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Tracing the Edges of the LLSVPs in the Spatial Distribution of Seamount Volcanism

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Most active hotspots today are located above the “plume generation zones” located on the edges of the LLSVP zones at the base of the mantle beneath Africa and the South Pacific. In addition, many singular volcanic events in Earth’s history, such as the eruption of large igneous provinces and kimberlites, can also be tectonically-reconstructed to the edges of the LLSVPs. Here we test whether seamounts, which are poorly understood despite their abundance on the ocean floor, represent another form of intraplate volcanism that preferentially erupts above the edges of the LLSVPs. To do this, we first examined a database of seamounts detected using satellite altimetry, which is thought to be complete for seamounts larger than 1 km in height. The volume of these large seamounts is equivalent to an 18 m layer spread across the seafloor, but we show that this thickness varies regionally from close to zero to well over 50 m in the central Pacific and in portions of the Atlantic and Indian basins. We also used a recent tectonic reconstruction to compute the time that each point on the seafloor has spent above the edges of the LLSVP zones during its lifetime. By comparing these two maps, we demonstrate significant regional correlation between portions of the seafloor that have spent some time over the LLSVP edges. In particular, the average seamount equivalent thickness over the 38% of seafloor that has never moved within 5 degrees of an LLSVP edge is only 10 m, whereas the average for the rest of the seafloor that has moved over an LLSVP edge is 25 m. Indeed, we show that seamounts volumes are greater for seafloor that has passed over the LLSVP edges, compared to seafloor that has not, for the Atlantic, Indian, and Pacific basins. Furthermore, we note that the average equivalent thickness of seafloor volcanism increases with the length of time spent over an LLSVP edge. These correlations provide support for the hypothesis that various forms of intraplate volcanism - hotspots, kimberlites, large igneous provinces, and now seamounts as well – are associated with heat carried to the lithospheric base by plumes generated along the LLSVP edges.