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Swelling inhibition of bentonite clay by $Mg(OH)_2$ precipitation using different Mg salts

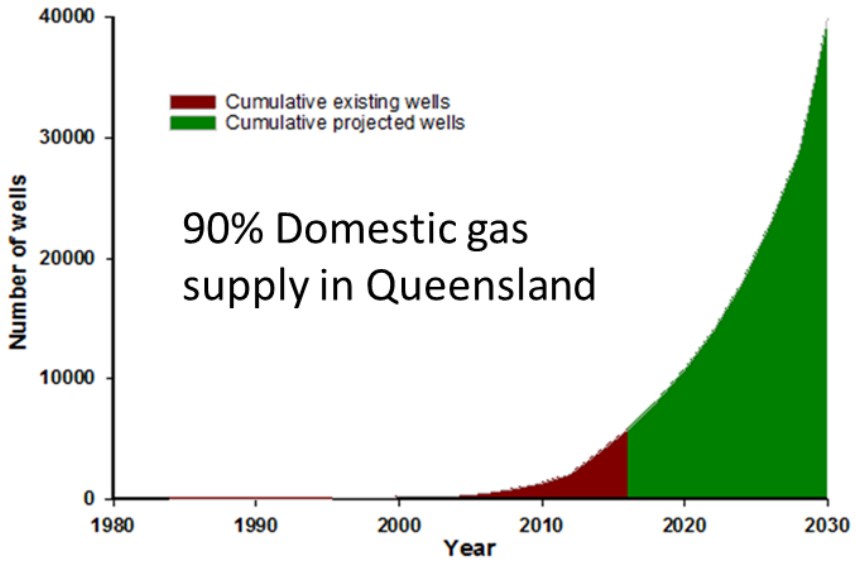
Dr Archana Patel, Dr Tom Rufford, Prof. Brian Towler, Prof. Victor Rudolph

School of Chemical Engineering

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

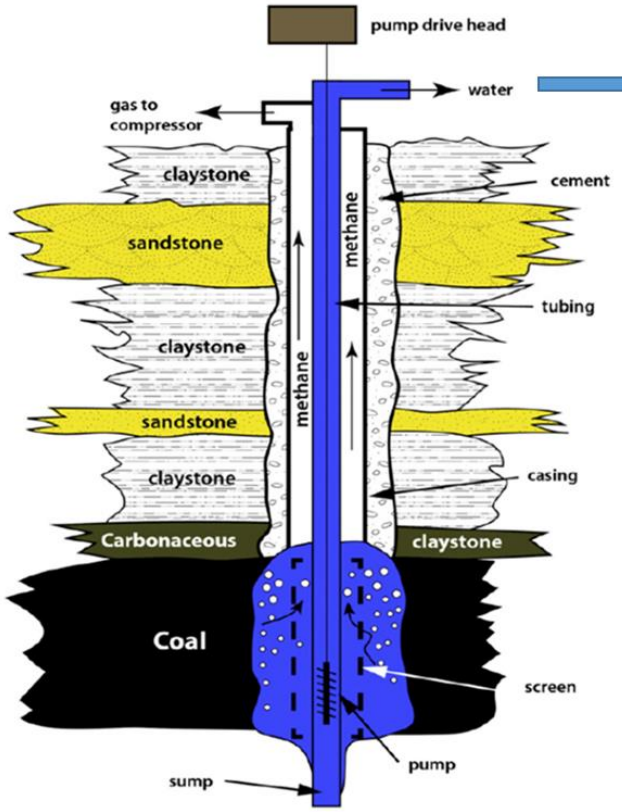
Centre for Natural Gas

Introduction



Current and future projection of coal seam gas wells in Queensland (ABC Radio 2012)

Effect of clay swelling on the coal seam gas production



Production of solids with Water

↓

Blocking the pump and decrease in permeability

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Needs shutdown in the production for pump maintenance

