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On the convective history of the Pacific mantle

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The characteristics of intraplate volcanism in the Pacific are very diverse. There is probably more than 10ˆ6 seamounts on the Pacific seafloor created by past or present volcanism. Among them, a number are organized in alignments, some of which presenting increasing ages along the track in the direction of plate motion. Sorting the latter by their track duration further shows two populations : a big peak around 20 Myr and a few tracks longer than 50 Myr. Some tracks originate at an oceanic basaltic plateau and others do not. There is also a number of isolated oceanic plateaus. Finally, the Polynesian " superswell " is a region of anomalously shallow sea-floor several thousands of kms in extent with an unusually dense concentration of alignments. Tomographic images of the Pacific mantle reveal several 3D structures of slow velocities, presumably indicating hot material. Moreover, paleo-reconstructions show replication of volcanism over certain areas on a 100 Myr time-scale.

In a heterogeneous viscous fluid like the mantle, several kinds of upwellings may develop, from the classical, mushroom-shaped, thermal plume to more complicated thermo-chemical structures. Fluid Mechanics studies give definite constraints on the necessary conditions for these upwellings existence, characteristics (spacing, recurrence time, temperature anomaly), and ability to reach the lithosphere. We therefore use those constraints together with the observations to reconstruct the history of convection in the Pacific mantle in the last 200 Myr.