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Episodic formation of oceanic plateaus during plume-ridge interaction: insights from St-Paul-Amsterdam, Azores, Easter and Galapagos.

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Oceanic plateaus are among the most remarkable manifestations of the interaction between mid-oceanic ridges and plumes. They are characterized by crustal thicknesses greater than the average (6km) and up to 20 km. Studies of large plateaus such as Iceland, Azores or Galapagos have highlighted the importance of several parameters that can control the morphology of an oceanic plateau (e.g. Hey, 1977; Ito and Lin 1995; Ito et al., 1996; Ribe and Delattre, 1998; Cannat et al., 1999; Bourgeois et al., 2005). The physical parameters (i.e. size, morphology, and geologic structure) and chemical characteristics of these plateaus depend mainly on the strength of the interaction between the plume and the ridge, and therefore on the intrinsic characteristics of the plume (size, temperature, temporal variation of the magmatic flux) and the ridge (spreading rate, absolute migration of the ridge relative to the plume, segmentation). This large range of parameters suggests that each oceanic plateau may be unique.

Here, we analyze bathymetric and gravity-derived crustal thickness anomalies along present and paleo-axes of oceanic spreading centers influenced by the Azores, Galapagos, Amsterdam-St. Paul, and Easter hotspots. Residual bathymetry and crustal thickness anomalies increase with decreasing ridge-hotspot distance. Construction of each of these plateaus appears to have two main stages of high magma flux separated by a period of relatively lower magma flux. This common pattern of plateau construction and evolution is surprising considering the large differences in respective geodynamics contexts. Indeed, the above locations span a large range of full spreading rates (from 26 to ∼100 mm/yr), ridge migration rates (from 12 to 63.5 mm/yr), plume buoyancy fluxes (from >1 to 3.3 Mg/s), include both young and old plateaus, two or three lithospheric plates, and low to high degree of ridge segmentation with small to large transform faults. The observed time lapse between two maxima in crustal production ranges between 5 and 10 Myr. These values are comparable to the episodicity of magma input already observed on several hot spot tracks, and whose origin has been related to episodicity in the plume buoyancy flux. This suggest that plume pulsations might be an important ingredient to consider when modeling plume-ridge interaction.