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Unraveling the Eyjafjallajökull 2010 plumbing system and magma chamber dynamics through high-resolution geochemical investigations

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The April–May 2010 eruption of the Eyjafjallajökull volcano (EFJ, Iceland) was triggered by an intrusion of fresh magma coming from deeper portions of the crust migrating into shallower depth of 3-6 km in the magmatic system. Here, we present new EMPA and LA-ICP-MS analyses on groundmass glasses of ash particles erupted between 18 and 22 May 2010, the last days of the eruption. The glasses define two well separated groups. The first group is basaltic in composition with SiO_2 ranging from 49.98 to 51.76 wt.% and a total alkali content (Na2O + K2O) in the range between 4.63 and 5.17 wt.%. The second group ranges between trachyandesitic and rhyolitic compositions with SiO_2 ranging between 57.13 to 70.38 wt.% and a total alkali content from 7.21 to 10.90 wt.%. Least square modelling after Störmer and Nicholls (1978) discriminates best the origin of the basaltic glass by both fractional crystallization of a more primitive basalt or mixing of a basalt and a felsic magma. Furthermore, this model proves that the trachyandesitic range is the result of mixing of trachyandesite and trachyte magma. Magma mixing modeling after Langmuir (1978) and element concentration histograms indicate a probable incomplete magma mixing as the main process forming the great compositional variability observed in the erupted products. Finally, we estimated mixing end-members of intermediate (∼59 wt.% SiO_2) and felsic composition (∼66-68 wt.% SiO_2) with a felsic melt-proportion of 0.35-0.47. In the 90s, recorded seismicity and ground deformation indicated intrusions at shallow depth under the EFJ edifice probably forming separated sills. Therefore, the origin of the trachyandesite is presumably to find in a discrete magma batch that generated years before eruption. The rhyolite composition can be considered as the residual melt that remained in the plumbing system of EFJ since the last eruption in 1821-23. We suggest that these different magma batches formed the plumbing system of EFJ and have been remobilized by the intrusion of new basaltic magma from depth, triggering the 2010 eruption.