Depositional Setting and Pore Distribution in Mudstones of the Upper Cambrian Eau Claire Formation - SEM Observations on Ion-Milled Samples

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The Upper Cambrian Eau Claire Formation consists of fine grained sandstones interbedded with varying amounts of mudstones. Based on sedimentary structures and mudstone content the Eau Claire has been divided into five distinct lithofacies, A, B, C, D and E. Lithofacies A is very thin to thin bedded mudstone with small amounts of siltstone and sandstone. Lithofacies B consists of thin bedded sandstone with mudstone interbeds. Lithofacies C consists of thick sandstone beds with mudstone partings (usually less than 0.04 inches thick). Lithology D consists of massive appearing sandstone with rare internal breaks. Lithofacies E consists entirely of sandstone and internal lamination is barely visible. Lithofacies A was deposited offshore, Lithofacies B represents sediments of the offshore to shoreface transition. Lithofacies C and D were deposited in a shoreface setting, and Lithofacies D is interpreted as a foreshore deposit. Petrographic thin sections of the Eau Claire show an abundance of fossil debris (trilobites, brachiopods and echinoderms) throughout the mudstones of lithofacies A. The sandy portions of the Eau Claire consist largely of quartz grains, variable amounts of glauconite, and a very small proportion of microcline grains. Throughout the Eau Claire Formation sandstones are cemented with dolomite and calcite.

For a petrographic assessment of the Eau Claire as a seal for CO2 sequestration, a selection of shale samples were ion-milled and examined by SEM. Overall, all Eau Claire mudstones have a firmly packed tight fabric. Isolated pockets of pores are commonly associated with pressure shadows of larger, compaction resistant grains. Within these pressure shadows, framework textures of phyllosilicates are common that show triangular pores ranging in size from 50 to 600 nanometers. The overall abundance of these pores thus correlates positively with the silt content of a given sample. Particles of organic matter/kerogen may also show internal pores, but organic matter content is generally low in these mudstones.