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Structural architecture of a highly oblique divergent plate boundary

A.E. Clifton (1), S.A. Kattenhorn (2), L. Fernandes (2)

(1) Nordic Volcanological Center, Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland, (2) Department of Geological Sciences, University of Idaho, Moscow, Idaho, USA (amy@hi.is / Fax +354 562 9767)

We present new data from recent mapping of fractures on the Reykjanes Peninsula in SW Iceland, using high-resolution digital air photos and Differential GPS in the field, which reveal a structural complexity not previously described. Because the orientation of this divergent plate boundary segment is highly oblique with respect to the Nuvel-1A spreading direction, its structural architecture is complex, comprising a combination of normal, oblique, and strike-slip faults, along with eruptive and non-eruptive fissures. Recent advances in the acquisition and analysis of geodetic and seismic data are providing us with a detailed picture of the present-day state of stress along the plate boundary in Iceland. Data from GPS, optical leveling and InSAR indicate that the plate boundary on Reykjanes Peninsula is accumulating primarily left-lateral strain, and the dominant mode of seismicity in recent times has been strike-slip. We also know that the peninsula experiences episodic fissure eruptions lasting several hundreds of years. Our detailed maps show differences in structural style which vary significantly from west to east on the peninsula and are consistent with seismic and GPS data which indicate that the peninsula does not behave as a uniform tectonic domain. The westernmost tip of the peninsula, where the Reykjanes Ridge comes onshore, is dominated by extensional structures. A complex network of interacting normal-, oblique- and strike-slip faults and eruptive fissures occurs at the inside corner of a bend in the plate boundary. East of the bend, strike-slip faults become more prominent. Structural style also varies with distance from the zone of maximum volcanic activity. Near the rift zone axis, normal faults generally parallel the strike of eruptive fissures and strike-slip faults cross the zone of maximum volcanic production at an average angle 30 degrees counter-clockwise to eruptive fissures. At the northern margin of the rift zone,

faults typically strike 10 to 40 degrees clockwise to eruptive fissures and appear to have experienced oblique slip. Across the peninsula, old faults are buried by relatively younger lava flows and are subsequently reactivated as the stress environment varies temporally. This may account for the numerous kinks or dog-legs observed in the fault pattern. Our data indicate that there has been both spatial and temporal variability in the stress field on the Reykjanes Peninsula due to the combined influence of four factors: 1) the plate spreading direction, 2) the geometry of the plate boundary itself, 3) spatially variable magma pressures in the zone of active volcanism along the rift axis, and 4) local stress perturbations caused by slipping faults and eruption of magma.