

Relative viscosity measurements between Olivine and Orthopyroxene

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Viscosity of the Earth's upper mantle is considered to be dominated by olivine. Because olivine which is the most abundant mineral in the upper mantle, is thought to be the softest in the constituent minerals in the upper mantle. However, recent studies (*e.g.*, Zhang et al., 2020), which conducted deformation experiments of orthopyroxene, reported orthopyroxene was softer than olivine. Relative viscosity between olivine and orthopyroxene is controversial. In addition, around 3 GPa, amount of Al_2O_3 component in orthopyroxene drastically decreases. With decreasing Al_2O_3 component in orthopyroxene, water solubility of orthopyroxene and water distribution between upper mantle minerals also change. To understand relative viscosity of olivine and orthopyroxene, effect of Al_2O_3 content in orthopyroxene is also important because of large effects of water on viscosity of mantle minerals. In this study, in-situ uniaxial deformation experiments of Olivine aggregate and Al-free or Al-bearing orthopyroxene aggregate simultaneously were conducted at ~ 2 GPa and 1273-1473 K using deformation type DIA apparatus at BL04B1 beamline in SPring-8 to determine relative viscosity between olivine and orthopyroxene at same pressure, temperature, deviatoric stress and water fugacity conditions. At same conditions of this study, strain rate of olivine is ~ 1.2 -3 times larger than that of Both Al-free and Al-bearing orthopyroxene. This result suggest olivine would be dominate viscosity of upper mantle at shallow depth.

Keywords: relative viscosity, olivine, Orthopyroxene