Fluid inclusion Studies and Mineral Liberation Analysis (MLA) of Hydrocarbon Prospective Basins in the Newfoundland and Labrador Offshore Massif.

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This project uses a range of microscopic techniques that facilitate the study of aqueous and hydrocarbon-bearing fluid inclusions and their potential use as temporal markers of palaeo oil migration events. In addition, provenance analyses are performed on the same suite of samples using SEM-MLA techniques. This includes mineral identification and investigation of provenance-sensitive minerals.

The Sample Suite

The samples of cuttings used in this baseline study are from nine offshore wells located to the east of Labrador and Newfoundland. The wells under investigation are from four basins with significant hydrocarbon potential: Flemish Pass, Hopedale, Saglek and South Whale Basins (Fig. 1). The samples are generally from Jurassic to Cretaceous horizons (Fig. 2).

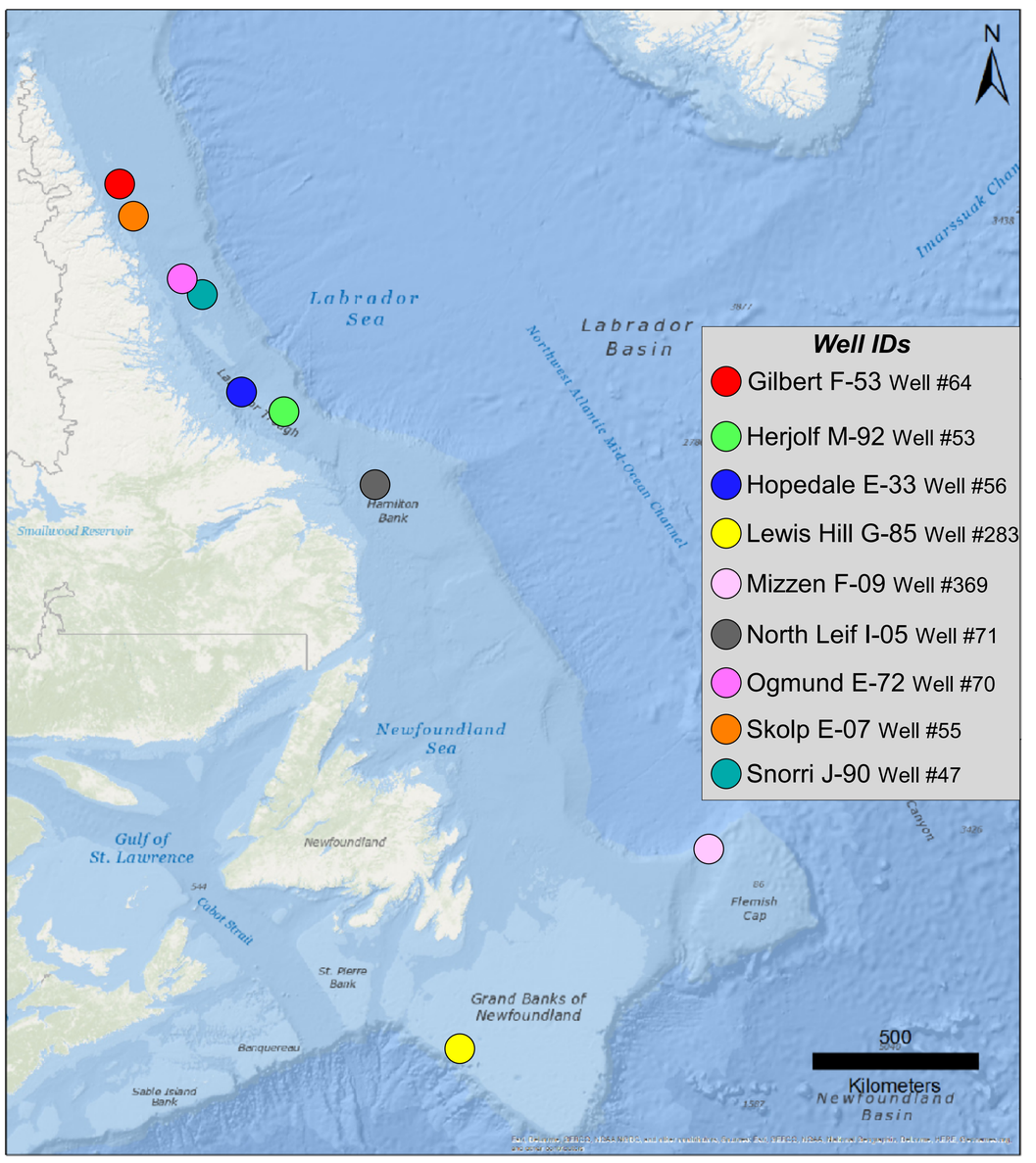

Fig 1. Map of offshore Labrador and Newfoundland showing the location of the nine wells used in this study.

