Geoscience Evolution: Extensive Data Integration for Real Time Geosteering and Modeling in Unconventional Reservoirs*

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Abstract

Over the past 5-7 years, effective and low-cost geosteering technologies became a game changer for unconventional development in North America, allowing thousands of oil and gas companies to stay profitable during the ongoing economic downturn. Modern geoscience and geosteering technologies indicate an increasing focus on IT and software, rather than downhole hardware tools. IT technologies have advanced enormously over the past 8-10 years, but these capabilities are not yet fully endorsed by the oil and gas industry. Modern computing power, low cost storage facilities, super-efficient algorithms, big data analysis, artificial intelligence and cloud collaborative technologies will eventually completely transform the current practices. This will lead to a new way of how we model reservoirs, geosteer wells, integrate data and communicate with each other. But this process is an evolution, rather than a revolution, due to a fact that the oil and gas industry is conservative and adapts slowly to new technical and economic trends and realities.

Knowing the true stratigraphic position of a well trajectory, constantly and proactively monitoring this position and adjusting as needed in real time while drilling - represent a significant breakthrough in keeping the well in the best target zones no matter how thin those are. However, this is just the beginning. The next step in geoscience technology is to be able to integrate massive amounts of available data, such as previously drilled wells, production history, various types of logs, cores, seismic, maps, correlations, regional geological trends, etc. Connect this with the modern IT capabilities and you get geoscience to be real time, high resolution, fully collaborative, intelligent and automatic.

Part I – Geoscience Technologies

Rather than big scale regional geological and hydrodynamic modeling, this new wave of geoscience software technology will mainly be focused on a single well's drilling efficiency, placement, life cycle and recovery factor. Building a static geological or flow simulation model will not be the end goal, it will be a natural automatic part of the well planning and execution process. The models will be sector, sub-seismic,

high resolution, high accuracy and integrating all available data. These sector models can be easily connected together as puzzle blocks into a bigger picture at any time if needed.

The sector models will be constructed automatically as a pre-job and corrected “on the fly” as you drill using the data from the current well and hundreds of previously drilled vertical and horizontal wells and their associated sector models. Massive data integration: wells, logs, cores, seismic, sedimentology, geochemistry and other data will be combined into a process while drilling a single well with a goal to drill each next well better and more efficiently than the one before. All this data seamlessly used “in the background” for the purpose of (for example) correcting the well trajectory will dramatically increase confidence of that decision. In addition to increased well productivity, this will lead to tremendous savings in terms of LWD tools needed, data collected and pilot wells drilled.

Part II – IT Technologies

In order to make this all happen, IT will bring to the table enabling and communication technologies. The key components are the following:

1. **Real time** data streaming for monitoring and geosteering is already widely used, however real time geological interpretation, big data integration and multivariable analysis as you drill will be extremely important for lightning-fast decision making (Figure 1).

2. **Online, cloud-based collaborative environment** will allow specialists to contribute to the project at any time, from any geographical location and from any electronic devices. Built-in communication tools and a centralized cloud data base will reduce non-productive time to a minimum, allowing for maximum efficiency in managing the execution of the project.

3. **Big data, artificial intelligence, automation, machine learning and predictive analytics** will simply result in creating an additional member of your geoscience team – a robot (Figure 2). Not necessarily the one with hands and eyes, but the one that can (a) process and learn from hundreds or thousands of previously drilled wells, (b) analyze a wide spectrum of attributes, such as geology, production history, hydraulic fracture parameters and effects, EOR, etc., and (c) make predictions and recommendations for the new well given its specific conditions and further learn and update the multi-dimensional neuron networks.

Part III – Closing the Gap

Closing the gap between the current practices of geoscience, mainly still built on the technologies of 1990s and early 2000s, and the ultra-modern IT capabilities is imminent and is a matter of time. Parts of IT technologies described above are already available and widely used in some other industries, such as internet, medical or military. The challenge is to bring them together and adapt them to oil and gas data, which in general is very dirty, inconsistent and unstable.

