The secular evolution of the Galapagos mantle plume

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Ascent of material in mantle plumes connect the deep Earth with surface processes, resulting in large igneous provinces and some of the modern intraplate volcanoes. The accreted Galapagos-related terranes along the western margins of Central America allows the study of the evolution of the Galapagos Plume, providing a record since the plume's onset in the Cretaceous. We discovered that ~90 Ma Galapagos-related Tortugal Suite records mantle potential (T_P) temperatures as high as ancient Archean komatiites (~1800 °C) and also record high olivine-spinel crystallization temperatures (1600 °C). Komatiites occurrences were more frequently during the Archean due to overall higher ambient mantle temperatures, yet our data suggest that anomalously hot, isolated domains still exist in the deep portions of the planet that have survived billions of years of mantle convection and cooling. Our data support the existence of primitive reservoirs but from a temperature evidence, although in most modern plumes cooler ambient mantle entrainment probably dilutes this signature. Our new results suggest that the isotopic heterogeneity of the Galapagos Plume existed since the onset of this plume. However, more extreme isotopic end-members became more evident as the plume cooled down (T_P<1600 °C) around 70 Ma. During this turning point, olivine trace element systematics from the accreted terranes lavas suggest the presence of recycled components in the plume source. It is possible that high melt fractions formed during plume-head melting stage at ~90 Ma diluted these heterogeneities and as the plume cooled down more “exotic” components became evident.