Unravelling the history of the longest-lived hotspots in the Pacific.

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The Cook-Austral volcanic lineament is comprised of three overlapping hotspot tracks, each anchored to an active (or very young) volcano at the leading eastern terminus. We use a plate motion model, together with existing geochemical and geochronological constraints, to show that the three hot spots, all currently active in the Cook-Austral Islands, are long lived. In other words, each hotspot has generated hotspot volcanism over a period spanning 100 million years.

The traces of all three hotspots have been extensively sampled within the Cook-Austral volcanic lineament. However, the older portions of these hotspots, lying west and north of the Cook-Austral Islands, remain poorly studied. Portions of two of the hotspots between ~47 and ~100 Ma have been partially sampled in the Tuvalu, Gilbert Ridge and Tokelau seamount trails. The geochemistry and age-dates associated with these segments of the hotspots are consistent with an origin in the Cook-Austral volcanic lineament, and point to at two separate hotspot locations (Rurutu and Macdonald). A third hotspot in the Cook-Austral Islands, anchored near Rarotonga Island, is likely to have contributed volcanism to the Western Pacific Seamount Province (WPSP). The traces of all three hotspots pass through the region of the Samoan hotspot between 10 to 40 Ma, and some interloping seamounts along the Samoan hotspot exhibit geochemical affinities with the three Cook-Austral hotspots.

However, two segments of the Cook-Austral hotspots tracks remain uncharacterized. First, a ~1,200 km swath of the Pacific that lies between the Cook-Austral volcanic lineament and the Samoan hotspot remains completely unsampled. Second, the portions of the Cook-Austral hotspots that are older than >100 million years, predicted to lie in the Western Pacific Seamount Province (WPSP), remain poorly characterized. The traces of the Cook-Austral hotspots may exhibit a “bend” prior to 100 Ma, which suggests a shift in plate velocity at that time. Thus, sampling the WPSP is critical not only for verifying the antiquity of the longest-lived hotspots in the Pacific, but also to constrain absolute plate motion models during a time period not represented by volcanism at Hawaii and Louisville hotspots (which are currently the longest-lived hotspots known in the Pacific).