Geophysical Research Abstracts
Vol. 13, EGU2011-1597, 2011
EGU General Assembly 2011

The study of physicochemical characteristics of the rocks and assessment of groundwater contamination in the storage sites of mining industries waste products

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The study of brines - rock interactions was carried out with the purpose of information supply of the geomigration models which using for forecast of groundwater contamination in the mine field, located in the Verkhnekamsky deposit of potassium salts. The hydrogeological conditions of the site under consideration are characterized by availability of the aquifers in the Permian rocks: a) in the terrigenous – carbonate layer, which thickness is about 100 m and b) in the overlying lithified sandy-argillaceous rocks – "speckled" layer, which water-bearing thickness is about 30 m. Considerable changes of the natural hydrogeochemical conditions have been fixed in the territory of the mine field. Groundwater contamination was caused mainly by the leakages of solutions with very high salinity (brines) from the sludge storage where salt-clayey pulp with salinity in liquid phase to up 250-300 g/l was stored. The comprehensive tests of clay fraction mineralogical composition, rock microstructure, salinity, exchange capacity and exchange cations contents in the rocks, as well as updating of experimental laboratory techniques of brine –rock interactions in static and dynamic conditions were carried out. The performed researches of the rock technogenic transformation have allowed one to specify the character of brine - rock interactions in the area and in the vertical section and also to define the zone of brine influence on the rocks of "speckled" and terrigenous – carbonate layers.
Received data of experimental laboratory tests permitted to find out the peculiarities of cation exchange in system brine-rock, to define the kinds of exchange "two-stage' isotherms, to estimate the cation exchange parameters, to establish the possibility of brine metamorphization if filtering through the rocks. When estimating the parameters of Lengmuir isotherm by the use of the modified technique it was found out that the value of maximum adsorption capacity (Qmax) decreased in a vertical section from 460 mg-ekv/kg to 129 mg-ekv/kg that accounted for the decrease of rock clayiness with the increasing depth, and also for increase of the hydromicaceous and chlorites packages and decrease of the montmorillonite packages characterized by higher capacity of absorption. When carrying out the experiments in the dynamic conditions (brine from sludge storage was filtered through the rock samples), considerable metamorphization of the brines was observed, affecting both cationic, and anionic composition and caused by a combination of the processes occurring at various stages of experience: concentration of the brine in a stage of slow saturation of the rock sample, cationic exchange of calcium and magnesium of the absorbed complex of rocks for sodium and brine potassium, sedimentation of calcium sulfate of and sodium chloride from filtrates (the halite crystallization stage). The values of maximum adsorption capacity were less to a little degree than the values received in the static conditions. The results of experimental researches have allowed to reveal the possibility of considerable metamorphization of technogenic brines when filtering through the rocks of "speckled" and terrigenous – carbonate layers. At the final stage of the study the thermodynamic modeling of the interactions in the system brine – rock with the use of the software package HCh (Shvarov, Bastrakov 1999) was carried out.