Sedimentary evidence for moderate mantle temperature anomalies associated with hotspot volcanism

Peter D. Clift
Department of Geology and Petroleum Geology, University of Aberdeen, Meston Building, Kings College, Aberdeen, AB24 3UE, United Kingdom

ABSTRACT

One of the characteristics of deep-rooted mantle plume models, and the hotspot volcanism with which they are associated is the presence of anomalously buoyant asthenosphere underlying the lithospheric plate. The presence of hot, upwelling, low-density asthenosphere causes shallowing of the seafloor over the plume center. It is commonly assumed that as the plume mantle disperses, greater subsidence occurs compared to normal oceanic crust. However, in this paper analysis of the sedimentary cover from a range of hotspot-related seamounts, plateaus, and ridges of various ages from all major ocean basins shows either no subsidence anomalies or only moderate ones that can be linked to hot asthenosphere during hotspot magmatism. Assuming that all the uplift is caused by excess mantle heat, temperature anomalies rarely exceed 100 °C for a plume head ~100 km thick and could be somewhat lower if dynamic flow or composition are important causes of uplift. On the Ontong-Java Plateau, Mid-Pacific Mountains, Emperor Seamounts, Hess Rise, and MIT Guyot, subsidence is slower than for normal oceanic lithosphere, suggesting either colder than normal mantle temperatures or, more likely, the formation of a buoyant lithospheric root under the hotspot province at the time of its formation.