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A mid-crustal metamorphic field gradient in Val Strona di Omegna, Ivrea Zone, Italy: constraints from metabasic rocks

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The Ivrea Zone has been the subject of several studies in the last decades and is commonly interpreted as a section through the lower continental crust. Most existing *P–T* estimates have used conventional thermobarometry on metasedimentary rocks, in which peak metamorphic conditions of 600–800°C and 4–8 kbar (e.g. Henk *et al.*, 1997) show a discrepancy with conditions expected in the lower crust. In particular, the pressure estimates of 4–8 kbar are too low, and the Ivrea Zone is better interpreted as a section through the mid continental crust.
This study focusses on metabasic rocks that are interlayered with the metapelitic rocks in the classic section through the Kinzigite Formation in Val Strona di Omegna. Although the metabasic rocks are volumetrically abundant, they have received relatively little attention. Field and petrographic observations are combined with mineral chemical data and thermodynamic phase equilibria modelling to provide independent constraints on the metamorphic evolution of this part of the Ivrea Zone. Peak metamorphic conditions are constrained via *P–T* pseudosections calculated in the NCFMASHTO (Na_2O–CaO–FeO–MgO–Al_2O_3–SiO_2–H_2O–TiO_2–O) system using the software THERMOCALC (Powell & Holland, 1988) and the Holland & Powell (1998) data set.
Mineral assemblages are dominated by hb+pl+q+bi+ilm at lower grades, through those dominated by di+hb+pl+ilm±bi±g at intermediate grades, to assemblages containing opx+di+hb+pl+ilm±bi±g±q at the highest grades, and record the transition from amphibolite to granulite facies conditions. Close to the amphibolite–granulite facies transition, the rocks contain small leucocratic segregations that are interpreted as evidence for *in situ* partial melting of the metabasic rocks. The abundance of leucosome increases with metamorphic grade. Euhedral clinopyroxene porphyroblasts within the leucosomes are consistent with the fluid-absent breakdown of hornblende and plagioclase to produce clinopyroxene and melt. Although partial melting of the metabasic rocks has previously been proposed (Reinsch 1973a, 1973b), more recent studies specifically preclude the possibility (Harlov & Wirth, 2000).
Systematic sampling along Val Strona di Omegna allows reconstruction of a near-linear regional metamorphic field gradient. The modelled *P–T* estimates range from a minimum of 500°C and 4 kbar at the lowest grades to in excess of 900°C and 9 kbar at the highest grades. Maximum temperatures are about 100°C higher than most previous studies have reported and exceed the experimentally determined fluid-absent solidus for amphibolite (e.g. Wyllie & Wolf, 1993), consistent with the field evidence for partial melting. Field evidence combined with petrographic identification of peak metamorphic assemblages provide the framework for a detailed characterisation of a consistent metamorphic evolution via mineral equilibrium modelling.

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