Thermodynamic Modeling of Lake Katwe Brine for Industrial Salt Extraction

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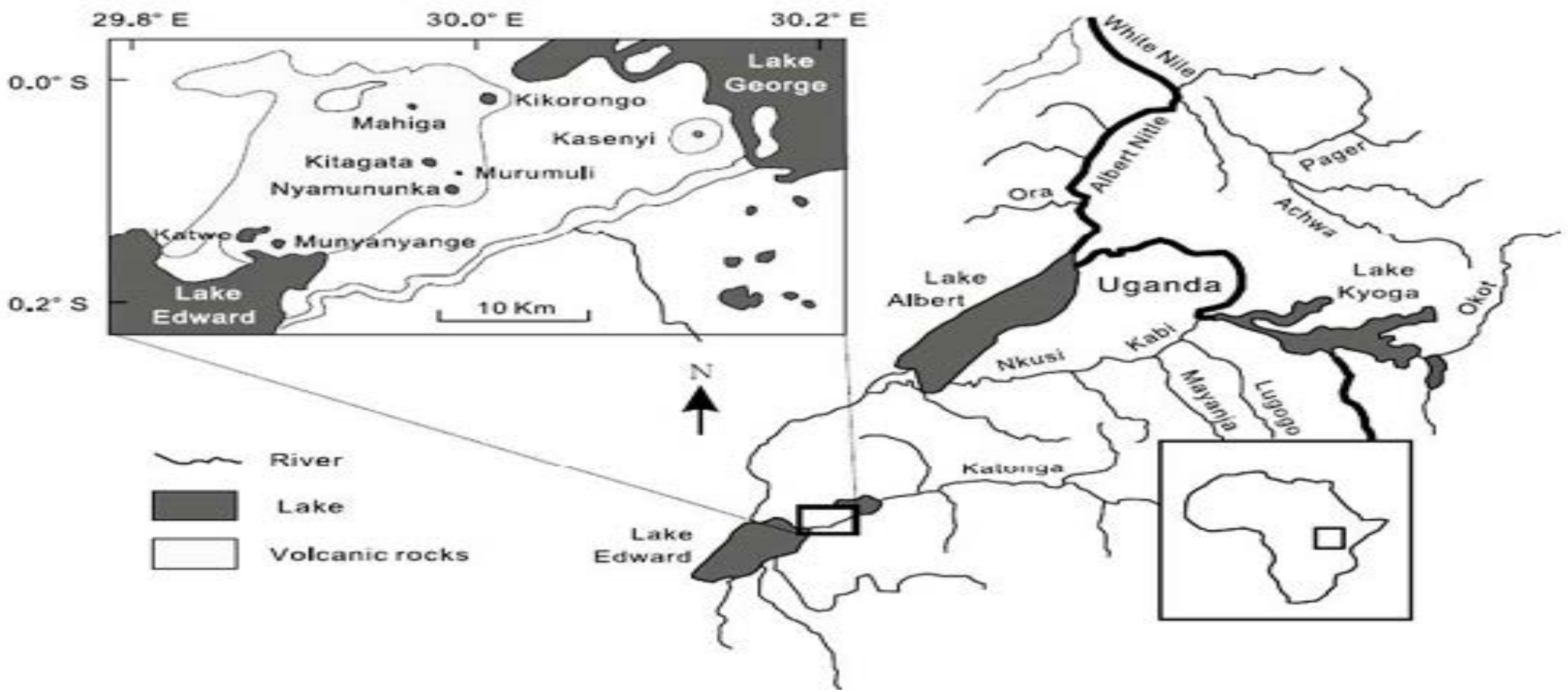
Location



