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Tectonic Evolution of the Reykjanes Ridge During the Past 15

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We present a new detailed tectonic model of the Reykjanes Ridge which examines the rift propagation hypothesis for the V-shaped gravity and topography ridges and its asymmetric lithospheric accretion. Forward modeling of the Reykjanes Ridge magnetic anomalies south of Iceland strongly suggest rift propagation both toward and away from Iceland, explaining the observed discontinuous asymmetric lithospheric accretion. Four major southward rift propagations extend through our entire survey area and several additional small scale rift propagations are observed, including northward propagators. If plume pules drive southward propagators, then two mechanically different kinds of propagators must exist. We find that there is a major difference in the crustal accretion asymmetry between the area immediately off the Iceland shelf and farther south, both in rift propagation pattern and free air gravity lineations. The pattern is more complex on the Iceland shelf but simplifies further south on the Reykjanes Ridge, at a greater distance from the anomaly under Iceland. Furthermore, we identify two small shortlived offset features coined ponsu-transforms, from which rift propagation is both initiated and stopped. Also, we have identified northward pointing Vs in the free air gravity and a major flowline-parallel free air gravity low, re-enforcing the conclusion that the V-shaped Ridges are not simple linear continuous features.
We attempt to link the rift propagation model to the tectonic evolution of Iceland. By linearly extrapolating the four major southward rift propagations to Iceland we can estimate when they left Iceland. Two of these, that left Iceland at ca. 15 Ma and 6.5 Ma, coincide with the shut down of two well established paleo-spreading centers on Iceland (Vestfirðir and Snæfellsnes-Skagi, respectively). Rift propagation might have been initiated at these shut downs, because a local change in the tectonic geometry limited the supply of magma down the ridge. If this is correct, then our results suggest a shut down of a previously unknown paleo-spreading center at ca. 10 Ma. The youngest propagator left Iceland at ca. 4 Ma and it could be linked to the evolution of the currently active Western Volcanic Zone on Iceland.
Our rift propagation model produces excellent fits to magnetic data and provides a self-consistent model for the evolution of the Reykjanes Ridge during the past 15 Ma.