

Redox conditions of hydration in Hess Crust

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The main goal of this investigation is determination of differences in fluid regime related with hydration of the upper oceanic lithosphere levels corresponding to normal (basalts) or Hess types (peridotites) oceanic crust.

The modeling is carried out on base of thermodynamic calculations of the interaction between percolated sea water and peridotite or basalt substratum. For this purpose, complex GEOCHEQ including program of equilibrium calculation and thermodynamic data base (on a basis of SUPCRT92) were implemented. The system Na-K-Ca-Mg-Fe-Si-Al-C-S-H-O has been studied. Calculation follows by flowing reactor method. This reactor is consists of seven consecutive blocks at $T^{\circ}\text{C} = 30^{\circ} - 500^{\circ}\text{C}$, $P = 0.4 - 4$ kbar and $W/R = 1000 - 1$. We have shown earlier that three different redox regime are realized by hydration of Hess crust into depth interval from surface of the oceanic bottom to crust level corresponding to 6 km. These three fluids regime types are following: 1) sharp oxidizing (near-surface) with characteristic mineral assemblage aragonite+goethite; 2) moderate oxidizing (fluid-dominating) - serpentine+chlorite+hematite+pyrite (Mt-Hem buffer), and 3) reducing (rock-dominating) - serpentine+olivine+magnetite+pyrrhotite (QFM buffer). As was apparent after modeling conducted, similar three main alternating (during increase in temperature and decrease in W/R ratio) stages in the redox conditions accompany of basaltic layer hydration in the oceanic crust: 1) sharp oxidizing - lomontite+goethite+pyrite; 2) moderate oxidizing - clinocllore+talc+hematite+pyrite+heylandite, and 3) reducing - magnetite+zoisite+tremolite+oligoclase+daphnite. As for peridotite - sea water system, the sharp geochemical barrier is established in basaltic substratum interacting with sea water. This barrier corresponding to temperature 250°C and manifested in anhydrite appearance. Hydration of basalts occurs on this temperature level is favorable to effective generation of methane. Such methane formation by hydration of oceanic crust begins in system peridotite - sea water at lower temperature. As distinct from peridotites, the temperature 250°C in basaltic system is not boundary between manifestation of two different redox regimes (moderate oxidizing and reducing). This boundary in basalt - sea water system has been established at temperature about 450°C . It is apparent that differences in specific character of fluid regimes of hydration of basalts and peridotites in the oceanic crust primarily depend on bulk composition of initial rocks governs their buffer features.

This investigation has been supported by RFBR grant N 03-05-64018.