Extremely low $^{3}He/^{4}He$ ratios observed in Siberian mantle xenoliths

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To obtain some constraints for the influences of the subducted components, we have analysed noble gas compositions of subcontinental mantle-derived ultramafic xenoliths from Far Eastern Siberia. In the Far Eastern Siberia area, oceanic crusts have been subducting underneath the Eurasian plate since about 100 Ma. Hence, the mantle beneath the Far Eastern Siberia might have been influenced by the components derived from the subducted crustal materials.

By applying both methods of vacuum crushing and stepwise heating for extraction of noble gases, we have revealed the occurrence of $^{3}He/^{4}He$ ratios extremely lower than that of MORB in olivine separates for some mantle xenoliths from the Far Eastern Siberia. Since the noble gases were extracted by the crushing method, it would be located mostly in fluid inclusions of minerals. While, MORB-like high $^{3}He/^{4}He$ ratios have also been observed for some samples in gases extracted by the crushing method. Hence, at least two kinds of fluid sources with the low $^{3}He/^{4}He$ ratio and the MORB-like value should exist in the upper mantle underneath the Far Eastern Siberia area. Furthermore, the orthopyroxene and clinopyroxene of two xenoliths show similar helium compositions to those of olivines. It may indicate that those minerals have trapped the same fluid in fluid inclusions.

The extremely low $^{3}He/^{4}He$ ratio in mantle xenoliths requires the occurrence of some mantle source where the He/U ratio should be quite low. However, present sample with an extremely low $^{3}He/^{4}He$ ratio does not show low He/U ratio. Since the Far Eastern Siberia area had been located at the subduction zone, occurrence of the extremely low $^{3}He/^{4}He$ ratios may have resulted from infiltration of melt related to the old subducted slab.

Lower crustal renewal associated with formation of sedimentary basins and arc volcanism in the Middle to Late Cenozoic in Japan

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An island arc is a site of active volcanism on the Earth. The successive accretion of island arcs to continental margins is now thought to be the major process of continental growth (Reymer and Schubert, 1978). The process of continental growth through arc magmatism (Yanagi and Yamashita, 1994; Taylor and McLennan, 1995), however, has not yet been made clear. There have been many debates. One of the unknowns is tectonic behaviour of the lower crust. Lower crust delamination and basaltic underplating have often been advocated in relation to the evolution of continental crust (Arndt, and Goldstein, 1989; Bohlen and Mezger, 1989, Kay and Kay, 1991; Rudnick and Fountain, 1995). Both of them seem to have key importance for understanding the unique chemical composition of upper continental crust (Condie, 1993; Wedepohl, 1995; Taylor and McLennan, 1995) and material circulation between the continental crust and the mantle (Doe and Zartman, 1979; Arndt and Gp;dsstein, 1989). Extensive lower crust delamination and basaltic underplating must be reflected on the surface as geologic events such as land subsidence, formation of sedimentary basins, land uplifting and intense volcanic activity.

A marked change in development of sedimentary basins occurred in the Middle Cenozoic in Japan, which had been land until then. Though much different in scale, the back-arc side of Southwest Japan and Northeast Japan underwent the same series of geological events starting from land subsidence through subsequent development of thick sedimentary successions to finally extensive uplifting in association with intense volcanic activity. This series of events may well be accounted for by assuming lower crust erosion and subsequent magma accumulation due to diapiric upwelling in the mantle beneath the sedimentary basins. $^{87}Sr/^{86}Sr$ ratios of volcanic rocks erupted after the series of events indicate the extensive renewal of the lower crust. Quaternary volcanic rocks erupted in the Miocene sedimentary basins in Northeast and Southwest Japan are low in $^{87}Sr/^{86}Sr$ ratio (<0.7045) while those erupted on Miocene land areas are high (>0.7045). This suggests the replacement of Cretaceous lower crust by newly formed lower crust beneath the sedimentary basins. The evolution of arc sedimentary basins simultaneously with the intense arc volcanism suggests the generation of arc magma in association with the diapiric upwelling in the arc mantle.