Helium isotope geochemistry of mantle xenoliths and Cenozoic basalts in Jeju Island, South Korea

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Jeju Island (South Korea) is an intraplate volcano located at the eastern margin of the Eurasian plate, which has begun volcanic activity 2 Ma ago. Although there have been a lot of geochemical studies on Jeju Island, it is still controversial whether the source of magma is upper mantle or mantle plume [1, 2]. Here we first report helium isotope compositions ($^3He/^4He$) in mantle xenoliths and basalts from Jeju Island in order to constrain the source of magma. Major element geochemistry of whole-rocks and minerals analyzed by XRF and EPMA, respectively. $^3He/^4He$ ratios of Ol and Cpx separates were measured by a noble gas mass spectrometer. The mantle xenoliths from SE Jeju are spinel lherzolite with $^3He/^4He$ ratios of Ol ranging from 2.9 to 6.5 R_A. These ratios are generally comparable with $^3He/^4He$ ratios of the Korean peninsula (3.5 – 7.9 R_A) and the European mantle xenoliths (5.2 – 7 R_A) [3, 4]. The basalts from the west Jeju Island are tholeiitic to alkaline, showing $^3He/^4He$ ratios of Ol and Cpx phenocrysts from 3.5 to 7.3 R_A, similar to the Jeju mantle xenolith values. It is unlikely that $^3He/^4He$ ratios of the basalts indicate crustal contamination by using the relationship of SiO_2 and K_2O/P_2O_5. Thus, the $^3He/^4He$ ratios of the basalts can provide information on the source of magma. According to the seismic tomography model in Jeju Island, decompression melt could occur at the sub-lithospheric mantle depth by edge-driven mantle convection [5]. Moreover, based on trace element modeling [6], it has been suggested that the mantle source of Jeju basalt is mostly garnet lherzolite and eclogite. Therefore, we suggest that the lower part of SCLM played a pivotal role in the production of magma in Jeju Island.

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