



TECH TALK SERIES

# Investigating impure water effects on rare earth bearing mineral flotation

with Associate Professor Bogale Tadesse



Thursday 2 July 2026

5:00pm - 6:00pm

Long Neck Brewery Function Space

# The Effects of Water Quality on Rare Earth Mineral Flotation

Bogale Tadesse

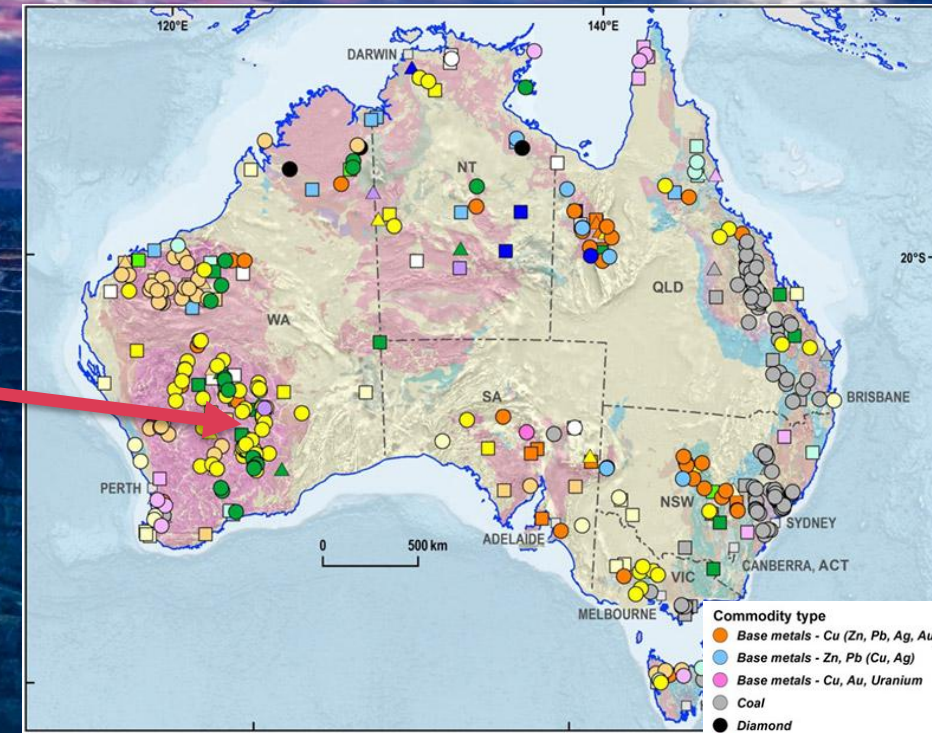
**Associate Professor**

Western Australia School of Mines, Curtin University, Australia

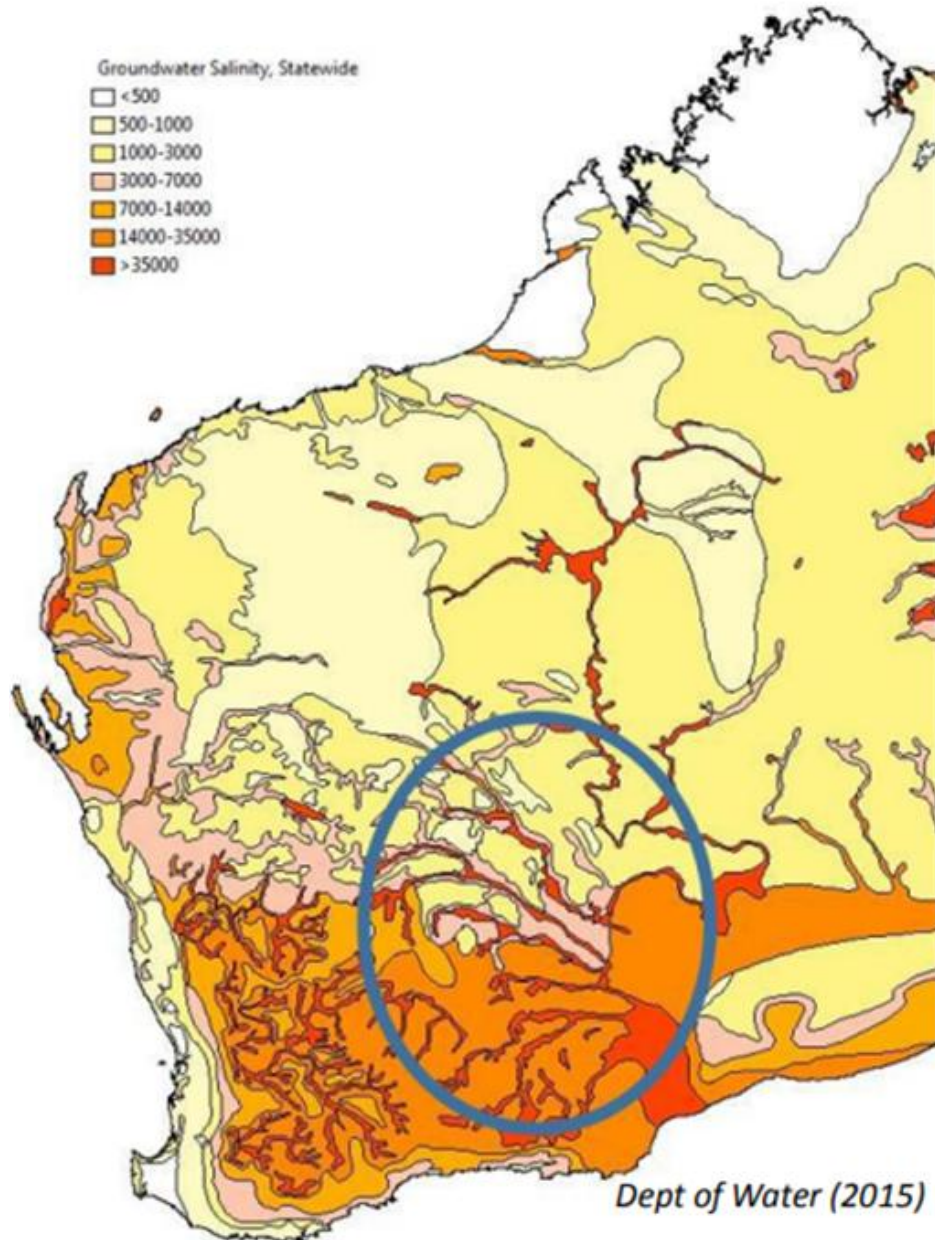
PhD Student: Moonchul Jung (Jay)

