

Geochemistry, time evolution and solute fluxes of hydrothermal systems of Karymsky volcanic center, Kamchatka

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Karymsky volcanic center at the middle of the frontal volcanic chain of the Kamchatka arc consists of two joined calderas (Karymsky Lake and Karymsky volcano) and hosts two hydrothermal systems: Akademii Nauk (AN) and Karymsky (K). The AN is a typical boiling system, Na-Cl in water composition (TDS ~ 1 g/L), low gas content (CO₂-N₂), with the calculated deep temperature > 200°C, whereas the springs of the K system have lower temperatures (to 41°C), strong gas bubbling, TDS ~2.5 g/L, enriched in HCO₃⁻ and SO₄²⁻ and with Mg²⁺ as the main cation. There are two intriguing characteristics of the K field: (i) the highest ever measured for Kamchatka ³He/⁴He ratio of 8.2R_a (R_a=1.4x10⁻⁶, air ratio) in the CO₂-rich gas (>97 vol %) and (ii) unusual cation composition of thermal water (Mg>Ca>Na>K). After the 1996 sublimnic eruption, new hot springs appeared close to the 1996 eruption center. We generalize all published and our own geochemical data on geochemistry of the existed and new thermal manifestation. The Karymsky Lake and new thermal springs after the 1996 eruption demonstrate exponential temporal decreasing in main dissolved species with a characteristic time of ~ 8-9 years. The chemistry of AN and K springs did not changed after the eruption. However, the concentration of chloride in the lake water is approaching value of ~35 mg/L, instead of 8-12 mg/L before the eruption, that evidence about a new source of hot water within the Karymsky lake caldera. All thermal fields are drained by Karymsky River with the outflow rate at the source of ~2m³/s and at the exit from the Karymsky volcano caldera ~5 m³/s. Using the measured solute fluxes at the source (only AN springs) and at the exit (AN + K springs) the natural heat flux from two systems can be estimated as ~60 MW and ~110 MW, respectively and more than 20 t/d of the chloride output from both systems.