Experimental constraints on pre-eruptive conditions of a chemically-zoned peralkaline ignimbrite: The Green Tuff eruption at Pantelleria Island (Italy)

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Pantelleria island is the type locality for pantellerite, an iron and alkali-rich rhyolite. The eruptive products outcropping in the island fall in a mafic end member (mildly alkaline basalt) and a felsic end member (metaluminous trachytes and pantellerites). A key event in the volcanological history of the island is the Green Tuff eruption the sole ignimbrite at Pantelleria compositionally zoned from crystal-poor pantellerite at the base to crystal-rich trachyte at the top.

We experimentally investigated the phase relations of the pantelleritic end member AI = 1.8 (agpaitic index = molar ratio Na_2O+K_2O/Al_2O_3) and trachyte end member AI = 1.05 of the Green Tuff eruption. The intensive variables were investigated by performing phase equilibrium experiments at 0.5, 1 and 1.5 kbar, 750-950°C, fluid saturation conditions with $XH_2O= (H_2O/H_2O+CO_2)$ between 0 and 1, and redox conditions close to FMQ (fayalite-magnetite-quartz buffer).

Preliminary results show that at 850°C pantelleritic charges were above the liquidus regardless their water content. Below 800°C clinopyroxene is the liquidus phase followed by amphibole and alkali feldspar. Aenigmatite and quartz crystallized at 750°C and XH_2O lower than 0.8. Considering the other end-member, trachytic charges at 850°C are strongly crystallized. The liquidus phase is clinopyroxene crystallizing at 950°C and $XH_2O<0.8$ followed by iron-rich olivine and alkali feldspar. Iron-bearing minerals record the effect of both H_2O and fO_2, showing progressive iron enrichment when XH_2O decreases. Alkali felspar becomes the most abundant mineral phase when $XH_2O<0.8$ at 900°C or $XH_2O<1$ at 850°C both at 1 and 1.5 kbar. Experiments reproduce well the mineral assemblages of the natural rocks, giving information on magma storage conditions and showing that compositional zoning in magma chamber is related to gradients in temperature and volatile contents. A still open question is the parent-daugther relationship between trachyte and pantellerite. Even though pantelleritic magma evolution has been well reproduced experimentally more experiments are needed to clarify this issue.