研究題目

コロラド台地に産するローソン石エクロガイトの地球科学

Petrology and trace element geochemistry of eclogite xenoliths from the Colorado Plateau

氏名

臼井寛裕 (東京工業大学理学部地球惑星科学科)

Tomohiro Usui (Department of Earth and Planetary Sciences, Tokyo Institute of Technology)

受け入れ教官

中村栄三 (基礎宇宙科学部門)

研究報告書 (平成 11 年度岩鉱学会、要旨)

It is very important to characterize the trace element behavior in subducted oceanic crust for better understanding of mantle/crust recycling. Eclogite xenoliths from the kimberlite diatreme breccias on the Colorado Plateau have been thought to be fragments of subducted oceanic crust, because of their basaltic bulk compositions and mineralogical textures similar to ophiolitic eclogites from blueschist terranes (Helmstaedt and Doig, 1975). The aims of this study are to verify the hypothesis that the eclogite xenoliths are the consequence of subduction zone metamorphism, and to determine the trace element behavior during subduction of oceanic crust using the eclogite samples.

Eclogite xenoliths examined in this study mainly consist of almandine-rich garnet, Na-clinopyroxene, lawsonite, phengite, zoisite, rutile, pyrite and zircon. Additionally, coesite, which was identified by using a laser Raman microscopy, occurs as minute (<20μm) inclusion in garnet. The maximum temperature deduced by the method of Ellis and Green (1979) for neighboring rims of garnet and clinopyroxene ranges from 550°C to 650°C at 2.5GPa. Garnet crystals are extremely zoned in Mn content from core (~1.5wt%) to rim (~0.3wt%), with euhedral zoning texture preserving growth during prograde metamorphism. The major element compositions of clinopyroxene and lawsonite occurring as inclusions in garnet indicate that the inclusions were crystallized at lower-grade metamorphic conditions than the same minerals in the matrix.

Trace element compositions of constituent minerals in the eclogite xenoliths were analyzed by an ion microprobe, Cameca ims-5f. Combining the ion microprobe data with the mineralogical observations, we evaluated the trace element behavior in the eclogite xenolith, which represents subducted oceanic crust. Based on the mass balance calculations, it is suggested that most of HREE and Zr have been preserved in garnet and zircon, both of which are stable in the eclogite facies. Moreover, approximately 97% of the LREE and 89% of the Sr in the bulk rock are retained by lawsonite, which decomposes during progressive metamorphism in the lawsonite eclogite facies. From these observations, it is inferred that: (i) migration of the HREE and Zr to the mantle wedge is significantly small; and (ii) migration of the LREE to the mantle wedge is significantly smaller than that of Sr, because LREE contents in lawsonite increase with nearly constant Sr content during progressive metamorphism.

In addition, we preliminary determined ages of the zircons in garnet of the lawsonite eclogite by a newly installed ion microprobe, Cameca ims-1270, resulting in approximately 80Ma. Throughout the course of these observations, it is finally concluded that the lawsonite eclogite xenolith is a fragment of oceanic crust subducted into more than 90km depth along a cold geotherm and with a subduction rate >2cm/y, underneath the North American continent.