Preliminary interpretations of chemical analysis of tephra from Eyjafjallajökull volcano

Olgeir Sigmarsson, Níels Óskarsson, Þorvaldur Þórðarson, Guðrún Larsen, Ármann Höskuldsson

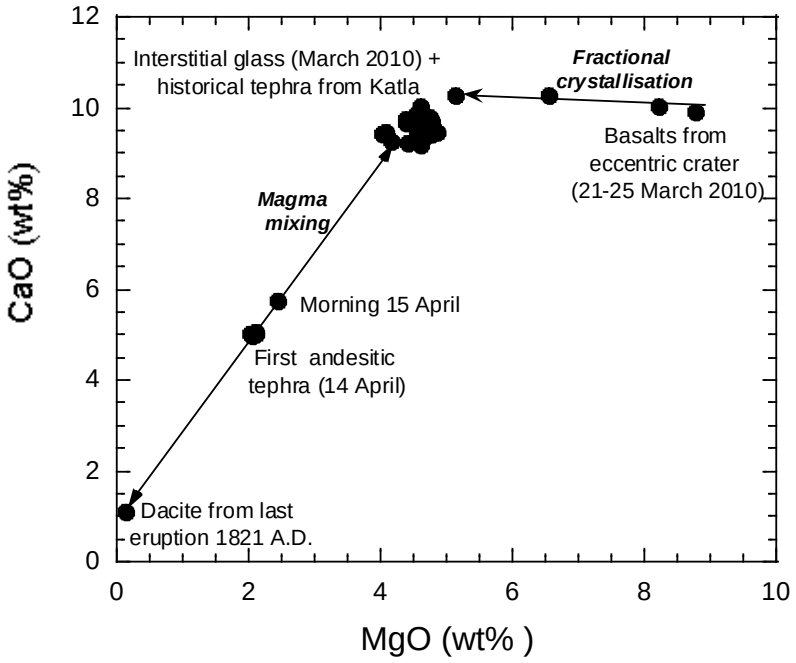
The first chemical analysis of the tephra from the 14 April-ongoing eruption indicate an intermediate (trachyandesite) composition that falls between that of the trachydacite erupted in 1821-23 and the evolved FeTi basalt typically produced by the Katla volcano. The primitive basalt (> 8% MgO) produced by the 20 March -12 April flank eruption at the pass of Fimmvörduháls between Eyjafjallajökull and Katla, confirms that magma of deep origin has been injected into the plumbing system beneath Eyjafjöll volcano. Interstitial glasses of these highly-vesicular-and-crystallized basalts have very similar major-element composition as those of the evolved Katla basalts (see Table below).

	Tephra glass from 22.3.2010	SD		Katla1918	SD
SiO2	47,27	0,15		47,00	0,54
TiO2	4,60	0,08		4,61	0,06
Al2O3	13,27	0,07		12,91	0,06
FeO*	14,56	0,09		14,62	0,17
MnO	0,18	0,04		0,25	0,01
MgO	5,01	0,15		4,69	0,13
CaO	9,47	0,04		9,38	0,10
Na2O	3,07	0,04		3,14	0,13
K2O	0,80	0,01		0,78	0,01
P2O5	0,71	0,03		0,81	0,04
Sum	98,94			98,18	

Based on this information our current working hypothesis is as follows:

Primitive basalt of deep-origin was injected into the plumbing system of Eyjafjoll volcano during the period December 2009 and 20 March 2010 as indicated by the continuous seismic and GPS monitoring stations (for further details see www.vedur.is). After temporary halt in migration of the magma at 10 km depth (as indicated by the seismicity; c/o www.vedur.is) the magma erupts at the Fimmvörðuháls flank fissure. After 24 days of continuous eruption at the Fimmvörðuháls vents the rising primitive basalt magma (ca. 1200°C) is deflected into a conduit directly beneath the volcano's summit, where it partially crystalliszes before encountering and remobilizing a trachydacite magma body at shallow depth (ca. 1 km). A 1:1 mixture of the incoming basalt and the pre-existing Eyjafjöll trachydacite can produce the trachyandesite magma that has been erupting since 14 April from vents in the ice-filled summit crater.

Chemical analysis of the tephra collected the morning of 15 April is somewhat less evolved (see Figure below) and may indicate diminishing proportion of the trachydacite component in the mixture. When the erupted magma reaches MgO concentration of ca. 4 wt% the explosivity of the eruption is likely to decrease because of lower magma viscosity and, hence onset of open-system degassing. A more mildly explosive activity will persist as long as melt-water has access to the vents.


Interstitial glass (March 2010) +
historical tephra from Katla
Fractional
crystallisation
Basalts from
eccentric crater
(21-25 March 2010)
Magma
mixing
Morning 15 April
First andesitic
tephra (14 April)
Dacite from last
eruption 1821 A.D.
CaO (wt%)
MgO (wt%)
0
2
4
6
8
10
12