

Geochemical characterization of the initial phase of El Hierro eruption

DOMINGO GIMENO^{1*}, MERITXELL AULINAS¹ AND GUILLEM GISBERT¹

¹Dpt. Geoquímica, Petrologia i Prospecció Geològica, Universitat de Barcelona, Spain domingo.gimeno@ub.edu (* presenting author), meritxellaaulinas@ub.edu, ggisbertp@hotmail.com

Ongoing submarine eruption at El Hierro]

A submarine eruption close to the La Restinga village (south of El Hierro island, Canary Archipelago, Spain) started october the 13th 2011 and is still (1st february 2012) ongoing. During some weeks the eruption was manifested by a discoloured plume (green) of dissolved gas (and probably suspended fine-sized particles) marking the site of submarine vents on the sea surface, and by the punctual emission of a rare type of decimetre to metre-sized buoyant pyroclasts, ovoid in shape. At the moment of emerging, pyroclasts crack or explode producing small steam plumes as a consequence of cooling by water. The initial phase of eruption provided mingled massive bombs (the so-called “restingolites”) while successively the buoyant pyroclasts became hollow balloons, exclusively basic in composition.

Rhyolite-basanite composite mingled pyroclasts

“Restingolite” pyroclasts are formed by two parts intimately mingled: a white microvesiculated pumice, rhyolitic in composition and a deep green-black glassy basanite with porphyritic (phenocrysts < 3 %) and locally macrovesicular textures. The basanite constitutes the skin of the pyroclasts, while the inner part is formed by planar pumitic discontinuous plastic fragments roll-wrapped with black partings of basanite. Locally, the basanite clearly looks vitreous with conchoidal fracture (sideromelane). Under the stereomicroscope, the basanite and rhyolitic glass are sinterized at their contact along planar surfaces, without trace of substantial mixing. The whole pyroclast is very friable, pulling apart as fragments with thin basanitic crust and centimetre thick of pumitic rhyolite; this provides pieces with the appearance of coconut fragments.

Trace element geochemistry and isotopic geochemistry gives evidence of an unequivocal magmatic character for both materials. In fact, the ¹⁴³Nd/¹⁴⁴Nd isotope ratios of the pumitic rhyolite and the roll-wrapped basanite are very close (0.512926 ± 0.000005 and 0.512975 ± 0.000007 , respectively) and similar to the Nd isotopic data reported in literature for El Hierro magmas. ⁸⁷Sr/⁸⁶Sr of the basanite component is 0.702947 ± 0.000006 whereas alkaline rhyolite show higher ratios (0.706040 ± 0.000005) the latter indicating an interaction with hydrothermal fluids prior to eruption. Moreover, Nb/Zr ratio of the rhyolite component is close to the ones displayed by oceanic islands rhyolitic peralkaline rocks [1].

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[1] Leat et al. (1986) *J. Geol. Soc. London* **143**, 259-273

New insight into long-term dissolution rates of borosilicate glasses

S. GIN, P. FRUGIER*, F. ANGÉLI, C. JÉGOU, N. GODON, Y. MINET

Commissariat à l'Énergie Atomique (CEA),
DEN - Marcoule, 30207 Bagnols-sur-Cèze, France
stephane.gin@cea.fr (* presenting author)

Ten borosilicate glass compositions were leached at 90°C for up to 14 years under static conditions in deionised water, and then characterized by SEM, TEM and XRD in order to establish a correlation between the glass composition and the long-term rate. Within a ternary sodium borosilicate glass, some of the key elements present in nuclear glasses (Al, Ca, Zr, Ce) have been progressively incorporated. A qualitative inverse correlation between the forward and residual rates of these glasses has been observed. This unexpected result is related to the effect of gel reorganisation on the diffusive properties of the passivating layer. No simple relations was found between the residual rates and the solution composition. A first-order rate law based on silica fits only the first few weeks, but a large deviation is observed thereafter. In most of the experiments, no real saturation occurs even during the residual rate regime: the silica concentration slowly increases towards saturation with respect to amorphous silica. The role of some glass components is examined. Glasses containing a hardener element (Al or Zr) and Ca have lower residual rates than those containing only one of these two categories of elements. the detrimental effect of precipitation of silicate minerals on the residual rate is also evidenced. Finally, the 6-oxide glass, called CJ4 in this study, as well as the more complicated CJ5 and CJ6 glasses are good analogues of the actual nuclear glass. CJ4 glass has been selected at an international level as a reference glass for a common understanding of glass corrosion mechanisms.,

In conclusion, the residual rate strongly depends on the glass composition. This rate depends on the transport properties of transient amorphous layers formed by glass hydration and in situ reorganization.