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Serpentinite hosted hydrothermal systems of mid-ocean ridges: Kinetic and thermodynamic modeling of downwelling limb of a hydrothermal circulation cell

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A model is development for the kinetic and thermodynamic simulation of the interaction of seawater derived fluid with oceanic peridotites (Sp-Harzburgites). Thermodinamic model is based on the GEOCHEQ complex which makes it possible to simulate equilibria in systems of aqueous solutionsœmineralsœgases. The calculating code was modified and adjusted for the thermodynamicœkinetic simulation of the passage of irreversible solutionœrock reactions with time. The results of our simulations demonstrate that the degree of Peridotite serpentinization under the effect of low-temperature seawater when the rocks are exposed at the seafloor surface remains very low even after 10 000 years of interaction. Serpentinization becomes efficient only at temperatures of 130-150°C at crustal depths of 3.5œ4.5 km. The results of our simulations of the phase transformations during the hydrothermal alteration of MOR peridotites led us to propose a geodynamic model for the development of hydrothermal systems related to peridotites in slow-spreading ridges. This model takes into account the principal phases of the compositional and tectonic evolution of the Hess crust. According to the model, low-density serpentinite material formed at crustal depths of about 3.5œ4.5 km has an excess volume compared to the pristine unaltered peridotites, and this results in the uplift of this material to upper crustal levels.This processes is associated with faulting of the rigid and cold lithosphere. The detachment fault arrays produced thereby drain lower crustal magmatic chambers and trigger the emplacement of shallow-depth gabbro intrusions. As a result, conditions favorable for the —startup“of a hydrothermal circulation in serpentinites are created.