Help yourself to some more mantle components! No, thanks, I'm fine.

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Igneous geochemists hold an infinite supply of mantle components. Geochemical literature is rife with acronyms which initially helped capture a small set of geodynamic conditions that shaped mantle geochemistry. Unfortunately, adding more and more of these mantle components eventually confused this relatively simple picture: first, it has not always been clear whether these newcomers are actually demanded by existing data, and second, they added so many dimensions to the problem that they stopped providing a useful description of mantle composition and dynamics altogether. I here focus on the problem of eliminating spurious components and finding criteria for defining the minimum number of self-sufficient but exhaustive mantle components that will account for the geochemical variability of a given data set.

Mixing does not produce linear arrays in isotopic ratios diagrams unless the denominator isotopes are identical or in constant proportions. Such a linearity condition promotes Pb isotopic compositions as the prime criterion to assess a number of components with the full power of statistical tests. Mass conservation relationships in composite isotopic spaces such as Pb-Nd-Sr-Hf-He are curvilinear (hyperbolic). Simple simulations show that handling such relationships as linear relationship, e.g., using Principal Component Analysis, will spuriously redistribute variance among existing components and even create new ones. Propagating errors on PCA results helps identify this source of scatter, which is, however, further aggravated by elemental fractionation (e.g., Hf/Pb) during melting. I here give a few examples from the Mid-Atlantic MORB for which a careless PCA would produce 4-5 components whereas three geochemical components and precisely three are identified by Pb isotopes. In addition, among the competing components FOZO, PHEM, and C, only C passes the test of plotting on a PCA eigenvectors for Pb isotopes, while a participation of the HIMU component seems excluded by the data.

An additional test for the presence of live components is the consistence of the dominant wavelengths of isotopic anomalies over long distances along mid-ocean ridges. For instance, a harmonic analysis of the three Pb isotope components has been calculated for Atlantic MORB between 80°N and 60°S. The wavelengths of the relative abundances DM/C and EM/(DM+C) are very different, which requires that these components formed by distinct geodynamic processes.

The Hikurangi oceanic plateau: Another large piece of the largest volcanic event on earth

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New $^{40}Ar/^{39}Ar$ age, geochemical and bathymetric data have been generated for the Hikurangi oceanic plateau (near New Zealand) with an area of ≥800,000 km^2, if subducted portions are included. The data are consistent with the Hikurangi 1) having been part of the "Greater Ontong Java Event", during which 1% of the Earth's surface was covered with submarine volcanism, and 2) having been connected to the Manihiki Plateau, presently located more than 3000 km to the north. The Hikurangi plateau basement (93-118 m.y.) was derived from an enriched mantle (EM) source, similar in composition to the Ontong Java and Manihiki Plateaus (ca. 122 m.y.); whereas large alkalic guyots on the plateau (86-99 m.y.) were derived from a distinct high 238U/204Pb (HIMU) mantle source, similar to alkalic dikes (90 m.y.) on Ontong Java and possibly to seamounts (ca. 75-86 Ma) on Manihiki. Observations supporting the hypotheses that the Hikurangi and Manihiki Plateaus may have once formed a single plateau include bathymetric data indicating that the NW Hikurangi margin is a rifted margin and overlap in age range and Sr-Nd-Pb isotopic compositions of basement samples. Together a combined Hikurangi/Manihiki Plateau could have covered an area of ≥1.3 million km^2, similar in size to the Ontong Java Plateau (1.5 million km^2), the largest oceanic plateau on Earth. The compositional range of the Hikurangi Plateau is similar to the Cook Austral Islands, suggesting derivation from a common or at least similar source(s). We pose the question of whether a combined HikuMani Plateau might represent the initial event of the Cook Austral Island and seamount volcanism. Similarities in age and geochemistry of late-stage volcanism on the Hikurangi, Ontong Java and Manihiki Plateaus further suggest that all three plateaus may have had a similar long-term geochemical evolution lasting more than 30 m.y.