Co-authors: Laurence Dyer, Boris Albijanac

# Heart of the Mining Industry - Kalgoorlie



# Ground Water Salinity (mg/L) in Western Australia

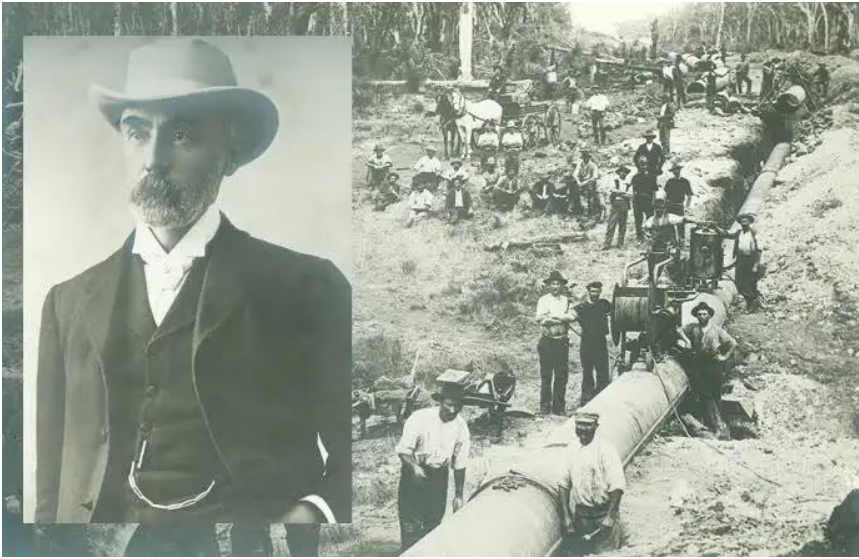


Some examples (processing plants) – typical ground water composition

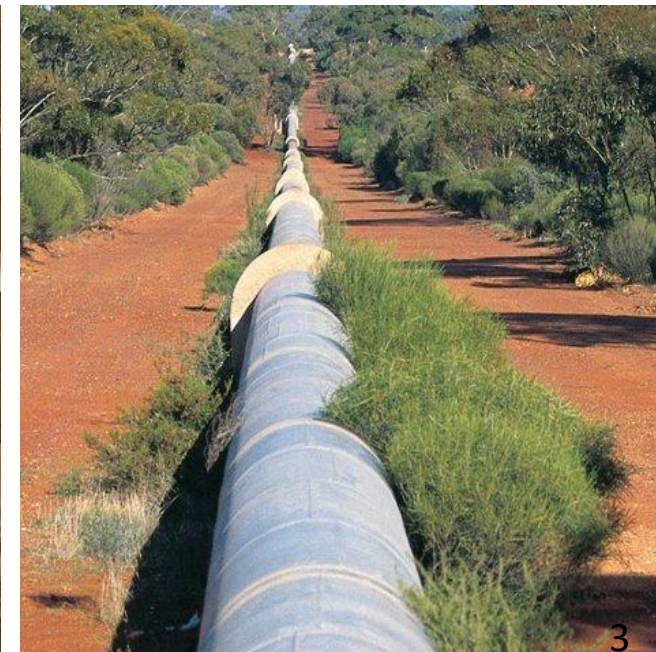
Ions (mg/L)	Mt Keith (Leinster)	Mt Weld (Laverton)
Na <sup>+</sup>	20000	2360
Ca <sup>2+</sup>	400	170
Mg <sup>2+</sup>	5100	180
SO <sub>4</sub> <sup>2-</sup>	23000	1810
Cl <sup>-</sup>	32000	776

TDS of ground water in the Goldfields region of WA ranges from 1 g/L - 250 g/L

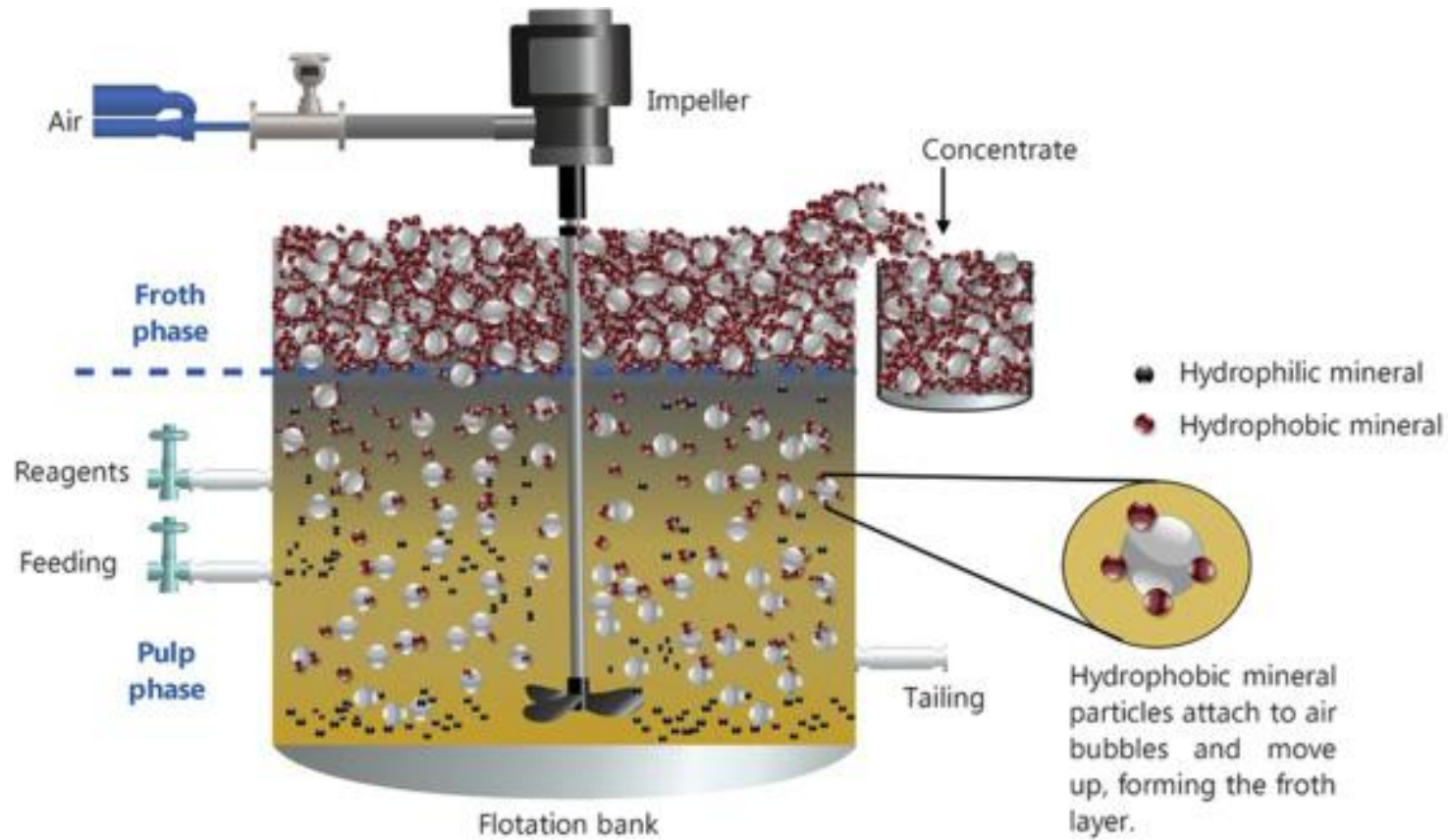
# Water scarcity is a seriously big problem in regional WA



- Story of CY O'Connor and the 566 km long Goldfields water pipeline
- Built between 1898 and 1903, the project was a world-first, as water had never before been pumped so far



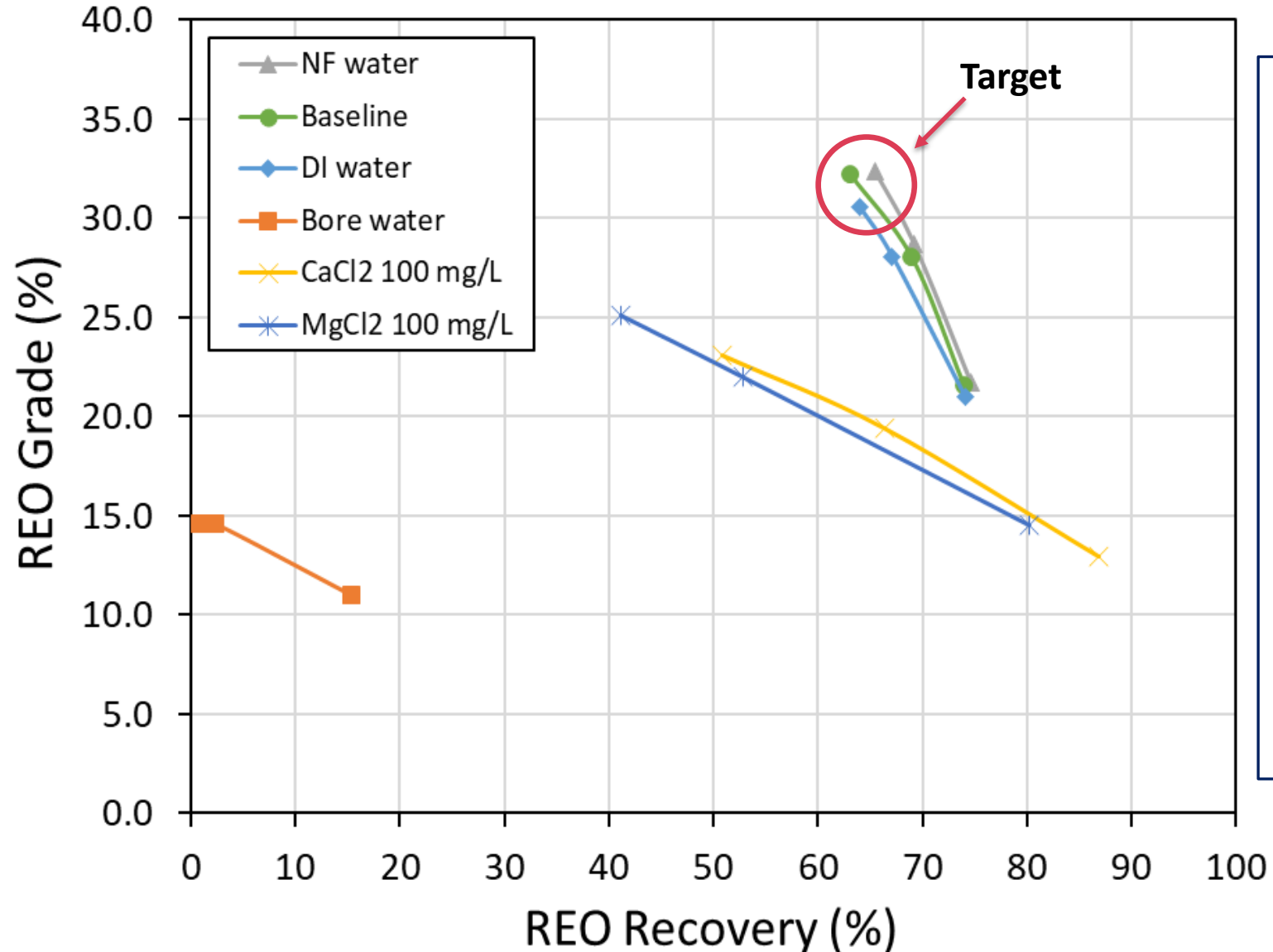
# What is Froth Flotation?



