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Near-constant layer 2A thickness along the slow-spreading Lucky Strike segment of the Mid-Atlantic Ridge

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The Lucky Strike segment of the Mid-Atlantic Ridge has both a typical slow-spreading ridge axial valley morphology and a segment center magma chamber (1). As a part of the 2005 SISMOMAR cruise, we collected seismic reflection and refraction data to constrain crustal velocities and the depth to seismic boundaries along the whole length of the segment. The reflection data were recorded on a 4.5 km, 360-channel streamer using a shot spacing of 75 m and the refraction data were recorded on 12 ocean bottom seismometers using a shot spacing of 425 m.

The data reveal a layer 2A reflector whose depth is nearly constant over the middle 44 km of the $\sim$65 km long segment. There, both the 2A reflector and the 4.5 km/s isovelocity contour lie about 0.75 km beneath the seafloor, except within the central 4 km of the segment, where the reflector shallows to about 0.6 km. At both segment ends the 2A reflector shallows whereas the isovelocity contour deepens. If the 2A reflector marks the transition between extrusive and intrusive volcanics, as proposed at other spreading centers, the extrusive crustal thickness is nearly constant along 2/3 of the segment length, far beyond the extents of the central magma chamber. We suggest that most of this uniformity comes from efficient along-axis crustal magma transport by diking during eruptions. The thinning of layer 2A and thickening of the isovelocity contour beyond this zone suggests a transition from a magmatic/diking regime to a tectonic regime, in which the extrusive layer marked by layer 2A reflection is formed by surface lava flows from the magmatic/diking zone or by occasional horizontal or vertical magma injections, whereas rock fracturation has lowered the upper crustal velocities.

(1) Singh, S.C. et al., Discovery of a magma chamber and faults beneath a Mid-Atlantic Ridge hydrothermal field, Nature, 442(7106), 1029-1032, 2006.