Cryo SEM Investigation of the Microstructure of Gulf of Mexico Clay Slurries

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ABSTRACT

I show that plunge freezing causes a honeycomb structure in clay slurries due to crystallization. The honeycomb structure forms when the growing ice crystals push clay minerals and salt to the boundaries (Figure 1). Furthermore, I utilize high pressure freezing method and show that the microstructure of clay slurries consist of individual clay particles and clay aggregates randomly distributed in water (Figure2). Unlike plunge freezing, high pressure freezing prevents ice crystallization and associated volume changes that alters the microstructure.

I use cryo SEM to image plunge frozen and high pressure frozen clay slurries. In plunge freezing, a small sample is frozen in nitrogen slush. In high pressure freezing, the sample is first pressurized to 2.1 kbar before cooled with a jet of liquid nitrogen. The samples are then fractured and sublimated to reveal fresh details for imaging. These results change the current understanding of the initial structure of mudrock deposition.

CLICK ON IMAGE FOR LARGER VIEW

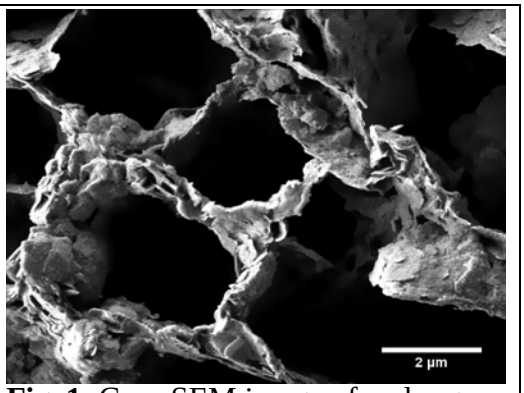


Fig. 1: Cryo SEM image of a plunge frozen GOM-EI slurry sample with pore salinity of 64 g/l. The image shows the formation of a honeycomb structure due to ice crystallization. This structure forms when growing ice crystals push salt and clay particles to the boundaries.

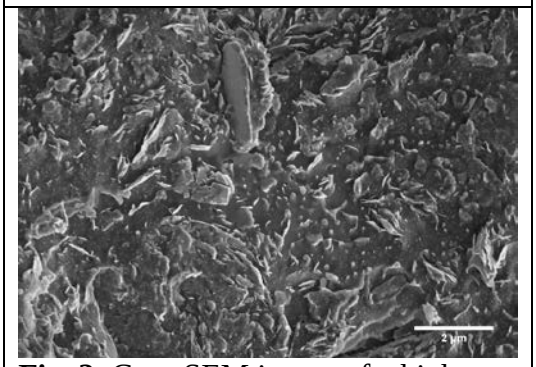
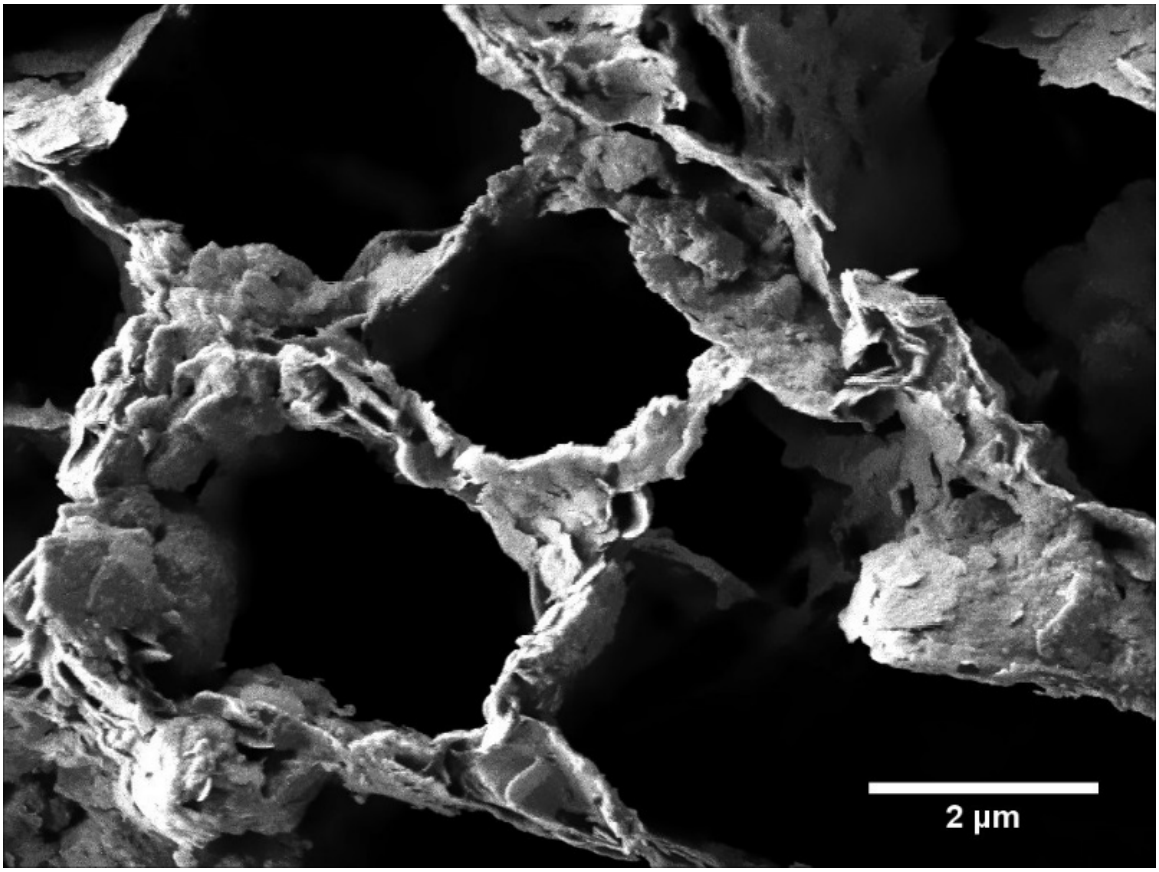


