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Is alkalic oceanic volcanism caused by mantle metasomatism?

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Metasomatic models have long been invoked to explain mantle enrichment ultimately leading to alkalic volcanism. Recent examples include the publications of Rodney et al. (2025) and Sun et al. (2025), among many others. A common rationale for this is that recycled oceanic crust (Hofmann and White, 1982) is claimed to be too depleted in incompatible elements and therefore cannot provide an appropriate source for alkali basalts. This would be correct if recycled crust consisted of “normal” MORB only. But actual subducted oceanic crust also includes OIB, more than 100,000 seamounts, E-MORB, and oceanic plateaus, as previously pointed out by Hémond et al. (2006), a point largely ignored in the subsequent literature.

There are, in my opinion, two compelling arguments against the metasomatic mechanism as an explanation for alkalic oceanic volcanism: (1) The virtual absence of alkalic basaltic volcanism in Archean time: Why should low-degree melts have migrated and generated enriched source rocks only in post-Archean time? Surely, low-degree melts must have existed somewhere in the Archean mantle as well. (2) Given the wide acceptance of crustal recycling, and given the fact that substantial amounts of E-MORB, oceanic plateaus, oceanic islands and many of the seamounts are subducted (and recycled), these recycled enriched basalts constitute appropriate sources for present-day alkalic basalts erupted in EMORB and alkalic seamounts

The mechanism of recycling is now well understood in the framework of mantle dynamics. During Earth’s evolution, each recycling event generated basalts with incompatible element enrichments. However, to reach present-day levels of trace element enrichment, several cycles of melting, subduction, and recycling were required. By contrast, large-scale mantle metasomatism remains largely in the realm of speculation. Actual evidence for metasomatism is found in xenoliths only, and it occurs on a very local scale (Kiseeva et al. (2017). This suggests that metasomatism is not the cause, but an effect, of alkaline magmatism.

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