Source: Ma et al., 2011

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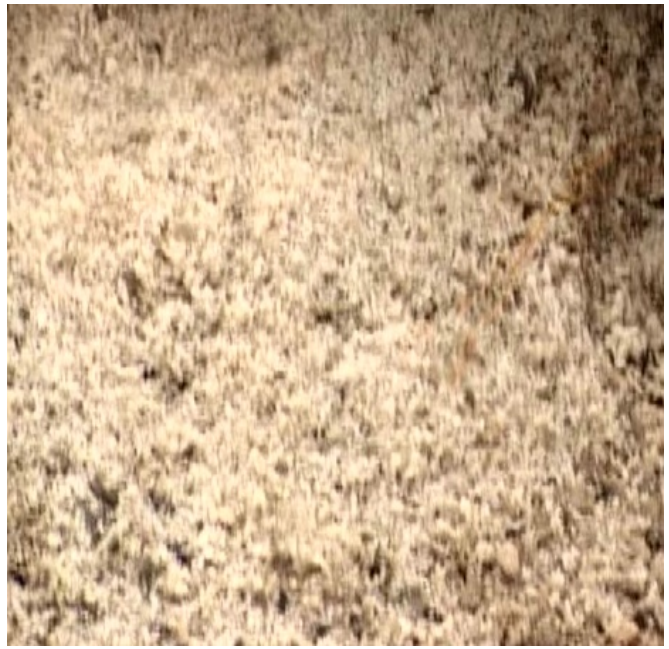


Previous Works

- Previous studies have characterized and have shown that the brines are highly alkaline and rich in Na^+, K^+, Cl^-, SO_4^{2-}, CO_3^{2-}, and HCO_3^-.

- they contain trace amounts of Mg^{2+}, Ca^{2+}, Br^-, and F^-.

- The lake is hydro-chemically of a carbonate type with the brines showing an intermediate transition between Na-Cl and Na-HCO_3 water types.

- They, however, did not investigate the effect of temperature and other physico-chemical brine parameters on the crystallization process in their study.

Materials and methods

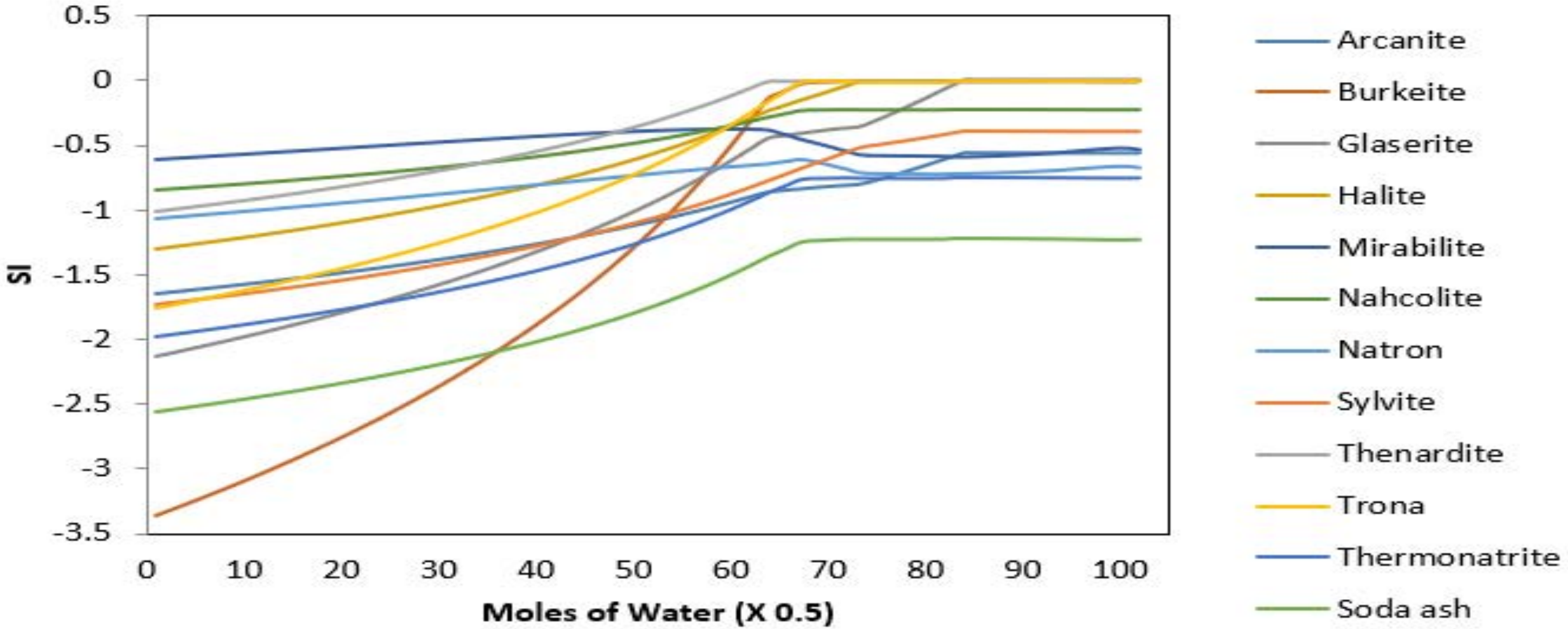
PHREEQC program version 3.0, a geochemical software was used to model the thermodynamics of Lake Katwe brine.

