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Non-Plume Models For Intraplate Volcanism

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The Plume hypothesis has been widely criticized for failing to adequately account for the observational evidence from intraplate volcanic regions and melting anomalies. On the other hand, many Earth scientists feel that a coherent, unified alternative hypothesis is still lacking. The alternative model has matured sufficiently that such an hypothesis may now be laid out. Most alternative mechanisms fall under the umbrella of the 'Plate' hypothesis, which attributes intraplate magmatism to processes associated with plate tectonics. The huge diversity of melting anomalies, from short-lived intraplate flood basalts to persistent but minor melt excesses at spreading plate boundaries, requires that any unifying hypothesis must be multi-faceted. The Plate hypothesis can account for all Earth's significant melting anomalies by processes that are known to occur, namely: a) continental breakup, b) fertility at mid-ocean ridges, c) enhanced volcanism at plate boundary junctions, d) oceanic intraplate extension, e) slab tearing or breakoff, f) shallow mantle convection, g) abrupt lateral changes in stress at structural discontinuities, h) continental intraplate extension, i) catastrophic lithospheric thinning, and j) sublithospheric melt ponding and draining. Critically, many melting anomalies require melt to pre-exist in the mantle. This circumstance is typically appealed to where no other explanation for observed volcanism is available, but it is disregarded elsewhere, *e.g.*, at localities postulated to be underlain by plumes. The nearly ubiquitous existence of pre-existing melt has major implications and offers opportunities for establishing and testing new models. The stress state of the lithosphere is critical and also presents numerous opportunities for model-testing, especially in view of the increasing availability of long-term regional GPS deformation fields. Potentially fruitful approaches using seismological and petrological techniques include looking for accumulations of melt in the mantle and determining the depth of melt formation using major-element phase relationships. This paper will present a clear, coherent statement of a mature Plate hypothesis, along with its implications and the observational approaches that can test it.