Structural Interpretation of seismic, geological realism and 3D thinking

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SUMMARY

Our notion of reality in seismic interpretation and structural geology usually follows a series of careful observations and ideas that eventually crystallize into a best-case model. In most other branches of science the strength or reality of such models (or hypotheses) is increased by the number of robust tests that either refine or fail to disprove the original idea. However, geological models in the Exploration and Production (E&P) sector differ because the starting point for testing is usually an interpretation of seismic or other remote measurements, rather than the direct observation of an effect. This means that whatever tests we are able to apply have, in themselves, significant margins for error and are further compounded by the intellectual issue of constructing a 3D view or model of the perceived geologic reality. This model building is an early stage of the E&P process, but errors and uncertainty at this point propagate throughout the subsequent workflow and arguably, amount to the single biggest factor affecting perceived value and in particular drilling risk.

Key words: seismic interpretation, structural geology, 3D.

The scientific method of prediction tested by observation is a key part in the process of mapping 3D structures in the field. Indeed, many structural geologists probably selected their professional path on the basis of their innate ability to think in 3D. Unfortunately most seismic interpreters are not structural geologists. However, possession of 3D spatial skills and the building of 3D geologic models of faults and horizons from seismic interpretation are fundamental to the checking of interpretation and creation of an E & P reality. A good structural model should go beyond the aesthetic, it should include more than fault and horizon surfaces. It must also honour the rules of structural geology. In addition, a significant number of seismic interpreters, whether they are physicists or structural geologists, do not fully understand perspective. This leads to poor decisions about software purchase, which result in work practices that often revert to map and section style interpretations despite the software vendors' claim of 3D viewer perspective.

The problem of poor interpretation is further compounded by an industry which to a large extent still harbours the cultural divide of geology and geophysics, and this division is then reflected in the approach that an interpreter will take to generate their model. Then there is the issue of time and corporate inertia, and the quest for good 3D interpretation can be hindered by management that often still requires 2D, paper-based or PowerPoint reports to make their decisions. The most pragmatic way to combat this problem is to allocate more time to the interpretation so that when the 3D structure is challenging, simple structural geological rules, which we present here, can be applied iteratively as the seismic interpretation evolves.

In order for the industry to fulfil its goals of 25 years ago, i.e. to embrace a truly multidisciplinary approach to E&P, it needs to think carefully about the 3D process. It needs to encourage software vendors to develop innovative and integrated tools to test 3D interpretations during, or as part of, the interpretation process and not after it. Most importantly, since it is managers who control the E&P workflow, they, above all, need to be informed about the advantages of using a structurally-qualified 3D model in a go-forward project.