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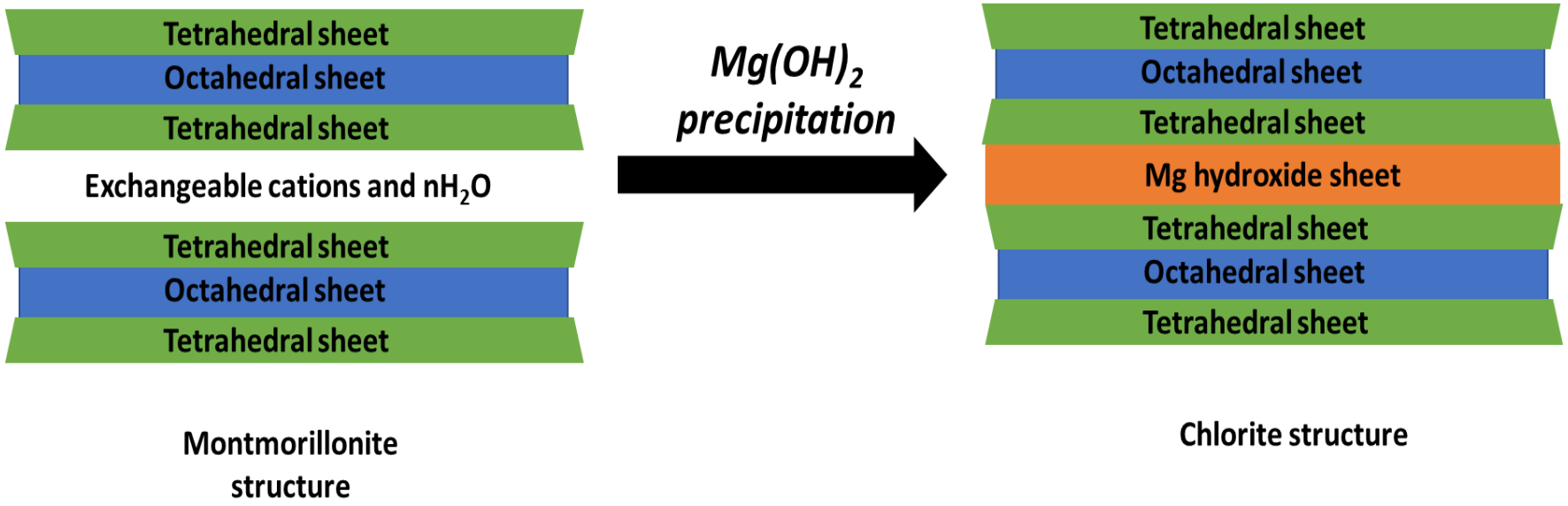
Increase in the operational cost

Overview

- The precipitation of Mg/Al/Fe hydroxide between the clay layers of montmorillonite is a simple process which happens during weathering leading to mineral transformation from montmorillonite to chlorite.
- The chlorite is non swelling clay so if montmorillonite structure changes to chlorite, the swelling can be prevented.
- The chloritization of montmorillonite is already been studied and reported in open literature long time ago to understand the formation of chlorites from montmorillonite but never focused as a tool to inhibit swelling.

The illustration of $Mg(OH)_2$ precipitation and mineral transformation

$$Mg\ salt + NaOH \rightarrow Mg(OH)_2 + Na\ salt + H_2O$$



Key results

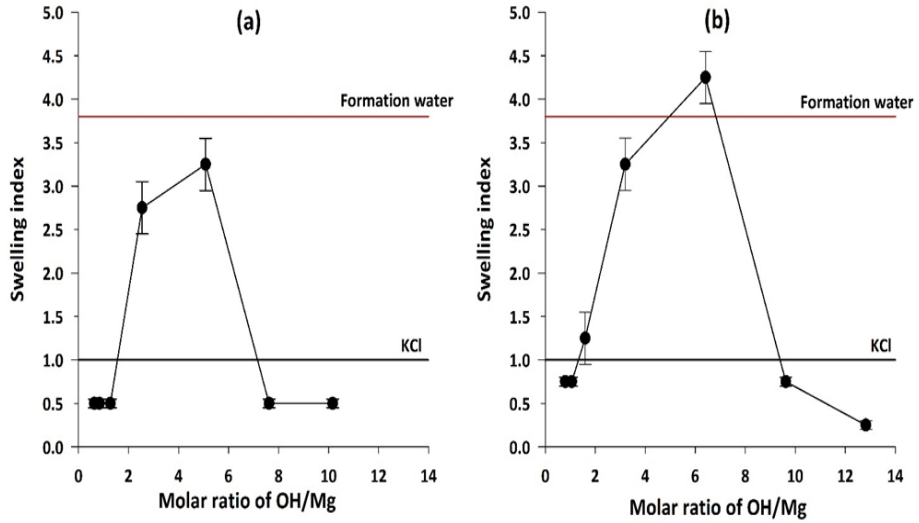
Swelling index of model bentonite precipitated with $Mg(OH)_2$ using

