

Structure, Metamorphism and Cooling History of the Central Karakoram (North Pakistan)

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ABSTRACT. Prior to the Eocene (ca. 50 Ma) collision of the Indian and Asian plates, the southern margin of Asia in the Karakoram region was dominated by a series of Andean-type plutonic belts (Hushe gneiss, Muztagh Tower gneiss, K2 orthogneiss) and regional low-pressure andalusite, staurolite and garnet-grade metamorphism (M1). Crustal shortening, thickening and regional metamorphism following collision occurred between 50-37 Ma and has been dated by a U-Pb zircon age from the Mango Gusar two-mica leucogranite which cross-cuts syn-metamorphic fabrics in the country rocks. Thermobarometry of kyanite and sillimanite-grade rocks indicates peak metamorphism (M2) at around 700°C and 8-9 kbars. Temperatures increase northwards along the Baltoro glacier transect towards the contact with the Baltoro granite where *in situ* partial melting begins in the sillimanite gneisses. Post-metamorphic folding of M2 isograds was associated with deep crustal gneiss domes and initiation of the Main Karakoram Thrust in the south. Post-M2 thermal relaxation followed from 37-25 Ma after which localised high heat concentrations at the base of the thickened crust caused widespread crustal melting and intrusion of the Baltoro granite at 25-21Ma. A high-temperature, low-pressure thermal aureole (M3) along the northern contact of the Baltoro monzogranite-leucogranite is synchronous with the 21±0.5 Ma U-Pb zircon crystallisation age of the granite. The Mitre contact aureole contains the assemblage: andalusite+cordierite+biotite+muscovite+chlorite+plagioclase+quartz and indicates pressures less than 3.5 kbars. The increase of T along the southern contact of the Baltoro granite is interpreted as the thermal upwarping of pre-37 Ma M2 isograds by 21 Ma M3 contact metamorphic isotherms. In the southern Karakoram pressures up to 10 kbars were attained by 37 Ma ago meaning that around 37 km of overburden has been eroded since the Eocene-Oligocene boundary giving a time-averaged exhumation rate of 0.95mm/year. The 21 Ma Baltoro granite crystallised at temperatures above 750°C and pressures above 10 kbars equating to depths of burial between 26-35 km. The exhumation or unroofing rate, which includes processes of uplift and erosion is between 1.2-1.6mm/year. Subduction of Indian continental crust and mantle lithosphere northwards beneath the Karakoram and Tarim Basin continental crust southwards beneath the KunLun and the northern Karakoram has created a lithospheric-scale pop-up structure with its axis of maximum uplift aligned along the Karakoram.

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