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High CO_2 content in magmas at an arc volcano: the andesitic Enco eruption of Mocho-Choshuenco volcano (Chile)

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High volatile contents are thought to be one of the main causes of explosivity of poorly to moderately differentiated magmas that lead to effusive volcanic eruptions otherwise. In particular, CO_2 may be a key factor in promoting high gas pressures and subsequent magma fragmentation owing to its low solubility.

We address this issue by investigating the pre-eruptive volatile (H_2O, CO_2, Cl and S) content in the crystal-poor andesitic magma that led to the sub-Plinian Enco eruption of Mocho-Choshuenco volcano, one of the most hazardous volcanoes in the southern volcanic zone of Chile.

Though the whole rock composition of the Enco magma is andesitic (60.2 ± 1.1 wt.% SiO_2), the melt inclusions have compositions ranging from 50.3 to 67.3 wt.% SiO_2, following the magmatic series of Mocho-Choshuenco, and the compositions of the most mafic melt inclusions are close to that of the most mafic erupted magmas.

We measured the volatile contents in melt inclusions trapped in minerals (olivine, plagioclase and pyroxene) using electron microprobe and ion microprobe (SIMS). Glass analysis revealed typical parental arc magma values for H_2O (2.6-3.1 wt.%), S (116-1936 ppm) and Cl (620-1993 ppm), but exceptionally high contents in CO_2 with concentrations above 4000 ppm in some melt inclusions. Presence of solid carbonates inside inclusion-hosted bubbles, revealed by 3D confocal Raman mapping, clearly indicated that the CO_2 contents measured in the glass phase were minimum values. We conclude that the high CO_2 content could be one of the causes of explosivity of the Enco eruption that generated pyroclastic flows.