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TITLE: The origin of the Line Islands: plate or plume controlled volcanism?

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SESSION TITLE: V51E. Seamount Trails: Implications for Global Plate and Hotspot Motion, Mantle Flow, and the Geochemical Evolution of Mantle Plumes I Posters

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ABSTRACT BODY: Geochemical compositions of melts produced in the Earth's mantle provide key data for our understanding of the Earth's internal structure. Particularly, the range in compositions for oceanic intraplate volcanism has fueled the ongoing debate on the dynamic origin of hotspots. Traditionally, hotspots have been interpreted to originate from narrow, upwelling plumes of hot mantle material that reach the bottom of the tectonic plates. Progressively younger volcanoes, as seen at, for example, Hawaii, are then derived from plume melts. However, such a plume may originate from the core-mantle boundary, the top of seismically defined superplumes, or the origin may not lie in a buoyantly upwelling plume at all. The presence of an age progressive volcanic chain and a large igneous province, a high buoyancy flux, the geochemical composition of the erupted lavas, and seismically slow velocities have been used to distinguish different hotspot origins. Volcanic chains that lack most of these features may originate from the eruption of shallow melts along lithospherically controlled cracks. A unique area to study this type of volcanism is the Line Islands. These islands define a complex chain of volcanoes south of Hawaii that morphologically define multiple sub-groups. Moreover, recent age dating has revealed a complex geochronology. Combined geochronological and geochemical data from the Line Islands allude to the presence of shallow mantle melts that feed eruptions where there are weaknesses in the plates due to fractures or fissures.

The Line Islands consist of elongated ridges, seamounts, atolls and islands that form the northern segment of the Line-Tuamotu chain of volcanoes. The volcanic chain is divided into three morphologically distinct regions; the northern, central and southern provinces. Long en echelon ridges of the Line Islands Cross Trend intersect the northern province at 14-16°N, which consists of the section between the Molokai and Clarion fracture zones. The foundation of the central and southern provinces is shallower than the regional seafloor, suggesting that the thickness of the lithosphere in these two provinces may have an influence on the chemical compositions of seamounts.

A suite of samples, previously analyzed for 40Ar/39Ar age data, was processed for lead (Pb), neodymium (Nd), hafnium (Hf) and strontium (Sr) isotope measurements to investigate whether the

Line Islands are caused by 4-5 concurrent plumes or a lithospherically controlled source. Pb isotope compositions define two distinct groups: (1) low 206Pb/204Pb and 207Pb/204Pb ratios, and (2) high 206Pb/204Pb and 207Pb/204Pb ratios. When Pb isotope compositions are considered in relation to their dredge locations, the two identified groups do not define age-progressive volcanic chains expected for a plume origin. Instead, high 206Pb/204Pb and 207Pb/204Pb samples are strictly limited between the Molokai and Clarion fracture zones, suggesting that ocean crust segmentation related to mid-ocean ridge spreading and adjustments in the Pacific-Phoenix-Farallon triple junction partly controlled the melt compositions. These results, therefore, suggest that this major volcanic chain was likely not plume-derived.

KEYWORDS: [8400] VOLCANOLOGY, [1000] GEOCHEMISTRY.

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