Bringing these geoscience and IT technologies together is critical considering the new world we are living in now: the world of low oil prices, high drilling rates, unconventional developments and fast decision making. The industry is ready for a change. Now.

Imagine all of the above to be on your desktop or a tablet within the next 2-3 years, sounds ambitious? And yet this is how we imagine it at ROGII while developing StarSteer geoscience technologies and SOLO cloud collaborative platform.

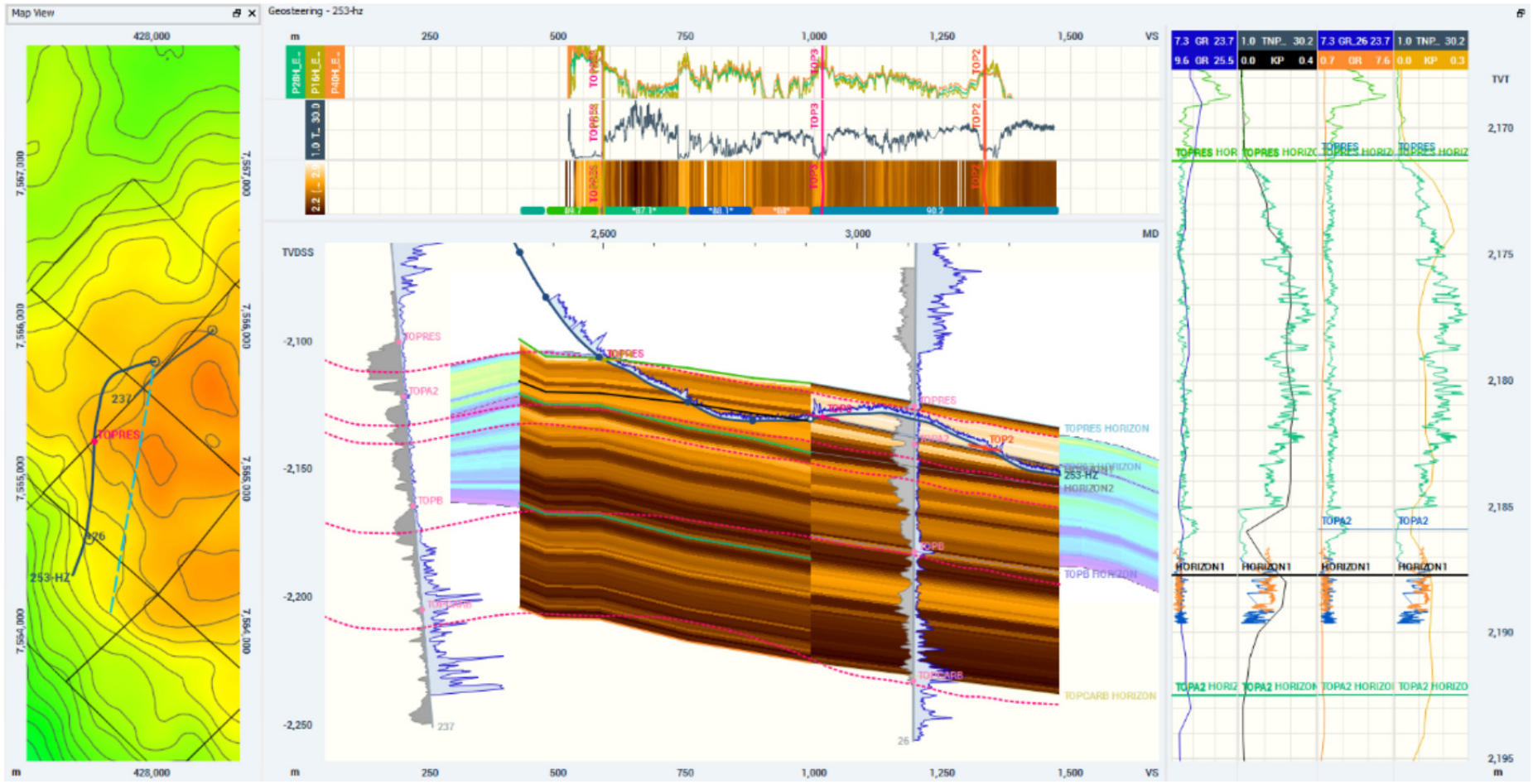

Figure 1. StarSteer - geosteering interpretation using multiple offset wells.