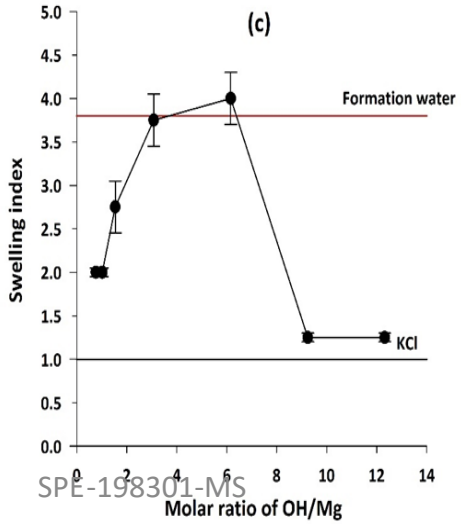
(a) $MgCl_2 \cdot 6H2O$

(b) $Mg(NO_3)_2 \cdot 6H_2O$,

(C) $Mg(SO_4)_2 \cdot 8H_2O$ with NaOH at different OH/Mg ratio.

The swelling tests were carried out in model formation water (TDS 2500 ppm, pH 5) via vial test methods for 72 hours.





Replenishment test

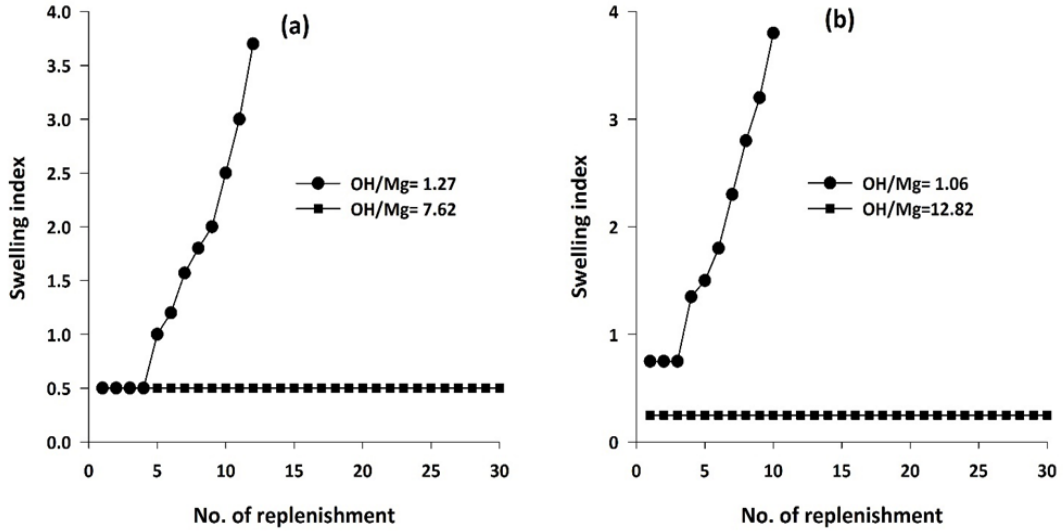
Swelling index of model bentonite precipitated with $Mg(OH)_2$ water using:

