

## Irreversible fixation of Arsenic during formation of Mg-bearing minerals at alkaline condition

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Dissolved anionic species such as As has received a more important focus due to its prevalence in West Bengal as a toxic contaminant affecting several hundreds of thousands of people. Chemical weathering of slag and fly ash recycled as cement materials can release anionic chemical species (As, Se, F, B, Cr and etc.) that have alarmed the industrial community. Long-lived dissolved anionic nuclides such as  $^{14}\text{C}$ ,  $^{36}\text{Cl}$ ,  $^{79}\text{Se}$ ,  $^{99}\text{Tc}$  and  $^{129}\text{I}$  from radioactive wastes of the nuclear power industry are also a cause for grave concern in the disposal conditions, especially hyperalkaline condition from cement degradation. The behavior of dissolved anionic chemical species in the natural environment has proved to be the most important factor in determining their hazards and their accumulation in minerals that comprises rocks and soils.

In this context, a determination of mineral phases emerged at ambient temperature and alkaline conditions in Mg-Si-Al system and investigation on sorption behavior of As to the mineral phases were performed for understanding of safety removal and encapsulation of As by minerals in the alkaline conditions.

From the results of synthesis with 7 days duration at room temperature, and pH 11, a ternary phase diagram including serpentine, smectite, hydrotalcite and etc. was obtained in Mg-Si-Al system. Several kinds of mineral phases can be easily expected at the condition due to the chemical composition of reactive fluid. For each mineral phase emerged at the different conditions, sorption experiments were conducted before and after formation of the mineral phases (static and dynamic sorption experiment, respectively). For understanding of As association with the minerals phases, a leaching test by phosphate-bearing fluid was also performed. From the comparison of As behavior before and after the mineral formation, irreversible fixation of arsenic during formation of serpentine and hydrotalcite was observed at dynamic sorption experiment after leaching test. Among the serpentine and hydrotalcite phases, the phase rich in Al has a great irreversible As fraction. This implies that irreversible encapsulation of As by minerals in the alkaline conditions is undoubtedly expected by the control of pore water chemistry using Mg-Si-Al slag with high reactivity.

## Petrogenesis of the Whakamaru supervolcano, New Zealand, from *in situ* micro-analytical studies

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The Whakamaru ignimbrite ( $> 1000 \text{ km}^3$ ) is a product of one of the largest known caldera forming eruptions in the Taupo Volcanic Zone, New Zealand. Competing end-member models of fractional crystallisation of parental mafic magmas and partial melting of lower crust have been proposed for rhyolite magma generation. Distinguishing between these models is difficult as rhyolitic magmas of similar composition can potentially be generated by either mechanism. A solution to this may lie with *in situ* micro-analytical studies of melt inclusions and individual crystals. Electron microprobe, laser ablation inductively coupled plasma mass spectrometry and fourier transform infra-red mass spectroscopy have been used to measure major and trace element and volatile concentrations of melt inclusions and plagioclase phenocrysts. Samples were taken from the basal lag layer for the melt inclusion study and throughout a 100 m section for the crystal zoning study.

Quantitative modelling of the rare earth element concentrations of quartz- and orthopyroxene- hosted melt inclusions using a pure fractional crystallisation model cannot explain both the light rare earth (e.g. La = 13-53 ppm) and heavy rare earth element (e.g. Yb = 1.4-5.5 ppm) concentrations. A two stage model of magma generation can explain the observed trends: (1) ca. 80% fractionation from a parental mafic melt coupled with assimilation of ca. 20% greywacke country rock resulting in a crystal mush zone with a highly evolved interstitial silicic (e.g.  $\text{SiO}_2 = 70-75 \text{ wt}\%$ ) melt at 6-12 km depth; (2) migration of the interstitial melt into a shallow (2-6 km) crustal magma chamber and mixing with a 10-50% greywacke partial melt(s). The rejuvenation of the crystal mush zone can potentially be examined by the compositional changes observed within quartz and plagioclase phenocrysts. Compositional zoning and Sr diffusion modelling of profiles across plagioclase crystals allow us to constrain the timescales over which crystal growth and accumulation occurred. The outer zone of the plagioclase crystals ( $\text{An}_{30-40}$ ) have a maximum residence time of 2 ka which we interpreted as the timescale for stage 2 of the magma generation. Residence times of 12-70 ka from the cloudy crystal cores ( $\text{An}_{45-60}$ ) may represent the time required for the formation of the crystal mush zone.