Season	H	Brine Temp (°C)	Density (g/ml)	EC (us/m)	Na	K	Mg	Ca	Cl	Br	SO_4	HCO_3	CO_3
Rainy	9.72	25.2	1.15	14109	69.6	11.6	0.0519	0.0048	44.2	0.461	32.7	18.2	38.8
Dry	9.69	30.0	1.19	15127	87.3	14.8	0.0613	0.0046	50.8	0.561	40.4	22.1	46.5
Mean	**9.71**	**27.6**	**1.17**	**14618**	**78.5**	**13.2**	**0.0566**	**0.0047**	**47.5**	**0.511**	**36.6**	**20.2**	**42.7**

Results & Discussions

Phase		SI
Arcanite	K_2SO_4	-1.65
Burkeite	$Na_6CO_3(SO_4)_2$	-3.40
CO_2	CO_2	-3.47
Glaserite	$NaK_3(SO_4)_2$	-2.15
H2O	H2O	-1.48
Halite	NaCl	-1.31
Kalicinite	$KHCO_3$	-2.71
Mirabilite	$Na_2SO_4 \cdot 10H_2O$	-0.62
Misenite	$K_8H_6(SO4)_7$	-67.68
Nahcolite	$NaHCO_3$	-0.83
Natron	$Na_2CO_3 \cdot 10H_2O$	-1.08
Soda ash	$Na_2(CO_3)$	-2.57
Sylvite	KCl	-1.73
Thenardite	Na_2SO_4	-1.03
Themonatrite	$Na_2CO_3 \cdot H_2O$	-2.15
Trona	$Na_3H(CO_3)_2 \cdot 2H_2O$	-1.76

Brine Concentration



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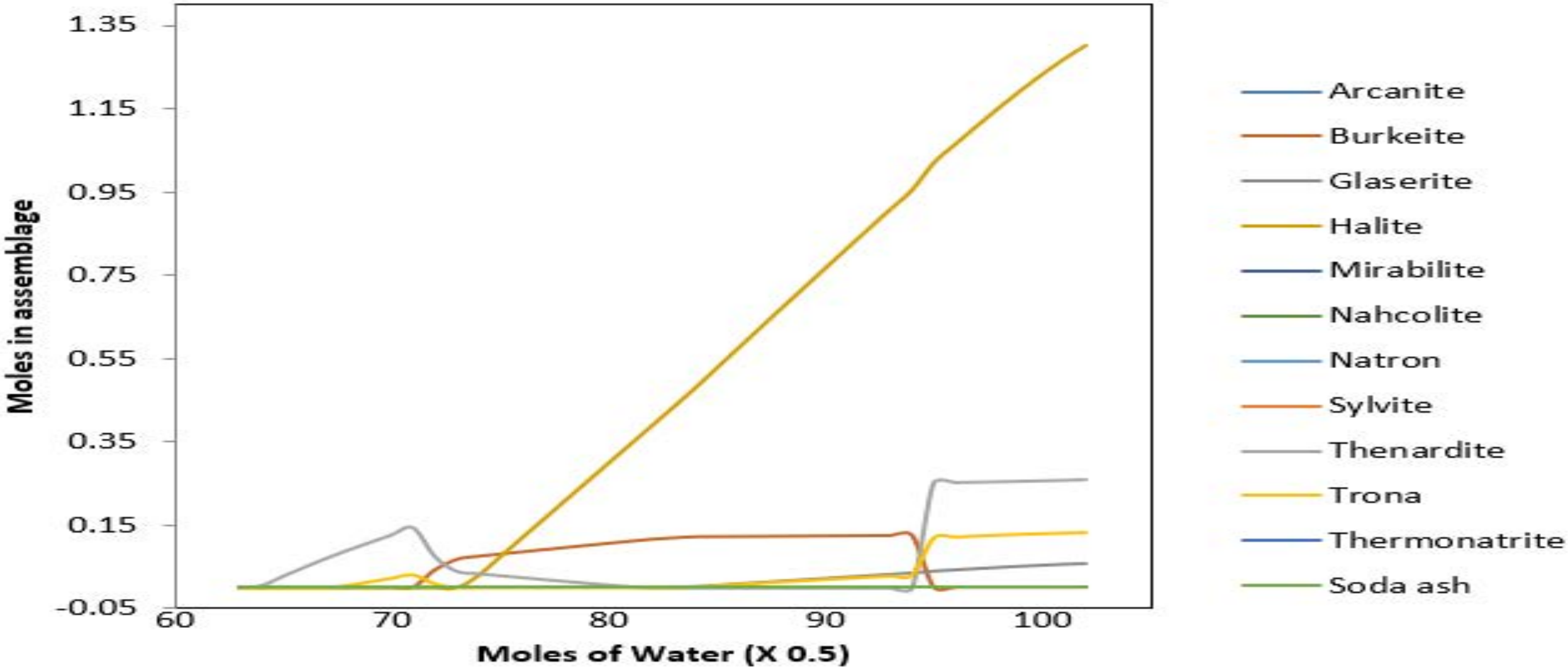
Mineral yield variation with brine concentration



