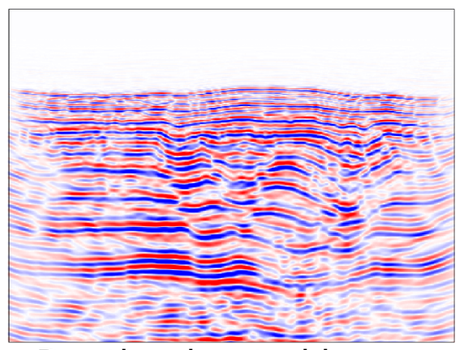
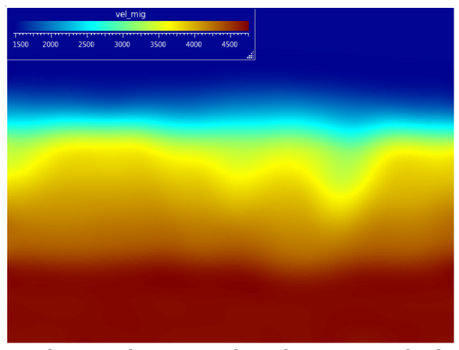
Reducing fault related structural uncertainties

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I. Introduction & aim

Interpretation uncertainties are inherent in structural modeling (e.g Bond et al. 2007). We propose a strategy to obtain consistent interpretations, and to rank available valid interpretations.
As input, we need a seismic image and its migration velocity model.


Depth migrated image

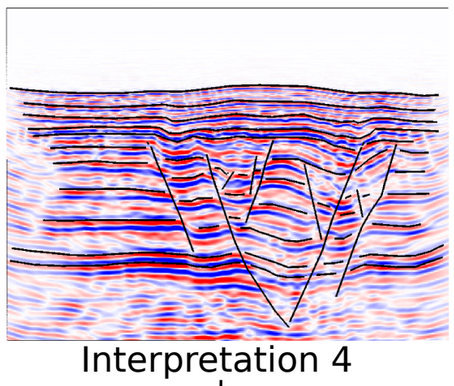


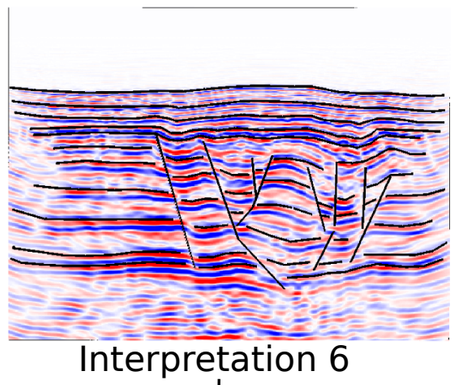
Migration velocity model

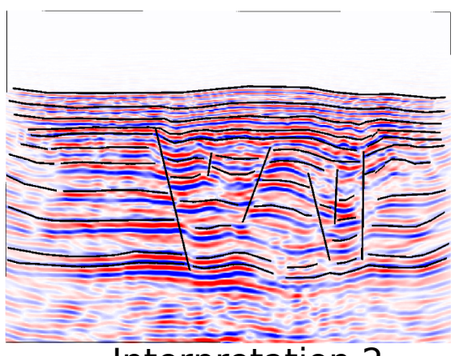
II. Methods & theory

a. Sampling structural uncertainty

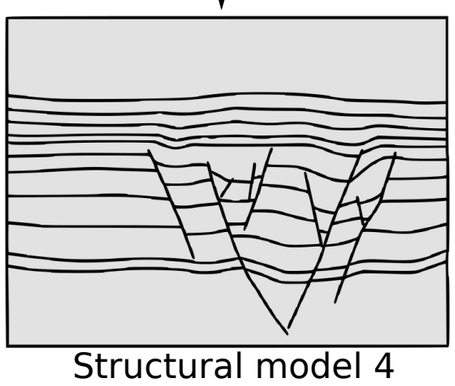
The first step is to sample structural uncertainties attached to the seismic image by generating multiple interpretations.

