Geophysical Research Abstracts
Vol. 14, EGU2012-2023-3, 2012
EGU General Assembly 2012

High explosive 2010 Merapi eruption: Evidence for shallow-level crustal assimilation and hybrid fluid

A.Y. Borisova (1), C. Martel (2), S. Gouy (1), I. Pratomo (3), S. Sumarti (4), J.-P. Toutain (5), I. N. Bindeman (6), L. Danyushevsky (7), J.-P. Metaxian (8), and S. Surono (9)

(1) Géosciences Environnement Toulouse, Observatoire Midi Pyrénées, Toulouse, France (anastassia.borisova@get.obs-mip.fr, 05-61-33-25-60), (2) Institut des Sciences de la Terre d'Orléans, ISTO-CNRS, 1A rue de la Férollerie 45071 Orléans Cedex 2, France, (3) Museum Geologi, Pusat Survei Geologi, Jln. Diponegoro No. 57, Bandung, Indonesia, (4) Volcano Investigation and Technology Development Institution, Yogyakarta, Indonesia, (5) Institut de Recherche pour Développement, IRD, Indonesia, (6) Geological Sciences, University of Oregon, Eugene, Oregon, USA, (7) ARC Centre of Excellence in Ore Deposits, Tasmania University, Hobart, Australia, (8) Institut des Sciences de la Terre – Université de Savoie, Chambery, France, (9) Center of Volcanological and Geological Hazard Mitigation, Bandung, Indonesia

The last eruption of the Merapi volcano (Central Java, Indonesia) was unexpectedly highly explosive. To better understand the processes controlling the magma-fluid system responsible for the paroxysmal subplinian eruption, we investigated first-stage tephra and pyroclastic flow samples collected in October - November 2010, and second-stage ashes sampled shortly after the 5 - 6th November 2010 paroxysmal subplinian eruption. Plagioclase phenocrysts from the pyroclastic flow and tephra reveal highly calcic cores (up to An_{94}) and $\delta^{18}O$ values of $\sim$6.5 ‰ which is in the range of $\delta^{18}O$ for the Merapi plagioclases and bulk rocks (Gertisser and Keller, 2003). The ash samples have strongly radiogenic $^{87}Sr/^{86}Sr$ ratios (0.70571-0.70575) approaching the compositional field of the 1998 calc-silicate xenoliths described by Deegan et al. (2010). The major and trace element compositions of silicic glasses and mineral phenocrysts, and O and Sr isotopic signatures of the plagioclases and the bulk rocks erupted in 2010 are explained by complete digestion of the 1998 calc-silicate xenoliths. The crustal xenoliths were assimilated in the 2010 basaltic andesite magma through mixing between a calcic melt ("crustal assimilant", CaO up to 10.5 wt%, CaO/Al_2O_3 up to 1.2) and a hydrous K-rich melt. Similarly to the 1998 calc-silicate xenoliths described earlier (Chadwick et al., 2007), the 2010 crustal assimilant was enriched in Mn (MnO up to 0.5 wt%), Sr, Zn and V. In contrast, the hydrous K-rich melt issued from a deeper magmatic source was enriched in volatiles (Cl up to 0.37 wt%, H_2O+CO_2 up to 6 wt%), and Al_2O_3, TiO_2, and REE. This melt may have been saturated with an aqueous fluid at about 200 MPa, a pressure value consistent with the depth of the crustal assimilation. Experimental leaching of the ash samples evidences for the presence of an aqueous fluid enriched in Cl, Na, Ca, Cd, Sb and Zn during the paroxysmal eruption. Thus, 2010 eruption may have been caused by liberation of this NaCl-HCl-rich fluid from the pre-eruptive basaltic andesite magma.

References: Chadwick J.P. et al. (2007). J. Petrology 48, 1793-1812. Deegan F.M. et al. (2010). J. Petrology 51, 1027-1051. Gertisser R., Keller J. (2003) J. Petrology 44, 475-489.