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The L-SCAN Experiment: Mapping the Axial Magma Chamber Beneath the Eastern Lau Spreading Center

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The L-SCAN (Lau Spreading Center Active-source Investigation) seismic experiment was designed to examine the relationship between melt supply and magmatic, tectonic, and hydrothermal processes along the Eastern Lau Spreading Center (a RIDGE2000 focus site). This 3-D active-source ocean-bottom-seismometer experiment covers a 100-km-long section of the spreading center, which exhibits significant along-strike variability in seafloor morphology, tectonics, and hydrothermal venting. Presumably these changes arise from variations in mantle melt supply and crustal melt storage. During the seismic experiment, we deployed 84 4-component ocean bottom seismometers (OBS), obtained from the OBSIP national instrument pool, over a 40 x 100 sq. km area centered on the ridge at 20°30'S. Sixty-five seismic lines (50-150 km in length) were shot using the R/V M. G. Langseth's 36-element airgun source, generating $\sim$1 million seismic travel time observations. The experiment extends across three ridge segments, separated by two overlapping spreading centers. We present preliminary analysis of the L-SCAN refraction data collected along these ridge segments. Travel times of P-wave seismic energy were measured and compared for ray paths as a function of distance from the ridge axis, thereby allowing us to map, to first order, the location of the crustal low-velocity zone that extends beneath the ridges. Only P-wave energy that has traveled within $\sim$2-3 km of the ridge axis clearly exhibits the travel time delays indicative of a crustal low-velocity "mush" zone. It has been previously observed that high-temperature venting along this ridge segment is restricted to a narrow region at the ridge axis. We suggest a model in which a narrow magmatic system acts as the primary driving force for hydrothermal buoyancy, and that substantial upward flow only occurs along the borders of the magmatic system. Fluid may be further focused to the axial zone by dikes above the melt lens. Off-axis crust will have already passed through this cooling process and does not require large off-axis hydrothermal cells for cooling.