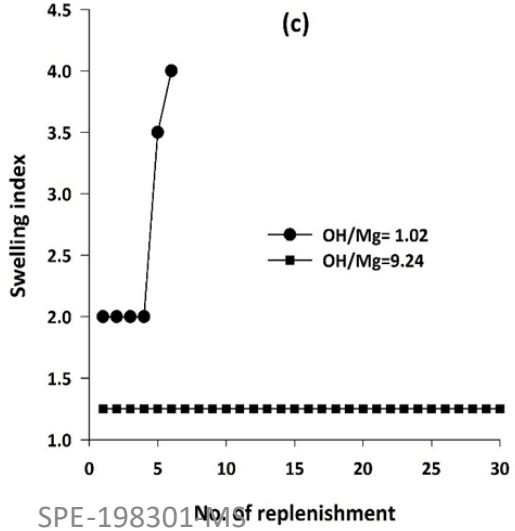
(a) $MgCl_2 \cdot 6H_2O$

(b) $Mg(NO3)2 \cdot 6H_2O$,

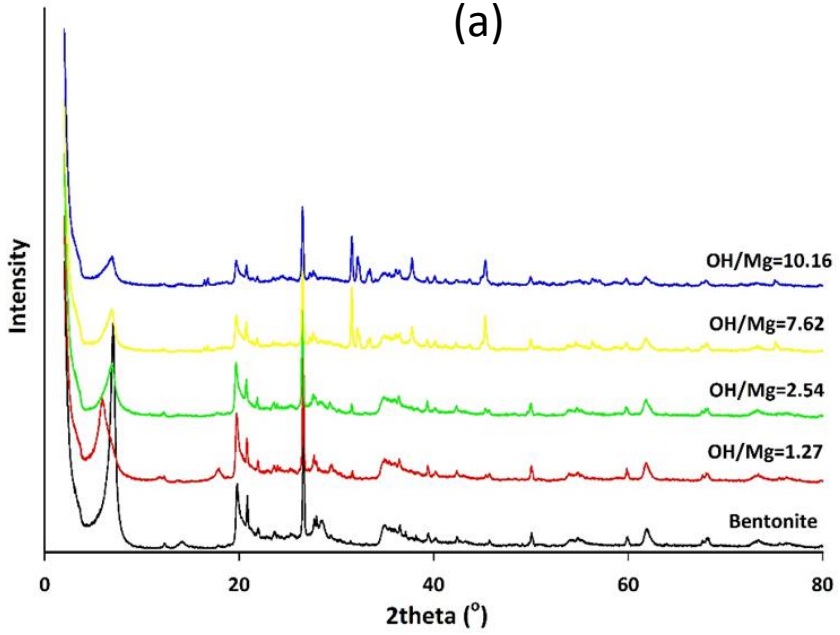
(c) $Mg(SO_4)_2 \cdot 8H_2O$ and NaOH with OH/Mg ratios after replenished with fresh formation water.

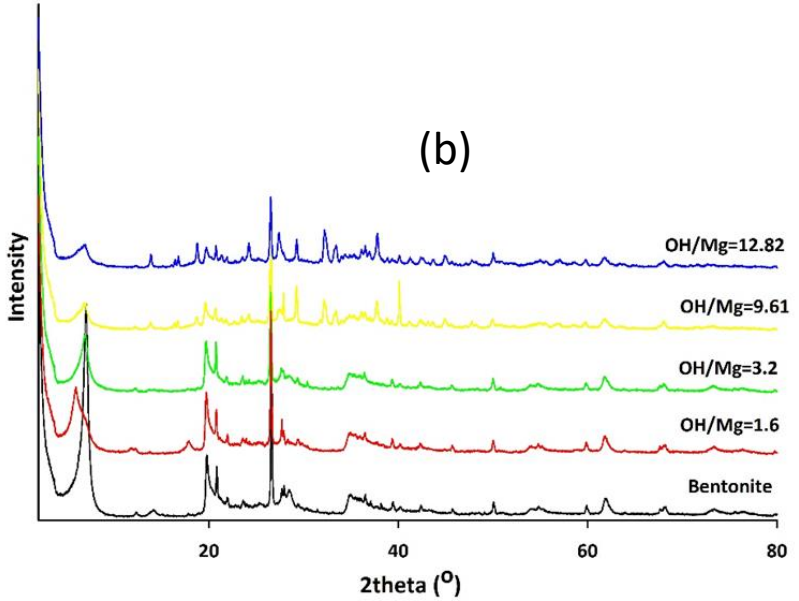
The swelling tests were carried out in model formation water (TDS 2500 ppm, pH 5) via vial test method.