**Froth**

# Background

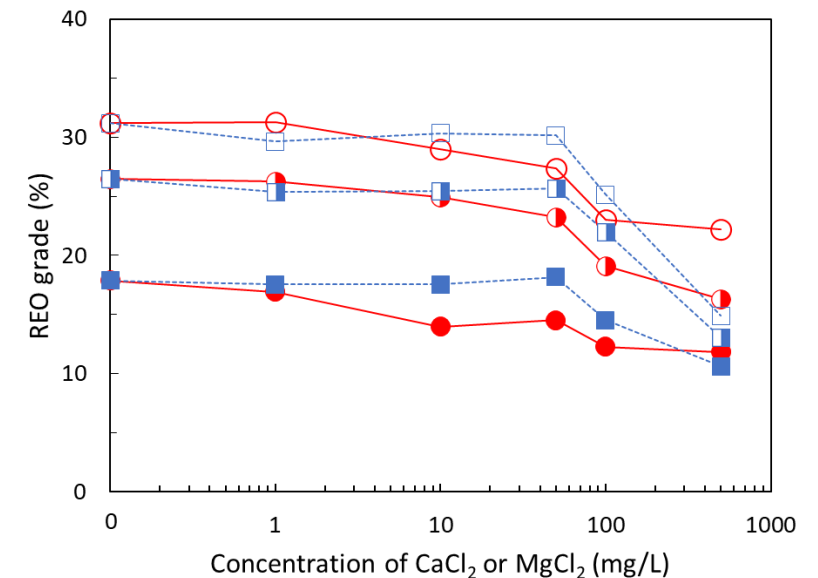
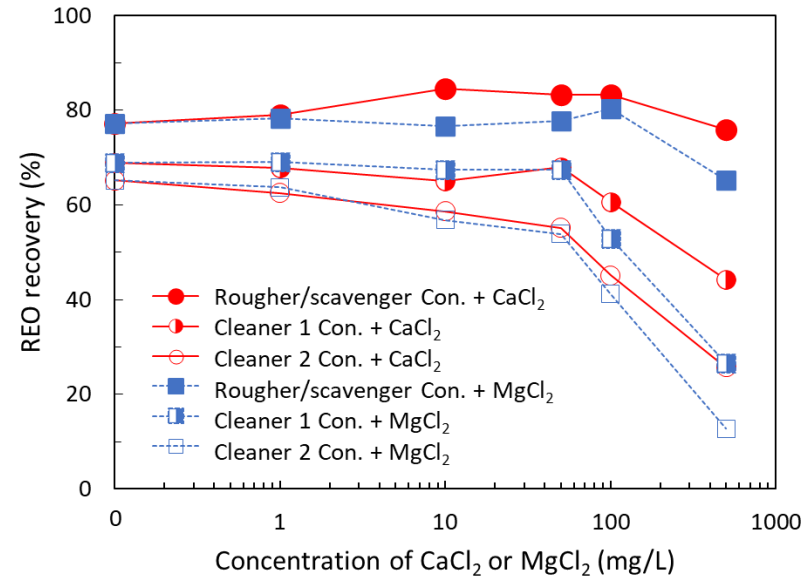
## Monazite flotation performance with different water systems



- The effects of hyper saline water in flotation of sulfide ores is well established
- The impact of divalent cations is generally well studied
- Studies on water chemistry in rare earth minerals flotation are not common

# Motivation and Objectives

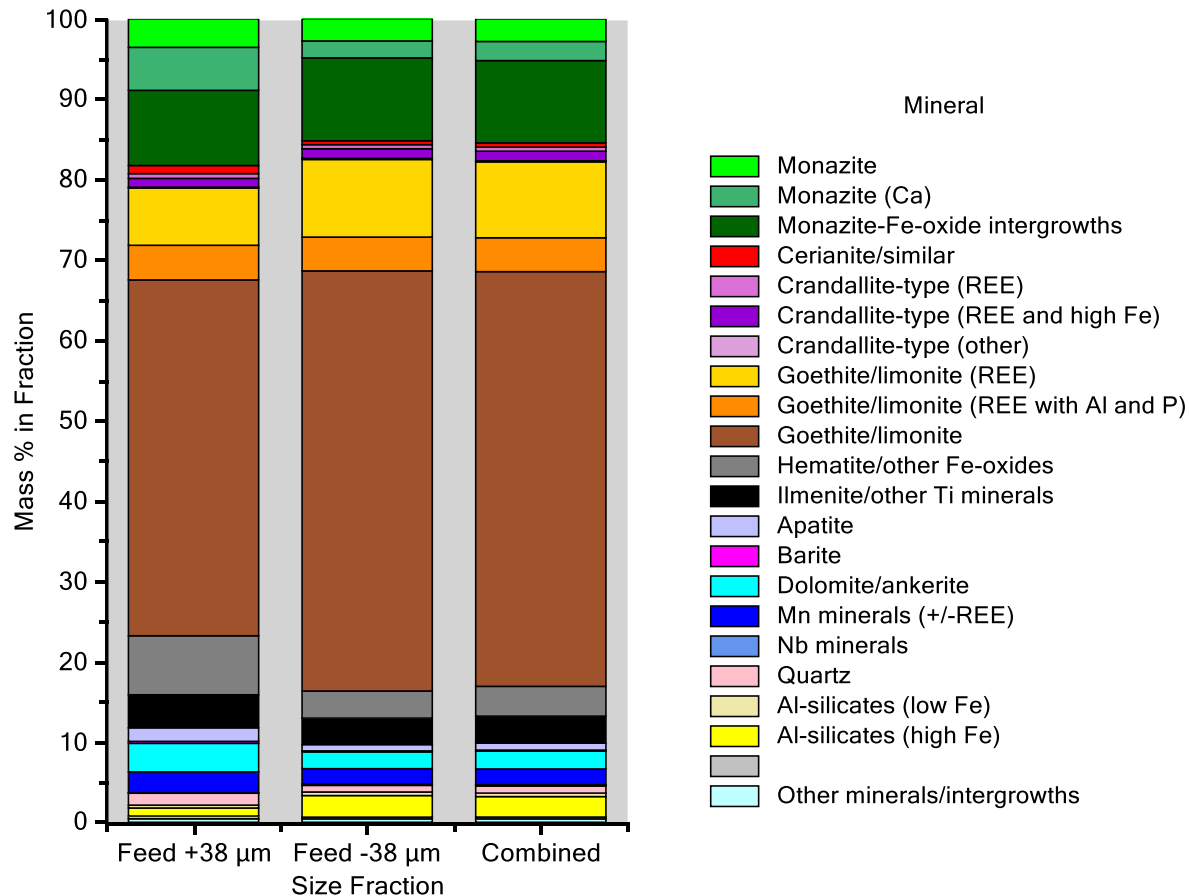
- Investigate the impact of monovalent and divalent ions on the flotation of REE (monazite)
- Quantify concentrations at which the impact of ions is detrimental – what is the threshold?
- Investigate alternative water treatment options