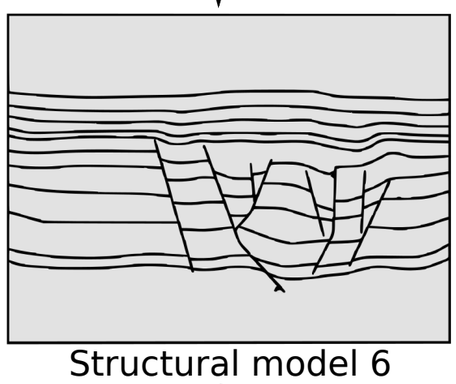

Interpretation 4

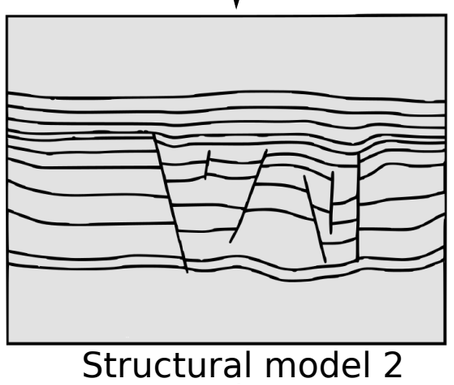

Interpretation 6


Interpretation 2

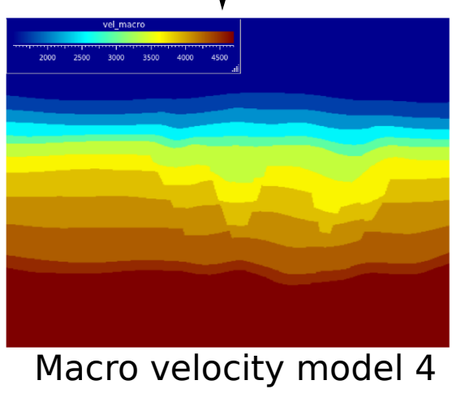
The second step is to create structural models for each interpretation. In this study, structural modeling was performed using SKUA's structure and stratigraphy workflow.


Structural model 4

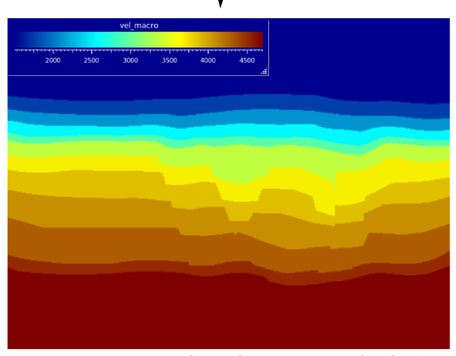

Structural model 6


Structural model 2

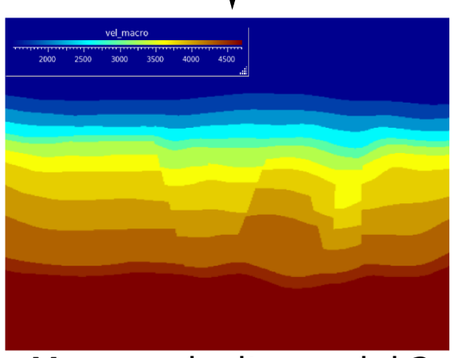
The third step is to create macro-layered velocity models for each interpretation. This was achieved by painting the migration velocity model into the structural models, then averaging velocities in each layer.



