IGI NEWSLETTER

Q2 2020

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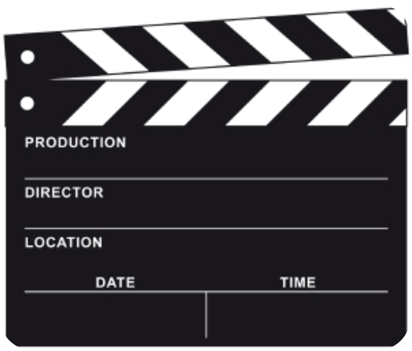
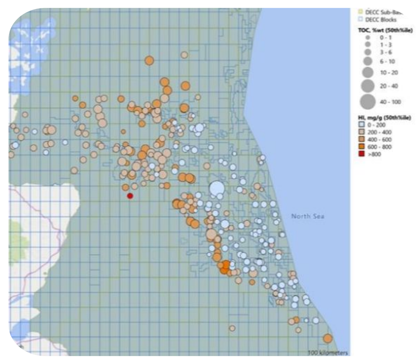
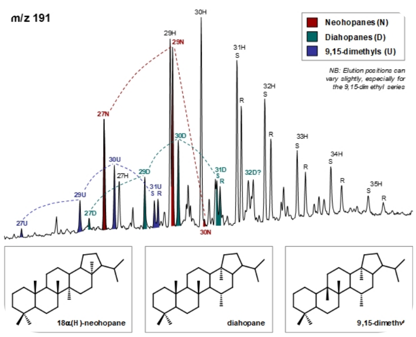
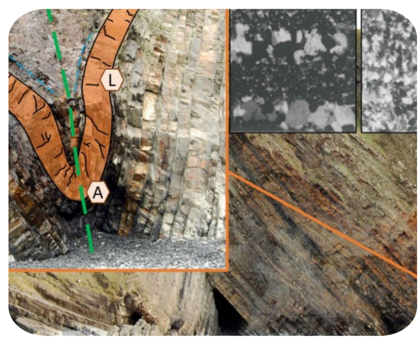








Directors' Cut

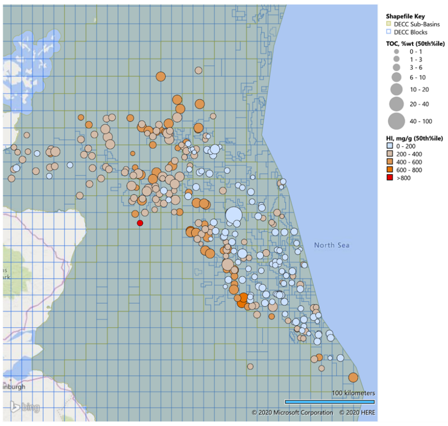
Welcome to our second Newsletter...You won’t need reminding that these are not normal times. However, we can assure you that IGI Ltd is very much open for business “as usual”. Although staff are working from home, we are making use of technology to keep our teams together and interacting as normally as possible.

We have ongoing single-client and multiclient projects that are progressing well, together with the development of our specialist software products p:IGI+ & Metis. We are currently migrating our extensive commercial geochemical databases to the new software making use of its greatly extended data structure. New projects are being formulated with clients and partners, and we continue to maintain effective support for our software and geochemical database clients. Although our training courses are currently on hold, please keep an eye on our website for new dates which we will decide on when it becomes possible to schedule them.

We sincerely hope that you and your organization are able to continue to operate smoothly during these difficult times, and we look forward to maintaining contact in future. In the meantime we wish you all the very best.

Geochemical Software

We are fortunate that our software team was already well set up for working remotely, and we now have team members currently working in the UK, and temporarily in Poland and Portugal. We've been working on some key features recently, and are really pleased to be able to include some key new features in the recently released version 1.22, including a completely revamped map feature, a significant overhaul of the way we manage well data across the software, providing a complete well manager solution integrated into p:IGI+.



We've included an example of the sort of maps you can now easily create showing the median (50th percentile) HI (colour) and TOC (size) in the Humber group in the UK central North Sea. This is based on our OGA UK datasets compiled over the last two years.

Moving forward we are currently working on providing fully integrated PCA and multi-depth plots in p:IGI+, and improving the interaction and ability to use project properties across the system. We are also investing in improving the performance and scalability of the Metis system which will greatly improve usability and interactivity.

New Maps for IGI's Interpretation Software p:IGI

p:IGI is IGI's geochemical interpretation software environment where we as consultants and our clients as users import, explore, filter, plot, map, analyse and interpret petroleum geochemical data. In 2016 IGI Ltd. released the first version of its newly developed p:IGI+ software (IGI's replacement for the previously used p:IGI-3). With the release of p:IGI+ version 1.22.0.2 in March 2020, came a completely new map feature. In this short article, we explore p:IGI+'s new mapping capability.

