Mineral Equilibria at the Eclogite-Granulite Transition

Geoffrey Clarke* and Matthew C. DePaoli
School of Geosciences, University of Sydney, Sydney, NSW 2006, Australia
Geoffrey.clarke@usyd.edu.au

and

K.A. Klepeis
Department of Geology, The University of Vermont, Burlington, VT 05405, USA

And

N.R. Daczko

School of Earth Sciences, Macquarie University, NSW 2109, Australia

Summary

The Breaksea Orthogneiss, a high–*P* component of the *c*. 126–116 Ma Western Fiordland Orthogneiss, has distinctive composite mafic layering and dyke structures in a monzodioritic host, mostly transposed into an intense shallowly–dipping S_1 foliation. Delicate centimetre– to metre–scale layering and dyking structures are interpreted to reflect mafic sill emplacement and/or cumulate processes. Mafic components preserve eclogite facies S_1 garnet and omphacite with or without orthopyroxene, interlayered with metadioritic components that preserve granulite facies assemblages involving S_1 garnet, omphacite, plagioclase, K–feldspar and kyanite. As both eclogite and granulite assemblages reflect $P \approx 1.8$ GPa and $T \approx 850$°C, the Breaksea Orthogneiss presents an unusual natural example of the eclogite–granulite transition. The facies distinction was controlled by whole rock composition, whereby mafic components recrystallised to eclogite and dioritic components recrystallised to granulite. Omphacite in both components is partially pseudomorphed by symplectites of sodic–diopside and albitic plagioclase that reflect near–isothermal decompression to $P \approx 1.4$ GPa. The Breaksea Orthogneiss also occurs as pods and layers in the post–S_1 mafic Resolution Orthogneiss, which is distinguished on the basis of it mostly lacking garnet and being homogeneous. Along the northern shore of Resolution Island, hornblende granulite and high–*P* amphibolite facies S_2 assemblages involving garnet, hornblende and clinozoisite are well developed in both the Breaksea and Resolution orthogneisses. A 200 m thick, shallowly south to south–east–dipping D_2 shear zone forms a carapace to these orthogneiss units, and separates them from other Cretaceous orthogneiss and Palaeozoic schists that reflect lower grade conditions ($P \approx 1.2$–1.4 GPa). The Breaksea Orthogneiss extends the thickness of the Cretaceous island arc developed off the Gondwana margin to more than 60 km, close to the thickest of known Andean–style margins.