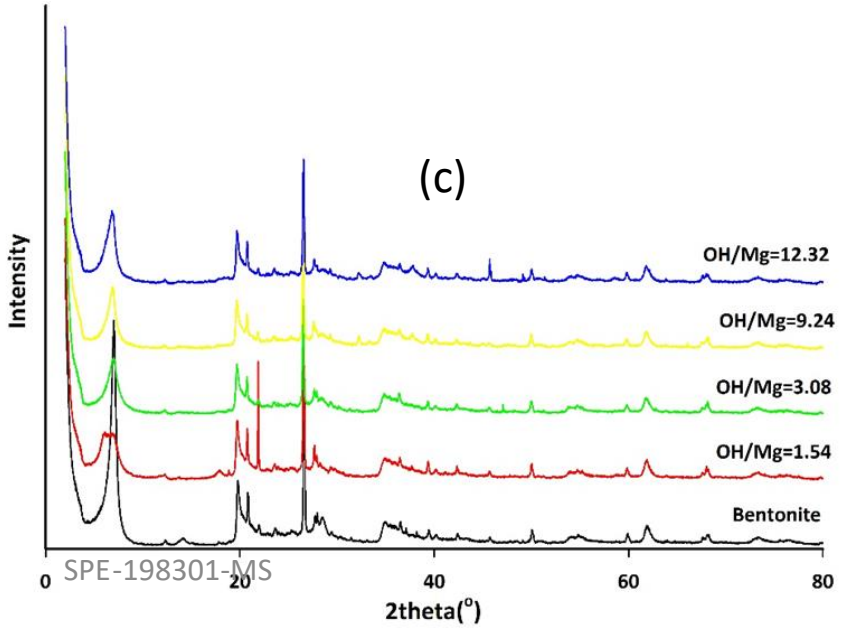




X-ray diffraction

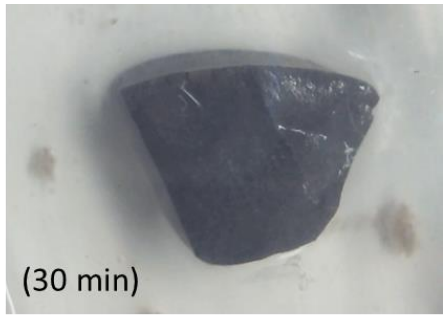


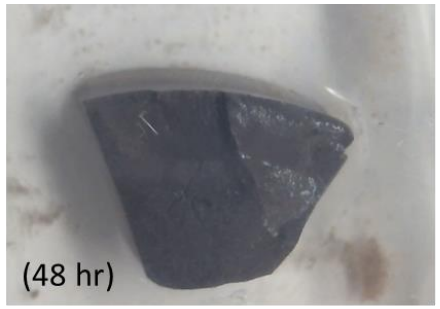


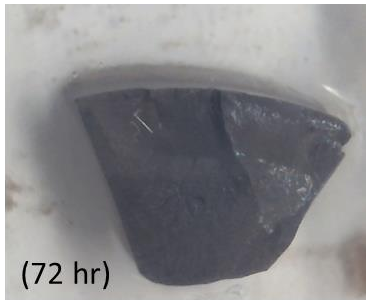


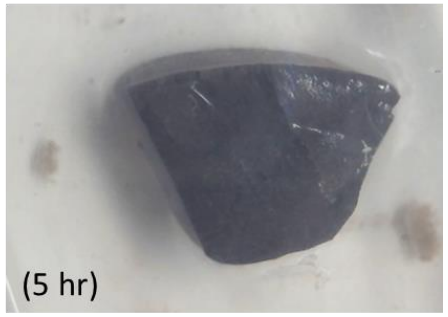
Wide angle XRD spectra of model bentonite clay precipitated with $Mg(OH)_2$ using (a) $MgCl_2 \cdot 6H_2O$ (b) $Mg(NO_3)_2 \cdot 6H_2O$ and (c) $Mg(SO4)_2 \cdot 8H_2O$ with NaOH at different OH/Mg ratio

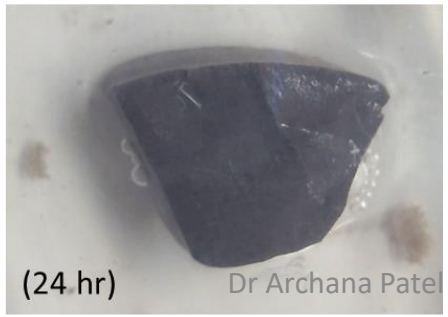
Effect of $Mg(OH)_2$ precipitation on mudstone swelling



