Eur. J. Mineral.
2016, **28**, 1155–1168
Published online 14 October 2016

Paper presented at the
XI Eclogite Conference, Dominican Republic,
2–5 February 2015

EBSD-measured crystal preferred orientation of eclogites from the Sanbagawa metamorphic belt, central Shikoku, SW Japan

Hafiz Ur REHMAN[1,*], David MAINPRICE[2], Fabrice BAROU[2], Hiroshi YAMAMOTO[1] and Kazuaki OKAMOTO[3]

[1] Graduate School of Science and Engineering, Kagoshima University, Japan
*Corresponding author, e-mail: hafiz@sci.kagoshima-u.ac.jp
[2] Géosciences Montpellier, UMR CNRS 5243, Université de Montpellier, France
[3] Department of Earth Sciences, Faculty of Education, Saitama University, Japan

Abstract: Electron back-scattered diffraction (EBSD) maps and crystal-preferred orientation (CPO) of eclogite-facies (omphacite and garnet) and amphibolite-facies (hornblende and actinolite) phases are reported for understanding the rheological behaviour of crust during subduction. Two types of eclogites from the subduction-related high-pressure/low-temperature type Sanbagawa metamorphic belt, Japan, have been investigated. Type-I eclogite (sample Sb-1) is composed of garnet, omphacite, secondary actinolite and hornblende. Type-II eclogite (samples Sb-2 and Sb-2a) are mainly composed of omphacite, garnet, and retrograde hornblende with no actinolite. Omphacite, the peak eclogite-facies phase, exhibits L-type CPO (maximum density of [001] axes parallel to and high density of {110} poles normal to the lineation) in Type-I eclogite, suggesting intra-crystalline plasticity with [001] {110} and ⟨110⟩{110} active slip systems, indicating a constrictive strain regime at mantle depths. Omphacite in Type-II eclogite exhibits a similar fabric but with much weaker CPO. Using the LS-index symmetry analysis (one for the end-member L-type, zero for the end-member S-type, and intermediate values for LS-types), a progressive change in LS index of 0.80 for Type-I and 0.61 to 0.44 for Type-II eclogites is observed. These values suggest a transition from axial extension parallel to the lineation for Sb-1 and weaker CPO associated with pure or simple shear for Sb-2 and Sb-2a. Garnet, the second dominant phase in the eclogite-facies stage, exhibits weak and complex fabric patterns in all eclogite types, behaved like rigid bodies and does not show plastic deformation. Amphibolite-facies phases (*e.g.*, hornblende and actinolite) exhibit more than two types of CPO. Hornblende and actinolite in Type-I eclogite have a strong CPO along [001] axes aligned parallel to the lineation, indicating homotactic crystal growth probably by the replacement of omphacite during the early stages of retrogression. Type-II eclogites have weak CPO in hornblende but with characteristic alignment of [001] parallel to the lineation and other poles to planes (100), (010), and {110} normal to the lineation. This fabric might have resulted from a cataclastic deformation and could be related to the late-"D1" deformation stage in the Sanbagawa metamorphic belt.

Key-words: Sanbagawa metamorphic belt; high-pressure/low-temperature eclogites; EBSD; crystal preferred orientation; CPO; omphacite; garnet; deformation; rheology.

1. Introduction

Eclogites, rocks now exposed at the Earth's surface, are generally interpreted as remnant mafic parts of the oceanic and/or continental crust which have once been subducted to upper mantle depths, underwent high- and ultrahigh-pressure (*HP/UHP*) metamorphism, and were exhumed to the Earth's surface without significant retrogression (*e.g.*, Helmstaedt *et al.*, 1972; MacGregor & Manton, 1986). Garnet and clinopyroxene (mainly omphacite) are the two major minerals, which are volumetrically important for constraining the rheology of the bulk Earth. Garnet, the main constituent of eclogite at the base of continental crust, within subducted slabs and in the mantle (in peridotites and as majoritic garnet), is a key metamorphic mineral for constraining the rheology of crust and mantle (*e.g.*, Karato *et al.*, 1995; Mainprice *et al.*, 2004; Storey & Prior, 2005). In addition, garnet may behave as rigid bodies in the presence of omphacite, the second most abundant mineral in eclogites. In such cases, plastic deformation in eclogites would be accommodated in omphacite, which is a framework-supporting mineral in medium- and high-temperature eclogites at *ca.* 500–750 °C, >1.5 GPa (van Roermund, 1983; Godard & van Roermund, 1995; Abalos, 1997). Therefore, the fabric of omphacite is widely used to determine rheological behaviour of the eclogites during *HP* metamorphism. Plastic deformation of rocks is often recorded by the development of crystal-preferred orientation (CPO) in their constituent minerals (Nicolas & Poirier, 1976; Bascou *et al.*, 2002). The CPO symmetry patterns in low-symmetry minerals tend to coincide with the active slip direction and planes (*e.g.*, Mainprice & Nicolas, 1989; Mainprice *et al.*, 2011).

0935-1221/16/0028-2574 $ 6.30
DOI: 10.1127/ejm/2016/0028-2574