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A Holistic Earth System Approach: the Final Frontier for understanding the Earth's Evolution and Aiding Natural Resource Exploration

Graeme Nicoll and Benjamin Greselle
Neftex Insights, Halliburton, UK (graeme.nicoll@halliburton.com)

Modern geoscience has been built on the shoulders of giants over the last 200 years. New ways of thinking, individual technology elements, and, more recently, digital techniques for understanding geological systems have all transformed and revolutionised modern understanding of the Earth and the formation of its resources. The amount of new geological data published each year continues to grow at exponential rates. However, while increasingly more data is generated and released into the public domain, more often than not, it simply becomes another stranded and isolated asset. Operators have more data and technology than ever before, but has knowledge been lost from an inability to envision all this disparate information together?

The creation of a globally consistent and standardized temporal and spatial geological framework, even containing a fraction of the data published every year, yields significant dividends for understanding the Earth's 4D evolution. Using this 4D framework, present day geography can be considered as the data repository where even the ability to query and view a wide array of disparate geological data types together enables a considerably enhanced regional understanding. This framework therefore provides a context and aids the collation of the ballooning public domain literature base. Through the integration of advanced individual geological "big ticket" items, such as regional seismic interpretations, depositional environment maps, plate tectonic models, and paleoclimate predictions, a truly dynamic next-generation holistic 4D Earth model is possible. The added ability to instantly view geological data in context within its paleogeographic setting is where real understanding occurs and new exploration relevant ideas can be generated. The public domain data can then act as a positive feedback loop for improving individual model elements.

Examples are presented of how this holistic 4D Earth model can be used for more in-depth analysis into source-to-sink systems. The clastic systems are assessed in the central Atlantic region during the Cretaceous period. Having an understanding of the complete sedimentary system within its tectonic and climatic context has implications for the initial erosion of hinterland source areas in the catchment, transport of materials, and the final deposition and amount of clastics in the sink area. These are all important aspects that require consideration while making economic predictions as well as the de-risking of exploration projects.

With the growing ability to combine and further enhance this 4D framework with Big Data-style approaches for analytics and leveraging the power of artificial intelligence for assisting geological interpretations, the surface of what these whole Earth models can do is merely being scratched in relation to gaining insight into natural resource exploration, let alone being a catalyst for further academic insight. While modern geoscience is far from peak, operators are entering a new era where a more complete whole Earth understanding is just on the horizon.