Fig. 2: Cryo SEM image of a high pressure frozen GOM-EI slurry sample with pore salinity of 16 g/l. The image shows that the microstructure of GOM-EI consists of clay particles and clay aggregates randomly distributed in water.



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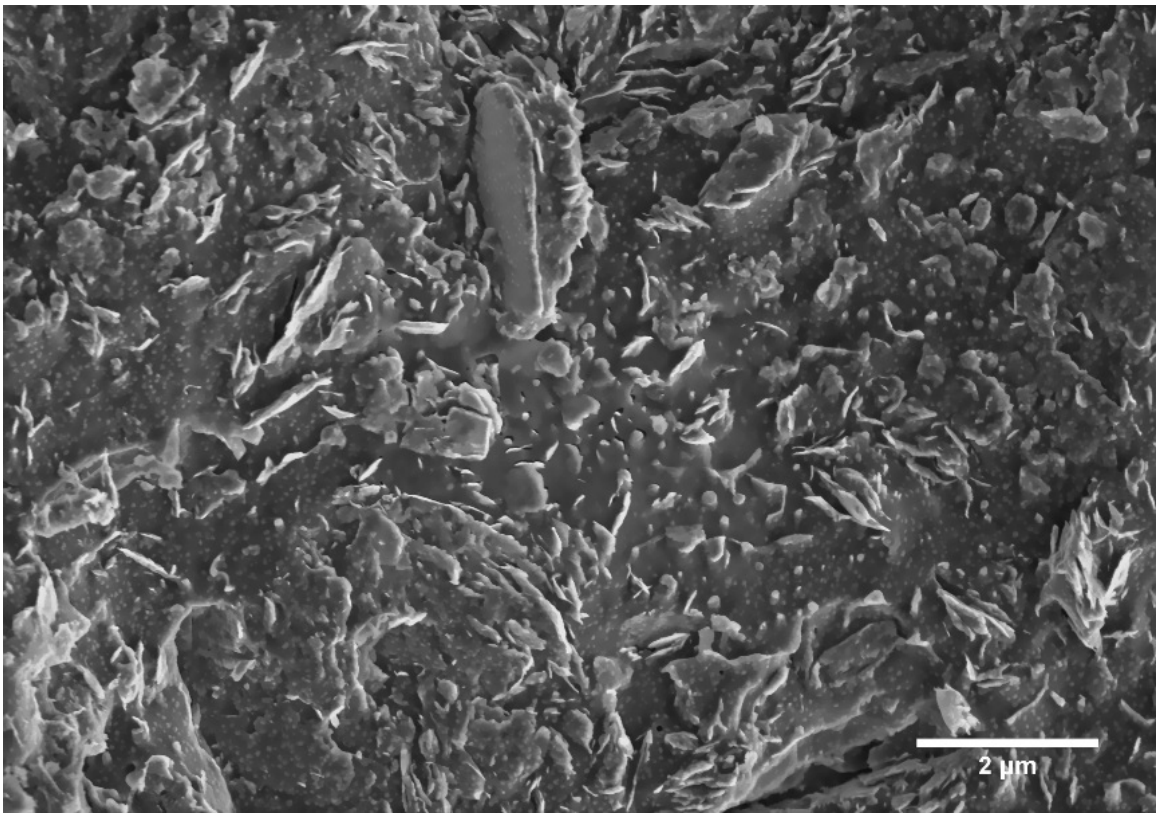

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