# Methodology

## Characterization of ore by QEMSCAN

Mineral abundance  
Feed

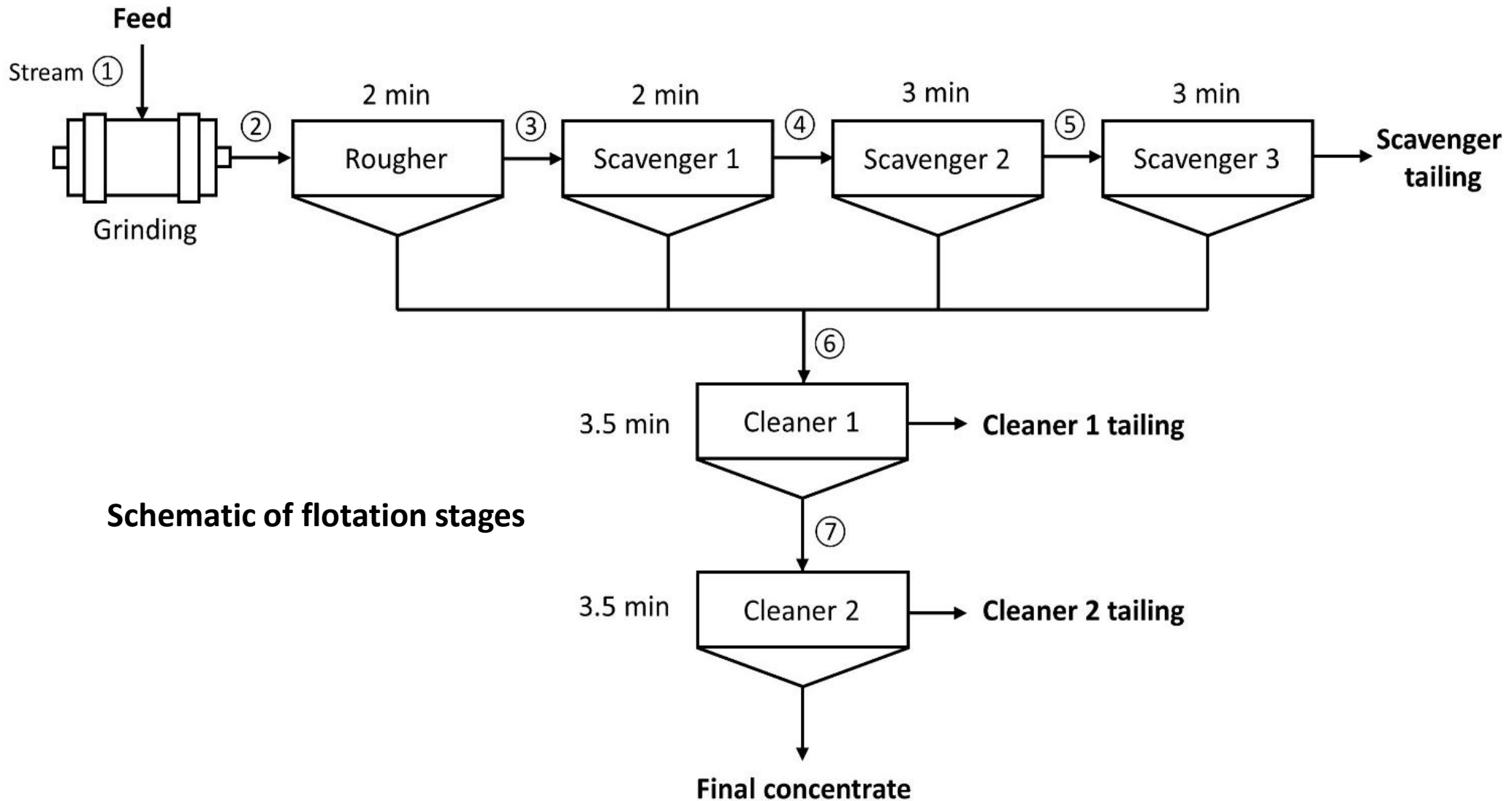


Mineral	Mass %
Monazite	<u>2.8</u>
Monazite (Ca)	<u>2.4</u>
Monazite-Fe-oxide intergrowths	<u>10.2</u>
Cerianite/similar	0.5
Crandallite-type (REE)	0.5
Crandallite-type (REE and high Fe)	1.2
Crandallite-type (other)	0.1
Goethite/limonite (REE)	<u>9.4</u>
Goethite/limonite (REE with Al and P)	<u>4.2</u>
Goethite/limonite	<u>51.6</u>
Hematite/other Fe-oxides	3.7
Ilmenite/other Ti minerals	3.4
Other minerals/intergrowths	8.9
<b>TOTAL</b>	<b>100.0</b>



