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➤ **WELL CORRELATION, SEISMIC INTERPRETATION AND GEOLOGICAL MODELING**

Integration of visualization tools & disciplines

Exploration and asset development teams are composed of multiple disciplines that have traditionally used different tools to analyze different data types.

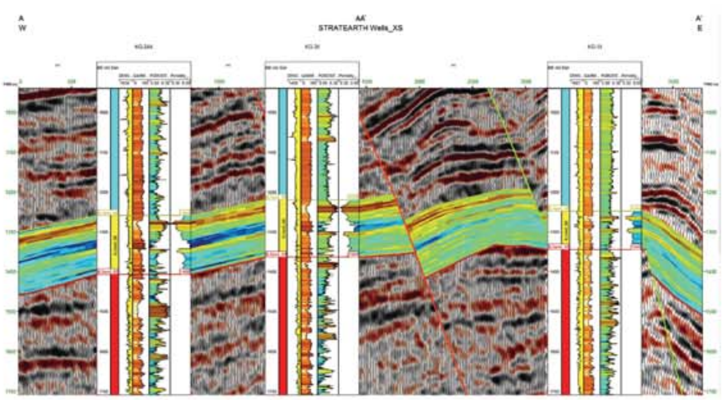
Aymen Haouesse, Paradigm, suggests that seismic data has often not been readily available to petrophysicists, and geologic cross-sections were often performed by staff other than the seismic interpreters. Integration of visualization tools helps integration across disciplines, as evidenced by this example of well correlation, seismic interpretation and geological modelling.

The image shows a porosity inversion plotted in order to validate it against well log data. It was created using Paradigm's subsurface knowledge unified approach (SKUA), a 3D methodology that unifies subsurface discrete models.

Modern systems can integrate a multitude of data types into a common view. 2D and 3D seismic surveys, well data and seismic interpretations can now be seamlessly displayed in a single section or 3D view. This enables different disciplines to collaborate in the same scenes, sharing their data and tools, which in turn results in a unified interpretation where data consistency is enhanced and anomalies become easier to observe and correct. One simple way to define a cross-section is by drawing a line between wells on a base map. This is often done in the map view of the data, which in many application s is referred to as the "Base Map", where the display also contains a time structure map with fault outlines and the position of a cross-section through multiple wells. Once this cross-section is defined, 3D seismic data can be extracted along the section to indicate changes in structure and stratigraphy between the wells. The extracted seismic is "live", and can be filtered, flattened and analyzed for better integration with well data.

The ease of generating all available data along any well section means that interpreters are no longer constrained to the in-line and cross line acquisition directions but can now look at data, and interact with it, along many different azimuths through the survey. Sections can be along dip, strike, or radial and tangential around circular features such as salt domes. The cross-section display can include log panels inserted within the scaled seismic data and seismic interpretation, and the well panels can include both the well data and a stratigraphic column. The example shown is quite simple; additional well tracks can be used to display biostratigraphic, lithostratigraphic, chronostratigraphic, computed log, perforation, pressure test, fluid data, seismic synthetics and many other types of information. Such cross-section displays enable well data to be visually correlated with the seismic data, which in turn drives the correlation of well data from well to well. Conversely, the injection of the well data into the seismic section also illuminates the seismic interpretation and may initiate reappraisal of the seismic interpretation given clearly correlated well log signatures.

While 2D section views are useful, they are not sufficient to interpret geologic targets that are 3D in nature, such as channel fan complexes, reefs or complex structures. In such cases, 3D views can be very beneficial for the interpreter. 3D visualization enables the interpreter to effortlessly see the structure rather than having to be fully engaged in constructing a mental image of the structure. A 3D view can also provide a better understanding of geology and structure across a major fault. The interpreter can more easily understand when part of the section is along the fault or is perpendicular to the fault. The structural reference is enhanced with the aid of a partially transparent horizon surface and correlated well data.



SKUA cross section with porosity derived from geostatistical inversion, to validate it against well log data.

The final deliverable resulting from the integration of geological information and seismic interpretations is a 3D geological model which, in addition to describing the subsurface, is used to quantify hydrocarbon volumes and predict flow performances. Having an accurate geological model is therefore a key factor for taking the right exploration and development decisions.

Recent advances in modelling technology have enabled an accurate representation of the structural and stratigraphic complexity of the subsurface-as captured by the geological and seismic interpretation-while accelerating and facilitating the overall modelling workflow. The most important aspect of the model is that it is a 3D geological replica that honours all the fault and horizon interpretations in addition to the well correlation results and the stratigraphic interpretations, regardless of their level of complexity. This model can be used for 3D petrophysical modelling and flow simulation. The modeller has access to the same tools and views used by interpreters, which provides them with continuous quality check of his model while building it. Finally, the common platform for interpretation, cross-section and modelling, in addition to recent breakthroughs in modelling technology, has made modelling accessible to interpreters to quickly generate 3D models to validate their interpretation, avoiding time-consuming iterations between interpreters and modellers. ■