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Editorial

HIGHLIGHTS FROM THE NEW ISSUE OF INTERPORE JOURNAL

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As we publish this new issue of *InterPore Journal*, I take great pleasure in acknowledging the collaborative efforts that make each edition possible. The contributions featured here are a testament to the dedication and innovation of our research community. I thank the authors for sharing their valuable work, the reviewers for their constructive evaluations, and the editorial team for their dedication and hard work. Together, your efforts not only shape the quality of this journal but also help propel our field forward.

In an Invited Commentary, Berre et al (2) call for a shift in subsurface modeling from field-scale to regional-scale approaches that can assess the cumulative and interconnected effects of multiple subsurface operations. As activities like resource extraction and storage grow, regional effects spanning tens to hundreds of kilometers become increasingly significant. The authors propose a roadmap for advancing mathematical and numerical methods, emphasizing multiscale modeling, hybrid physics- and data-driven techniques, and efficient computational tools to support comprehensive regional-scale analysis.

Mushabe et al (3) investigate hydrogen loss during underground hydrogen storage (UHS) caused by a model sulphate-reducing bacterium in drainage-storage cycles that mimic porous media UHS. Experiments in sand pack columns showed microbial hydrogen consumption decreased over three storage cycles, with a total loss of about 15%. The decline in microbial activity was linked to increased brine pH after the first cycle. Their findings improve understanding of microbial hydrogen loss during UHS and its impact on recovery and storage efficiency.

Patsoukis Dimou et al (4) investigate the trapping and dissolution of CO_2 bubbles at the pore scale experimentally and numerically, which is an important topic for effective carbon capture and storage. Using 3D-printed micromodels with different geometries, their experiments demonstrated consistent CO_2 trapping and dissolution at low flow conditions. Direct numerical simulations (DNS) were compared with experiments, but struggled to accurately model the process due to numerical limitations. By artificially reducing interfacial tension in simulations, they could successfully reproduce the bubble dissolution in simpler geometries. They have provided the complete experimental dataset to benchmark and improve future numerical models.

Amrollahinasab et al (1) highlight the impact of rock heterogeneity on immiscible fluid displacement, particularly under unfavorable mobility ratios. Traditional Special Core Analysis (SCAL) methods assume rock homogeneity, which may not hold for larger, heterogeneous samples. The authors combine experimental data with numerical models that incorporate porosity-based heterogeneity and permeability as well as capillary scaling to better interpret two-phase flow. They find that standard relative permeability measurements remain valid if subgrid heterogeneities are accounted for in the SCAL workflows.

Wang and Class (6) use hydro-geomechanical models to explore the effects of engineered carbonate precipitation via biomineralization in a faulted cap-rock, aiming to reduce gas leakage in CO_2 storage. The process alters both hydraulic and mechanical properties of the rock. They presented a conceptual modeling approach in the open-source simulator DuMu^x and applied to a CO_2-storage scenario to examine how biomineralization influences the internal stress patterns of the rock and its potential impact on fault reactivation and induced seismic activity. Their results show that carbonate precipitation increases rock stiffness, which may trigger earlier shear failure but with reduced seismic magnitude.

Senthil Kumar et al (5) introduce a novel experimental platform using 3D-printed porous media to enable controlled, repeatable mineral precipitation experiments. They manipulated material surfaces (high impact polystyrene; HIPS) via sulfonation to promote calcite precipitation, confirmed through X-ray diffraction (XRD) and weight-based analysis. They observed enhanced precipitation with increased surface functionalization and solution saturation index. Their results demonstrate the potential of functionalized 3D-printed media as a flexible platform for studying geochemical reactions in complex porous systems.

As we wrap up this edition, I would like to once again emphasize that it is your commitment that continues to drive the growth of the *InterPore Journal*. I warmly invite you to contribute your research to future issues, as your input is essential for the journal's continued, organic development. I trust you will find the articles in this issue insightful. Happy reading!

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