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Post-subduction magmatism (PSM): its recognition, and implications for the subduction process and evolution of the Earth's crust, mantle and core.

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Several well-known arguments suggest that syn-subduction magmatism (SSM) of arcs may stem, not from wholesale melting of the crustal material at the subduction interface but from relatively minor amounts of fusion at a thin interface shear zone. To resolve the matter consider what happens when subduction stops. If the subducted oceanic plate was young its asthenospheric heat will, after a time, obliterate the plate's chilled boundary layer (= slab), and progressive melting of the fusible interface material will occur, starting at the deep end. In the case that this material has been but little diminished by SSM as it passed the sub-arc point the ensuing PSM will

(a) result in much greater additions of heat and material to the crust (and over a much wider zone) than occurs with arc SSM,

(b) exhibit a characteristic trenchward younging of its onset, and

(c) risk interpretation that subduction was continuing.

Both (a) and (b) are well demonstrated by the post-Iapetus-closure 420-390Ma magmatism and metamorphism in Scotland, and by the post-Laramide 44-25Ma "sweep-back" of silicic magmatism of southwestern N. America. The broadly 400Ma events of the N. Appalachians and of the Lachlan Foldbelt, and the post-Hercynian intermediate and silicic magmatism of western Europe, promise other Phanerozoic examples.

In the Archaean, PSM could explain the episodic major additions to the continental crust: every time subduction stopped, a wide strip of thick oceanic-type crust (greenstone belt) was rendered unsubductible by PSM additions, themselves derived from similar oceanic-type crust at the former subduction interface.

If this model of PSM is correct, what of the vast amounts of crustal material that have been subducted during active subduction? High-pressure studies indicate that in the lower mantle, and perhaps in the lower part of the transition zone (TZ) too, silicate melts will be denser than the local solid mantle, so subduction interface melts in the TZ will gravitate towards the core, enhancing seismic V_p below subduction zones.

A tentative potted history of the Earth emerges.

Around 4.5Ga whole-Earth convective overturn produced magmas whose FeO was reduced to Fe/FeS during eruption, by a dense primordial atmosphere, and was then subducted to form the core. Whole-mantle overturn was uninterrupted (no PSM) until *ca*.3.9Ga but continued, with increasingly frequent (local?) interruptions, until *ca*.2.6Ga , when komatiite genesis virtually ceased, mantle convection may have ceased altogether (due to cooling overshoot), and ocean floors subsided, causing widespread erosion. About 2.3Ga separate upper mantle overturn began, and still continues to deplete it, re-enriching the lower mantle with melts from subduction zones.