A NEW GENERATION OF FRONTIER EXPLORERS

Regional Models for CCUS, Gold Hydrogen, Geothermal

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Over the past 18 years, DIG has applied its considerable experience toward multiple applications in the oil and gas industry. I would like to discuss in detail how this experience translates seamlessly to the low–carbon applications which we continue to support and develop.

A Little About DIG…

In 2006, Dolan Integration Group opened its doors with a clear goal to remain diversified in our skill set. The nascent shale revolution was in full swing and organic geochemistry was a high demand skill in the early part of this century in the U.S. The Lower 48 oil and gas sector required geochemical and laboratory expertise. DIG began to develop a laboratory that would concentrate on the hydrocarbon fluids that were now flowing from all those newly discovered oil and gas wells.

To succeed in this highly competitive industry, DIG adopted the idea of “Great Service” to distinguish our company. We adopt these ideas to our core principles:

- Our clients’ needs are respected and acted upon. Customer service should be foremost in the mind of every DIG associate.
- Mutual respect of all DIG associates keeps us consistent in our actions and deeds. No DIG associate is more or less important than any other.
- Teamwork is critical to our continued growth and success. Keeping the lines of communication open and honest provides an environment of trust and respect. We are the DIG Team. We pride ourselves in Great Service!

We compile and update data sets that continue to serve our client’s needs. We service exploration, development, production, and environmental components of the many businesses we serve. The following is an example of how those data are used to serve our clientele.

Regional Data in Frontier Exploration

Frontier exploration of oil and gas provides multiple components in workflows that have developed from the process of trial and error. This work process development coincides with the history of oil and gas exploration. Subsurface maps generated at the regional scale can be critical to successful de-risking of oil and gas prospects.

Applying the techniques and workflows developed for oil and gas exploration toward risk assessment of renewable, sequestration & storage, geothermal, and geologic hydrogen energy can provide the efficiency of resources that were unknown to early oil and gas exploration geologists.

Developing a geographic information system (GIS) tool for viewing, interpreting, and communicating maps and data that support renewable and transition systems will provide efficiency not available to oil and gas exploration geologists.

Frontier exploration for oil and gas is still conducted today by major integrated oil and gas companies and select mid-range oil exploration companies. Regional studies are often updated every decade by companies to invoke the latest data and technology into the exploration workflow. There are select individuals that conduct certain frontier exploration practices using tried and tested field geology techniques and a healthy dose of internet resources. Geologic, geophysical, and geochemical techniques are used to evaluate areas of interest.

The scale and scope of the work varies widely depending on the objective and the evaluation technique being utilized by the explorer. There are public datasets available to the explorationist but expertise in a certain geology or engineering field might cause one individual to ignore a treasure trove of information compiled for a separate line of expertise. Major oil companies make sure that the exploration teams possess individuals with a wide scope of skillsets, including geochemists.

Magoon and Dow (1994a)1 introduced the oil and gas explorationist to the idea of the petroleum system. All scales of exploration activity had already adopted this system definition directly into their exploration workflows. The petroleum system in its simplest form comprises the components of a source rock, reservoir rock and a trap/seal along with the processes of migration of fluids and the timing of the processes. As a result, tremendous data sets exist today supporting evaluation of these components in sedimentary basins across the globe. Consideration of all the components gave rise to the expert explorationist who was deemed the petroleum systems integrator. This was the person who considered all the lines of evaluation to proclaim an effective petroleum system was present in an area of interest.

Additional exploration resources might be provided, and seismic acquisition was then considered in the focus area. Screening at the regional scale preceded cost prohibitive techniques like 2D and 3D seismic acquisition programs.

These ideas can be applied to low carbon industries that are emerging as the need for services increases, sometimes exponentially.

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Integration at the Regional Scale

As an analogy, the petroleum system proved to be an indispensable tool in any oil and gas exploration workflow. Geothermal, carbon capture, and geologic hydrogen systems have been and will be defined by the essential components and processes. When evaluating these components on a regional scale, one might be considered a frontier explorationist.

Evaluating regional subsurface maps, the explorer will engage in de-risking certain components to focus the exploration effort into an area identified for additional investment. For example, in a sedimentary basin, 3D distribution of present-day heat flow is an essential component of understanding geothermal fluid systems. Heat, pressure, rock mechanics, rock composition, porosity and permeability will be essential evaluation components of a CO2 injection reservoir in a carbon capture facility.

Sources of geologic hydrogen may require conduits to mantle with trap/seal permeability as essential components of an effective geo-hydrogen system. Web-enabled geographic information systems (GIS) are a cost-effective and rapid method of integrating and evaluating multi-component map and data systems.

Integration of multiple components of a system into a single interpretive map has evolved quickly. Multiple mylar maps on a light table have evolved to digital computations in a geographic information system (GIS).