**- 9.8% total REO (analyzed by XRF)**  
**- at P80 of 38 µm, 70% liberation**

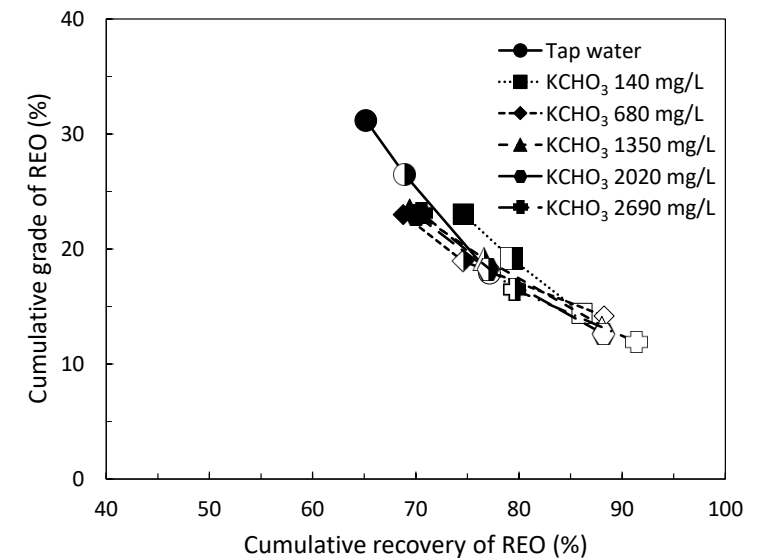
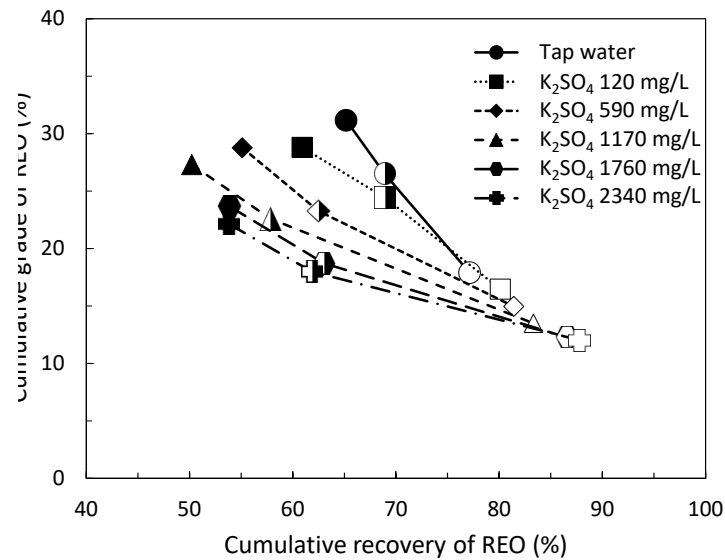
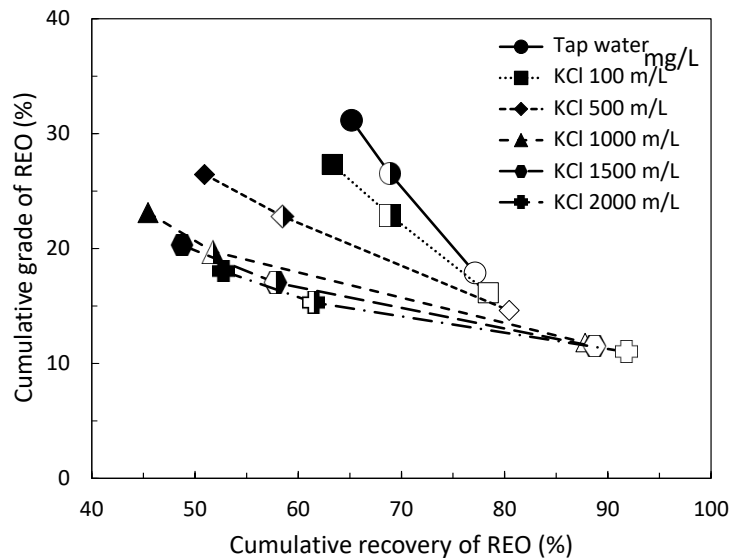
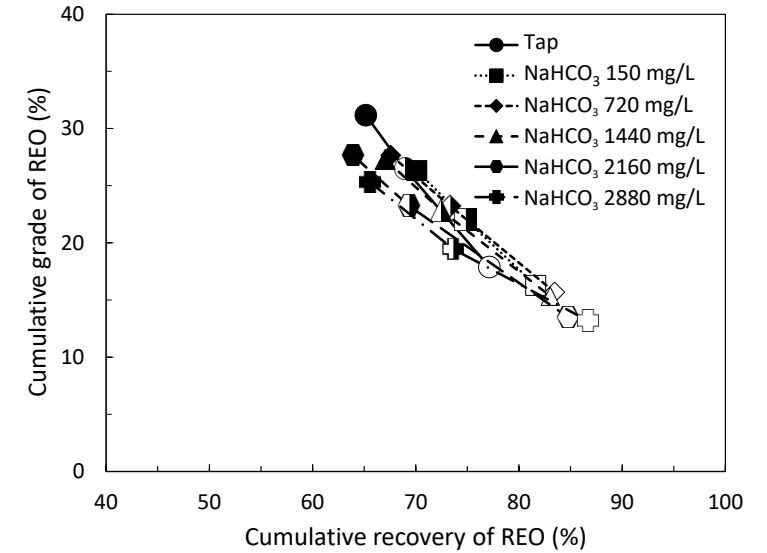
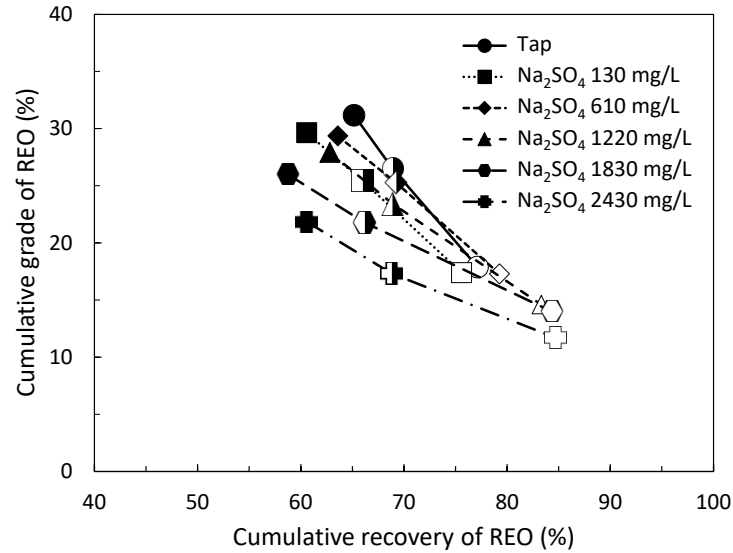
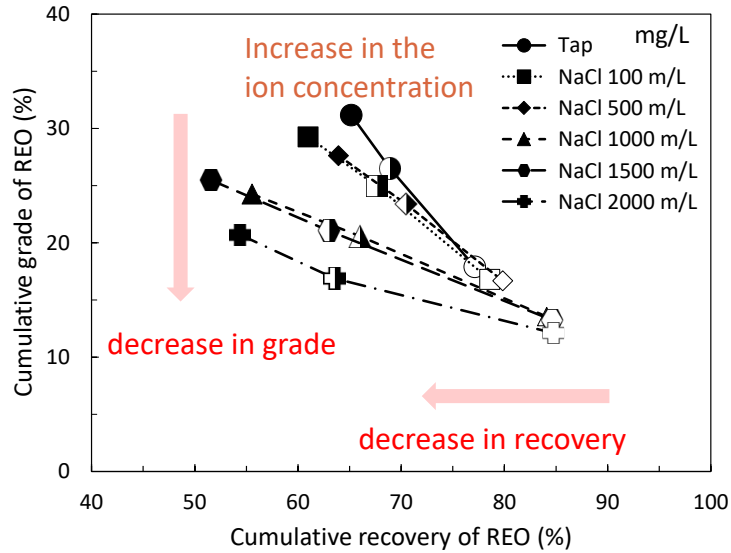
# Procedure of bench scale flotation experiments



- Different concentrations of Ca, Mg, Na and K salts were added during flotation

# Results and Discussion

## Grade and Recovery curve



- Detrimental effect in the order:  $\text{Cl}^- > \text{SO}_4^{2-} > \text{HCO}_3^-$



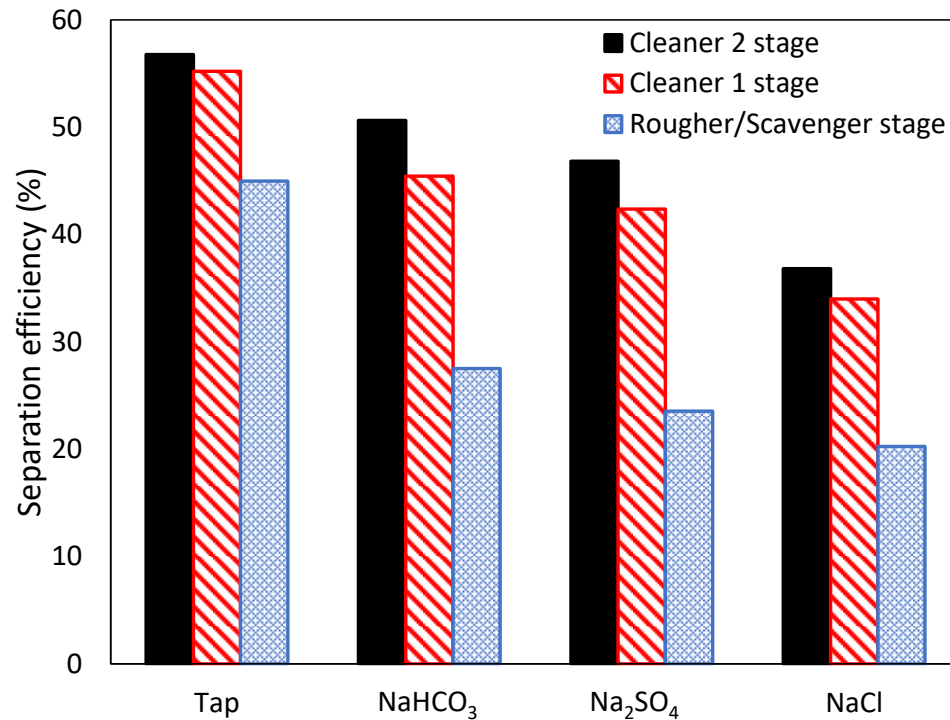
# Effects of ions on the separation efficiency