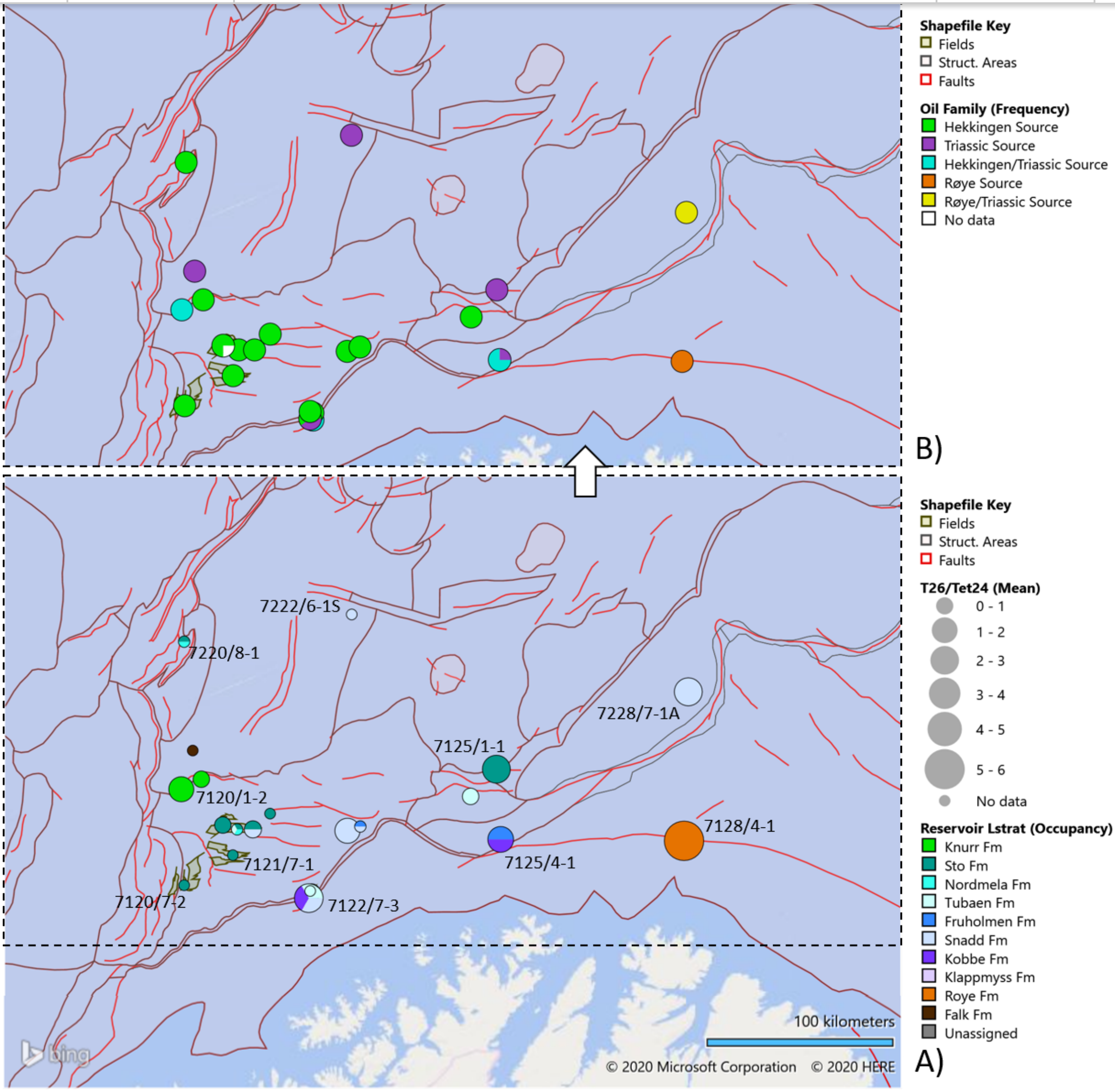
Fig 1: p:IGI+ map of a segment of the Barents Sea, Norway displaying a selection of oils and condensates across core structural areas of the basin; Hammerfest Basin, Loppa High, Nysleppen Fault complex, Nordkapp Basin and the Finnmark Platform. Supporting several visualisation modes A) displays the lithostratigraphic reservoir intervals per well as a colour occupancy pie wheel with each well scaled in size according to the mean of the Tri/Tetracyclic Terpane ratio reported in Bjorøy *et al.* (2010). B) Displays the IGI Ltd. assigned most likely oil-source interpretation per well as a colour frequency pie wheel based on carbon isotope and molecular biomarker ratio data available in 2015. The complete IGI Ltd. Barents Sea Geochemical interpretation report, along with others, is available to purchase from our website: https://www.igiltd.com/data/

Being able to explore the spatial variability of data using maps is a crucial element in the interpretation of geochemical data, and particularly in integrating both raw data and interpretations with the regional geology.

