

## **Impact of carbonate dissolution on particulate pyrite mobilization during water-shale interaction**

SIMON EMMANUEL, DAVID RAYNES AND HAN ZHANG

The Hebrew University of Jerusalem

Presenting Author: [simon.emmanuel@mail.huji.ac.il](mailto:simon.emmanuel@mail.huji.ac.il)

The interaction of water with shale can result in the mobilization of micrometer-sized grains of iron sulfide (pyrite), which often contain elevated levels of hazardous elements, including arsenic. Although previous research has implicated calcite dissolution in iron sulfide mobilization, the link between rock composition and particle release remains unclear. In this study, we conducted laboratory experiments simulating subsurface water-rock interaction on five distinct shale formations: Eagle Ford, Marcellus, Mancos, and Barnett from the USA, and Ein Zeitim from Israel. Employing high-resolution imaging techniques, we assessed the impact of reactive fluids on shale surfaces and utilized image analysis software to quantify the rate of iron sulfide grain mobilization. Comparative analysis of shale surfaces pre- and post-experimentation revealed that the dissolution of calcite cement significantly influenced sulfide mobilization. Grains predominantly surrounded by calcite cement were found to be up to 85 times more likely to be mobilized compared to those embedded within the shale matrix, which comprises a heterogeneous mixture of submicrometer-scale phases such as phyllosilicates, organics, and carbonates. By contrast, iron sulfide embedded in organic matter tended to remain fixed in place, suggesting that while the presence of calcite facilitates sulfide detachment in shales, organic matter may serve as an adhesive inhibiting particle mobilization. However, the adhesive effect of organic matter is expected to be of secondary importance. Overall, our findings indicate that during hydraulic fracturing operations involving fluid injection into shales underground, formations with elevated levels of carbonate cement are more prone to releasing particulate iron sulfide, potentially compromising the quality of flowback water and increasing treatment expenses.