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Lithospheric response to plume- and plate-tectonic interactions

V. Puchkov
Ufimian Scientific Centre (RAS), Institute of Geology, Ufa, Russian Federation (puchkv@ufaras.ru, +7 347 2730 368)

Plate movements and deformations of lithosphere are driven mostly by a thermochemical convection in asthenosphere. Contrariwise, plume-tectonic processes result from a larger-scale thermochemical convection in the whole mantle, starting at the core-mantle boundary (CMB) and depending on core-mantle interactions. The plate-tectonic processes affect lithosphere as a whole, dividing it into moving and deforming plates, while the plume-tectonic ones are manifested locally or regionally as LIPs (Large Igneous Provinces) and hot spots. Meeting in the lithosphere, these processes interact, resulting in a series of tectonic effects that deserve a special consideration.
1. It was noted (e.g. Sengor, 2001; Li et al., 2008) that destruction of supercontinents is accompanied by growth of a superplume (LIP) activity within continental territories. Meanwhile, there are cases when a superplume activity is not connected with continents and conversely, superplumes on continents do not necessarily lead to their splitting. According to V. Trubitsyn (2000), the break-up of a supercontinent is a result of a "blanketing effect" of heat accumulation under it, inducing a restructuring of a convection pattern. I suggested that superplumes simply add the heat to this effect, supplying the process with an additional energy and making the break-up of a supercontinent more easy.
2. One more example of a joint action of plate and plume processes is a formation of continental passive margins, that belong to two types: volcanic and avolcanic (Jeffroy,2005; Melankholina, 2008, 2011). Such characteristics of the volcanic type as a high volcanic activity, underplating, presence of specific seaward-dipping reflectors, are the result of an interference of a passive rifting with active plume processes after the break-up of a supercontinent.
3. Another example of a co-operation of plume- and plate tectonic mechanics is well known: it is a formation of time-progressive volcanic chains (Morgan,1971). Recently, the author (Puchkov, 2009) compiled an upgraded scheme of such chains in the modern oceans. A comparison of this scheme with vectors of lithospheric plate motions (http://itrf.ensg.ign.fr) have shown a very good correlation.
4. A special evidence of a co-operation between plume and plate tectonic mechanics comes from rare places where a plume coincides with a MOR. The most bright example is Iceland, where a very proliferous "non-MORB" volcanism occurs, and a conspicuous bend of the spreading axis with its small jumps in the eastward direction takes place. It can be explained by a slight westward drift of the spreading axis as a whole, relative to the plume, while the plume "attracts' and bends the MOR axis, being mechanically the weakest area. Such interactions ought to take place between Karlsberg MOR and Kerguelen and Reunion plumes 38-33 Ma ago. A different example of such an interaction is the Galapagos plume, coinciding with the Cocos-Nasca branch of the East Pacific spreading system (O'Connor et al., 2007). Here the drift direction of the spreading ridge is parallel to the ridge itself, and therefore the volcanoes activated by the plume are split and make two branching chains.
These interactions give an additional perspective to development of a modern global tectonic theory.