$$\text{Separation efficiency (S.E.)} = R_m - R_g$$

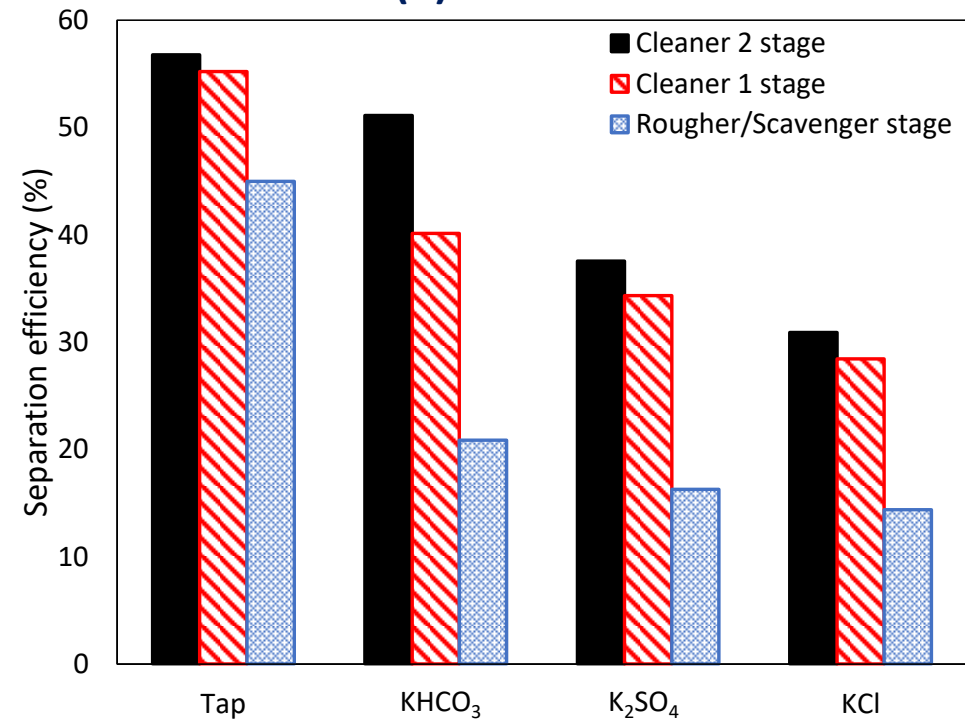
$R_m$  = recovery of RE minerals

$R_m$  = recovery of FeO minerals

(a) Sodium salts

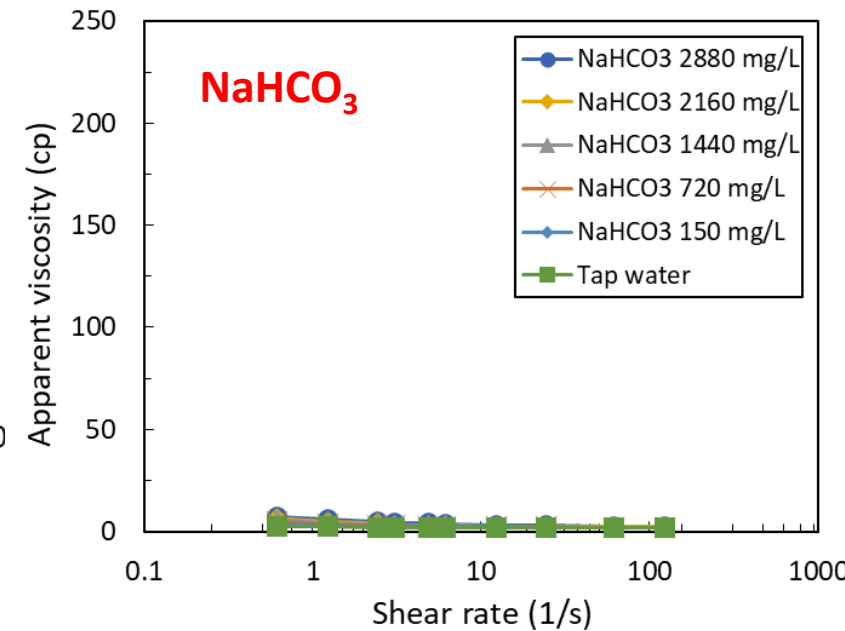
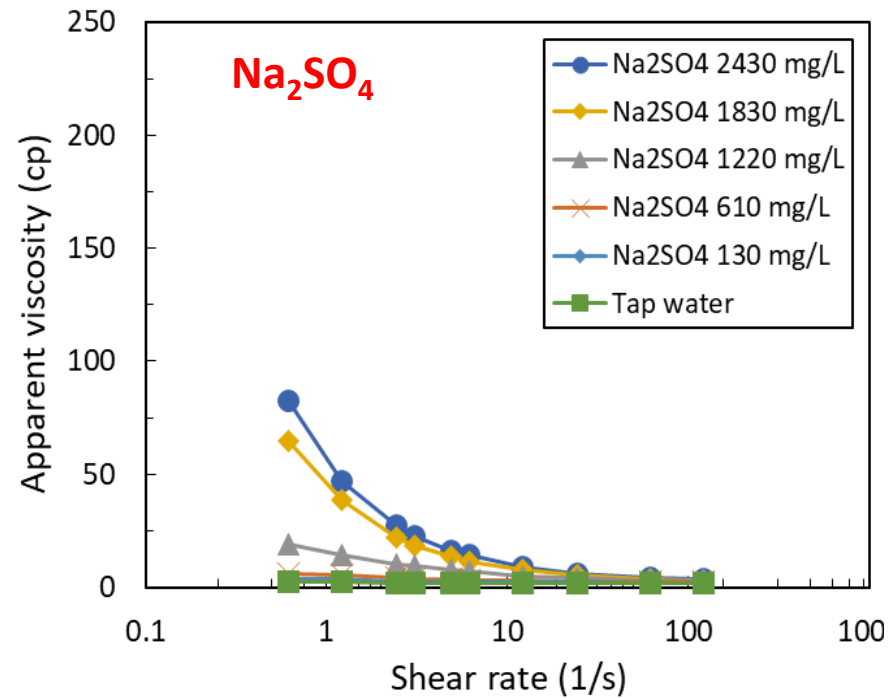
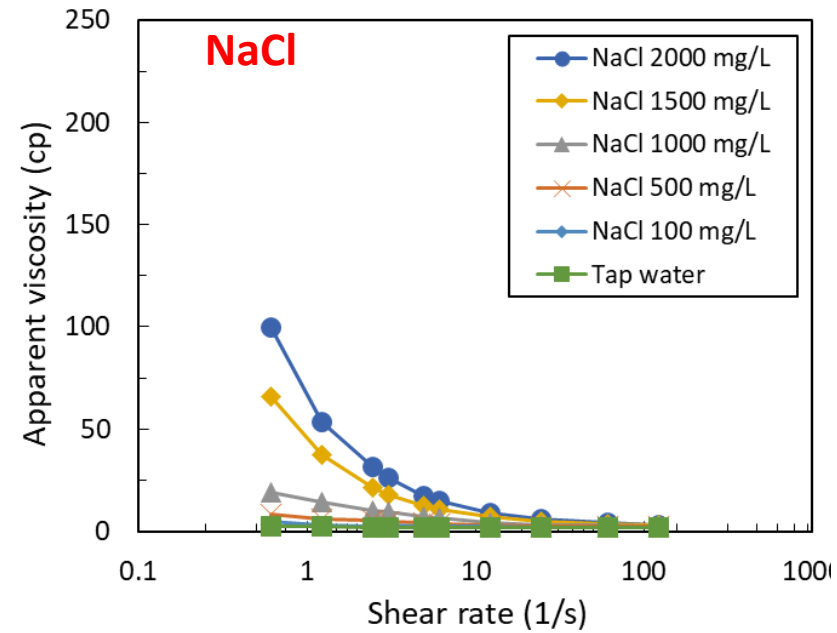


