Geochemistry of geothermal fluids from the Maanping Hotspring Area, Jiangxi Province, SE-China

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Background

The Maanping Hotspring Area is located in the central part of Jiangxi Province that is one of the Provinces in which hotsprings are most widely distributed in China. Strata exposed in the area include the Sinian System (Z) composed of schists, the Cretaceous System (K) characterised by sandstone and conglomerate, and Yanshanian granites (γ_5^2) as well as Quaternary sediments (Q). Distributed along a NE-trending fault, more than 5 hotsprings issue 39℃ to 42℃ waters in the study area.

Hydrochemistry and subsurface temperature estimation

The hotsprings are Na·K-HCO_3 waters with TDS higher than 1000 mg/L. The geothermal reservoir temperatures are estimated to be from 72℃ to 82℃ by silica geothermometers. The fluid-mineral equilibria studies show that chalcedony, calcite, aragonite and dolomite are close to equilibrium with solution in the geothermal system.

Isotope geochemistry

The chemical composition of the geothermal gases collected from the bubbling hotsprings in the area using the water-replacement method are the carbon dioxide-dominat type with CO_2 concentrations ranging from 97.76% to 97.90%, N_2 from 1.75% to 1.88%, Ar from 0.025% to 0.027%, and O_2 from 0.32% to 0.33% respectively.

The $\delta^{13}C$ values of CO_2 for the geothermal gases are from −4.18‰ to −7.0‰ (PDB) showing that the CO_2 may come from the mantle source, thermogenic decomposition of carbonates in deep crust, or the mixture of the two components.

The $^3He/^4He$ ratios of the geothermal gases range from 0.15 Ra to 0.18 Ra suggesting input of radiogenic ^4He in crystalline rocks of the crust in the area.

The $\delta^{18}O$ and δD values of the geothermal waters in the hotspring area vary from −6.84‰ to −7.23‰ (SMOW) and from −44.1‰ to −48.8‰ (SMOW) respectively. In comparison, the values of local shallow groundwaters range from −3.97‰ to −5.46‰ for $\delta^{18}O$ and from −22.3‰ to −37.6‰ for δD. The evidence shows that the geothermal waters are recharged from a higher altitude area compared to local shallow groundwaters.

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