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Distribution of the helium isotope ratios in Kyusyu district

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Kyusyu island is located at the intersection of the SW Japan arc and the Ryukyu arc. The Philippine Sea plate is subducting beneath the Eurasian plate at the Ryukyu trench and the Nankai Trough along these arcs. The subduction angle of the Ryukyu trench is larger than that of the Nankai Trough. The former angle is almost orthogonal and the subduction of the Philippine Sea plate is seismically detected to the depth of 150-180 km (Nakajima and Hasegawa, 2007). The Okinawa Trough is to the west of the Ryukyu trench and extends as a back-arc basin of the Ryukyu arc. The Beppu-Shimabara Graben in central Kyusyu is regarded as an extension of Okinawa Trough. Strong low-velocity anomalies are distributed extensively along the volcanic front and extend to the back-arc side in the crust and upper mantle. Volcanisms are supposed to result from the fluid supplied by the dehydration processes of the descending Philippine Sea plate. In addition, the hot upwelling materials related to the back-arc opening have contributed to the Unzen volcanism in Beppu-Shimabara Graben (Wang and Zhao, 2006). Thus two different mechanisms for volcanism exist in north Kyusyu.

In this study, we measured the helium isotope ratios (^{3}He/^{4}He ratios) of hot springs around the area of the prefectural boundary of south Fukuoka and north Kumamoto in order to study the precise geographical distribution of helium isotope ratios in this region and to compare them with tectonic data. This area covers the Beppu-Shimabara Graben and its northern and southern areas. We collected 13 samples of hot spring waters in the above area. High ^{3}He/^{4}He ratios were observed at the Beppu-Shimabara Graben, and low ^{3}He/^{4}He ratios were observed in the northern and southern area of the Beppu-Shimabara Graben. It is very peculiar since the observed area belongs to the back-arc region where ^{3}He/^{4}He ratios are generally higher than the atmospheric value as commonly seen in NE Japan. We indicated that the high ^{3}He/^{4}He ratios simply reflected a high velocity region of about 25-30 km in depth under the sampling region (Xia et al., 2008), and was not due to the addition of fossil pore water drawn from impermeable marine clay layers as suggested by Mahara and Kitaoka (2009). Thus, ^{3}He/^{4}He ratios could be closely related with the presence of deep fluid at the basement of the crust.

Keywords: helium isotope ratio, Kyusyu, Beppu-Shimabara Graben