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The A.D. 79 eruption of Mt. Vesuvius: timescales and dynamics of magmatic processes

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The A.D. 79 Pompei eruption (Vesuvius, South Italy), is one of the first well-documented and most studied Plinian eruptions occurred in the last two millennia. This study is aimed at geochemically characterize the 79 A.D deposits cropping out at Cave Pozzelle (Terzigno), the most complete and representative proximal sequences of the Pompei eruption. Representative samples of the entire eruptive sequence have been analysed for major and trace elements by ICP-MS, moreover the chemical composition of the most abundant mineral phases of the "white" and "grey" pumice fall deposits have been determined by EMPA. He isotopes of selected minerals and $^{87}Sr/^{86}Sr$ of whole rock and minerals from the representative samples, have been measured in order to investigate magma chamber processes. Whole rock analyses confirm a variation trend in major and trace elements along the eruptive sequence while mineral analyses reveal a complex-zoning pattern in clinopyroxene and alkali feldspar crystals. We performed a detailed characterization of clinopyroxene zoning pattern by acquiring major elements concentration (Si, Ti, Al, Fe, Mg, Mn, Ca, Na) along core-to-rim profiles in 35 clinopyroxene crystals. Clinopyroxenes are mostly diopsidic and Fe-diopsidic ($Wo_{53-45}En_{49-17}Fs_{30-6}$) in composition, and show normal, reverse and multiple zoning, with several crystal cores being characterized by patchy zoning. Mg# [molar $Mg^{2+}/(Mg^{2+}+Fe_{tot})*100$] of clinopyroxene ranges between 91 and 52, with some differences among the clinopyroxene belonging to the "white" and "grey" pumice. Chemical zoning records changes in magma composition, temperature and pressure. At least four chemically different groups have been identified in the clinopyroxene zoning pattern and they can be related to distinct magmatic environments, each of them representing crystals growth in a specific set of magmatic conditions. The $^{3}He/^{4}He$ measurements corrected for contamination by atmosphere-derived fluids (expressed as Rc/Ra) were determined in olivine and clinopyroxene and varied in the range 1.60-2.70Ra. The less radiogenic samples fall in the range of the signature inferred for the magmatic source of Vesuvius. We combine the study of clinopyroxene zoning pattern with the $^{87}Sr/^{86}Sr$ isotopic composition of minerals and whole rocks in order to constraining the plumbing system dynamics and retrieve timescale of magmatic processes occurred before the Pompei eruption.