

Two pyroxene samples with chemical formulae of  $\text{Mg}_{0.89}\text{Al}_{0.11}\text{Fe}_{0.11}\text{Si}_{0.89}\text{O}_3$  (Fe11Al11) and  $\text{Mg}_{0.91}\text{Al}_{0.07}\text{Fe}_{0.11}\text{Si}_{0.91}\text{O}_3$  (Fe11Al7) were each mixed with 5 wt. %  $(\text{Mg}_{0.9}\text{Fe}_{0.1})\text{O}$  ferropericlasite and 5 wt. % Ir metal, and the mixtures were used as starting materials. The mixtures were loaded into Pt capsules, which were then loaded into 5.7/1.5 cell assemblies. High-pressure experiments were conducted at 2300 K and 33–50 GPa in a 1500-ton Kawai-type multianvil press with the Osugi-type guide block system. The oxygen fugacity ( $f\text{O}_2$ ) was determined from the composition of an Ir-Fe alloy to be around +1.5  $\Delta\text{IW}$ . The  $\text{Fe}^{3+}/\Sigma\text{Fe}$  ratio in recovered bridgmanite was determined by Mössbauer spectroscopy. The results of our experiments at four different pressures show that the  $\text{Fe}^{3+}/\Sigma\text{Fe}$  in both of the two different bridgmanite compositions did not change with pressure (Fig. 3.3-12).

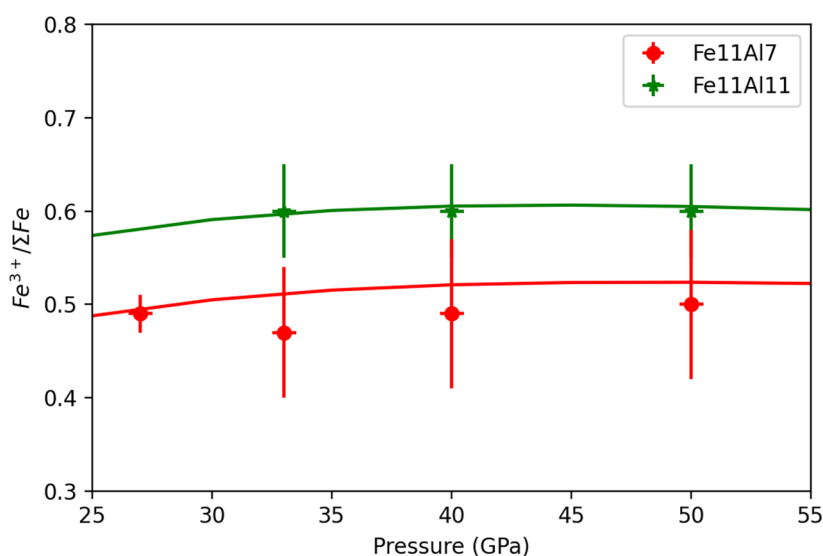


Fig. 3.3-12:  $\text{Fe}^{3+}/\Sigma\text{Fe}$  ratio in two distinct (Al, Fe)-bearing bridgmanite compositions as a function of pressure. The solid lines were calculated from a thermodynamic model using the same compositions as given in the text.

**k.** *Crystallographic features of omphacite in lawsonite-eclogite xenolith from Colorado Plateau* (R. Fukushima and T. Tsujimori/Sendai, N. Miyajima, T. Boffa Ballaran, G. Criniti and C.A. McCammon)

Lawsonite-eclogite xenoliths from the Navajo volcanic field, central Colorado Plateau, are of considerable importance as fragments of the subducted Farallon plate. One can therefore expect that mineralogical/geochemical analyses of its constituting minerals are useful to examine the prograde eclogitization process and dynamics of the diatreme emplacement.

To this end, we have investigated the crystallographic features of omphacite in the lawsonite-eclogite xenolith. The omphacite grains are slightly enriched in  $\text{Fe}^{3+}$  ( $\sim \text{aug}_{35-45} \text{jd}_{40-50} \text{aeg}_{15-20}$ ) and characterised by local compositional heterogeneities. Although the peak metamorphic temperature ( $\sim 620$  °C) is below the critical temperature of its order-disorder transition ( $\sim 865$

°C), our X-ray diffraction analysis of representative crystals demonstrated the absence of any super-lattice diffraction peaks belonging to the ordered phase. However, our observation of the omphacite from the same eclogite with transmission electron microscopy revealed the presence of diffuse scattering related to the ordered structure (Fig. 3.3-13).

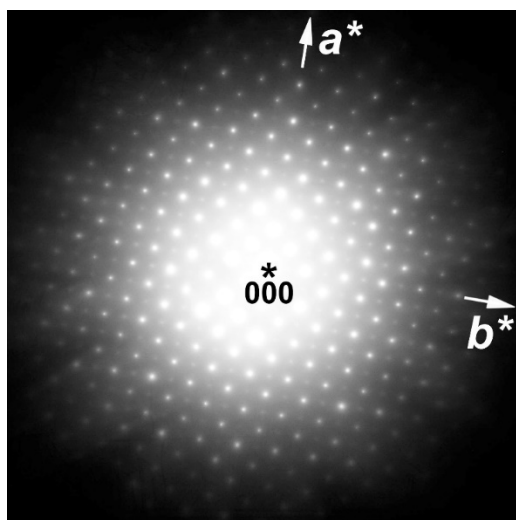


Fig. 3.3-13: Selected area electron diffraction pattern of an omphacite grain in the lawsonite-eclogite xenolith. Odd reflection spots are visible along the  $b^*$  direction in the  $[001]$  zone axis.

Even if such incomplete ordering is due to their compositional deviations from the ideal omphacite composition ( $\text{Ca}_{0.5}\text{Na}_{0.5}\text{Mg}_{0.5}\text{Al}_{0.5}\text{Si}_2\text{O}_6$ ), we should consider why short-range order remains in the omphacite specimens. This is because a previous study has suggested a Cenozoic thermal pulse ( $> \sim 800$  °C) that lasted for  $< \sim 1700$  years, which may have caused some extent of disordering. Was the heating temperature/duration too low/short for complete disordering, or is this merely a result of reordering during the cooling process? How can the degree of order change due to the later-stage metasomatism? If we consider the sluggish ordering kinetics of omphacite, as a first approximation, we may explain the short-range order by incomplete heating just before the diatreme emplacement. Nevertheless, we still require additional constraints to fully answer these questions, especially with respect to the potentially short-lasting temperature fluctuation and compositional modification. These peculiar omphacites highlight the difficulty in constraining the detailed thermochemical history of the subducted, metamorphosed, and fragmented slab, based only on the petro-mineralogical information preserved in a given eclogite xenolith.

**1. The electron diffraction pattern of quenched davemaoite and the unit cell volume at ambient pressure (N. Miyajima, L. Wang and T. Katsura)**

The precise volumes of high-pressure minerals at ambient pressure ( $V_0$ ) are very important for quantitative discussions in mineral physics. The recovered high-pressure samples are used for the further physical and chemical measurements, even though they are metastable at ambient conditions. Calcium-rich perovskite, davemaoite (Dvm), is often unquenchable to ambient