

Interaction between central volcanoes and fissure swarms along divergent plate boundaries: an example from Askja Volcano, Northern Iceland.

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Central volcanoes located along divergent plate boundaries are typically part of a larger volcanic system that consists of a central edifice and a fissure swarm through which magma propagates and spreads plates apart. Regional normal faults and graben structures develop within the volcanic system, also dissecting portions of the central volcano with ring-faults faults and eruptive fissures related to the caldera structure.

Both the fissure swarm and the caldera structure influence the pathway of the ascending magma, however, the influences of the structures on magma propagation and vice versa are not well defined and understood.

Here we aim to understand the relationship between the activity of the central volcano structures (e.g. caldera ring faults, radial dykes and cone sheets) and those of the fissure swarm (e.g. regional normal faults, regional dikes).

We focus on Askja volcano, located in the Northern Volcanic Zone of Iceland. It is comprised of three nested calderas, largely filled in with subaerial basaltic lava flows and surrounded by a massive hyaloclastite mountain on the Eastern side. Formation of the youngest, the Öskjuvatn caldera, was initiated during the 1874-1876 rifting episode on the Askja system. This major event was followed by several localized radial and circumferential magmatic intrusions taking place along the new-formed caldera ring fault, as well as intruding in the fissure swarm related to the regional tectonics.

In order to characterize the influence of the caldera structure on the regional tectonics, we analysed the structural framework of the caldera and direct surroundings using remote sensing (optical imagery and high resolution DEM from TanDEM-X data). Then we made detailed field measurements (500 data) by analysing azimuth, dip, and opening of eruptive fissures, dikes, faults and extension fractures. Both remote sensing and field measurements have been then integrated producing a detailed structural map of Askja. Our results show that magma intrusions are controlled by the ring fault structures in the inner portion of the two calderas, being less important in the outer portion of the edifice. To the West, the caldera structures are dissected by regional tectonics and intrusions are influenced by both local and regional tectonics. These results provide an example of interconnection between regional and local tectonics on volcanoes at divergent plate boundaries, to be considered for any plan of hazard mitigation.