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Please fill in your manuscript title.	Industrial Workflow for Automatic 3D Object Detection in a Stratigraphic Deposition Context

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Abstract

This paper details a novel workflow for automatic 3D geological objects mapping, from detouring to metrics tuning, through a stratigraphic split of the seismic data. The method was performed on a real use case for mapping in 3D turbiditic systems.

Interpretation of geological features like faults or salt domes is carried out by manual or automatic methods, based on propagation or picking. When using deep learning segmentation methods, the seismic data are managed with sliding 3D windows or managed in multi 2D section by section. However, when mapping other objects that follow deposit times like turbiditic systems, a new strategy is proposed that combines the choice of an adequate seismic attribute and a search in a stratigraphic multi-2D split of the seismic cube. In addition, the image segmentation is tuned for these complex sinuous shapes focusing on core texture part and decreasing the importance of the border parts, allowing for simple detouring strategy and a user-oriented metric. Finally, the 3D reconstruction is quite straightforward with vertical interpolation.

We applied this workflow for turbiditic systems detection in a real use case. The stratigraphic split has been automatically done by computing a Relative Geological Time cube and deducing a fine layering of hundreds of images. Then, we used a deep learning neural network for the image segmentation applied on these stratigraphic images. Indeed, on these images stratigraphically consistent, channelized systems can be followed on large distances. About the labeling, the choice of coherency seismic attribute particularly enhanced these structures in the stratigraphic images. With our loss modification, the labelling was very fast and easy. Then, a few labelled part of the data has been used to specialize a model from a pre-trained generic one (that step was optional). Results were clearly better than the common method based on vertical section image segmentation, both in pixel accuracy and object continuity.

In our knowledge, the main novelty of this work concerns the fully stratigraphic split of seismic data cube into multi-2D images. It changes the point of view of common image segmentation from vertical sections to surfaces that follows the deposit times of targeted geological objects. This idea can be industrialized with a choice of adequate seismic attributes, fast detouring strategy and tolerance metrics.