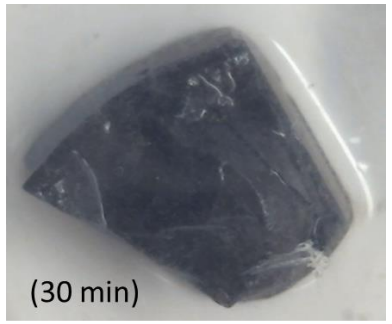


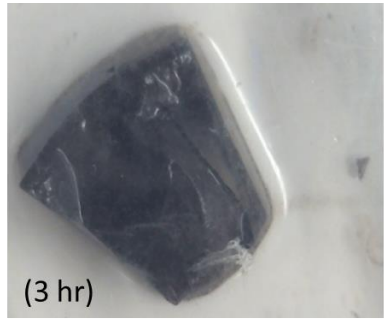


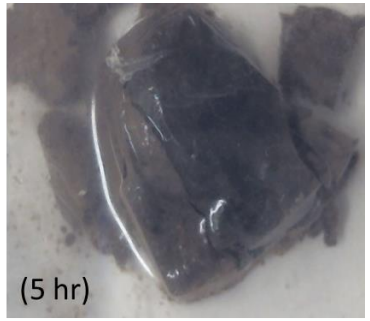




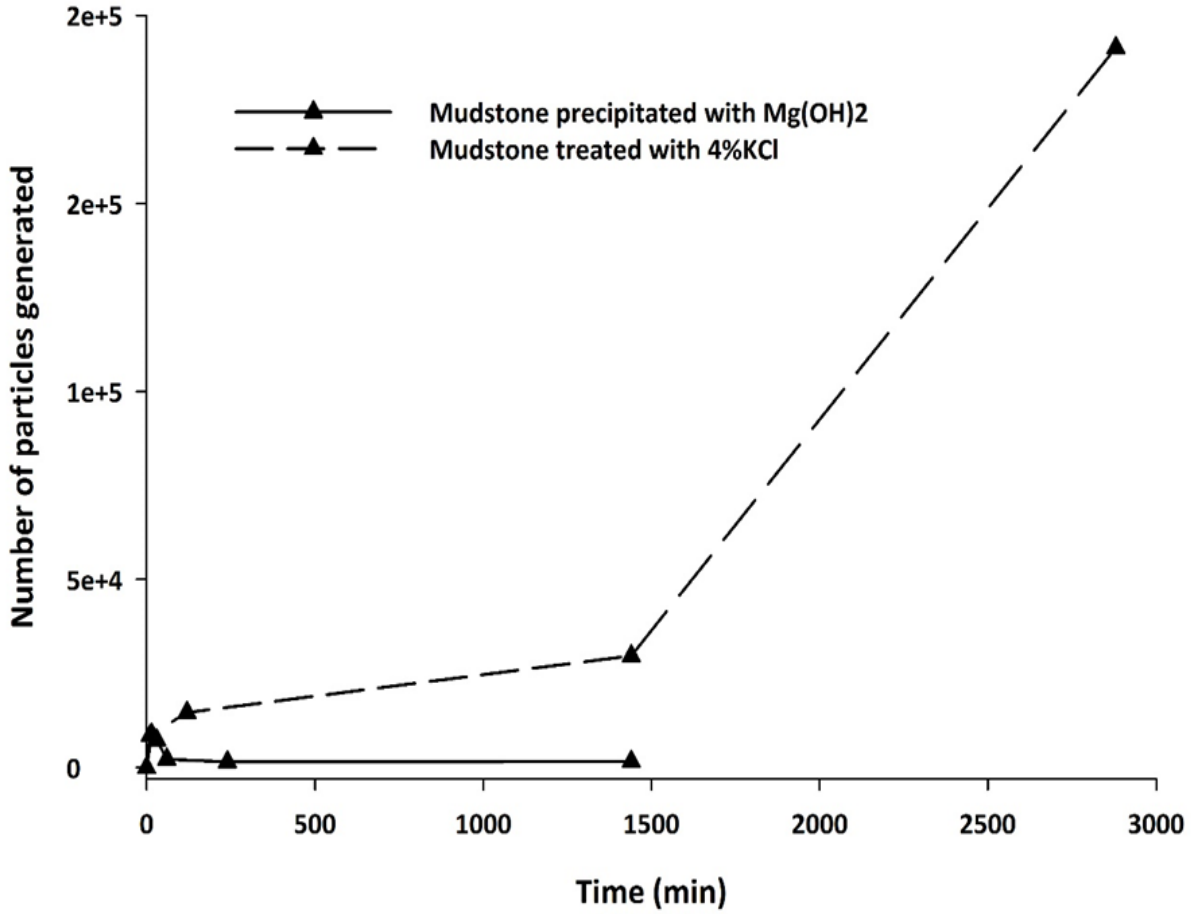
Effect of 4%KCl treatment on mudstone swelling







Amount of particles generated during flow test



Profile of number of particles generated during the mudstone flow test of sample precipitated with $Mg(OH)_2$ and treated with 4%KCl under flow of formation water

Summary of the results

- $Mg(OH)_2$ precipitation between the clay layers can inhibit clay swelling by changing the clay structure from montmorillonite to chlorite.
- Chlorite is non swelling clay so the structure change from montmorillonite to chlorite leads to swelling inhibition.
- Further experiments and investigations required to understand precipitation mechanism, swelling inhibition and fines generation in real mudstone sample.

Acknowledgements / Thank You / Questions

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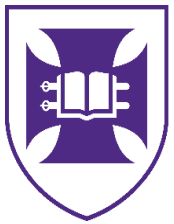
Contact details: Dr Archana Patel
Email ID: a.patel3@uq.edu.au



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