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“Aerosol Impacts on Marine Ecosystems”

ABSTRACT: The initial melting of mantle plumes produced unparalleled volumes of lava that formed large igneous provinces (LIPs). These events were sometimes so large that they triggered catastrophic mass extinctions and oceanic anoxic events. Global tomography and numerical models suggest that mantle plume occurrences are closely linked to the margins of the large low shear velocity provinces (LLSVPs) located on top of the core-mantle boundary. We identified episodic upwellings of the Pacific LLSVP during the Mesozoic separated by ~10 to 20 Ma that resulted in LIPs. Therefore, as the surface expression of deep mantle processes, LIPs provide the only window into the deep Earth reservoirs and evolution. We recently discovered that the ~90 Ma Galapagos LIP-related Tortugal Suite accreted in Costa Rica not only record mantle potential temperatures as high as ancient Archean komatiites (~1800 °C). We also collected the highest olivine-spinel crystallization temperatures ever reported in the literature (1600 °C) making this suite the hottest Phanerozoic (last billion years) lavas. These exceptionally hot plume-related magmas occurred more frequently during the Archean due to overall higher ambient mantle temperatures and are extremely rare in the Phanerozoic. Yet our new data suggest that anomalously hot and isolated domains still exist in the deep Earth that have survived billions of years of mantle convection and cooling. It is possible that all mantle plumes sample these reservoirs; however, ambient mantle entrainment probably dilutes the temperature signature, resulting in secular cooling as also recorded in the Galapagos Plume after the main LIP event.