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Control of eruptive fissure geometries by the preexisting structural fabric at an oblique spreading center, SW Iceland

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Oblique spreading centers may exhibit a complex pattern of faults and fractures in a range of orientations that reflect the long-term effects of extension and shearing across the plate boundary zone. Superimposed on this are the effects of short-term oscillations in instantaneous strain related to the waxing and waning of a tectono-magmatic cycle. The currently active plate boundary zone on the Reykjanes Peninsula (RP) in SW Iceland is oriented about 30 degrees oblique to the direction of absolute plate motion. Field, seismic, GPS, and InSAR data have suggested at least some temporal partitioning of oblique spreading, manifested as extensional magmatic events associated with eruptive fissures followed by amagmatic periods dominated by strike-slip faulting. Strike-slip motion appears to be accommodated along an E-W trending zone of seismicity and subtly expressed N-S bookshelf-style faults. Extension is accommodated by normal faults and en echelon volcanic fissure swarms characterized by right-stepping structures aligned along an average trend of 040 degrees, perpendicular to the predicted direction of maximum horizontal extensional strain in a region subject to a 30 degree oblique extension. Linear eruptive features on the RP can be divided into subglacially-erupted hyaloclastite ridges of Pleistocene age, and post-glacial crater rows and eruptive fissures oriented between 035 and 045 degrees. These structures reflect the emplacement of dikes of similar orientation at depth. However, individual segments along eruptive fissures show significant deviations from the general trend. Long-term counterclockwise rotation within the plate boundary zone due to left-lateral transtension may explain why topographic lineaments in older sub-glacially erupted hyaloclastite ridges sometimes show significant deviations from the average trend of

Holocene eruptive fissures, with notable N to NNE trends and subordinate E to ENE trends within the strike-slip belt. Many eruptive fissures also show abrupt changes in strike where they intersect the zone of N-S strike-slip faults and may follow that trend for distances of up to 2 km. Along-strike deviations in the trends of individual segments along an eruptive fissure are common and are mirrored by a similar variability in the orientations of adjacent normal faults and fractures. Our observations suggest that in addition to dike emplacement being influenced by the preexisting structural fabric at depth, magma transport through the upper crust is also controlled by the complex network of faults and fractures related to long-term oblique extension. We conclude that in an oblique rift zone, magma utilizes all favorably oriented pathways as it makes its way to the surface, allowing eruption of lava to occur along along new eruptive fissures as well as along both normal and strike-slip faults.