

**IODP Proposal Cover Sheet****636-Full3**☐ New☒ Revised☐ Addendum

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Title:	IODP Drilling of the Louisville Seamount Trail Implications for geodynamic mantle flow models and the geochemical evolution of primary hotspot	
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Keywords: (5 or less)	Mantle Geodynamics; Hotspots; Geochemical Evolution	Area: South Pacific

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Permission to post abstract on IODP Web site: ☒ Yes ☐ No**Abstract: (400 words or less)**

The Louisville seamount trail is a 4,300 km long volcanic chain that is inferred to have been built in the past 80 Myr as the Pacific plate moved over a persistent melt anomaly or hotspot, and is the South Pacific counterpart of the much better studied Hawaiian-Emperor seamount trail. ODP 197 drilling in the Emperor seamounts has documented a substantial ~15° southward motion of the Hawaiian hotspot prior to 47 Ma, calling into question whether the Pacific hotspots constitute a fixed frame of reference. Primary hotspots in the Pacific (Hawaii, Louisville, Easter) may have moved in concert and hence might constitute a slowly moving reference frame in the Pacific. Alternatively, these primary hotspots may have moved independently, as suggested by geodynamically modeled mantle flow patterns that reproduce the observed latitudinal motion for the Hawaiian hotspot but that predict essentially no latitudinal shift for the Louisville hotspot. These end-member models can be distinguished through drilling the Louisville seamount trail.

We propose a drilling program designed to examine (i) the possible motion of the Louisville hotspot and its geodynamical implications, and (ii) the eruptive cycle and geochemical evolution of this seamount trail. This drilling program will replicate the ODP Leg 197 drilling experiment by matching the ages of the proposed drill sites (as closely as possible) to the ages of Detroit, Suiko, Nintoku and Koko seamounts in the Emperor chain, allowing us to directly compare paleolatitude estimates between the two longest-lived hotspot systems in the Pacific. Both objectives will provide important data to investigate the possible link between the Louisville mantle plume and the formation of the Ontong Java Plateau. Finally, the thin cover of sediments on these guyots may provide additional information on the subsidence history of the Louisville seamounts and guyots, as well as a valuable southern hemisphere paleoclimate record.

These objectives can be addressed by drilling at least 350 m into igneous basement at three small and one larger Louisville guyots. A detailed site survey onboard the *R/V Revelle* was carried out in January-March 2006. During the AMAT02RR site survey cruise, SIMRAD bathymetric data and multi-channel seismic lines were collected for 22 seamounts. In addition, 24 sites were dredged on 20 seamounts for high-resolution <sup>40</sup>Ar/<sup>39</sup>Ar geochronology, major and trace element geochemistry and Sr-Nd-Pb isotope analyses. Together with the dredges of the *F/S Sonne* Leg 167 cruise (Stoffers et al., 2003) these samples provide the essential framework required to carry out the comparative experiment with ODP Leg 197.

Scientific Objectives: (250 words or less)

**Mantle Geodynamics and Hotspot Motions.** New high-resolution age dates and paleolatitude results will improve our knowledge of the motion of the Louisville hotspot relative to the Hawaiian hotspot and constrain its possible motion relative to the Earth's spin axis. These data will help us to distinguish between the possibilities (i) that the Pacific hotspots have moved coherently, or (ii) that these hotspots show significant inter-hotspot motions, possibly with the Louisville hotspot showing less or no discernible latitudinal motion. Comparison of these results with predictions from mantle flow and plate circuit models will allow us to critically test and calibrate these geodynamical models. The outcome of these comparisons are of fundamental importance to understanding the nature of hotspots, the convection of the Earth's mantle and true polar wander.

**Geochemical Evolution of the Louisville Hotspot.** Existing data from dredged lavas, including preliminary data from the SO167 and AMAT02RR (site survey) cruises, suggest that the mantle plume source of the Louisville hotspot has been remarkably homogeneous for as much as 80 Myr. In addition, these samples are predominantly alkalic (occasionally transitional) and likely represent a mostly alkalic shield-building stage, which is in sharp contrast to the massive tholeiitic shield-building stage of Hawaiian volcanoes. Chemical and isotopic data for lavas from the proposed drill sites thus will provide important insights into the magmatic evolution and melting processes of Louisville volcanoes between 80 and 47 Ma and from their shield to post-shield and maybe post-erosional stages. These data further will help us to characterize the Louisville seamount trail as a product of one of three primary hotspots in the Pacific, by constraining its plume-lithosphere interactions and by providing key data on its plume source, including temperature, depth(s) of melting and compositional evolution.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

We propose to deploy 3<sup>rd</sup> party magnetometer from Goettingen for logging purposes (see detailed description by Steveling et al. 2003).

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
<b>LOUI-1B</b>	4140 km from hotspot 26°28.66'S–174°43.46'W	1840	~50	>350	>400	Shield building lavas on large guyot
<b>LOUI-2B</b>	3320 km from hotspot 33°41.90'S–171°26.94'W	1259	~59	>350	>409	Shield building lavas on small guyot
<b>LOUI-3B</b>	2960 km from hotspot 36°54.26'S–169°47.91'W	982	~65	>350	>415	Shield building lavas on small guyot
<b>LOUI-4B</b>	2800 km from hotspot 38°10.98'S–168°38.26'W	1248	~60	>350	>410	Shield building lavas on small guyot