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Uplift and 'extension' (that isn't) at young continental margins: a result of mantle phase-changes and deep-crust metamorphism

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The upper crust of passive continental margins widely shows tectonic features characteristic of basement extension occurring at or soon after the time of ocean initiation. Whereas this evidence is largely offshore and obtained by seismic reflection, such margins also widely display coastal uplifts, sometimes with mysterious selectivity between crustal blocks. The generation of young oceanic crust and mantle emplaces lots of hot material laterally against the continental lithosphere. Hitherto the consequences of the resulting lateral heat-flush have been considered wholly in terms of thermal expansivity, which varies very little among silicates. However, the petrological effects of this lateral heat-flush into the middle and lower continental crust, and into the mantle below, are worthy of attention.

In general, at the crustal level, an upward displacement of the metamorphic facies boundaries is to be expected, implying some degree of dehydration and the upward migration of the resulting fluid. Received petrological wisdom asserts that the water 'escapes from the system', so a net increase in column density is inferred. If, on the contrary, the water merely migrates to higher in the column it is readily shown that a major overall volume increase (several tens of percent in the zone affected) and reduction of column density results. This volume increase, moreover, is achieved with a tiny fraction of the heat input that pure thermal expansion would require. This makes non-unroofed deep crustal metamorphism potentially a major and sensitive player, both in epeirogeny and in horizontal displacements in the basement (Osmaston, 1973; 2000). The dilatation will especially affect the mid-crust, which receives the water/fluids from below. In a straight passive margin, along-strike dilatation will be inhibited, so the total dilatation will be partitioned between vertical and oceanward directions. Thus the mid-crust may be expected to extrude laterally oceanward. The resulting upper-crust tectonics are therefore to be seen as 'dilatation tectonics', not requiring extensional forces. Importantly, the magnitude of this effect, and related uplift, will vary with the constitution of the continental crust involved.

Where the continental tectosphere is old and thick, lateral heat-flush will also promote phase changes (garnet-to-spinel-to-plagioclase peridotite) within its mantle. This process converts joules into dilatation even more efficiently than the crustal one (Osmaston, 1973). But here the heat input is at much greater depth, so will spread further inland, given time. It is also ultimately reversible as the heat dissipates whereas, for the crustal process, reversibility is limited if shallower recombination of fluid occurs.

Evidence from the Gabon, Galicia and NW Yemen margins illustrates the reality of these processes.

Osmaston MF Limited lithosphere separation as a main cause of continental basins, continental growth and epeirogeny. In: Tarling DH & Runcorn SK (Eds.), Implications of continental drift to the Earth Sciences. Academic Press, London. 2: 649-674. 1973.
Osmaston MF 'Lithosphere extension' that isn't. Abstracts CD-ROM, 31st Int.Geol.Congr., Rio de Janeiro. General Symposium 4-2. 2000.