

## Magmatic processes at Mt. Ruapehu, New Zealand: melt-mush interactions determined from melt inclusions

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Mt. Ruapehu is an andesitic cone volcano situated at the southern end of the Taupo Volcanic Zone. Historical activity has consisted of frequent small phreatic and phreatomagmatic eruptions through Crater Lake - a warm, acidic lake. Eruptions are difficult to predict due to the very short seismic precursors and typically provide only minutes of warning. Three popular ski fields are located on the mountain and therefore it is important that the processes responsible for the generation of eruptions are better constrained.

Ruapehu scoria exhibit phenocrysts of plagioclase, clinopyroxene, and orthopyroxene with rare microphenocrysts of ilmenite and magnetite. We present geochemical data and volatile contents of phenocryst-hosted melt inclusions and groundmass glass from scoria erupted in 1969, 1971, 1977, 1995, and 1996. The groundmass glass composition spans a similar range to the melt inclusions (58-74 wt % SiO<sub>2</sub>). The volatile content of melt inclusions is very low in H<sub>2</sub>O (~ 1.5 wt %), high in F (up to ~ 2000 ppm), and high in CO<sub>2</sub> (up to ~ 1000 ppm). These magmas record some of the lowest H<sub>2</sub>O contents of an andesite in an arc setting.

Many phenocryst-hosted melt inclusions plot on a separate mixing line from the groundmass glass, which suggests that the phenocrysts are exotic to the melt. We show that the small volume magmas that are erupted at Ruapehu leave a remnant crystal mush that is re-entrained by the following eruption. This is seen in eruptions where the time interval between eruptions is short (e.g. 1969/1971 and 1995/1996). Consequently, most Ruapehu magmas interact with a resident crystal mush prior to eruption. The interaction of magmas with a crystal mush is probably a common process at other volcanoes, and the small volume of magmas at Ruapehu allows for more common preservation of these magmatic interactions at depth.

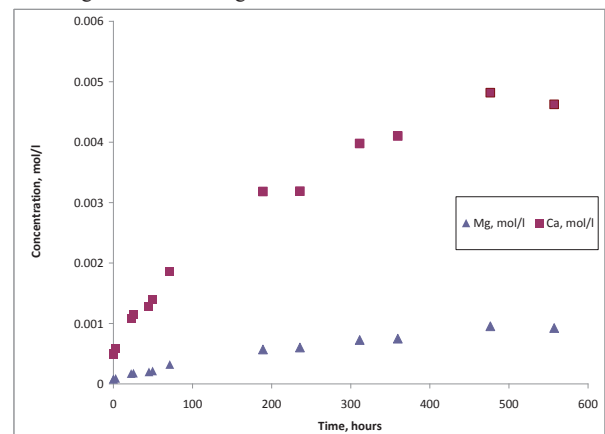
## Mineral Dissolution Kinetics Under Conditions Relevant to Geological Storage

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In the field of geological storage of carbon dioxide, a detailed understanding of the geochemical behaviour of the host reservoir is important in terms of both storage potential and security. Currently, most predictions of geochemical behaviour rely on sparse data from single mineral experiments conducted under a wide variety of pressures, temperatures and salinities not all of which will be relevant to specific storage sites.

Our experiments aim to bridge some of these knowledge gaps: CO<sub>2</sub> solubility and the kinetics of mineral dissolution in CO<sub>2</sub>-mineral-brine systems have been examined in a number of batch experiments at sub-critical (3 bar – 30 bar, 20°C – 70°C) conditions. Common reservoir mineral and rock samples have been utilised in these experiments, including dolomite, quartz, feldspar and UK sandstone. Figure 1 shows the results from an experiment following cation release from c.150µm sized dolomite in a CO<sub>2</sub> saturated brine at 21°C and 3 bar CO<sub>2</sub> pressure. Concentrations plateau at between 400 and 500 hours, a fairly long time relative to dissolution rates expected for calcite. The dissolution is highly incongruent, with calcium concentrations five to six times higher than those of magnesium. The exact reaction mechanism is still under investigation. These rates appear to be closer to those expected for silicate minerals and suggest that reaction rate imbalance between carbonate rocks and silicate rocks must be evaluated for specific lithologies and mineralogies.



**Figure 1:** Ca and Mg release during a CO<sub>2</sub>-brine-dolomite batch experiment. Temperature: 21°C, Pressure: 3 Bar, Brine: 1.36M NaCl.