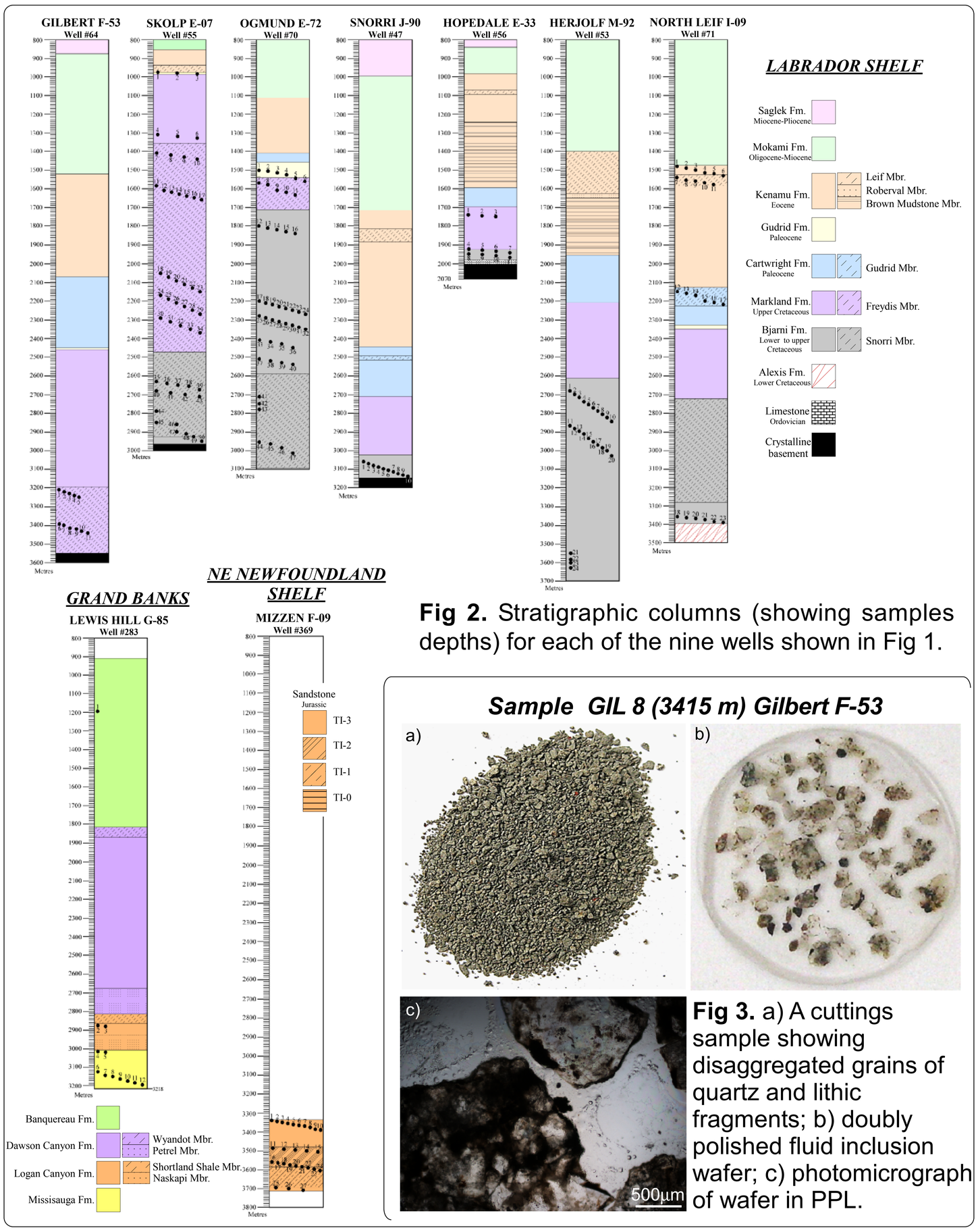

Fig 2. Stratigraphic columns (showing samples depths) for each of the nine wells shown in Fig 1.

MLA Studies

The basis for MLA studies is the derivation of an energy dispersive fingerprint for each mineral or mineral association (Species Identification Protocol - SIP). At MUN, a database of >300 SIPs for surficial sediments has been developed. MLA studies use an SEM configured in back scatter electron image mode (BSE). Heavy element abundance variations between constituent mineral grains causes grey scale variations. MLA can differentiate/define each grain based on these very subtle variations in grey-scale which allows definition of bedrock source and transport directions. In addition, they can help locate detrital zircons suitable for age determinations.

