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0.0.1 Evidence of Double Diffusive Convection in the Evolution of the Phlegrei Fields Reservoir

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Geochemical evidence for the possibility of pre-eruptive magma mixing in the Campi Flegrei volcanic system has prompted us to study the efficiency of the physical mixing of melts obtained from the Campanian ignimbrite (San Nicola OF104f and Mondragone OF152b2 samples).

To enhance mixing the initial magmas contained partially dissolved crystals. The experiments took the form of a time series at 1300 ˚C and stirring at 0.5 rotations per minute. After 16 and 25 hours, under constant stirring, Al-Ti-Fe spinel crystals were still present and locally traced the flow directions. Two separate convection cells originated: a lower one with a primary flow parallel to the bottom and side walls of the crucible, and an upper one, with a primary flow approximately at right angle to that of the lower cell.

Electron microprobe analyses of the products indicate a complex layering of cells bounded by clear gaps in oxide ratios and containing compositional gradients. At the cell interface, all analyzed oxides exhibit spreading horizons, where oxides contents range over 2% (SiO_2 and Na_2O) (De Campos et al., 2004).

The very low Reynolds numbers (10^{-7} to 10^{-9}) in these experiments are a consequence of restricted dimensions (cm scale) and of a very low rotation speed. However, they point towards mixing under laminar flow conditions. In the absence of a significant temperature gradient, convection in our experiments was driven primarily by the applied forced convection combined with the effect of local compositional gradients (diffusion) along the sample leading to a density distribution resembling a double diffusive system.

For comparisons with the natural Campi Flegrei system, melt inclusions in pyroxenes and matrix (data from Signorelli et al., 1999) have been compared to the experimental glasses. Notwithstanding scale restrictions, experimental data is in good to very good accordance with the natural compositions. This means that mixing, through a double diffusive similar process, might have led to the origin of layered horizons, where oxide contents and therefore densities might spread within a subtle but clear interval. Following preliminary conclusions can be drawn:

- Mixing and diffusion might be important processes in this system, particularly before fractional crystallization starts.

- The combined effect of convection and diffusion seems to play an important role to originate a vertically and laterally zoned chamber, whose different models are discussed in the literature (Signorelli *et al*., 1999; Pappalardo *et al.*, 2002).

References

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