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Origin of the King's Trough Complex in the North Atlantic: Interplay between a transient plate boundary and the early Azores mantle plume

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The King's Trough Complex (KTC), a huge, canyon-like structure in the eastern North Atlantic consists of a ~500 km long series of NW-SE oriented basins and flanking ridges and cuts into a plateau of thickened oceanic crust that surrounds the 45°N geochemical anomaly at the Mid-Atlantic Ridge (MAR). Here we present geochemical data (including radiogenic isotopes), as well as new $^{40}Ar/^{39}Ar$ ages from magmatic rocks dredged from the eponymous King's Trough and the smaller Peake and Freen Deeps adjoining to the east, together referred to as KTC, and from the Gnitsevich Seamounts located to the west. The samples can be divided into two groups: (1) King's Trough and Gnitsevich Seamounts as well as cored rocks from the plateau that possess mainly alkali basaltic, geochemically enriched compositions overlapping with Azores Island lavas, and (2) tholeiitic lavas from the Peake and Freen Deeps, located just outside of the thickened plateau, that exclusively show depleted, normal MORB signatures. Ages of lavas dredged along the flanks of the King's Trough progressively decrease from east to west and are systematically 3-5 m.y. younger than their surrounding oceanic crust suggesting that the sampled structures formed somewhat off-axis. Based on isotopic similarity, it is proposed that the 45°N anomaly at the MAR represents a remnant of a mantle plume, which formed the thickened plateau by plume-ridge interaction from ~53-55 Ma. A jump of the Eurasian-Iberian/African plate boundary to this region at ~37 Ma resulted in progressive opening of the KTC as a graben structure from E to W by oblique extension until ~24 Ma. The largest extension took place at its eastern end, outside of the area of plume-influenced, thickened crust, with the opening of the ultra-deep Peake and Freen Deeps resulting in high-degree, shallow decompression melting. Ages between 36.0 and 39.5 Ma obtained from this volcanism support this plate kinematic model. At ~20-23 Ma, the plate boundary relocated to the Azores-Gibraltar Fracture Zone further south, which caused deflection of the plume and formation of the Azores Plateau. The 45°N MAR melting anomaly is therefore regarded as a waning branch of the early Azores mantle plume.