Degassing history of the White Island magmatic-hydrothermal system (New Zealand) during the 1976-2000 eruptive cycle

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Magmatic volatiles efficiently transport elements thought as non-volatiles, such as base and precious metals, through formation of complexes. This is evident from the high emission rates of trace metals observed during major eruptions as well as in the high concentration of, for example, Cu, Au and Mo in ore deposits associated with magmatic-hydrothermal systems.

White Island is a subduction-related andesitic stratovolcano located off the shore of New Zealand. It has been passively degassing for the past 10 000 years. A dynamic magmatic-hydrothermal system occupies the upper part of the volcano, evidenced by the constantly evolving fumaroles and hot acid pools found in the crater floor. Freshly erupted ejecta were sampled during the 1976-2000 eruptive cycle. Major elements coupled with S and Cl contents of melt inclusions and groundmass glass indicate periodic input of undegassed, more mafic melt into the system leading to a degassing cycle of the magma through convection. We will discuss the pressure of crystallization and inclusion entrapment estimated by the H_2O and CO_2 content of the inclusions. High concentrations of trace elements occur in the melt inclusions. For example, Cu may be present at concentrations up to 200 ppm. Comparison with volcanic gases from low temperature fumarole (~170 °C), containing 4 ppb of Cu, and aerosols from the super-heated main conduit fumarole containing 47 $ng.m^{-3}$ of Cu, indicates retention of metals in the hydrothermal system. The presence of Cu-Fe sulphide inclusions (10 to 20 μm) in some plagioclase and clinopyroxene reinforces this hypothesis.