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Interaction between active volcanoes in Iceland

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Recently, we made a study of the mechanical interaction between several active central volcanoes in the central part of Iceland. Here we extend this study to a wider part of the Neovolcanic Zone of Iceland, defined as the part of Iceland containing rocks belonging to the Bruhnes magnetic epoch ($<$0.8Ma). We believe that for assessing volcanic hazards and associated risks in an active area, it must be known if its volcanoes interact mechanically. If volcanoes interact mechanically then, in our definition, an unrest in one volcano may trigger unrest in one or more nearby volcanoes.

The Neovolcanic Zone consists of three subzones: the North Volcanic Zone (NVZ), the West Volcanic Zone (NVZ), and the East Volcanic Zone (EVZ). The main geological features of the Neovolcanic Zone are the so-called volcanic systems. Of a total of 30, some 19 volcanic systems contain 23 central volcanoes, meaning that some systems contain more than one central volcano. A central volcano, by definition, has a shallow crustal magma chamber in addition to the deep-seated reservoir that underlies most of the associated volcanic system. The presence of a central volcano within a volcanic system indicates its level of maturity; the Vestmannaeyjar Volcanic System (the southernmost system in Iceland), for instance, has not as yet developed a central volcano and is therefore considered a young volcanic system. All the central volcanoes studied here belong to the EVZ.

We modelled the central volcanoes as circular holes or inclusions in an elastic crust, under a tensile stress of 5MPa in a direction parallel with the spreading vector. The modelling shows two main results. The first main result is that the central volcanoes of the EVZ form two clusters. One cluster is at the northern end of the EVZ, under the

Vatnajökull Ice Cap and over the mantle plume. The other cluster is at the southern end of the EVZ, and possibly influenced by the propagation of the rift-zone front of the EVZ to the southwest.

The second main result is that mechanical interaction occurs between central volcanoes of each cluster, but not between volcanoes in different clusters. Thus, there are no interactions that span the distance between the two clusters. Remarkably, the part of the EVZ located between the clusters is the site of the largest Holocene fissure eruptions in Iceland. At their present state of development, the models do not explain why the large fissure eruptions take place in this part of the EVZ. However, the models clearly indicate that the mechanical conditions for large fissure eruptions are most favourable away from clusters of central volcanoes.

A. Gudmundsson, Ruth E.B. Andrew, 2007. Mechanical interaction between active volcanoes in Iceland. Geophys. Res. Lett., 34, L103