Melting and Metamorphism in the Himalayan Orogen

TALK

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The thermal evolution of the crust during continental collision is closely related to deformation, yet the relative controls exerted by orogenic collapse and thrust tectonics on metamorphism in thickened crust is controversial. In the High Himalaya, both inverted metamorphism and partial melting in the Tibetan Slab have been ascribed to thrust tectonics and fluid infiltration. However, such models are inconsistent with the spatial relationship between the MCT and high-grade metamorphism, the field evidence for extensional tectonics during emplacement of leucogranite melts, and the evidence from both trace-elements and stable isotopes that precludes wet melting in the hanging-wall of the MCT. Uplift associated with extensional tectonics provides a mechanism for anatexis (under vapour-absent conditions) but thermal contrasts between juxtaposed sediments during uplift are insufficient to provide an adequate heat source.

Inverted metamorphism of the High Himalayan Crystalline Series is probably a consequence of dissipative heating associated with active thrusting[1]. Sufficient temperatures may be generated to cause fluid-absent metamorphism of muscovite-bearing protoliths, but significant melting by this process is unlikely since anatexis will strongly reduce shear stress on the thrust fault. Thrusting appears to have been distributed across the 10-15 km sequence of metasediments known as the High Himalayan Crystallines. Thus the MCT, as is generally represented, is one of several high-strain zones that separates supracrustals of contrasting isotopic, and metamorphic, characteristics. Either as a consequence of incipient melting, or as a result of transfer of thrusting southwards onto the Main Boundary Thrust, the hanging wall of the MCT was weakened and normal faulting was initiated. Orogenic collapse at ~20 Ma resulted in decompression melting, and emplacement of leucogranite melts into, or proximal to, the South Tibetan Detachment Zone.

[1] England et al. (1992) J. Geophys. Res., v.97, 2107-2128.

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