Investigating the impact of $\{Fe^{2+}\}:\{HS^-\}$ ratio on FeS formation: preliminary results on particle size and charge

Alemeh Karami[1], Janou Koskamp[1], Mariette Wolthers[1]

[1]Geosciences Department, Utrecht University

Introduction

Iron monosulfide, Mackinawite (FeS), is the first iron sulfide phase to form in anoxic systems containing ferrous iron and sulfide.

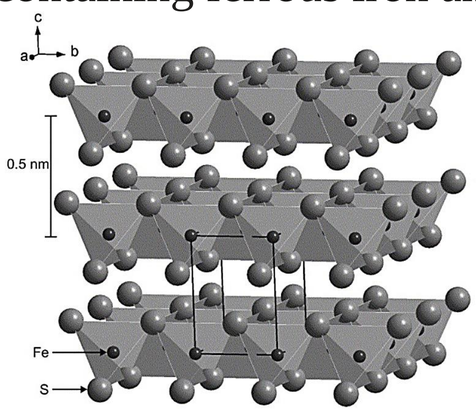


Fig. 1: Mackinawite structure

*Scale in oil and gas wells and pipes
*Early life precursor
*Heavy metal doping, immobilizing
*Potential application for energy storage

Since in natural conditions $\{Fe^{2+}\}:\{HS^-\} \neq 1$, investigating nonstoichiometric formation of FeS, can improve our fundamental knowledge on mineral formation and improve its application.

Methods

- FeS formation at a saturation index of 1.8 (~63 fold supersaturation), varying $\{Fe^{2+}\}:\{HS^-\}$ and at pH 10.2.
- DLS→ Particle size distribution in flow (2ml/min) and batch
- ELS→ Surface charge of particles (Zeta potential)

