

The Application of Fluid Inclusion Studies to Investigations of Hydrocarbon Systems



NUI Galway
OÉ Gaillimh

M. Feely, A. Costanzo, B. O'Rourke

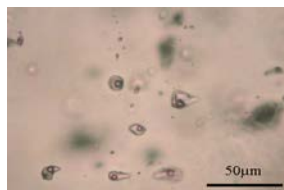
Geofluids Research Group, Earth and Ocean Sciences, School of Natural Sciences, NUI Galway



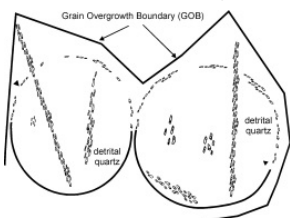
Fluid Inclusion Petrography

Fluid inclusions (FI) are micron scale fluid filled cavities (usually <50 microns in longest dimension) in or between rock crystals. They represent samples of fluids trapped during geological processes.

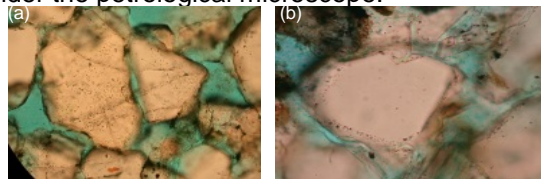
Microphotograph of FIs assemblage



Sketch of textural relationship between FIs and the host mineral.



FI petrography is used to identify different generations of FIs present within a sample. Solid, liquid and vapour phases are observed in FIs under the petrological microscope.



FIs hosted in (a) trails crosscutting grain boundaries and (b) in authigenic cements

A classification of inclusion types is constructed based on size, phases present and their relative proportion in the FI at room temperature. Textural relationship between inclusions and host mineral can be used to constrain the relative timing of fluid migration and/or reservoir filling.

Fluid Inclusion Microthermometry

Microthermometric analysis is carried out using a Linkam THMSG 600 heating-freezing stage, a non destructive analytical method which depends upon the accurate interpretation of phase changes which occur with varying temperature. Phase changes in HCFI and aqueous inclusion can be related to the minimum trapping temperature of hydrocarbon and aqueous fluids.

Information gathered are then used to model fluid compositions by applying the microthermometric data to experimentally determined phase diagrams: in this way chemical and physical characteristics of the trapped fluid can be ascertained e.g. gaseous species present (CO₂ and CH₄), fluid salinity and the minimum pressure and temperature of fluid entrapment.

Using microthermometric data and equations of state the true trapping conditions of hydrocarbon and aqueous fluids can then be modelled.



Linkam THMSG 600 heating-freezing stage at the Geofluids Research Lab.

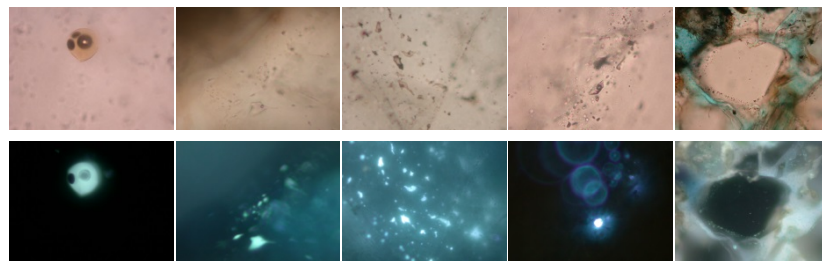
Why study Hydrocarbon bearing fluid inclusions (HCFI) in sedimentary basins

Fluids trapped in inclusions represent samples of reservoir fluids. Fluid inclusions can record fluid trapping and migration. HCFI can be used to trace hydrocarbon flow in oil wells that otherwise record no oil show. The Geofluids Group employs a variety of non-destructive analytical techniques to help constrain the fluid history of a sedimentary basin.

Since its establishment in the early 1990s the **Geofluids Research Group** has carried out numerous FI studies for the oil and gas exploration sector including the offshore Irish Massif (Porcupine, Rockall, Celtic Sea and Fastnet Basins), Central Europe, China (Eocene Dongying depression of Bohai Bay Basin), Canada (Newfoundland Basin), South America (Petroleum Charge Studies of the Llanos Field, Colombia), Africa (Sudan Basin petroleum studies) and numerous North Sea oil projects. These projects have exposed the Geofluids Laboratory to a wide range of hydrocarbon based projects in disparate geological settings.

UV Fluorescence

UV fluorescence is used to determine the presence of HCFI in the samples. When exposed to UV light hydrocarbons emit light in the visible spectrum. The relationship between fluorescence colour of HCFI and chemical composition of oils is highly complex but can give a first approximation of the composition of the hydrocarbon.



Photomicrographs of HCFI under plane polarised light and UV light.

