New advances in seismic interpretation workflows

Etienne Legeay*†[1] and Laurent Souche[1]

[1]ELIIS – ELIIS – France

Résumé

The integration of artificial intelligence and machine learning technologies has revolutionized subsurface geological exploration, enabling the development of sophisticated numerical tools for seismic interpretation. This work presents an innovative end-to-end digital workflow that combines advanced seismic interpretation algorithms with automated geological modelling to optimize exploration efficiency and resource assessment accuracy.
A geologically consistent fault-framework is extracted over the entire seismic volume thanks to a deep neural network trained to predict fault probability from a 3D seismic volume. A 3D AI-based image segmentation algorithm then enables intuitive extraction of non-layered intrusions and deposits, such as salt and volcanics, from seismic data. Then, both the extracted faults and geobodies are used for constraining the global interpretation of sedimentary horizons throughout the volume of interest. Automatically interpreted horizons can be manually edited, triggering an automatic re-interpretation of the entire sedimentary pile and yielding a consistent 3D relative geological time (RGT) model. Following this stage, sedimentary bodies such as channels, canyons, turbidite lobes, etc. are interpreted on chromatically-rendered stratal-slices using the semi-automated segmentation algorithm.
After depth-converting the data using key well and seismic velocity information, a global, non-rigid deformation is applied to the model, the seismic and all interpreted elements, ensuring that each chronostratigraphic marker matches a single RGT value. Finally, now that the entire volume has been interpreted, the last step of the workflow is to perform prospect screening and detailed evaluation, utilizing interpreted surfaces and well data for rapid resource assessment.
Performance metrics demonstrate significant improvements in interpretation cycle time while maintaining geological accuracy standards. The computational efficiency of this approach allows geoscientists to focus on complex geological scenarios while automated tools handle routine interpretation tasks. Validated across multiple basins, this workflow demonstrates significant potential for optimizing subsurface interpretation, modelling and prospect assessment.

Mots-Clés: Seismic interpretation, artificial intelligence, machine learning

*Intervenant
†Auteur correspondant: etienne.legeay@eliis.fr