Depth profile of helium concentration in a hot-spring well in Beppu, Japan

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Volatile components degassing from the crust provide important information on Earth interior. Helium fluxes from the crust because of its inert property are important precursors of crustal tectonic and thermal events. Helium isotopic ratios in crustal fluid serve as tracers in resolving groundwater age in the crust and contribution of mantle-derived fluid. Here, we will describe depth profile of helium concentration in a hot-spring well in Beppu, Japan using new sampling devices. The sampling devices allow gas exchange between the headspace in the sampler volume and the dissolved gases in the water though gas permeable silicon tubing, and we collected helium gases dissolving in well water by the devices.

Beppu is situated on east end of subsidence of the Beppu-Shimabara Graben in Kyushu Island, southwest Japan (Matsumoto, 1979), and is a famous area as a geothermal system. The geothermal system is located on the eastern flanks of the Tsurumi-Garandake volcanic center and spread until the coastline to the east. The geothermal activity is mostly concentrated in two areas, on the northern and southern sides of the fan deposit. These two areas are known as the Kamegawa and Beppu thermal zones, which are along with two faults, the Kamegawa and Asamigawa faults, respectively (Allis & Yusa, 1989).

The sampling devices were installed every 50 m from near bottom of the well to the surface in the periods of July 13-15 and August 21-24, 2015. The collected gases were measured by a noble gas mass spectrometer (Helix SFT; GV Instrument) installed at Atmosphere and Ocean Research Institute, University of Tokyo.

Helium concentrations and isotope ratios ($^{3}He/^{4}He$) is gradually lower, as setting depth becomes shallow. The highest in the isotope ratio shows 6.79 and 7.08 Ra (Ra=1.4E-6) around the bottom, and its high ratio can be of mantle origin. The screen of the borehole ranges 278-300 m, mantle helium could enter the well with hot spring water through the screen, and could go to the surface.

References

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