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The evolution of ocean island volcanoes in a stationary plate environment and its implications concerning hotspot dynamics

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The evolution of oceanic hotspot systems is strongly influenced by plate velocity relative to the melting source, age/thickness of the lithosphere, proximity to a plate boundary, and melting source parameters. In fast-moving plates, volcanic loci move away from the melting source and an obvious mechanism for the waning of volcanism is established. A linear island chain is thus created and a distinct edifice evolutionary pattern is recognizable. This evolutionary pattern is strongly influenced by long-term subsidence created by flexural loading and hotspot swell decay with plate movement, albeit some small uplift when edifices cross the flexural bulge; the transition from island to guyot is essentially dictated by subsidence. Conversely, in stationary or quasi-stationary plate environments, edifices do not or barely move away from the melting source so other mechanisms must be accounted for the long-term decrease in volcanic activity and the different edifice evolution. The Cape Verde Archipelago is the type-example of a hotspot in an old, stiff plate that is stationary with respect to its melting source, making it an ideal place to study ocean island evolution and oceanic hotspot dynamics in a stationary plate environment. Observations in this archipelago suggest that island evolution in such geodynamic environments is generally characterized by long-term vertical stability or even pronounced uplift trends, prolonging the islands lifetime above sea-level; the transition from island to guyot is essentially dictated by marine erosion. Uplift reconstructions for the Cape Verde Archipelago - using dateable relative sea-level tracers such as lava deltas, submarine volcanic units and marine terraces - suggest that two processes have acted to raise the islands during their lifetime. During an initial phase, mantle processes acted to build the swell. Subsequently, magmatic intrusions in the island edifice caused up to 350 m of local uplift at the scale of individual islands and often synchronous with vigorous volcanic stages. Finally, swell-wide uplift contributed a further 100 m of surface rise. This recent swell-wide uplift is well expressed throughout the archipelago by means of Quaternary marine terraces up to $\sim$100 m asl, even in islands without recent volcanism. These observations pose several constraints concerning oceanic hotspot dynamics: first, a seemingly episodic hotspot swell growth implies that the buoyancy source changes that act to raise the swell are probably cumulative, favoring a model that advocates for accumulation and spreading of depleted material leftover from partial melting; secondly, intrusive processes at hotspots in stationary plate environments are probably much more important than previously thought, and are the likely source of significant amounts of uplift; and thirdly, plate velocity relative to the melting source is expected to be a powerful constraint on intrusive vs extrusive processes of island building.