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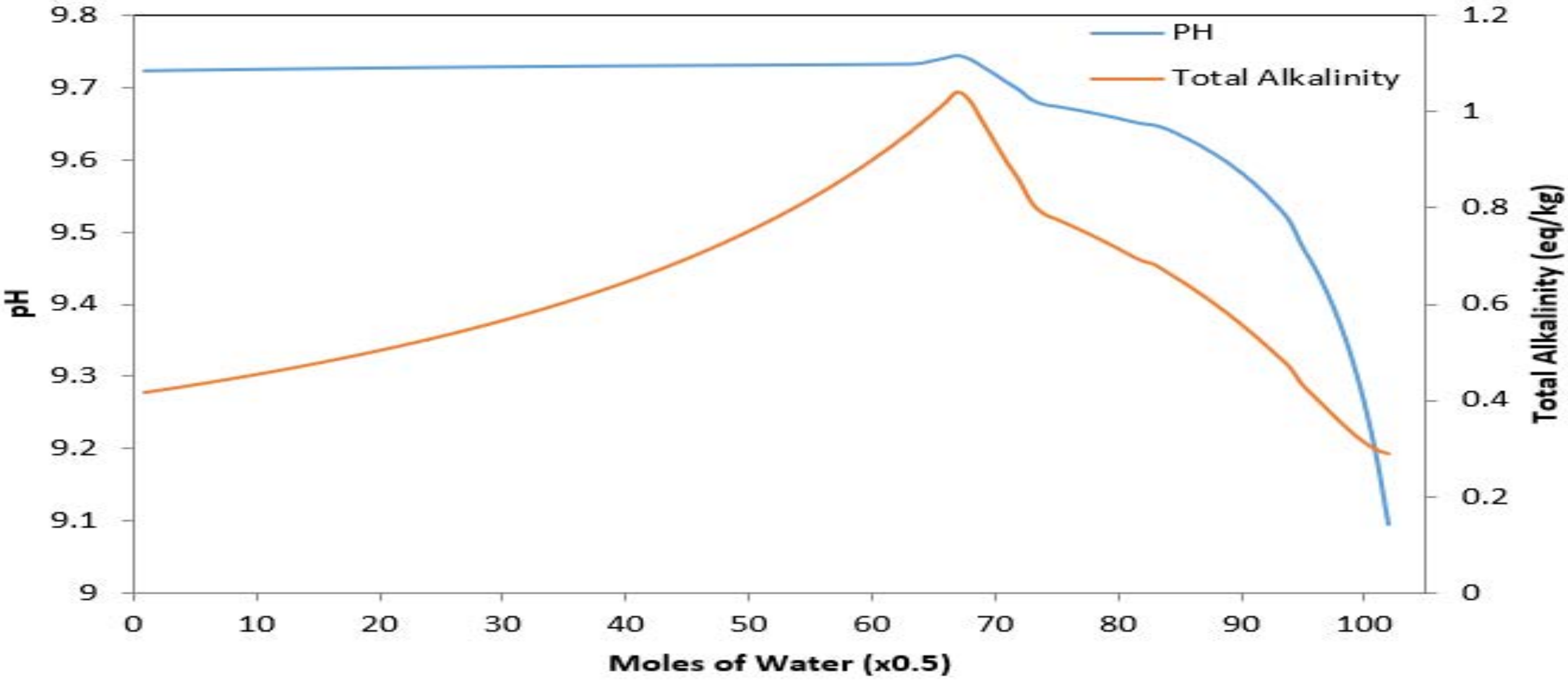
