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What does it cause plinian and subplinian eruption at Etna? Relationship between magma composition and explosive activity

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Eruptive styles are related to both short-term (hours, days) changes in composition and physical properties associated to magmatic processes occurring in the feeding conduits and to long-term (decades, centuries) compositional variations produced by magmatic processes present in the source zone or in magma chambers.

Etna volcano (Italy), world widely famous for lava flow eruptions, has produced even large magnitude explosive eruptions as demonstrated by recent tephrostratigraphic studies. The thick volcaniclastic successions, that blanket the eastern slope of the Etna edifice, record a history of important explosive activity in Holocene times characterised by 1 plinian (122 BC), at least 5 subplinian central eruptions (namely S4, FS, FL, FV, FF) and several violent strombolian flank eruptions (Coltelli et al., 1998; Del Carlo et al., 2004). The discovery of these explosive events has raised important issues for hazard assessment of basaltic volcanoes in almost persistent activity such as Etna. The explosive eruption of primitive magma occurred in the last years (2001-2003) and in Holocene (FS eruption, Coltelli et al., 2005)) has shown that explosivity is not related to differentiation of magma in a simple way. Moreover, high explosivity only in some cases (eg. 122 BC and FL eruptions) can be associated to magma-water interaction.

For these reasons, we have focussed on petrology of pyroclasts produced by the most voluminous and violent explosive holocenic eruptions at Etna to comprehend relationship between magma composition and explosive activity. In particular, we investigate chemical tracers (e.g. abundance of elements with different chemical affinity; isotopic

ratios) to discriminate processes that occurred in magmatic reservoirs/feeding systems from those taking place in the source zone. Investigated volcanics range in composition from basalt to mugearite.

First results outline that:

- the most energetic eruption (plinian) is fed by a magma that ranges from hawaiite to mugearite in composition. This variation seems related to the stratigraphic position and can be related to a emptying of a slightly zoned magmatic reservoir;

- subplinian eruptions are fed by magmas that vary from picrite basalt to mugearite in composition. However, subplinian eruptions fed by more primitive magmas are connected to a fast ascent of a volatile-rich magma directly from source zone (FS – Kamentsky et al., 2007) or from the deep portion of the plumbing system (S4). Conversely, subplinian eruptions with hawaiitic and mugearitic composition, are related to the dynamics of magma stationing in a shallow reservoir.

References

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