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The Burke Legacy: Plume generation zones and stability of TUZO and JASON

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The description of the movement and deformation of the Earth's outer layer has evolved from Continental Drift into Seafloor Spreading and then to Plate Tectonics in the mid- to late-1960s. But plate tectonics was an incomplete theory without a clear understanding of how plate tectonics, deep Earth dynamics and mantle plumes interact, a problem that plagued Kevin Burke (1929-2018) since the early 1970s when he worked with Tuzo Wilson.
Conceptually, Kevin argued that the link between plate tectonics and the deep Earth's mantle can be viewed as a simple mass-balance: subducted lithosphere slabs slowly restore mass to the mantle and trigger the return flow toward the surface [U+2500] including mantle plumes [U+2500] rising from the margins (plume generation zones) of two thermochemical provinces in the deep mantle, which he dubbed TUZO (beneath Africa) and JASON (beneath the Pacific). The surface manifestations of plumes are hotspot lavas, kimberlites and large igneous provinces (LIPs) which also punctuate plate tectonics by creating new plate boundaries as well as driving rapid climate changes and extinctions. This Burkian model of surface-mantle interaction emerged after the recognition of a remarkable correlation between reconstructed LIPs/kimberlites and the position of deep mantle structures, showing that TUZO and JASON have been stable for at least 300 Myrs [U+2500] and probably much longer. This is one of the most startling discoveries since the advent of plate tectonics, and we can now capitalize on Kevin's original finding by developing an integrated Earth system model that links surface tectonics and deep Earth dynamics in deep time.