MLA-SEM and fluid inclusion analyses – A twin-track approach to the study of cuttings from the Margaree A-49 well, offshore Newfoundland and Labrador, Canada

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This study is based on twenty-one cuttings samples from the Margaree A-49 well in the East Orphan Basin, offshore Newfoundland; eight samples were from the Upper Cretaceous limestone (Wyandot Formation equivalent) and thirteen from two different sandstone intervals, defined as Targets A and B, within the Upper Jurassic Tithonianaged interval (Jeanne d'Arc Formation equivalent). Mineral liberation analysis–scanning electron microscopy (MLASEM) techniques were used to evaluate both stratigraphic relationships within well and detritus provenance in all samples, and aqueous and hydrocarbon-bearing fluid inclusions (FIs) were examined from the thirteen Jeanne d'Arc Formation equivalent samples.

The MLA-SEM analyses indicate that the two sandstone intervals were composed of well to moderately sorted, subangular to subrounded, high sphericity detrital quartz grains, but the intervals also exhibit distinctive mineralogical and physical attributes. Texturally, Target B sandstone appears to be slightly more mature than Target A sandstone as indicated by better sorting and grain sphericity in the former. Mineralogically, the Target B sandstone appears to contain an enhanced igneous input, as suggested by Heavy Mineral indices calculated for the samples from the MLA data. Also, Target B sandstone contains enhanced siderite cement compared to Target A sandstone, suggesting an increased availability of iron within the former interval. The MLA-SEM analyses suggest that the uppermost limestone sample (Wyandot Fm. equivalent) was hydrothermally altered, possibly in near surface conditions, as it is the only limestone sample that contains Mn-bearing mineral phases and the only one that experienced significant dolomitization.

FI studies identified the presence of aqueous (2–20 μm) and hydrocarbon-bearing (<2–15 μm) fluid inclusions. Microthermometric data from the aqueous FIs indicate the presence of two distinct fluids: a low salinity-medium temperature fluid (~1 eq. wt.% NaCl and ~118°C) and a medium salinity-low temperature (~ 4 eq. wt.% NaCl and ~82°C) fluid. The hydrocarbon-bearing FIs (HCFI) exhibit a yellow/green fluorescence colour indicating oil with an estimated API gravity of 30°–35°. They occur along grain boundaries and in annealed microfractures suggesting at least two hydrocarbon trapping events. In general, the HCFI-bearing samples were identified by the MLA-SEM as being more mature with significant remnant carbonate cement.

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The twin-track approach adopted for this project facilitates the generation of data on provenance, stratigraphic relationships and oil charge history. The material used for this study was drill cuttings, which are typically very challenging to use for petrographic and textural studies due to their broken, fine-grained, disaggregated nature (in contrast to competent drill core). The MLA-SEM grain mounts and FI wafers offer an alternative, reliable means of generating quantifiable provenance, depositional environment, and oil charge data from such material.

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