14C2/2002G213

# Mechanisms and kinetics of the post-garnet transformation in natural pyrope

Tomoaki KUBO[1], Eiji OHTANI[1], Tomofumi HOSOYA[1], Tadashi KONDO[1], Takumi KIKEGAWA[2]
[1]Institute of Mineralogy, Petrology and Economic Geology, Graduate school of Science, Tohoku University, Sendai 980-8578, Japan
[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

## Introduction

Garnet, which is one of the major constituent minerals of the subducting oceanic plates, decomposes to form silicate perovskite (post-garnet transformation) at the depth of ~600-800 km. Kubo et al. (2002) [1] found that the kinetics of the post-garnet transformation is much slower than for the post-spinel transformation, and suggested that metastable garnet possibly exist in the slab even at a temperature of 1600 K and the geological time scale. In order to discuss how much and how long the metastable garnetite survives at the top of the lower mantle quantitatively, we examined temperature dependence of the post-garnet transformation rate at wider temperature ranges of 1320-2000 K and 28-32 GPa.

## Experimental

In-situ X-ray diffraction experiments were carried out using sintered-diamond multi-anvil apparatus "MAX-III" installed at KEK-PF. The sample assembly used in this study is shown in Fig. 1. The starting material is natural pyrope in garnet Lherzolite from Czechoslovakia, whose composition is $(Mg_{0.724}Fe_{0.184}Ca_{0.111})_3(Al_{0.872}Cr_{0.044}Ti_{0.010})_2Si_{3.064}O_{12}$. This pyrope garnet decomposes at around 25-30 GPa into magnesian-silicate perovskite, calcium-silicate perovskite, aluminous phase and stishovite. The sample was annealed at 20 GPa and 1523 K for 2 hours prior to the transformation to achieve equilibrium microstructures, resulting in equigranular polycrystalline pyrope of 12 μm in diameter.

## Results and discussion

The transformation did not occur at 1320 K in 3 hours. We could obtain kinetic data on the time dependence of the transformed fraction at 1600, 1710, and 1820 K. The transformation quickly completed at 2000 K. Time-resolved X-ray diffraction patterns of the sample are shown in Fig. 2. Microstructural observations suggest that the transformation started from the grain boundary of the parental garnet. The post-garnet assemblages did not show the lamellar growth texture as observed in the post-spinel transformation. These transformation microstructures are consistent with those of the transformation from pure pyrope to perovskite and corundum. More quantitative analysis of the obtained kinetic data based on the observed transformation mechanisms is in progress.

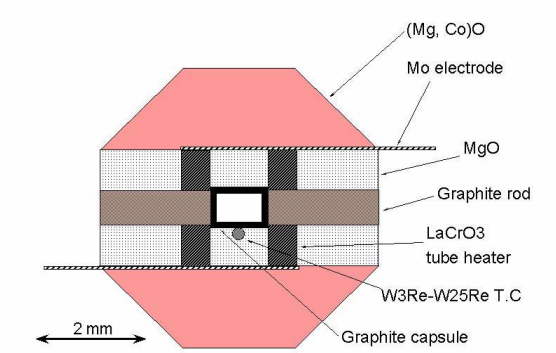


Fig. 1 Sample assembly used in this study.

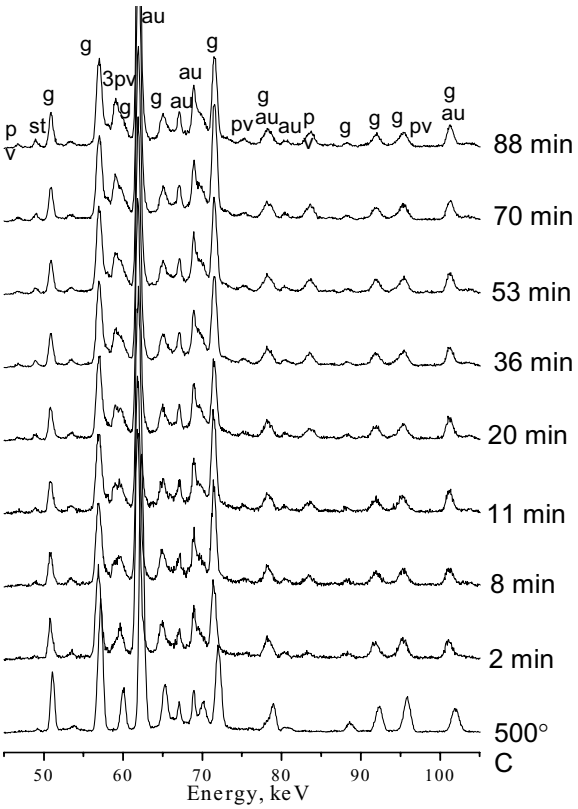


Fig. 2 Changes of diffraction patterns (2theta = 5.0°) of the sample during the post-garnet transformation obtained at 28.1 GPa and 1600 K using MAX-III (g, garnet; pv, perovskite; st, stishovite; au, gold).

## References

[1] T. Kubo et al., Nature 420, 803 (2002).

* kubo@ganko.tohoku.ac.jp