The new p:IGI+ map utilises Bing maps (©Microsoft Corporation 2020) to show the location of project wells, and non-well samples (outcrops, seeps etc) through the use of the WGS84 geographic coordinate system. The choice of Bing as the base map provides the user with a complete world map whose visual extent and geographic display are easily customised depending on the needs of the active project. This removes the need to select from a series of, or create project-specific georeferenced images to act as the base map, as was the case in p:IGI-3.

With roughly 30% of global crude oil output occurring from offshore production (i), it is important when interpreting geochemical data spatially in offshore areas to be able to do so with the support of contextual background mapping. In p:IGI+, we allow users to add supporting geospatial vector data in the form of ESRI® (II) Shapefiles (.shp) as shown in **Figure 1** (field outlines, faults and the boundaries of structural elements).

Also new to p:IGI+ maps is the visualisation of data through the application of colour and size palettes, providing the user with valuable tools to uncover spatial trends and outliers, and to present interpretation summaries. Colour palettes display information based on either sample data occupancy (presence/absence) or frequency (how often does a value occur) at a well or non-well site. Size palettes scale a well or non-well site to a chosen parameter relative to a selected statistic (8 statistics to choose from; minimum, mean, maximum, etc.). The presented data can also be filtered using sample sets, for example to just show data for oils, or a particular stratigraphic interval.



Although not a specialised mapping package, p:IGI+ maps with the aid of sample sets, palettes and interaction with graphs, now provide users with a very comprehensive interpretation tool to efficiently and effectively explore and display geochemical data.

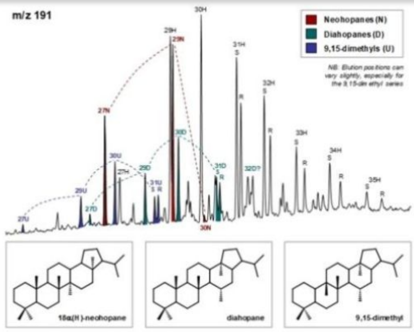
(i) Global Offshore production value taken from U.S. Energy Information Administration website: https://www.eia.gov/todayinenergy/detail.php?id=28492

(ii) ESRI: Environmental Systems Research Institute Inc.: https://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

Technical Note

Rearranged hopanes in petroleum geochemistry
by Paul Farrimond (edited from the full version published on IGI's website in March 2020)

Four series of rearranged hopanes have been identified in oils and source rocks. Three of these are usually visible in varying proportions in the m/z 191 mass chromatogram: 18a(H)-neohopanes (Ts series), 17a(H)-diahopanes (15-methyl-27-norhopanes), and an early-eluting series identified as 9,15-dimethyl-25,27-bisnorhopanes. Typically, however, only the three most abundant compounds are monitored and routinely reported by laboratories – Ts (27N), 29Ts (29N) and C_{30} diahopane (30D).



distribution to the regular hopanes, whilst the neohopanes are dominated by C_{27} (Ts) and C_{29} homologues. This difference is likely due to differing diagenetic pathways involved in the rearrangement of the biologically-derived regular hopanoid structure.

Rearranged hopanes have been extensively used in molecular maturity parameters where they are ratioed against non-rearranged hopanes. These parameters are believed to operate mainly due to the relative thermal stabilities of the compounds; molecular mechanics has shown that diahopanes are more thermally stable than neohopanes (Ts series), which are more stable than regular hopanes.

