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Geochemical evolution and origin of noble gases of hot spring waters of various types from the eastern area of the Korea

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The purpose of this study is to investigate the origin of the noble gases, the hydrochemical characteristics and stable isotopic composition of various hot spring waters located in the eastern area of Korean peninsular. For this study, 11 hot spring water samples and 14 gas samples were collected from 6 different hot spring sites. The chemical composition of hot spring waters except Osaek CO2-rich hot spring water shows weak alkaline and alkaline pH (7.0˜9.14). Osaek CO2-rich hot spring water shows weak acidic pH 5.71. The temperature of hot spring water ranges from 22.7ąÉ to 68.3ąÉ and electrical conductivity varies widely from 202 to 7,130 ěìS/cm. Electrical conductivity of Haeundae and Dongrae hot spring waters shows very high value of 3,890ěìS/cm in average. The chemical type of hot spring waters can be grouped as two different types: Osaek, Baekam, Dukgu and Cheoksan hot springs belonging to Na-HCO3 water type and Haeundae and Dongrae hot springs belonging to Na-Cl water type. The ěä18O and ěä D of hot spring waters are plotted around meteoric water line and show a latitude effect according to hot spring sites. The 3He/4He ratios of hot spring waters except Osaek are in a range from 0.1ą£10-6 to 1.1ą£10-6. 3He/4He ratios are plotted on the higher area than air and crust mixing line. It means that He gas in hot spring waters partly comes from mantle. In particular, 3He/4He ratios of Osaek CO2-rich hot spring water show 3.3ą£10-6 that is 2.4 times higher than that of atmospheric origin. It indicates that the helium gas of Osaek hot spring water comes from deep-seated sources such as mantle or magma. 40Ar/36Ar ratios have the highest ratios in Osaek CO2-rich hot spring water. It also indicates that excessive 40Ar comes from mantle together with helium gas.