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Partial Melting of Mantle and Crustal Sources beneath South Karakorum, Pakistan: Implications for the Miocene Geodynamic Evolution of the India–Asia Convergence Zone

G. MAHÉO[1]*, J. BLICHERT-TOFT[1], C. PIN[2], S. GUILLOT[3] AND A. PÊCHER[3]

[1]UNIVERSITÉ DE LYON, F-69622, LYON, FRANCE UNIVERSITÉ LYON 1, VILLEURBANNE ENS, LYON CNRS, UMR 5570, LABORATOIRE DE SCIENCES DE LA TERRE, BAT GÉODE, 2 RUE DUBOIS, 69622 VILLEURVANNE, FRANCE
[2]LABORATOIRE DE GÉOLOGIE, CNRS-UMR 6524, UNIVERSITÉ BLAISE PASCAL, 5 RUE KESSLER, 63038 CLERMONT-FERRAND, FRANCE
[3]LABORATOIRE DE GÉODYNAMIQUE DES CHAÎNES ALPINES, CNRS-UMR 5025, OSUG, UNIVERSITÉ J. FOURIER, MAISON DES GÉOSCIENCES, B.P. 53, 38041 GRENOBLE, FRANCE

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In south Karakorum, the western prolongation of southern Tibet, three distinct types of magmatic rocks were emplaced during the Neogene: (1) 22–24 Myr old lamprophyres, characterized by strong enrichment in large ion lithophile (LILE) and light rare earth elements (LREE), $^{87}Sr/^{86}Sr_{(i)} = 0{\cdot}7096$, $\varepsilon_{Nd(i)} = -7$, *and* $\varepsilon_{Hf} = -9$, *interpreted to reflect partial melting of a previously metasomatized spinel-lherzolite mantle source; (2) the 21–26 Myr old Baltoro high Ba–Sr granitoids, likewise strongly enriched in LILE and LREE, with* $^{87}Sr/^{86}Sr_{(i)} = 0{\cdot}7034$–$0{\cdot}7183$, $\varepsilon_{Nd(i)} = -6{\cdot}5$ *to* $-11{\cdot}0$, *and* $\varepsilon_{Hf} = -1{\cdot}8$ *to* $-8{\cdot}0$, *produced by partial melting of amphibole-bearing rocks in the lower crust, possibly the root of south Karakorum Cretaceous magmatic arc; (3) the 8–9 Myr old Hemasil syenite and its associated lamprophyre, also both enriched in incompatible elements but with isotopic compositions closer to those of depleted mantle (*$^{87}Sr/^{86}Sr_{(i)} = 0{\cdot}7043$–$0{\cdot}7055$, $\varepsilon_{Nd(i)} = +3{\cdot}5$ *to* $+4{\cdot}3$, *and* $\varepsilon_{Hf} = +10{\cdot}4$ *to* $+11{\cdot}2$*). The Hemasil syenite is interpreted as the product of partial melting of a time-integrated depleted spinel-lherzolite source that was enriched in K and LREE during a recent metasomatic event. We propose that the lamprophyres were formed during partial melting of the South Asian mantle previously metasomatized by fluids derived from the subducted Indian continental crust. This melting episode is interpreted to be related to a break-off event that occurred within the subducting Indian continental lithosphere. Intrusion of the resulting lamprophyric melts into the previously thickened south Karakorum crust caused partial melting of calc-alkaline igneous protoliths and generation of the Baltoro granitoids. Late-stage syenitic magmas were produced by low-degree partial melting during upwelling and adiabatic decompression of depleted mantle along the Shigar strike-slip fault.*

KEY WORDS: *India–Asia convergence zone; Karakorum; bimodal magmatism; slab break-off; heat advection*

INTRODUCTION

The evolution of collisional orogenic belts is associated with successive emplacement of a variety of magmatic rocks (Bonin, 1988). First, magmas related to partial melting of the metasomatized asthenospheric mantle wedge above a subduction zone are emplaced during oceanic and, possibly, subsequent continental subduction. At a

*Corresponding author. Telephone: +33 4 72 44 62 36.
E-mail: gmaheo@univ-lyon1.fr