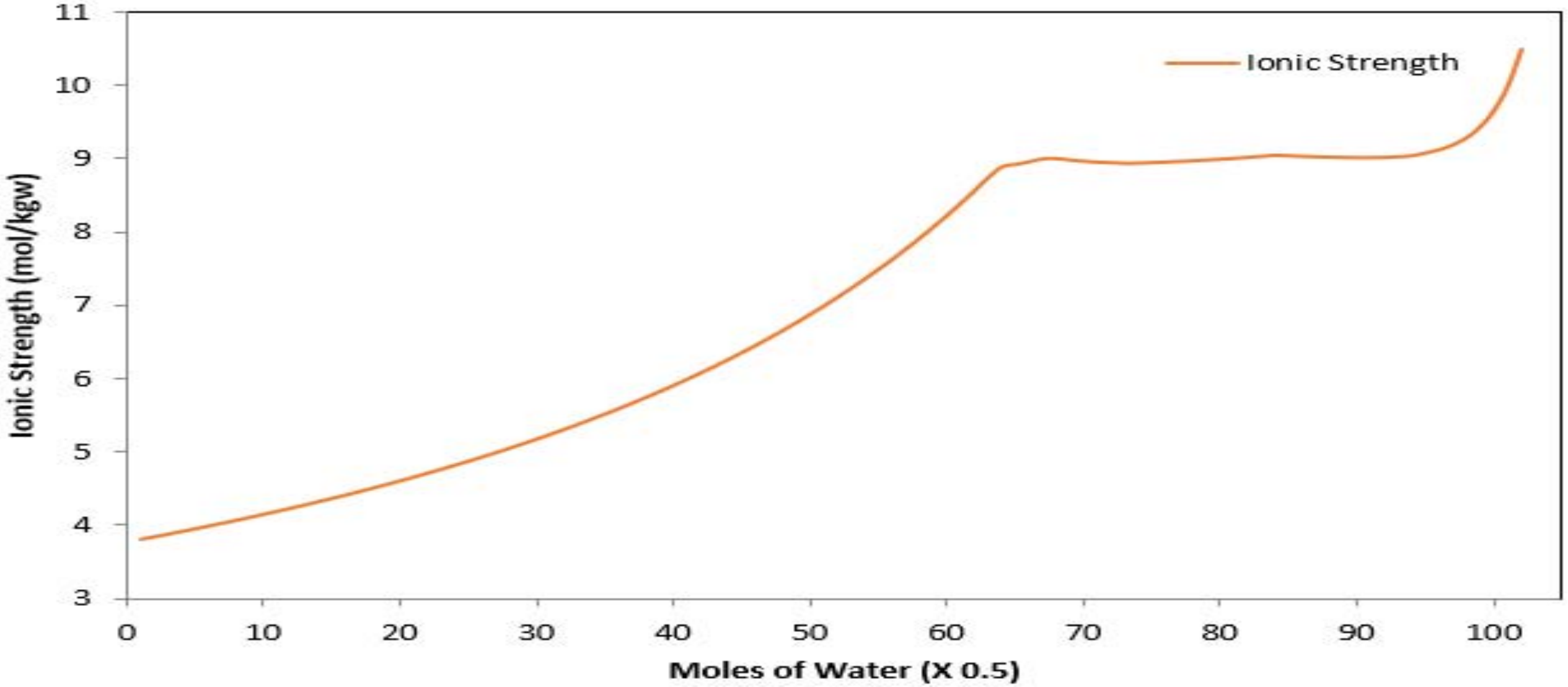
pH and Alkalinity variation with brine concentration



