

Superplumes and single plumes: their magmatic trails on moving lithospheric plates.

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Single plumes and superplumes have, in principle, the same nature and source: they are thought to be upward-directed mantle convective flows, heated and fluid-enriched. They are born in LLSVP (Large low-shear-velocity provinces), otherwise called superswells, situated within the D'' layer. They represent a paleomagnetically supported "reference frame for movements in and on the Earth" [Torsvik et al., 2014]. Arriving to asthenosphere and then lithosphere, they induce melting, which results in magmatism of various kinds and volume at the earth's surface. However these two types of plumes are very different in details.

Superswells generate at the earth's surface Large Igneous Provinces (LIPs) with the volumes of erupted and intruded magmatic rocks varying between 0.1 and 10 km³ and areas between 0.1 to 10 km². They are characterized by short impulses of activity, usually from 0.5 to several Ma; in case of several impulses, their general duration may grow to 20 Ma, and very rare – more than 40 [Ernst, 2014]. The main magmatic component of the eruptive parts of LIPs are flood basalts of typical chemistry connected with dolerite dikes, representing their plumbing system; alkaline basalts, carbonatites, kimberlites may be present as subsidiary phases; in the upper parts of the sections continental LIPs include rhyolites and granites. In continents, the plateaus of flood volcanos are combined with volcanos of active rift systems. In the oceans, the LIPs form vast volcanic plateaus; the thickness of their crust is greater than normal by several times. According to seismic data, the crust of the plateaus may consist of three parts (from below): underplated basites, pre-plume crust and basalt eruptions.

As for single plumes, they are born predominantly at the periphery of LLSVPs and form single volcanos or their small clusters, OIB type (LREE-enriched), arranged in regular "time-progressive volcanic chains". Author [Puchkov, 2009] compiled an upgraded version of their distribution in the world. The last years gave an additional information which supports previous conclusions concerning the vectors of recent plate movements, induced from both the volcanic chains and space geodesy [Altamimi et al., 2016], which are in a good accordance. Therefore time-progressive volcanic chains are trails of single plumes at the earth's surface.

Superplume trails are more problematic. The superswells spawn superplumes periodically, with interruptions, from different active parts of them. Therefore they form dashed, irregular, split trails (if any). There are two antipodal superswells (African, or Tuzo, and Pacific, or Jason). Their trails are preserved differently. LIPs of the Jason superswell were superimposed predominately on the oceanic crust and therefore Early Mesozoic and older Jason LIPS are mainly subducted or accreted and are present in ophiolites. As for Tuzo-born, they are traced through pre-, post-Pangean and probably -Rodinian continents [Kuzmin et al., 2011, 2013; Puchkov, 2016], though some oceanic areas are also affected.

The trails of plumes of both types are locally interrupted by superimposed spreading oceanic basins (gaps).

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