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Mechanical interaction between volcanic systems on the Reykjanes Peninsula, Southwest Iceland

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Where the Reykjanes Ridge (RR) comes on land on the Reykjanes Peninsula in Southwest Iceland it forms a part of the West Volcanic Zone (WVZ). On the Reykjanes Peninsula the general trend of the WVZ is not perpendicular to the spreading vector but rather makes an angle of about 30˚ to the vector. The part of the WVZ on the Reykjanes Peninsula is composed of four main volcanic systems, with a somewhat different orientation with respect to the direction of the spreading vector. Each of the system has a magma reservoir, a high-temperature geothermal field, and a tectonic fissure swarm with includes tension fractures, normal faults, and eruptive fissures. Holocene lava shields (monogenic shield volcanoes), while common on the Reykjanes Peninsula, have their centres mostly outside or at the margins of the volcanic systems. In addition to the volcanic systems, there is a seismic zone, trending about N70˚E, running along the peninsula. This zone is characterised by earthquake swarms as well as N-S-trending dextral strike-slip faults, some of which slipped in June 2000.

Tension fractures, normal faults, volcanic fissures, and volcanic shields are thus the main features of the Holocene volcanotectonic activity of the Reykjanes Peninsula. In comparison with the faults of the Hengill Volcanic System, the largest system of the WVZ, the normal faults on the Reykjanes Peninsula are short, with small throws (less than 10 m), and curved. The are numerous nested, narrow grabens, and in contrast with the Holocene part of the Hengill Volcanic System, the tension fractures, normal faults, and grabens are evenly distributed across the systems rather than being confined to narrow zones nearby the main boundary faults. The volcanic shields are composed of mechanically essentially homogenous pahoehoe lava flows (olivine tholeiite and picrite), whereas eruptive fissures issue aa lava flows which are mechanically much more heterogeneous than the pahoehoe lava flows. Tension fractures and normal faults

are much more common in the pahoehoe lava flows than in the aa flows. Eruptive fissures characterise the central part of a volcanic system, containing mostly spatter and tuff cones, which were fed by regional dykes. Some fissures show right-stepping en echelon arrangement, with offsets between individual crater-row segments.

Here we present new numerical models indicating how the volcanic systems on the Reykjanes Peninsula interact mechanically. All the models were run with the finite element program ANSYS. The results show that when the volcanic systems are modelled as comparatively soft elastic inclusions, loading through either internal magmatic overpressure (related to dykes) or external tension parallel with the spreading vector generates shear stresses in zones of two main trends. One trend is N-S and these zones occur between the nearby ends of the volcanic systems. The other trend is ENE and is associated with a zone running parallel with the south tips of the volcanic systems. Here we propose that some of the N-S trending strike-slip faults may be associated with shear-stress concentrations between the volcanic systems whereas the ENE-trending zone of earthquake swarms may be partly related to the zone of shear-stress concentration at and between the south tips of the volcanic systems.