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SPECIAL COLLECTION: DYNAMICS OF MAGMATIC PROCESSES

High-resolution geochemistry of volcanic ash highlights complex magma dynamics during the Eyjafjallajökull 2010 eruption

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Abstract

The April to May 2010 eruption of Eyjafjallajökull (Iceland) volcano was characterized by a large compositional variability of erupted products. To contribute to the understanding of the plumbing system dynamics of this volcano, we present new EMPA and LA-ICP-MS data on groundmass glasses of ash particles and minerals erupted between April 15 and 22. The occurrence of disequilibrium textures in minerals, such as resorption and inverse zoning, indicate that open system processes were involved in determining the observed compositional variability. The variation of major and trace element data of glasses corroborates this hypothesis indicating that mixing between magma batches with different compositions interacted throughout the whole duration of the eruption. In particular, the arrival of new basaltic magma into the plumbing system of the volcano destabilized and remobilized magma batches of trachyandesite and rhyolite compositions that, according to geophysical data, might have intruded as sills over the past 20 years beneath the Eyjafjallajökull edifice. Two mixing processes are envisaged to explain the time variation of the compositions recorded by the erupted tephra. The first occurred between basaltic and trachyandesitic end-members. The second occurred between trachyandesite and rhyolites. Least-squares modeling of major elements supports this hypothesis. Furthermore, investigation of compositional histograms of trace elements allows us to estimate the initial proportions of melts that interacted to generate the compositional variability triggered by mixing of trachyandesites and rhyolites.

Keywords: Eyjafjallajökull, volcanic ash, magma mixing, plumbing system dynamics.