(b) Potassium salts



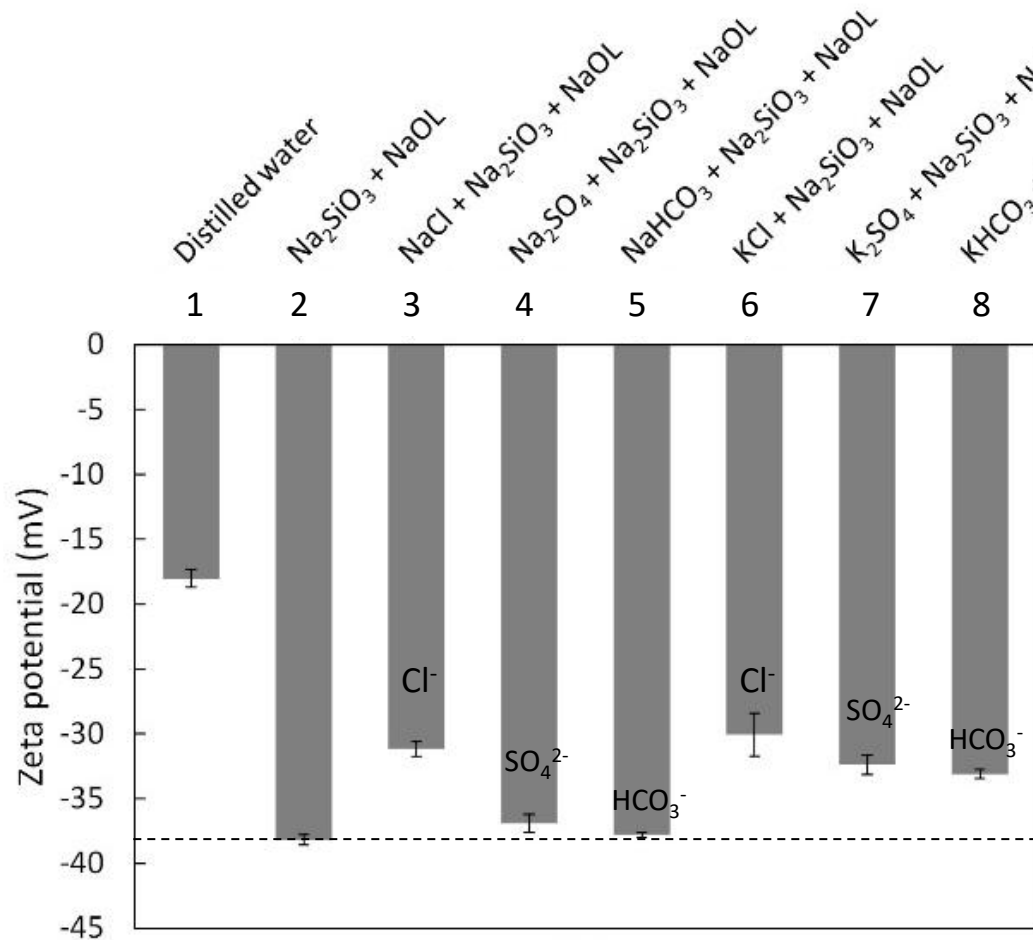
- Separation efficiency was higher in the following order:  
Tap > HCO<sub>3</sub><sup>-</sup> > SO<sub>4</sub><sup>2-</sup> > Cl<sup>-</sup>

# Apparent pulp viscosity vs various salt concentrations

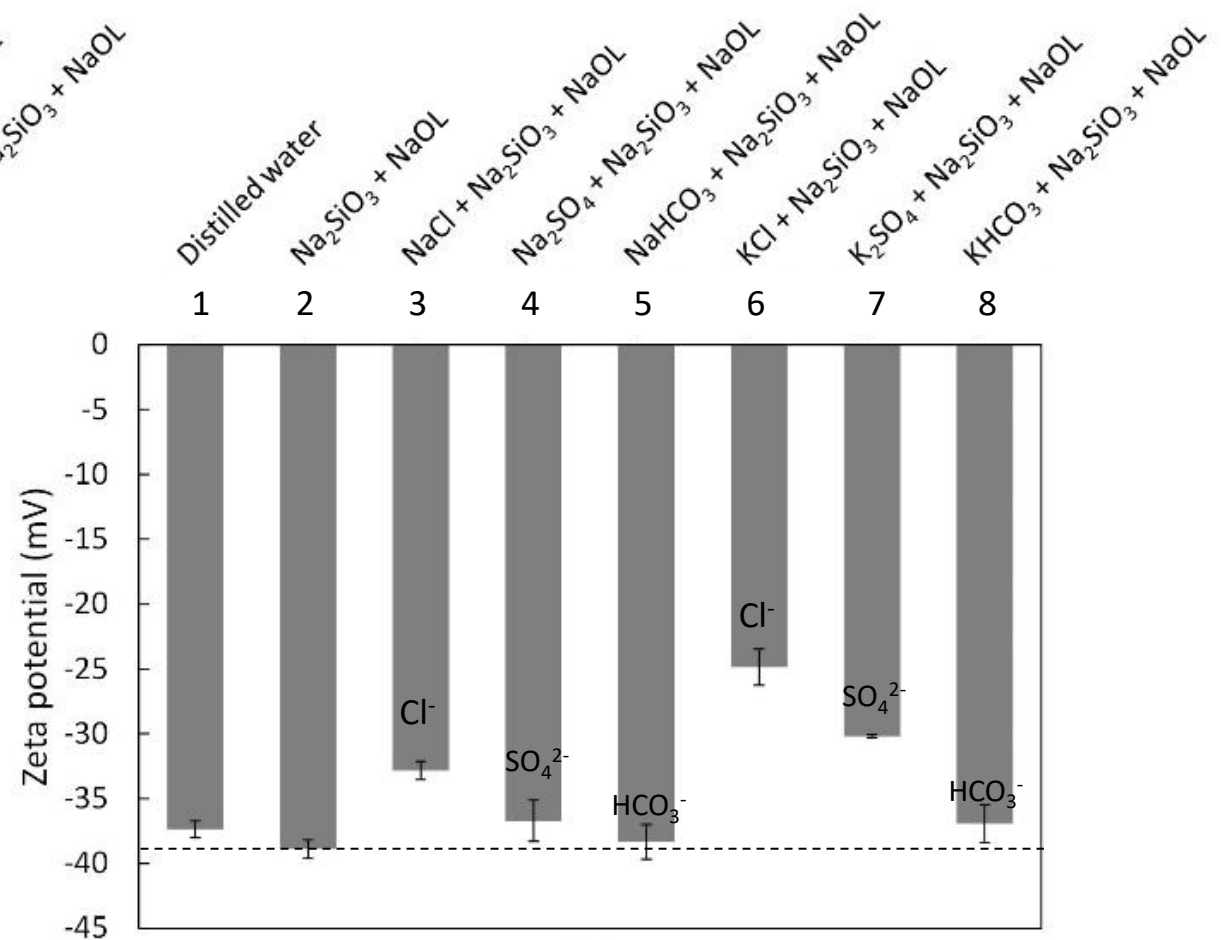


- The impact was significant in the following order:  
 $\text{Cl}^- > \text{SO}_4^{2-} > \text{HCO}_3^-$

