



Metamorphic and geochronological study of a newly recognized paired metamorphic belt in Ecuador: implications for HT-LP metamorphism in a suprasubduction zone

Nicolas Riel (1), Stéphane Guillot (1), Etienne Jaillard (1), Jean-Emmanuel Martelat (2), Jean-Louis Paquette (3), Pierre Lanari (1), Emilie Janots (1), and Philippe Goncalves (4)

(1) University of Grenoble, ISTerre, OSUG, Grenoble, France (nicolas.riel@ujf-grenoble.fr/+33476514058), (2) University Claude-Bernard, Laboratoire des sciences de la terre, Lyon, France, (3) University Blaise-Pascal, Laboratoire magmas et volcans, Clermont Ferrand, France, (4) University of Franche-Comté, Laboratoire Chrono-Environnement, Besançon, France

Paired metamorphic belt resulting from the juxtaposition of HP-LT metamorphic series and HT-LP metamorphic series have been recognized by Miyashiro in 1961. Understanding of modern plate tectonics led to extend the definition of paired metamorphic belt to syn-metamorphic belts recording different apparent thermal gradient (Brown, 2010). In collisional context, HT-LP pressure conditions are reached either during crustal thickening or post-collisional thinning. In the present forearc of the Andean active margin in south-west Ecuador, the Amotape-Tahuin massif exhibits an exceptional tilted continental crust section consisting of low-grade metasediments to Triassic migmatites intruded by S-type granitoids, juxtaposed with the gabbroic unit of Piedras and the HP-LT Arenillas metamorphic oceanic terrane. We used mineralogical and textural study coupled with RAMAN study of carbonaceous material (RSCM) and pseudosections on the migmatitic unit. Our results show that anatexis of the continental crust occurred by muscovite and biotite dehydration at temperature ranging from ~ 650 to ~ 720 °C and pressure of ~ 5 to ~ 8 kbar. Relictual kyanite dynamically replaced by sillimanite is widely observed, recording the switch from a moderate thermal gradient to HT thermal gradient. In the biotite dehydration melting zone, temperature was buffered at ~ 720 °C in a ~ 7 km thick layer. Although temperature is stabilized, modal % of biotite and garnet respectively decrease and increase with depth. The obtained average thermal (~ 30 °C/km) can be subdivided in two apparent thermal gradients, of ~ 40 °C/km for the upper part, and ~ 5 °C/km (quasi-adiabatic) for the lower buffered part, respectively. In situ geochronological study by U-Th-Pb method gave ages of 229 ± 2.1 and 224.5 ± 2.3 Ma on zircons and monazites, respectively. Since monazites show a lack of zoning and younger ages, they are interpreted as lately crystallized from the melt. This later age is correlated with cooling and stacking of the HP-LT Arenillas unit at 225 ± 1.8 Ma (Gabriele, 2002). As a consequence, stacking of the Arenillas unit is interpreted as postdating the thermal anomaly in a forearc position. Emplacement of the Piedras gabbroic unit in the Triassic forearc region together with crustal thinning provided the heat source necessary for continental crust anatexis. The thermal event with S-type granitoid production in a suprasubduction zone, immediately postdated by the stack of HP-LT unit, constitutes a new example of a paired metamorphic belt. We relate the formation of this paired metamorphic belt to a slab rollback, enhancing crustal thinning, asthenospheric upwelling and subsequent exhumation of HP-LT unit.

Brown, M., 2010. Gondwana Research 18, 46-59.
Miyashiro, A., 1961. Journal of Petrology 2, 277-311.