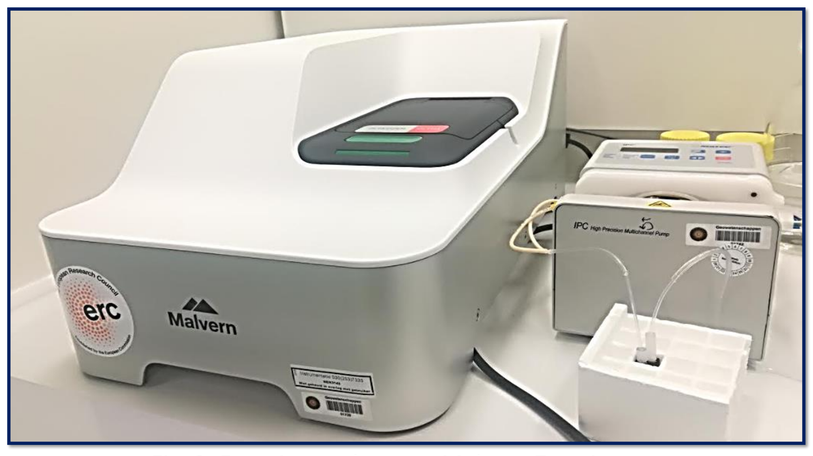


Fig. 2: Experimental set up, Malvern Zetasizer

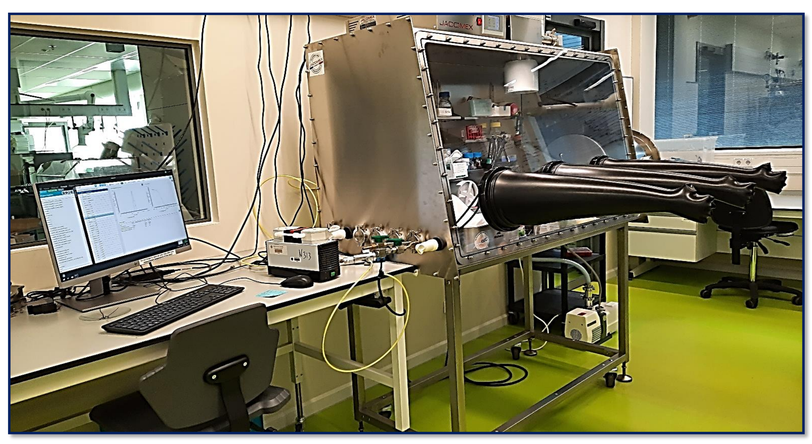


Fig. : Experimental set up, Jacomex glovebox

Results

Fig. 4: Average size distributions measured by DLS in flow

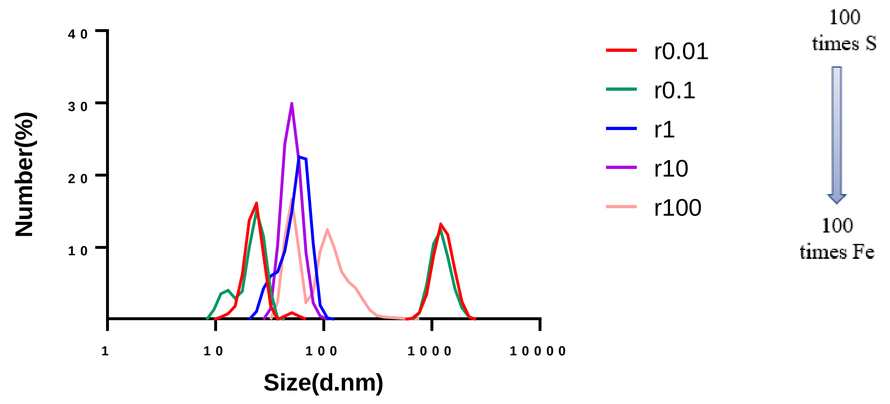


Fig. 5: Weighted average size distributions measured by DLS in flow

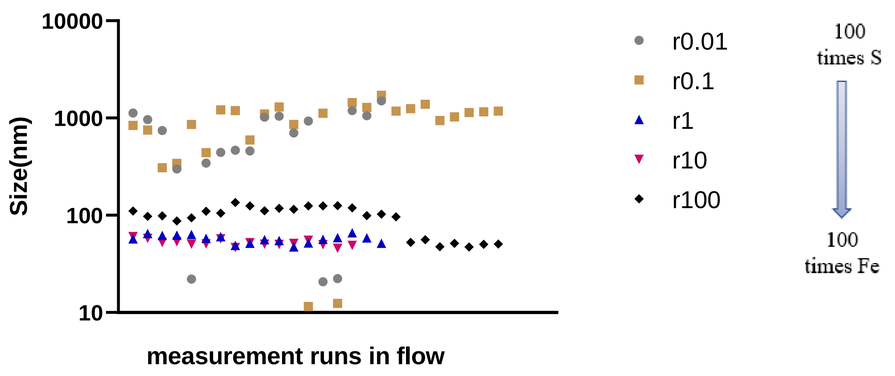


Fig. 6: Average count rate measured by DLS in batch

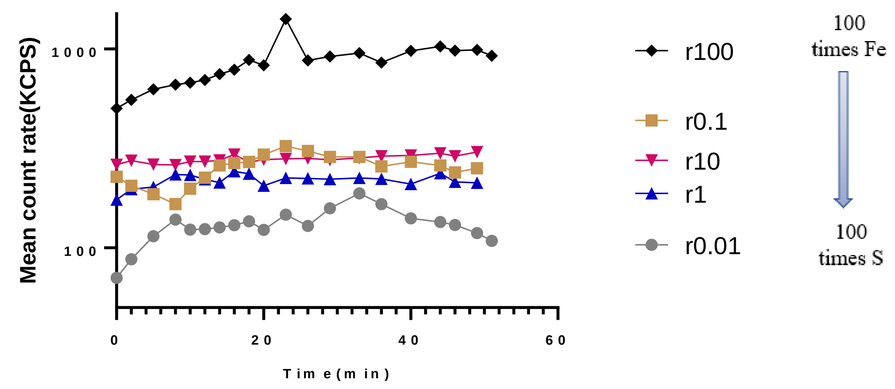
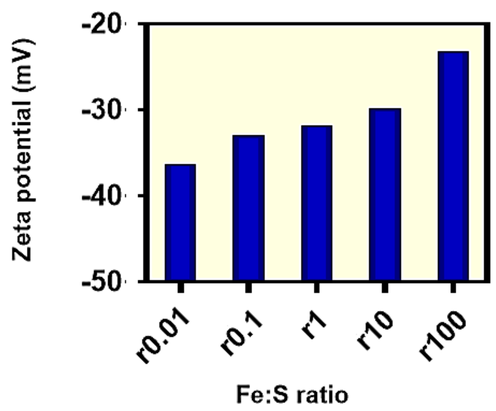


Fig. 7: Average Zeta potential measured by ELS- Count rate weighted average Zeta potential (mV)



Conclusions

➢Nuclei formation and growth of FeS is affected by imbalance in Fe:S ratio.

➢Higher concentrations of sulfide gave rise to the number of larger particles→ excess sulfide promotes growth over new nuclei formation, potentially due to sulfur atom's role in the mineral structure.

➢Whereas having more or equal amounts of iron induced smaller particles to form more therefore, nuclei formation dominates over growth in excess iron.

➢Surface charge of particles is affected by the ratio of cation:anion in solution. Presence of more Fe(II) led to less negative net surface charge