

Discovery of Axial Magma Chamber Reflections Beneath the Lucky Strike Hydrothermal Vents and Volcano and its Relationship with Median Valley Faults

S. Singh¹, W. Crawford¹, H. Carton¹, T. Seher¹, J. P. Canales², V. Combier¹,
D. Dusunur¹, M. Cannat¹, J. Escartin¹, M. J. Miranda³, A. Pouillet-Erguy¹,

¹ IPGP, Laboratoire Geosciences Marines, Case 89 IPGP, 4 Place Jussieu, Paris, 75015, France

² Woods Hole Oceanographic Institution, 360 Woods Hole Rd, Woods Hole, MA 02543, USA

³ CGUL, Campo grande, Ed C8, Lisboa, 1749-016, Portugal

Crustal axial magma chamber (AMC) reflections beneath intermediate and fast spreading centers have been observed for the last twenty years. However it has been difficult to image them beneath slow spreading centers because the AMC beneath these ridges might be short lived and imaging conditions are generally poor due to median valley bounding faults and rough ridge topography. In June-July 2005, we carried out a 3D seismic reflection survey over an 18 km x 3.8 km area that covers the Lucky Strike volcano, hydrothermal vent sites, part of the northern graben of the volcano, and which extends out to the median valley bounding faults. The receiver group spacing was 12.5 m, shot interval was 37.5 m and the cross-line spacing was 100 m. Shots from a tuned array of 14 air guns (2600 cubic inch) were recorded on a 4.5 km long 360-channel digital streamer. The 3D data show a bright reflection at about 1.2 s (3 km) below the seafloor, centered beneath the Lucky Strike volcano and hydrothermal vents, that we interpret as a reflection from a crustal magma chamber. The reflector is at least 3 km wide and is present in the whole box (3.8 km). An along axis seismic line suggests that it should extend at least 1-2 km beyond of the 3D box. We suggest that the active volcanism and hydrothermal activity at Lucky Strike are due to the presence of an AMC that provides the magma source for the volcano and the heat source for high-temperature hydrothermal circulation. The 3D seismic data also show reflections from off-axis median valley bounding faults that go down to about 3 km depth and seem to terminate tangentially at the edges of the AMC. Since the faults bounding the graben cut through the volcanoes where the AMC is observed, we suggest that the Lucky Strike segment of the Mid-Atlantic Ridge is formed by a continuous interplay between magmatic and tectonic processes. The presence of AMC only at the center of the segment confirms the theory of focused melt supply along the ridge axis.