Fig 3. a) A cuttings sample showing disaggregated grains of quartz and lithic fragments; b) doubly polished fluid inclusion wafer; c) photomicrograph of wafer in PPL.

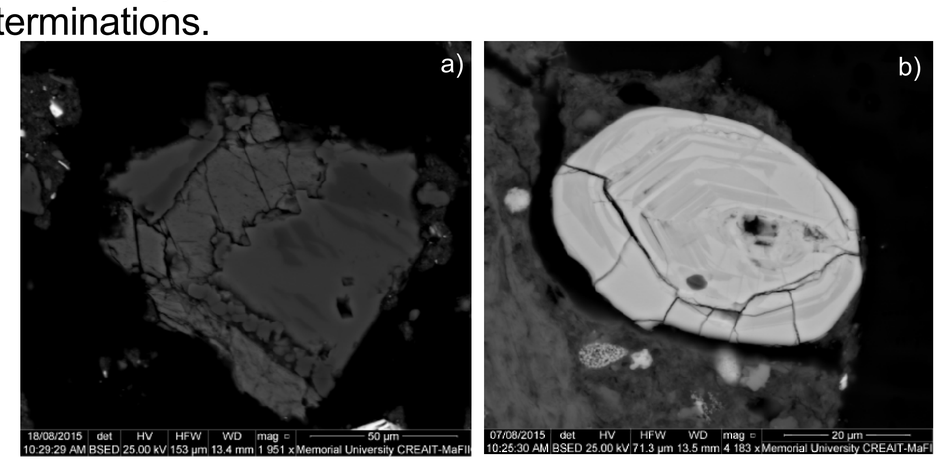

Fig 5. a) MLA map showing calcite cement enclosing a feldspar grain (Gilbert - 3390m); b) MLA map of detrital zircon (Gilbert - 3440m).

Fluid Inclusion Studies

Fluid inclusions are micron-scale samples of aqueous and hydrocarbon fluids trapped in annealed microfractures or in authigenic minerals *e.g.* quartz and/or calcite. By using a combination of transmitted light and UV light microscopy, cathodoluminescence, laser raman microscopy and microthermometry, it is possible to collate and compare textural and compositional data relating to the trapping history of aqueous and hydrocarbon fluid inclusions during basin formation.

Fluid inclusion petrography combined with UV microscopy has determined the presence of hydrocarbon-bearing FIs (Fig. 4) in 8 samples from Gilbert F-53 Well #64 (from 3210 to 3440 m depth). Preliminary microthermometric results indicate minimum palaeo oil trapping temperatures of ~80°C (sample GIL 8).

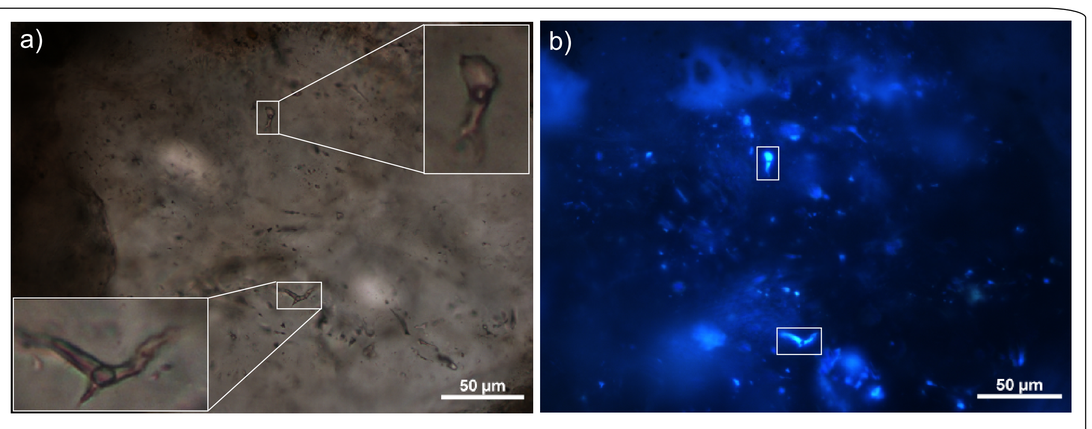

Fig 4. Photomicrograph in PPL (a) showing two-phase HC inclusions displaying light blue fluorescence under UV light (b). The fluorescence colour indicates an API gravity of ~45°.

Concluding Remarks: The twin-track approach adopted by this project *i.e.* combining SEM-MLA studies with Fluid Inclusion Studies will allow palaeo oil migration mapping in parallel with mineral analyses and provenance studies. The overall result of this research approach will be a serious de-risking for petroleum exploration in the Newfoundland and Labrador offshore massif.

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