ABSTRACT
Unconventional self-sourced sedimentary rocks of three important but contrasting plays, the USA (Eagle Ford), Canada (Montney) and Australia (Roseneath-Epsilon-Murteree, REM) are investigated for rock fabric, pore size and pore networks to better understand gas/liquid flow potentials. The Eagle Ford Shale contains marine carbonate mudstones, the Montney Formation has marine siliciclastic siltstone/mudstones and the REM has lacustrine siliciclastic siltstone/shales. Microscopic analysis of the different rock types show marked differences in the rock texture which is a key element for both gas/liquid flow as well as rock behavior during and after hydraulic fracturing. The samples in this study show high variability in detrital grains, diagenetic minerals as well as organic matter and clay mineral distribution. It is hypothesized that abundant clay minerals in these rocks reflect diagenetic alteration and neoformation during burial which then influence gas and liquid flow paths. During and after well stimulations, these and other clay-size minerals may contribute to fines migration.

Total mercury and He-porosity data of these contrasting plays vary and comparisons with micrographic investigations show that the amount of pore space is often a function of the rocks diagenetic pathways which is elaborated in this study. Mercury injection capillary pressure (MICP) analysis shows that the majority of the pore throats are <20-30 nm in size with few larger pore throats present. However, both Montney and Eagle Ford samples have common large (20 to > 400 nm) individual pores observed using Scanning Electron microscopy (SEM). These may be isolated or only connected through narrow pore-throats to the primary pore network and thus mercury access is limited during the MICP tests even under higher pressure conditions. MICP is limited to the detection of pore throats which are >3 nm in diameter and often underestimates the total porosity in tight rocks. Helium however can penetrate through narrow pore throats and yields different, higher porosity data compared to MICP. In this study, we present and compare various porosity methods in order to define the pore structure and connectivity which are important for both storage and transport of gas/liquid hydrocarbons in three endmembers of tight rock plays. Systematic comparisons between the three shale plays highlight the importance of properly characterizing tight rocks with appropriate methods.