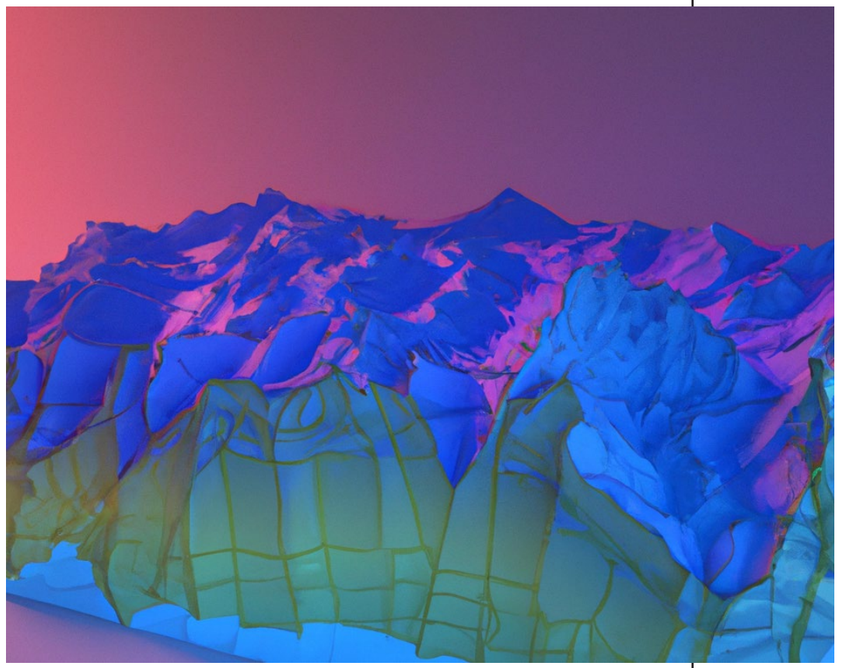
The frontier explorationist today can conduct sedimentary basin-scale models to predict the effectiveness of components of a petroleum system and define ancillary components of the system using web-interface software. This lends itself to frontier exploration in renewable and hydrogen energy sources and processes. Geothermal energy, carbon capture and geologic hydrogen should develop regional scale evaluation models to quickly de-risk the occurrence of essential components to the respective systems. Many regional scale datasets already exist for the calibration of these models.

Rapid integration of multiple and disparate data sets is needed for de-risking these systems. Web-enabled GIS provides rapid evaluation to all stakeholders.

Geothermal Systems

Regional geothermal models are needed for sedimentary basins. Calibration data already exist for these models such as heat flow data, oil and gas well bottom-hole temperature data, pressure data and fluids characterization.

Definitions of the lateral extent and depth to basement in a regional sedimentary basin utilize the field work



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conducted by the US Geologic Survey (USGS) and many others.

They are available in the public realm and in literature. Depth to basement interpretation is derived from gravity and magnetics (potential fields) data and can be interpreted for total sedimentary thickness and important structural components that might lead to identifying heat anomalies. These datasets can be more easily integrated with other types of geologic and engineering data in a web-enabled GIS system.

Carbon Capture

Carbon capture facilities are evaluated in limited areas today, but the areas needed to inject greenhouse gases (GHG) into subsurface reservoirs are expanding rapidly. Repurposed or bypassed oil and gas reservoirs are all good candidates for this effort. Transportation of gases will add costs and the overall economics of a project may deem it unsuitable for commercial pursuit.

Regional interpretations will focus planners, engineers, and geologists into areas where the critical components of an injection facility exist geographically. Pursuit of a project where many of the regional components exist and can be quantifiably de-risked will facilitate further investment and evaluation in a specific area. Analogous to regional oil and gas evaluation, this process will often remain proprietary to protect intellectual property and subsequent investment.

Geologic Hydrogen

Petroleum geochemists in oil and gas have often heard hypothesized theories for mantle-derived source of hydrocarbons. Synthesizing the complex components of oil from mantle-derived methane was often proposed but never proven with oil biomarkers and isotopes. One thing that is documented is mantle-derived sources of hydrogen gas. Isotopically distinguishable sources have been identified. Given this system's complexity, assessing its effectiveness requires regional screening and frontier exploration.

Conclusion

To dramatically improve project success rates in sectors such as geothermal, CCS (Carbon Capture & Storage), and geologic hydrogen, regional geologic screening technologies must be developed and employed. Work processes that are analogous to frontier exploration for hydrocarbons can quickly pivot to include the necessary components for effective geothermal, CCS, and geologic hydrogen systems.

Stay tuned for upcoming blogs that will detail these applications individually. Regional screening tools play a critical role in environmentally sustainable practices for all energy sources.

Let DIG provide additional services to support your efforts in all the important energy applications. Go DIG!