Cratonic keels and a two-layer mantle tested: plate motion examples of mantle expulsion during craton-to-craton convergence and of its lateral induction during their separation - Mediterranean, Atlantic-Arctic and India

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Two questions concerning mantle behaviour are the extent of cratonic tectospheric keels (e.g. [1, 2]) and whether the base of the upper mantle is a substantial barrier to flow [3], a two-layer mantle, in fact. Individually (geochemistry, seismology, rheology) the argument for each is indecisive but if both are true there should be major dynamical consequences for plate motions, susceptible to direct observation. If keels extend nearly to 660km the main questions are: Where does the intervening mantle go when two cratons approach one another? Where does it come from to put beneath a widening inter-craton ocean? Here we seek observation-anchored answers to each.

In the Mediterranean belt, the Caucasus region is a site of craton-to-craton convergence. My recent studies show that the Western Alps were primarily made by ~200km WNW-ward motion of northern Adria/Italy in early Oligocene, simultaneously probably initiating Apennine construction, and using a formerly-straight Insubric-Pusteria-Gailtal fault-Line, before the Giudicaria NE-ward offset differentially compressed the Eastern Alps. This motion is recorded in a dextral shear zone extending all the way to the Black Sea coast in the Dobruja area, N of the Neo-Archaean(?) Moesia block underlying much of Romania, known for its (W-ward) 'indenter' behaviour in the Cretaceous. Deep W-ward flow of mantle expelled from between the converging Arabian and Russian tectospheres apparently drove this motion by impinging on the microcratonic keel of Moesia, opening the western Black Sea, and it may explain the present deep seismicity in the SE Carpathians (Vrancea). The mechanism nicely explains the quasi-simultaneous presence of N-S and E-W convergence.

Formation of the Arctic ocean, formerly nearly surrounded by cratons, is a case of tectosphere separation, and the induction of mantle to put below it yields examples of similar tectonic responses. The Eurekan intra-Eocene major folding, across N Greenland from Svalbard to Ellesmere and Axel Heiberg islands, began the moment Greenland had become detached on both sides, ending when the inter-tectosphere gap on its E side had widened enough for the deep mantle flow to pass [4]. Before this gap appeared, mantle flow had to use the West Siberian gap between cratonic keels, assisting India's northward flight to Himalayan collision. This drag/suction has compressed Asia as never before and is still evident around southern India as by far the deepest dent in the geoid (>100m) and much N-S compressive seismicity there.

Finally we outline a new MOR model [3, 4] that could both generate this 'suction' and produce plate whose subduction results in only small-volume penetration of the 660km 'barrier'.

We ask; Is 'lithosphere' still appropriate usage?

[1] Gu et al (1998) EPSL **157**; [2] Agee (1998) Rev. Mineral. **37**; [3] Osmaston, IUGG2003 Abstr 016795-2; [4] Osmaston (2006) *in* ICAM IV, OCS Study MMS 2006-003, p.105-124. http://www.mms.gov/alaska/icam