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Preferential retrogression of high-*P* metasediments and the preservation of blueschist to eclogite facies metabasite during exhumation, Diahot terrane, NE New Caledonia

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Abstract

High-*P* metabasites of the Diahot terrane, NE New Caledonia occur as spatially restricted (cm to km-scale) lenses, boudins and layers in psammitic to pelitic metasediments. Although interlayered, the two rock types preserve distinct, tectonically disrupted metamorphic profiles in the transition from lawsonite blueschist in the SW to low-*T* eclogite in the NE. As the metabasites experienced comparatively low strain, igneous textures, and, more rarely, igneous minerals are preserved. Metamorphic assemblages in the metabasites range from lawsonite–omphacite–glaucophane-bearing assemblages (Zone 1; *P*=7–10 kbar, *T*=350–400 °C) in the SW, through clinozoisite–almandine-bearing assemblages (Zone 2; *P*=14–16 kbar, *T*=450–550 °C) and finally to clinozoisite–almandine–hornblende–omphacite-bearing assemblages (Zones 3 and 4; *P*=16–18 kbar, *T*=550–600 °C) in the NE. Metasedimentary assemblages range from spessartine–lawsonite–albite–chlorite (Zone 1), through almandine–clinozoisite–albite–chlorite (Zone 2) and almandine–epidote–omphacite–albite-bearing (Zone 3) lithologies. Mineral inclusion trails in coarse-grained albite and garnet in Zones 2 and 3 metasediments record prograde mineral assemblages that match the *P*–*T* conditions recorded by the metabasites (*P*=14–18 kbar, *T*=450–600 °C). The metasediments were intensely deformed at peak conditions (*P*=12–16 kbar, *T*=550–600 °C) and during retrogression, and developed coarse-grained albite, phengite and chlorite-bearing assemblages. Differences in strain history (competency contrasts), the timing of major dehydration reactions and variation in whole rock composition all played vital roles in developing the distinctive field relationships involving blueschist to eclogite facies metabasites enclosed

Abbreviations: Ab, albite; Act, actinolite; Ae, aegirine; Alm, almandine; Amp, amphibole; Aug, augite; Brs, barroisite; Chl, chlorite; Cpx, clinopyroxene; Cr, crossite; Czo, clinozoisite; Di, diopside; Fgln, ferroglaucophane; Gln, glaucophane; Grs, grossular; Grt, garnet; Hbl, hornblende; Jd, jadeite; Ky, kyanite; Lws, lawsonite; Omp, omphacite; Pg, paragonite; Phg, phengite; Prp, pyrope; Qtz, quartz; Rt, rutile; Sps, spessartine; Ttn, titanite.

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within strongly retrogressed high-*T* blueschist to greenschist facies metasedimentary lithologies exposed in NE New Caledonia.

Keywords: Blueschist; Eclogite; Metasediment; Metabasite; *P–T* pseudosection

1. Introduction

The observation of apparent metamorphic grade contrasts between interlayered rock types has long been a key focus for debate in the study of high-*P* assemblages (e.g., Klemd et al., 1991; Clarke et al., 1997; Schulte and Blumel, 1999; Wallis and Aoya, 2000; Aoya, 2001). Debate has generally focused on grade contrasts between basic and felsic lithologies, though grade contrasts are also commonly reported in homogeneous basic rocks (e.g., Gao et al., 1999; Gao and Klemd, 2001; Abbott and Greenwood, 2001).

Metabasic eclogites in many high-*P* terranes occur as spatially restricted lenses, boudins, layers or knockers within metasedimentary and/or basic lithologies that display distinctly lower pressure mineral assemblages (Ernst, 1988). Causal mechanisms inferred for these metamorphic grade contrasts include: (1) mineral assemblages developed from different bulk rock compositions at the same *P* and *T* (Schliestedt, 1986; Gomez-Pugnaire et al., 1997; Gao et al., 1999); (2) the failure of one or more rock types to equilibrate at the prevailing *P–T* conditions due to kinetic considerations (e.g., Rubie, 1990); (3) the post-peak tectonic interleaving of eclogites and lower pressure rocks (Clarke et al., 1997; Schulte and Blumel, 1999; Wallis and Aoya, 2000; Aoya, 2001); (4) the preferential retrogression of less competent or more reactive lithologies, or the preservation of low-strain windows within a single rock type (Rubie, 1990; Spalla et al., 1999; Carswell et al., 2000; Abbott and Greenwood, 2001; Gao and Klemd, 2001); or (5) variations in water activity and fluid availability during exhumation (Agard et al., 2000). Ambiguities related to the choice of interpretation are perpetuated by the absence of clear field relationships (due to poor outcrop, retrogression and/or strain partitioning) between metabasic eclogite and host rock. In many cases, fabric elements in all lithologies are coplanar irrespective of differences in the *P* and *T* at which they were formed (e.g., Gao et al., 1999). The re-examination of high-*P* and *UHP* terranes (e.g., Clarke et al., 1997; Gao et al., 1999; Carswell et al., 2000) has highlighted the caution needed when deciding on the correct interpretation.

High-*P* lithologies of NE New Caledonia are divided into two major terranes (after Cluzel et al., 1994): (1) the Pouébo terrane, comprising metabasic eclogite and glaucophanite; and (2) the Diahot terrane comprising interlayered metasediments and metavolcanics. The latter forms the focus of this study. The Diahot terrane has been the subject of numerous petrological studies (e.g., Brothers and Blake, 1972; Black and Brothers, 1977; Yokoyama et al., 1986; Ghent et al., 1987; Maurizot et al., 1989; Clarke et al., 1997; Fitzherbert et al., 2003) and its *P–T* evolution and relationship to the Pouébo terrane is still controversial (Cluzel et al., 1994; Clarke et al., 1997; Rawling and Lister, 1999, 2002; Fitzherbert et al., 2004).

In this paper we describe the petrology of metasedimentary lithologies that form the bulk of the exposed Diahot terrane and relate this to the summarised petrological features of the intercalated metabasic units; see Fitzherbert et al. (2003) for a detailed description of metabasic lithologies. To model the petrogenetic evolution of Diahot lithologies, a quantitative petrogenetic grid constructed for greenschist to eclogite facies conditions (Carson et al., 2000) is adopted. Calculated *P–T* pseudosections for bulk rock compositions appropriate to the Diahot metasediments and metabasites are then employed to examine the mineral evolution with respect to changing *P* and *T*.

2. Geological setting

The New Caledonian basement comprises Palaeozoic terranes (Fig. 1a), that were transgressively overlain by upper Cretaceous to Eocene sedimentary rocks deposited during Gondwana dispersal (Paris, 1981; Cluzel et al., 1994; Aitchison et al., 1995).