My Ref. IUGG95E.sam/lwp

IUGG 21st Gen. Assy., Boulder, Colorado. July 1995. Abstracts p. B5.

Construction and Evolution of the 3.0-2.0Ga Continental Lithosphere: the Central Significance of Post-Subduction Magmatism (PSM)

Miles F.OSMASTON, The White Cottage, Sendmarsh, Ripley, Woking, Surrey GU23 6JT, UK; +44-1483-224138.

Geochemistry and dating show that well over half the present continental area came into existence during the 3.0-2.5Ga interval at the end of the Archaean. It has been argued (Osmaston IGC'92, UKGA'93, IASPEI94) that, when subduction of a fairly young oceanic plate stops, reheating and melting of the subduction interface crustal material occurs (PSM) and is responsible for high-volume, wide spreads of broadly coeval syn- to post-tectonic granitoid/silicic magmatism generally. This offers, in the Archaean, an understanding of the hitherto puzzling episodicity of cratonic additions.

The heat source for this process depends upon interpreting LVZ (asthenosphere) seismic properties as due to interstitial volatiles which lower thermal conductivity and trap heat in the asthenosphere. This heat will emerge upon recompression of the plate in subduction zones. The same view of the Archaean asthenosphere resolves the paradox of high-temperature magmas but normal crustal metamorphic gradients.

It seems that whole-mantle convection prevailed throughout the Archaean, with generally intra-"oceanic" subduction zones, but that, by 3.0Ga, reduced heat production made subduction increasingly interruptible. Each interruption caused PSM (TTG) cratonisation of a wide strip of mainly juvenile crust. This had two big effects:- (1) The subducting plate's asthenospheric heat was released upward in huge amounts instead of being returned to the interior, further overdrawing the Earth's heat budget and causing (~2.5Ga) a collapse of whole-mantle overturn; (2) Vast precipitation of banded iron formation (BIF) from ocean water, seen as an interplay between the incomparable magmatic pollution and organic attempts to raise the O_2 level.

Separate overturn and depletion of the upper mantle was established by 2.2(?)Ga and continues today, re-enriching the lower mantle with high-density melts from the lower ends of subduction zones. During this period, subduction interface materials that had escaped PSM became locked within the deepening lithosphere. Anorogenic granites and kimberlites could, in part, be derived from these, triggered by later magmatic heat.