Ionic strength variation with brine concentration



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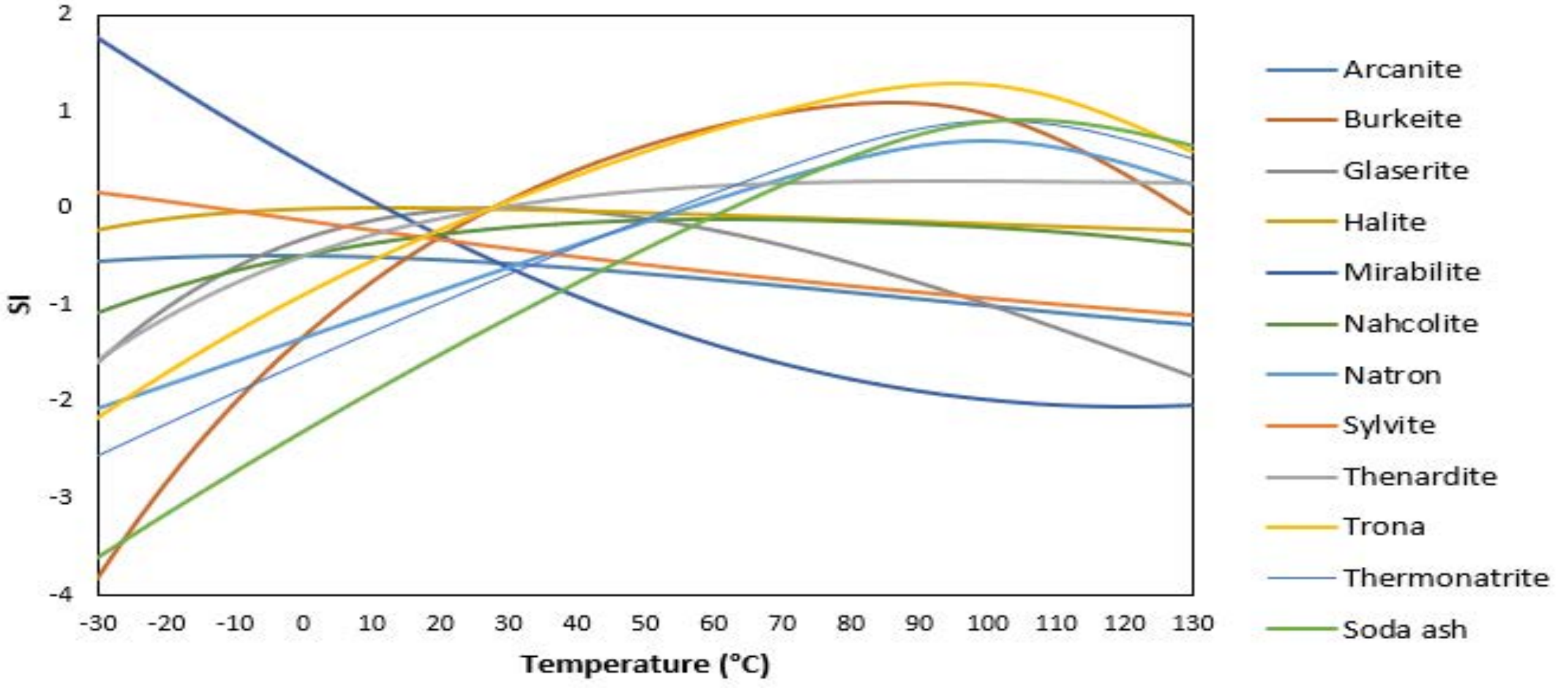
Effect of temperature on mineral solubility



Conclusions

- Thenardite, Trona, Burkeite, Halite, and Glaserite are the feasible salts that could be extracted at industrial scale.

- Several minerals precipitate massively at different temperatures

- concentration factor (65 – 95), pH (9.745 – 9.095), alkalinity (0.15 – 1.5 (eq/kg), and ionic strength (8.9 – 9.0 (mol/kgw)

- Experimental investigation need to be undertaken to validate the model results

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Thank you