

Provenance and porosity of onshore reservoir sandstones of the Anticosti Basin, western Newfoundland, Canada, using scanning electron microscopy combined with mineral liberation analysis (SEM-MLA)

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The Anticosti Basin of Atlantic Canada contains numerous conventional and unconventional hydrocarbon plays. This project applies an integrated field and laboratory approach to investigate the provenance and porosity evolution of Cambrian rift-drift and Ordovician foreland basin reservoir sandstones of the southern and central Anticosti Basin in the Port au Port peninsula and Bay of Islands areas of western Newfoundland. Polished thin-sections of the sandstones were analysed using SEM-MLA, which produces high-resolution digital maps that quantify the modal mineralogy, effective porosity, and grain-composition of the sample, including dissolution/precipitation reactions. This method was further successfully applied and tested on unpolished rock samples, such as thin-section cut-off blocks. The SEMMLA is non-destructive and results simultaneously provide information regarding provenance and porosity without having to perform petrophysical procedures on the core, or detailed petrographical point-count methods on thin-sections.

SEM-MLA showed that the foreland basin sandstones contain chromite and mafic volcanic rock grains, which represent easterly-derived debris from ophiolite complexes, whereas the rift-drift sandstones typically have abundant lithic (igneous, metamorphic, sedimentary) grains and heavy minerals (e.g., garnet) with west-derived, Laurentian basement provenance. The high-resolution maps clearly delineate secondary dissolution porosity in K-feldspars and chloritized (ultra-) mafic volcanic rock grains, as well as carbonate cements that fill in initial macro pores. This feature allows the visualization of the spatial resolution of occurrences of porosity in relation to matrix, rigid, and ductile grains in the SEM-MLA maps.

These methods enable us to simultaneously identify the primary and secondary porosity textures and provenance characteristics of prospective rift-drift and foreland basin reservoir sandstones. The results of this study are of significance not only for petroleum industry and exploration of onshore sandstones in the Anticosti Basin, but also have exploration implications for other conventional sandstone reservoirs globally.