Origin of isolated seamounts in the Canary Basin (East Atlantic): The role of plume material in the origin of seamounts not associated with hotspot tracks

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In contrast to prominent seamount chains, solitary small seamounts or small, isolated seamount clusters have generally been neglected in geological research. Despite their large number, they are rarely sampled and, therefore, their origins remain enigmatic. For a pilot study we have analyzed trace element, $^{40}Ar/^{39}Ar$ age and Nd, Pb, & Hf isotope ratios from the solitary Demenitskoy Seamount, the isolated Tolkien seamount group and the Krylov Seamount and Ridge, all located in the Canary Basin (central East Atlantic). Of particular interest is the guyot-shaped Demenitskoy Smt. that rises 3,200 m high on ~110 Ma old oceanic crust. It's ~88 Ma age indicates an intraplate formation on ~22 Ma old lithosphere, consistent with the alkaline composition of Demenitskoy lavas suggesting small degrees of melting in the presence of residual garnet. Tolkien (N-MORB) and Krylov Seamounts (E-MORB) compositions, ages and edifice shapes point to an origin at a spreading center and along a fracture zone, respectively. Lavas from all three seamounts, however, display isotopic trends towards a common enriched (Canary/Cape Verde plume-like) component although all seamounts formed >700 km away from these (and any other) hotspots.

The latest global and regional seismic tomographic images demonstrate that upwelling regions of slow seismic velocity beneath known major hotspots (interpreted to reflect mantle plumes) generally pond at ~1000 km (assumed viscosity change) and 660 km (phase transition) depths, where they can get laterally deflected and spread out. We show that the widespread velocity anomalies associated with the Canary and Cape Verde plumes (which merge in the lower mantle) still extend at mid-mantle depths to beneath the sites where Demenitskoy and Krylov Seamounts initially formed. It can be speculated that small, secondary "plumelets" occasionally rise from the thermal boundary layer at the top of this widespread anomaly and eventually melt in the upper mantle to generate/contribute to transient, small-scale seamount volcanism. This process may be extremely widespread but further studies of isolated (non-hotspot track) seamounts are necessary to test the applicability of our model on a global scale.