Generation of granitic magmas in Malay Peninsula — mechanism of crustal melting

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Granite magmatism in Malay Peninsula is largely the result of anatectic processes in the continental crust. An important and as yet unresolved question pertaining to this is the mechanism(s) primarily responsible for raising the temperature or lowering the solidus or both, to initiate crustal anatexis.

It is generally held that granite magmatism in the central and eastern belts was due to the influx of subduction-related basic magmas and fluids into the crust, whereas in the western belt the primary factor was the internal heating of the tectonically thickened crust consequent upon continental collision. It is unlikely, however, that these mechanisms were responsible for inducing crustal anatexis in Malay Peninsula in view of the fact that reappraisals of various lines of geological evidence have failed to support subduction-collision tectonic models.

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Mafic rocks associated with the granitoids in the central and eastern belts are volumetrically very subordinate, and also there is no evidence to suggest that large volumes of mafic rocks remain hidden within the crust. Consequently advective heat transfer through mafic magmas could not have played a significant role in initiating anatectic processes in these belts. It is more likely that most of the heat needed for anatexis in these belts was transferred by conduction from an upwelling asthenosphere beneath a thinning continental lithosphere. Bimodal magmatism and the earlier age of the mafic rocks relative to the granites are consistent with this mechanism.

Absence of basic magmatism is conspicuous in the western belt and hence subcrustal heat source as an important factor can be discounted. A striking feature of the western belt (Main Range) granites is their high concentration of radiogenic elements implying a source region enriched in these elements. High heat production in the source region coupled with heat retention due to thermal conductivity contrast between the source region and sediment cover, might have been sufficient to raise the temperature of the source region to the solidus. This seems to be the most appropriate mechanism for granite magmatism in the western belt. A contribution from deep crustal metamorphic processes is likely but remains speculative.