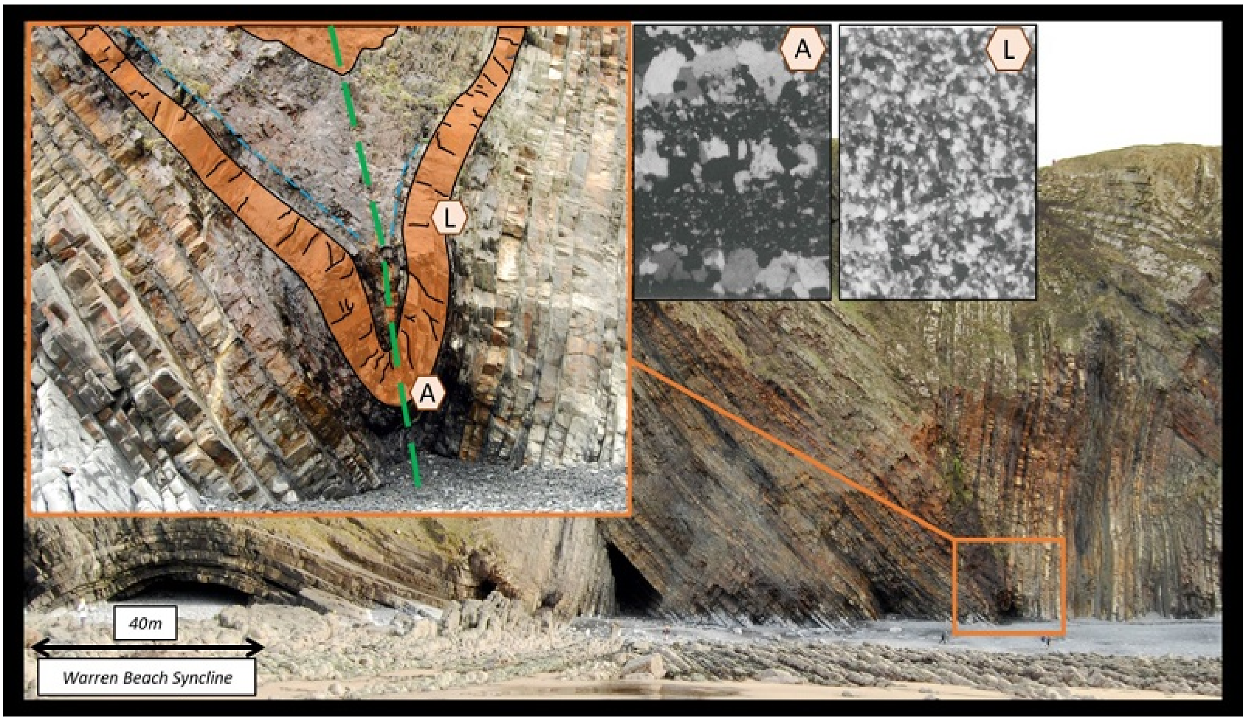
There is some source/facies/lithology dependency on the rearranged hopane abundance and composition in source rocks, and consequently rearranged hopanes offer significant potential in oil-source correlations. They also have the advantage of being more resistant to severe biodegradation than are the regular hopanes.

North Devon Geology

Title: Folding without cracking - **Location: Hartland Quay, Devon, UK - by Andrew Green**

Hartland Quay Car park (SS:223-247) to Warren Beach (SS:225-249)

Access: Warren Beach is accessed via Hartland Quay slip way north of The Wrecker's Retreat Inn (SS:223-248)



The cliffs north of Hartland Quay present a spectacular array of antiformal and synformal folds, including tight, straight-limbed chevron folds, which when studied provide detailed insight into structural processes which occur during major orogenic events. The orogenic collison responsible for this particular deformation was called the Variscan Orogeny. Occurring from the Late Dinantian (330.9ma) through to the Early Permian (290.1ma) this event saw both the closure of the ancient Rheic Ocean and the resultant formation of the supercontinent Pangea.

The sediments that comprise the folded cliffs at Hartland Quay belong predominantly to the Upper Namurian - Westphalian Crackington Fm (326.4ma – 315ma) and consist of interbedded quartz-rich (97%) standstone and dark grey-black shale. Deposited in a rapidly subsiding syn-orogenic foreland basin, the sandstone beds, commonly 30-60cm thick, are inferred as distal turbidites; fining upwards with sharp bases and associated sole and tool mark features. Turbiditic sands flowed E-W dominantly parallel to the basin axis into deep, largely anoxic water.

of the Hartland Quay sedimentary section to depths of ~7km against a higher than average palaeo-geothermal gradient of 38.5°C/km and subsequent uplift and erosion of 5-6km. Changes in geothermal gradient from the upper Carboniferous to the overlying unconformable Permian restrict burial, folding and uplift to a 15ma window.
Structural investigation of the tight chevron folding (left image inset) highlights two key observations: 1) shale thickening into the fold hinge zone, and 2) sandstone beds (highlighted orange in the image), roughly uniform in thickness, folded through 300° without fracturing.

The latter phenomenon is achieved due to the extreme rates of burial soon after burial along with the high pressure & temperatures experienced by the sandstones during folding. Two photomicrographs (right image insets), showing the sandstone grain structure from the fold axis (A) and fold limb (L), record the process of quartz grain dissolution and remigration from areas of high pressure (fold limb: L) to reprecipitation in areas of low pressure (fold axis: A). In photomicrograph A the large white-light grey banded grains are the quartz reprecipitated from solution, whereas in photomicrograph L such grain sizes are absent, instead showing elongation and flattening as the remaining grains are deformed.

And finally....

An average offshore oil well in the North Sea drills ~100m per day, about half the distance a snail could cover in the same time.