Sampling the Volatile Rich Transition Zone beneath Bermuda

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Intraplate magmatic provinces found away from plate boundaries provide direct sampling of the Earth's mantle composition and heterogeneity. Observed chemical heterogeneities in the mantle are commonly attributed to recycling during subduction, which allows for the addition of volatiles and incompatible elements into the mantle. Although many intraplate volcanoes sample deep mantle reservoirs, possibly at the core-mantle boundary, not all intraplate volcanoes are deep rooted and reservoirs in other shallower boundary layers likely participate in magma generation. We present new evidence that suggests that Bermuda sampled a previously unknown mantle domain, characterized by silica undersaturated melts that have significant enrichments in incompatible elements and volatiles, and a unique, extreme isotopic signature. Bermuda records the most radiogenic $^{206}Pb/^{204}Pb$ isotopes ever documented in an ocean basin (19.9-21.7) using high-precision methods, coupled with low $^{207}Pb/^{204}Pb$ (15.5-15.6) and relatively invariant Sr, Nd, and Hf isotopes, suggesting that this source must be <650 Ma. We interpret the Bermuda source as a new, transient mantle reservoir that resulted from recycling and storage of incompatible elements and volatiles in the transition zone, aided by the fractionation of Pb in a mineral that is only stable in this boundary layer such as K-hollandite. We suggest that recent recycling into the transition zone related to subduction events during the formation of Pangea is the reason why this reservoir has only been found in the Atlantic Ocean. Our geodynamic models suggest that this boundary layer was sampled by disturbances related to mantle flow. Seismic studies and diamond inclusions have shown that recycled materials can be stored in the transition zone. For the first time we show geochemical evidence that this storage is key in the generation of extreme isotopic domains previously thought to be related only to deep recycling.