Trace element evidence for trapped allochthonous fluid in subcontinental mantle

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By applying both methods of vacuum crushing and stepwise heating for extraction of noble gases, we have firstly obtained extremely lower 3He/4He ratios than the atmospheric value for olivines from Siberian mantle xenoliths. Moreover, high U content was observed in fluid inclusions of the samples showing low 3He/4He ratios. Hence the low 3He/4He ratios should be attributed to the occurrence of some mantle source where the He/U ratio should be quite low. However it takes more than a few gigayears for lowering the 3He/4He ratio of the subcontinental mantle with the initially like MORB source to the atmospheric value. Therefore it would indicate that the low 3He/4He ratios is resulted from the occurrence of the gases with initially low 3He/4He ratios encapsulated secondarily as the inclusions.

To reveal the geochemical characteristics in the subcontinental mantle and obtain some additional constraints for the influences of the subducted components, we analyzed the noble gas and trace element compositions of subcontinental mantle-derived ultramafic xenoliths from far eastern Siberia. In present study, by applying both methods of vacuum crushing and stepwise heating for extraction of noble gases, we have firstly obtained extremely lower 3He/4He ratios than the atmospheric value for olivines from mantle-derived xenoliths. Moreover, high U content was observed in fluid inclusions of the samples showing low 3He/4He ratios. Hence the low 3He/4He ratios should be attributed to the occurrence of some mantle source where the He/U ratio should be quite low, either by the enrichment of incompatible elements and/or preferential depletion of He within the mantle. However, it takes more than a few gigayears for lowering the 3He/4He ratio of the subcontinental mantle with the initially like MORB source to the atmospheric value. Therefore it would indicate that the low 3He/4He ratios is not resulted only from addition of radiogenic 4He generated in-situ, but from the occurrence of the gases with initially low 3He/4He ratios encapsulated secondarily as the inclusions. On the other hand, the 3He/4He ratios observed at the highest temperature by the heating method might be similar to the MORB-like value. It might be indicative of that the initial component like MORB source is located below far eastern Siberia. Hence, the far eastern Siberian mantle with the initially like MORB source might have been infiltrated by some fluids enriched in incompatible elements at least partly.