Metamorphic response to collision in the Central Himalayan Orogen

Ben Goscombe, David Gray, David A. Foster

PII: S1342-937X(18)30022-4
DOI: https://doi.org/10.1016/j.gr.2018.02.002
Reference: GR 1907

To appear in:

Received date: 10 November 2017
Revised date: 14 January 2018
Accepted date: 3 February 2018

Please cite this article as: Ben Goscombe, David Gray, David A. Foster , Metamorphic response to collision in the Central Himalayan Orogen. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Gr(2018), https://doi.org/10.1016/j.gr.2018.02.002

Metamorphic response to collision in the Central Himalayan Orogen

Ben Goscombe[1,3]*, David Gray[2], David A. Foster[3].

[1]Integrated Terrane Analysis Research (ITAR), 18 Cambridge Rd, Aldgate, 5154, SA, Australia.

[2]School of Earth Sciences, University of Tasmania, Hobart Tasmania. Australia.

[3]Department of Geological Sciences, University of Florida, Gainesville, Florida, 32611, USA.

*Corresponding author. Email: ben.goscombe@gmail.com. http://www.terraneanalysis.com.au

Supporting datasets (Appendices 1 to 4) are contained in electronic appendices.

ABSTRACT

Closure of the Neotethys Ocean and high-angle continent-continent collision between India and Asia after about 55 Ma resulted in low-angle subduction of the Indian plate below the Tibetan Plateau and by ~30 Ma established an arcuate 2,300 km long, shallow north-dipping metamorphic fold-thrust belt in the foreland. This Himalayan Metamorphic Front quickly established an Upper-Plate / Lower-Plate paired metamorphic architecture centred on the median High Himal Thrust that largely controlled subsequent evolution. The Upper-Plate is a thick slab of high-T/moderate-P high-grade migmatized metamorphic rocks, whereas the Lower-Plate is an inverted series of moderate-T/high-P schists in two crustal wedges, the broad Main Central Thrust Zone and at lowest structural levels the Footwall, below the Basal Main Central Thrust. Spatial and temporal patterns of metamorphic response in the evolving Himalayan Metamorphic Front has been characterized in a large-scale integrated structural-metamorphic study based on 8 profiles across eastern Nepal. Metamorphic response at all structural levels is established using a large dataset (n~160) of internally consistent quantitative PT determinations, petrology of metapelite samples, semi-quantitative P-T paths, metamorphic mapping and metamorphic field gradients. These results are integrated with previously published metamorphic studies, structural profiles and metamorphic chronology. From these datasets the architecture and evolution of the Himalayan Metamorphic Front is constrained by rock kinematics, metamorphic field gradients showing discontinuities, and diachronous metamorphism with contrasting P-T evolutions at different structural levels. Each of the three panels constituting the Himalayan Metamorphic Front: Upper-Plate, Main Central Thrust Zone and Footwall, experienced distinctly different tectono-metamorphic histories. Crustal processes operating during metamorphism and exhumation differ between the Upper- and Lower-Plates. The Upper-Plate experienced long-lived metamorphism starting from at least 28-38 Ma and tracking low $\Delta P/\Delta T$ clockwise P-T paths that culminated at ~19-27 Ma in peak high-grade condition with 27-31 ºC/km thermal regimes. Protracted high-grade conditions produced significant partial melt, which facilitated gravity driven southward extrusion involving internal ductile flow processes. Southward extrusion of the Upper-Plate was accommodated by coeval reverse movement on the High Himal Thrust and top down to the north, normal reactivation of the South Tibet Detachment System between ~22-10 Ma. Transport of this thick slab to the south resulted in further prograde burial of the Lower-Plate below, culminating in peak metamorphism at the highest pressures