

Large Off-axis Lava Flow Field from the southern East Pacific Rise at 14S — NIRAI-KANAI Cruise Yokosuka/Shinkai dives

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http://sepc5077.sci.shizuoka.ac.jp/~guest/Staff/Umino_j.html

Seismic studies on shallow crustal structures of the East Pacific Rise (EPR) show that seismic layer 2A (extrusive layer) thickens two to threefold within 1-4 km of the rise crest. This indicates that more than half of the extrusives were emplaced off-axis well beyond the limit of the axial melt lenses. Among these off-axis extrusives, there are some gigantic lava flow fields near off-axis sites which can be significant contributions to layer 2A thickening. For example, 8S flow, the world largest submarine flow field, have thicknesses ~100 m and volumes up to 12-19 km³, that is comparable to or larger than Icelandic flood basalt lava which erupt every ~2000 years and the average annual Global volcanic budget of 4-5 km³. Furthermore, high backscatter intensity and fresh surface volcanic features shown by the high-resolution side-scan imageries, and a few dredge samples along the southern EPR (SEPR) from 3S to 23S have shown that nearly zero ages for these off-axis flows, some of which have apparent fissure vents more than 1 km outside the summit graben. Moreover, these off-axis lavas have wider spectrum of lava chemistry than from the ridge axis. This indicates the complexity of magma plumbing system of the fast-spread SEPR and the presence of additional magma conduits other than that directly feeding through the axial melt lenses. Knowledge of the mechanism of off-axis thickening of layer 2A and its petrological-geochemical characteristics is essential to comprehensive understanding of the evolution of oceanic crust and the magma plumbing system of fast-spreading ridges.

NIRAI-KANAI Cruise Leg 1 was aimed to address this issue by using R/V Yokosuka and Shinkai 6500 submersible of JAMSTEC. Although we had only 7 Shinkai dives out of 15 planned dives due to a bad sea state, we could achieve many primary objectives of the cruise. Four dives on the 14S flow field provide the first direct observations of a large off-axis lava flow field. Eastern half of the 14S flow was first mapped by TAMU2 12-kHz side scan sonar imagery and bathymetry in 1995 during the Ridge Flux Project. During this cruise, we have completed mapping of the entire flow field using the SeaBeam 2112 multibeam sonar system on R/V Yokosuka. These mappings show that 14S flow extends from 13deg41'S, 112deg26'W to 14deg07'S, 112deg38'W and approximately in an area of 49 km X 16 km. Total area covered by the flow field amounts to 342 km² and 19 km³. Four Shinkai dives were carried out on this large flow field. Two dives visited the likely sources of the flow field: dive S829 on the summit region of a large flat cone on the central east of the flow field which lies at the foot of the western slope of the ridge axis; dive S833 traversed a small cone at the base of a chain of circular seamounts 6 km to the west of the flat-topped cone, which presumably lies on the fissure vent running 20deg, subparallel to the seamount chain. Dive S832 was done on a meandering channel in the southern flow lobe; dive S834 landed on the basement with 2-m thick sediment cover and went around the northern lobe, a lava channel and a lobate terrace in the north. Thickness of the sediments on the basement was measured to be 2-2.5m by the sub-bottom seismic profiler attached to Shinkai on dive S834. As the western half spreading rate at 14S is known to be 7.5 cm/yr, the age of the basement is calculated to be 113,700 yr. With this sedimentation rate of 17.6-22.0 cm/kyr (200-250 cm/113.7 kyr), the ages of the flow field were estimated to be 35.4-22.7 kyr.