# Effects of anions on the zeta potential of mineral particles



(a) Monazite

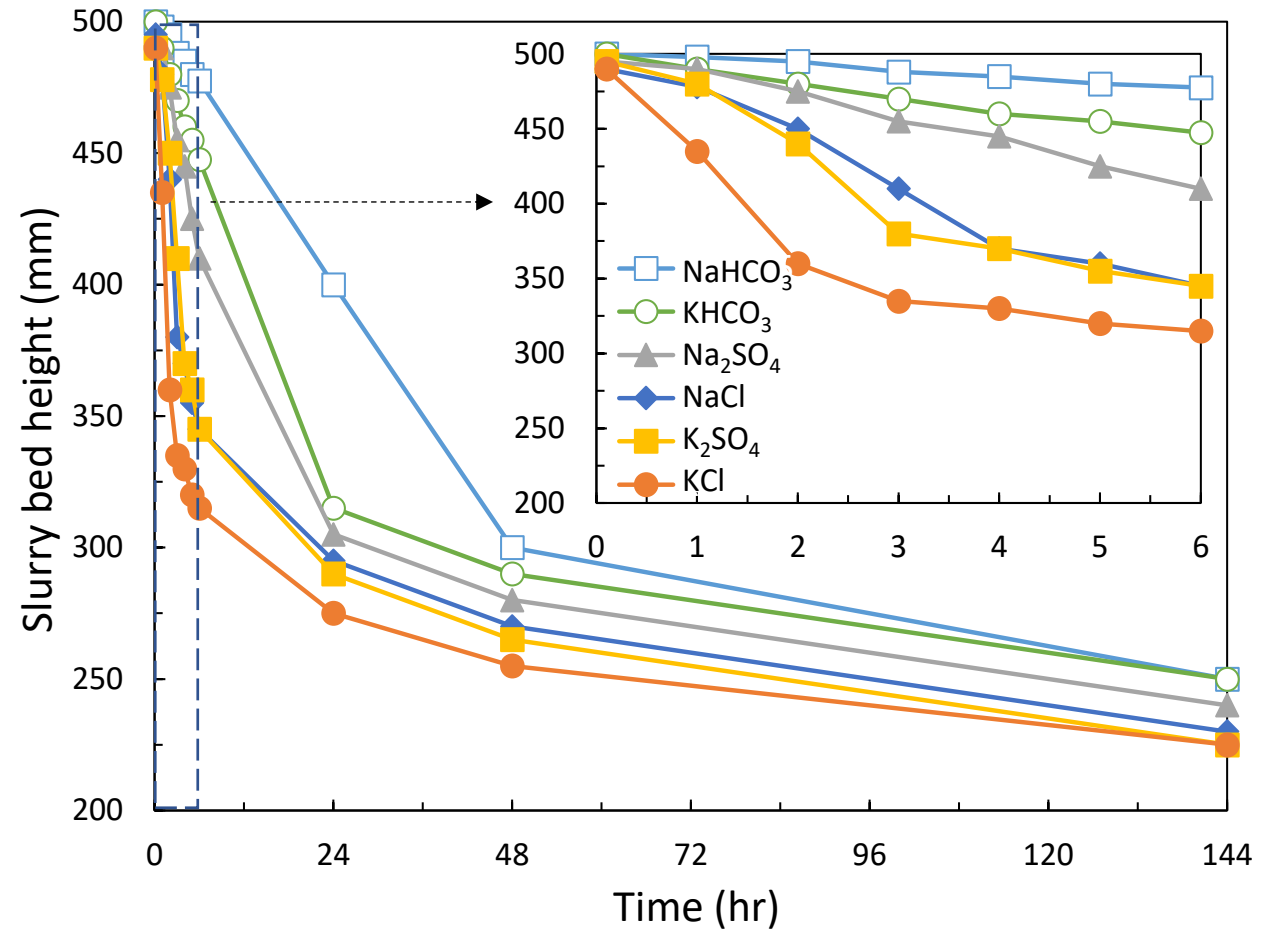
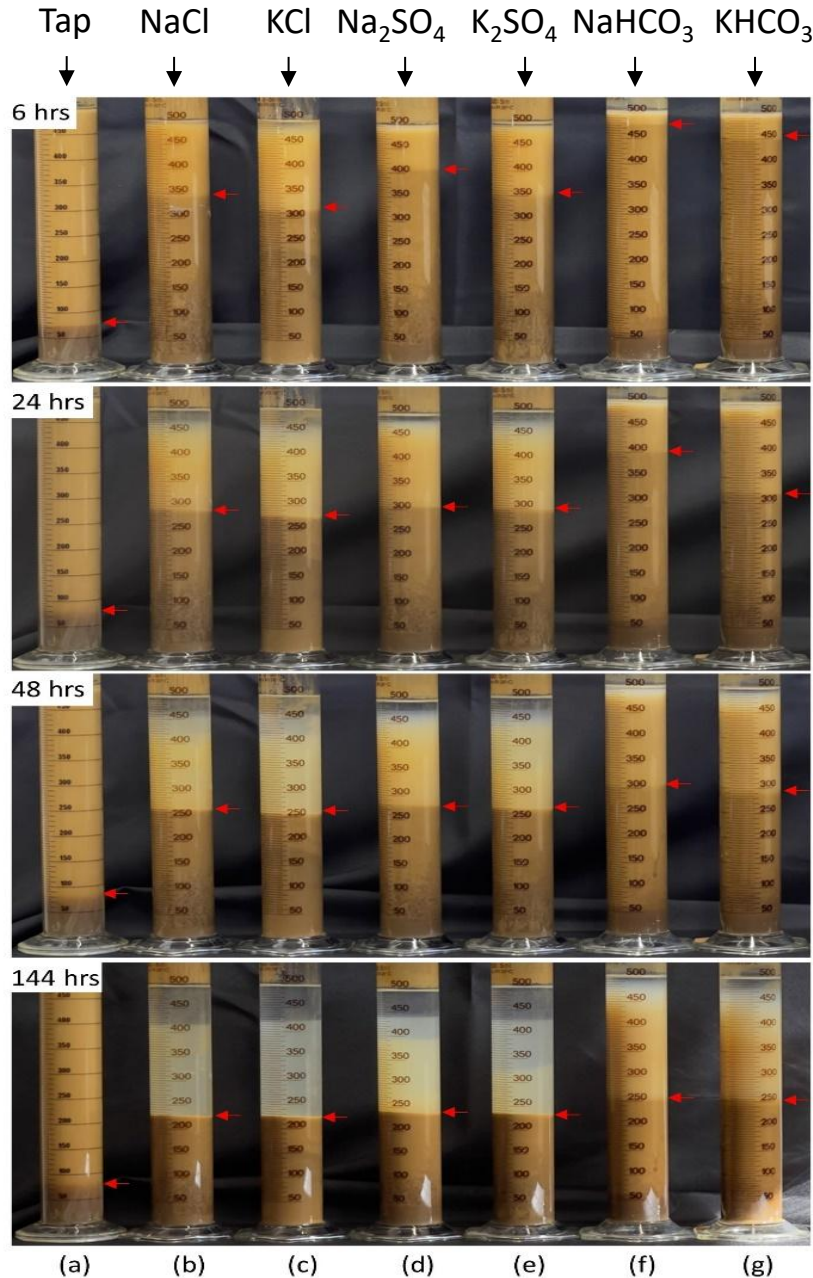


(b) Goethite

- The impact was significant in the following order:  
Cl<sup>-</sup> > SO<sub>4</sub><sup>2-</sup> > HCO<sub>3</sub><sup>-</sup>

[Na<sub>2</sub>SiO<sub>3</sub>] = 3800 g/t and [NaOL] = 2200g/t

# Settling rate in the presence of ions



■ Settling rate

$KCl > K_2SO_4 > KHCO_3$   
 $NaCl > Na_2SO_4 > NaHCO_3$

# Take home message

- If you are in the business of floating rare earths, please pay attention to ions in process water!

- May be nano filter it!

- < 5 mg/L in filtrate for  $\text{Mg}^{2+}$  and  $\text{Ca}^{2+}$
- < 250 mg/L for  $\text{Na}^+$  and  $\text{Cl}^-$
- < 10 mg/L for  $\text{SO}_4^{2-}$

- Offer: half price!!



# Publications

Journal of Rare Earths 42 (2024) 2172–2182



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Contents lists available at [ScienceDirect](#)

## Journal of Rare Earths

journal homepage: <http://www.journals.elsevier.com/journal-of-rare-earths>



Minerals Engineering 205 (2024) 108461

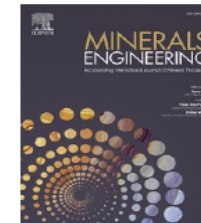


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## Minerals Engineering

journal homepage: [www.elsevier.com/locate/mineng](http://www.elsevier.com/locate/mineng)



Colloids and Surfaces A: Physicochemical and Engineering Aspects 653 (2022) 129975

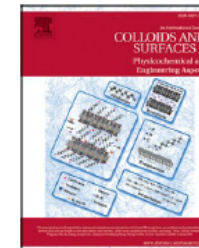


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