Volcano-tectonic interplay at the Askja volcanic system, Iceland: Finite element modeling constrained by geodetic measurements

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The observations of strike-slip faulting at the dyke tip do not agree with theoretical models postulating failure ahead of the dyke at angles of 30–60° with the propagation direction. Presumably this is because the dyke is re-using existing dyke-parallel fabric in a tensile environment with high fluid pressures, rather than breaking intact homogeneous rock.

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Md. Tariqul Islam[1], E. Sturkell[1], F. Sigmundsson[2,4], P. LaFemina[3], V. Drouin[4], and H. Geirsson[5]

[1]*Department of Earth Sciences, University of Gothenburg, Gothenburg, Sweden, tariqul.islam@gvc.gu.se*
[2]*Nordic Volcanological Center, University of Iceland, Reykjavik, Iceland,*
[3]*Department of Geosciences, The Pennsylvania State University, PA, USA,*
[4]*Institute of Earth Science, University of Iceland, Reykjavik, Iceland,*
[5]*European Center for Geodynamics and Seismology, Luxembourg.*

The Askja volcanic system, Iceland is located at the divergent plate boundary, the Northern Volcanic Zone, between the North American and Eurasian plates. A 1.2 km radial levelling line allows for investigation of subsidence or uplift of the caldera, by differencing the end points. Since 1984 the differences have decreased exponentially from -12.6 mm to 5.4 mm in 2015. Several processes are at work at Askja, 1) full plate spreading with 18.4±1.5 mm/yr; 2) a general uplift mostly attributed to glacial isostatic adjustment (GIA) of ~ 9-12 mm/yr; and 3) contraction and magma migration from two magma chambers. The maximum subsidence observed between 2008 and 2013 in the centre of the caldera at the station MASK (Mid Askja) is 11.9±0.1 mm/yr. Correcting this for the GIA uplift, the subsidence is ~24 mm/yr caused by volcano-tectonic deformation processes of Askja. To investigate the volcano-tectonic interplay of deformation processes in the Askja region, we construct a 3D finite element model of the volcanic system, including volcano deformation sources (two magma chambers) and plate spreading.

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$^{40}Ar/^{39}Ar$ dating basaltic melt segregations in Reykjanes Peninsula, SW Iceland

P. Nikkola[1]*, T. Thordarson[1,2], P.B. Gans[3] and O. Sigmarsson[1]

[1]*Nordic Volcanological Center, Institute of Earth Sciences, Sturlugata 7, 101 Reykjavík, ICELAND (*correspondence: paavo@hi.is)*
[2]*Faculty of Earth Sciences, University of Iceland, Sturlugata 7, 101 Reykjavík, ICELAND*
[3]*Department of Geological Sciences, University of California, Santa Barbara, CA 93106, USA*

The Reykjanes Peninsula in southwest Iceland is a subaerial part of Mid-Atlantic Ridge. Its surface geology is dominated by móberg ridges and pāhoehoe lavas erupted during the Brunhes normal polarity chron. Ages of the postglacial extrusives (age < 13 ka) are reasonably well-constrained. However, despite their regional importance, the chronology of the interglacial lavas (13–781 ka) is effectively unknown. These basaltic lavas have remained undated as they are too old for radiocarbon dating and their depleted character with low K-content makes them challenging for K–Ar, $^{40}Ar/^{39}Ar$ and U–Pb geochronometers.

In order to circumvent the problem of low-K, we sampled incompatible element-enriched basaltic melt segregation from the interglacial lavas for dating by $^{40}Ar/^{39}Ar$ method. Basaltic melt segregations are cylindrical or sheetlike vesicular formations present in the lava core of pāhoehoe flow lobes. They are formed by closed system fractional crystallization of the host lava and preferentially preserved during the period between flow stagnation and solidification. These melt segregations are enriched in K, and other incompatible elements, by a factor of 1.6–4.

Basaltic melt segregations and their host lavas were sampled from four locations on the Reykjanes peninsula. Geochemical work indicates that the potassium in the samples is primarily located in interstitial glass and in the outer most rind of feldspar. At the time of writing, interpretation of the $^{40}Ar/^{39}Ar$ age data is ongoing, but initial results reveal low radiogenic Ar values, and sub-atmospheric initial $^{40}Ar/^{36}Ar$ ratios. One sample produced a conclusive plateau age: a segregation from the town of Garðabær with a preliminary age of 327±51 ka (1σ). Despite the K-enrichment in segregations, ages cannot be determined for the other samples, possibly