability also increase. This striking result may be due to the influence of acid solution forming a quartz with very small pores. In addition there will be the influence of amorphous silica, which is more porous and more permeable than granular quartz. Pore size distributions support this interpretation, showing an increase of the number of small pores with increasing temperature. There is evidence, that with these opposing influences on velocities the effect of increasing density prevails.

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