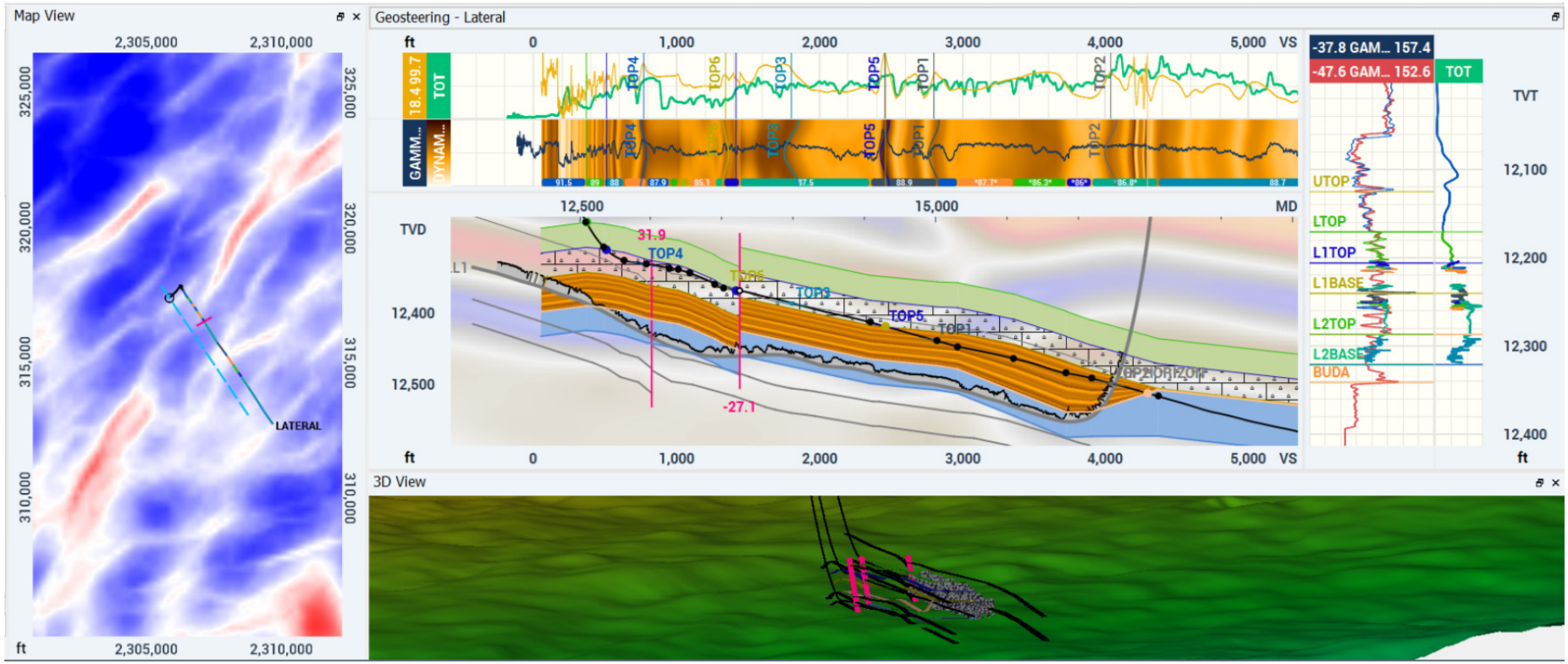

Figure 2. StarSteer - big data geosteering project.