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Origin of dissolved inorganic carbon of hot spring waters discharged from the non-volcanic region of central Kyusyu

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For elucidation of carbon sources of dissolved inorganic carbon (DIC) in the hot spring waters discharged from the non-volcanic region between Aso and Kirishima volcanoes of Kyusyu District, Japan, and also in order to search a deep-seated aqueous fluid derived from subducting oceanic plate in the region, we analyzed major chemical components, dD and $d^{18}O$ of water and $d^{13}C$ and concentration of DIC, rare gas isotope concentrations of dissolved gases of the hot spring waters. Although water of every hot spring is originated from meteoric water shown by water isotopic data (dD and $d^{18}O$), relationships between $d^{13}C$ and concentration of DIC suggests that the DIC should be formed by mixing of soil and two kinds of deep-originated CO_2. This idea is supported by isotopic date of rare gases ($^3He/^4He$ vs. $^4He/^{20}Ne$) and relation between concentrations of Ca and HCO_3 ions, and it is confirmed that the two kinds of deep-originated CO_2 are mantle-derived CO_2 and CO_2 originated from subducted marine carbonate by a calculation of contributions of source carbons of selected hot spring waters. Moreover, we calculated respective contribution ratios of deep-originated CO_2 to DIC of all the hot spring waters on the basis of the linear relation observed between contribution ratios of deep-originated CO_2 and $d^{13}C$ values of DIC of selected hot spring waters, and expressed hot springs showing high contribution ratios (more55percent) on a published map showing crustal resistivity structure of this studied area, thereby it appears that hot springs rich in DIC derived from the subducted marine carbonate are roughly concentrated on low electrical resistivity zone extending NE direction from Kirishima volcano. This result seems to suggest the possibility that an associated aqueous fluid of dehydrated fluid from subducting oceanic plate forms the low electrical resistivity zone. On the other hand, distributions of high contributions of mantle-originated $CO_2$of hot spring waters are concentrated in the Hitoyoshi Basin which is thought to be a tectonic basin formed by fault movement, and this result may suggest that a passageway for rising of mantle-derived CO_2 must be formed in the crust under this area.

Keywords: non-volcanic region, dissolved inorganic carbon, mantle, deep-originated CO_2, low electrical resistivity zone, dehydrated fluid from subducting plate