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3D OBS array imaging an extremely magmatic accretion and crustal variation along the ultraslow spreading Southwest Indian Ridge

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The oceanic crust is formed by a combination of magmatic and tectonic processes at mid-ocean spreading centers. Under ultraslow spreading environment, however, observations of thin crust and mantle-derived peridotites on the seafloor suggest that a large portion of crust is formed mainly by tectonic processes, with little or absence of magmatism. Using a total of 40 ocean bottom seismometers (OBS) array, four air guns as a source with a volume of 6000 in3 and its three-dimensional refraction seismic tomography at an ultraslow spreading Southwest Indian Ridge segment containing a central volcano at 50°28′E, here we report the presence of an extremely magmatic accretion of the oceanic crust. Our results reveal a low-velocity anomaly (0.6 km/s) in the lower crust beneath the central volcano, suggesting the presence of partial melt, which is accompanied by an unusually thick crust (∼9.5 km). We also observe a strong along-axis variation in crustal thickness from 9.5 to 4 km within 30–50 km distance, requiring a highly focused melt delivery from the mantle. We conclude that the extremely magmatic accretion is due to localized melt flow toward the central volcano, which was enhanced by the significant along-axis variation in lithosphere thickness at the ultraslow spreading Southwest Indian Ridge.