Geophysical Research Abstracts
Vol. 15, EGU2013-8402, 2013
EGU General Assembly 2013

Magma-sediment interactions in the Limagne trench (Massif Central, France): distinction between phreatomagmatic and stricto-sensu peperitic processes

Sebastien Leibrandt (1), Antoine Bénard (2), and Benjamin Brigaud (3)

(1) Laboratoire Magmas et Volcans, CNRS-UMR 6524, Université Jean Monnet, France (sebastien.leibrandt@univ-st-etienne.fr), (2) Research School of Earth Sciences, The Australian National University, Canberra, ACT 0200, Australia, (3) Laboratoire IDES, CNRS-UMR 8148, Université Paris-Sud 11, France

Magma-sediment interactions provide important information to reconstruct paleo-eruption dynamics in hydromagmatic environments. The lithofacies resulting from these interactions are usually named “peperite” as first described on rocks from the Limagne area (Massif Central, France). Nevertheless, it is nowadays admitted that both fluidal and blocky peperite formation refers to mostly non-explosive, hydrodynamic disintegration of magma intruding and mingling with unconsolidated wet sediments (e.g. Skilling et al., 2002).

Here we observe magma-limestones interactions (i.e. explosive and non-explosive) in phreatomagmatic vent-filling deposits, from outcrop scale to thin-section observations, with polarized, electronic and cathodoluminescence microscopy. Our field study is based on the comparison of selected localities from the Limagne trench that are mapped as peperites but which apparently only record phreatomagmatic processes leading to the deposit of sediment-rich maar diatreme material. Microscopic characterization mainly focuses on juvenile clasts and host carbonate sediment textural relationships, when mixed together and dispersed in the maar diatreme material. We deduce the mechanisms and timing of interaction of several generations of magmatic clasts with host pristine carbonate sediments or pre-existing volcaniclastic breccia. The extent of mixing and dispersion of the magmatic clasts is assessed in relation with the emplacement dynamics, magmatic cooling rates and host sediment properties. In this regard, cathodoluminescence microscopy allows us to deduce the properties of sediment before, during and after interaction, which also helps to reconstruct the paleo-environmental frame.

As a first outcome of this study, we distinguish (1) early syn-eruptive fragmented material during phreatomagmatic magma-sediment interaction from (2) secondary, non-explosive, magmatic intrusions in poorly consolidated and water-saturated vent-filling deposits. This second process can solely give birth to the stricto-sensu fluidal to blocky peperite microtexture, which we clearly distinguish for the first time in the Limagne area. A second outcome emerges thanks to the several approaches we use for microscopic characterization, which possibly reveal high-grade, non-explosive mingling of liquefied sediment with magma at the sub-millimetre scale. These observations provide new insights into peperite formation processes in carbonate sediments, when both considering experiments (e.g. Zimanowski and Büttner, 2002) and worldwide field observations in contrasting environments (e.g. McClintock & White, 2002).

McClintock, M.K., White, J.D.L., 2002. Granulation of weak rock as a precursor to peperite formation: coal peperite, Coombs Hill, Antartica. Journal of Volcanology and Geothermal Research, 114, 205-217.
Skilling, I.P., White, J.D.L., McPhie, J., 2002. Peperite: a review of magma-sediment mingling. Journal of Volcanology and Geothermal Research, 114, 1-17.
Zimanowski, B., Büttner, R., 2002. Dynamic mingling of magma and liquefied sediments. Journal of Volcanology and Geothermal Research, 114, 37-44.