Macro velocity model 4



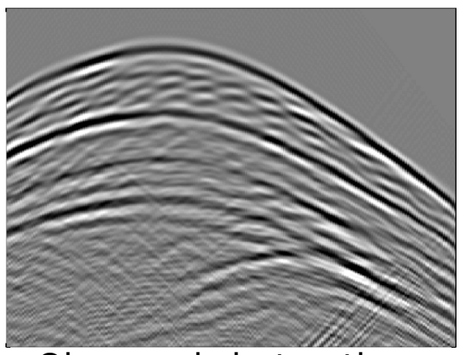
Macro velocity model 6

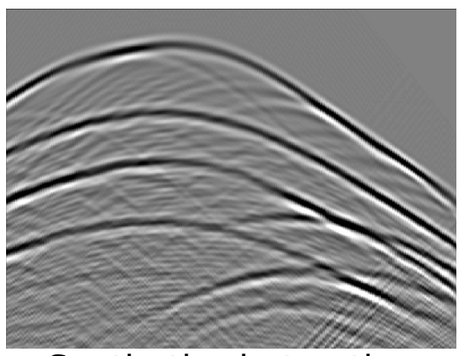


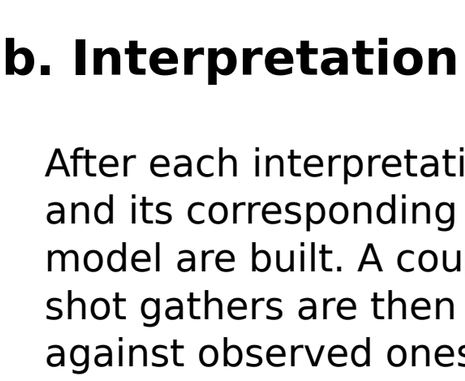
Macro velocity model 2

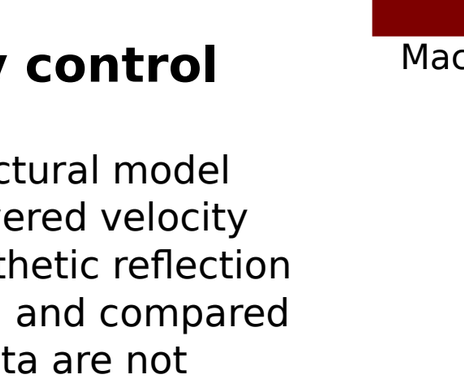
b. Interpretation quality control

After each interpretation, a structural model and its corresponding macro-layered velocity model are built. A couple of synthetic reflection shot gathers are then computed and compared against observed ones. If the data are not consistent, interpretations are updated accordingly.


Observed shot gather


Synthetic shot gather


Structural modeling after imaging and interpretation

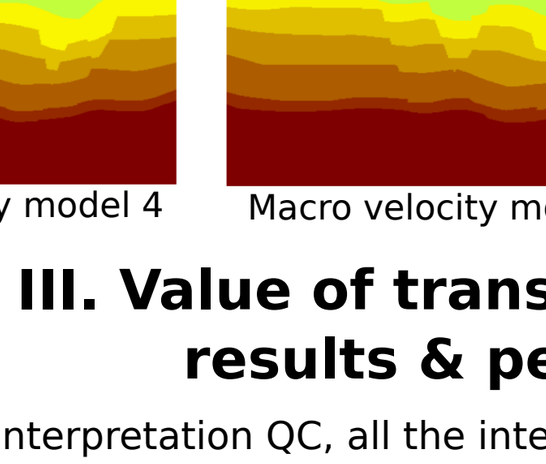


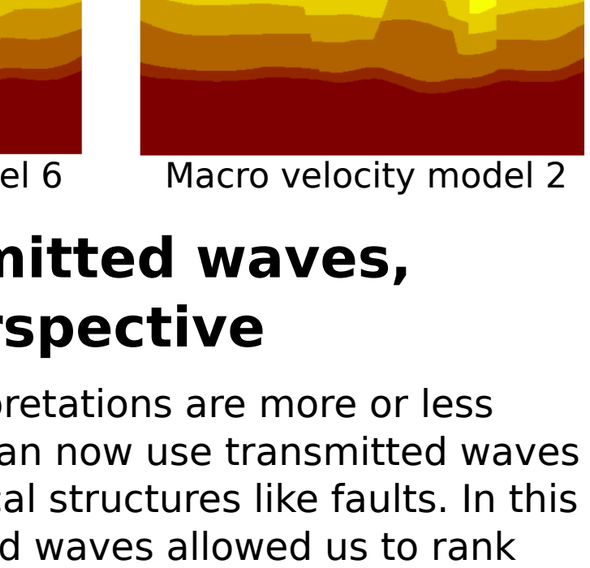
Macro-layered velocity model

III. Value of transmitted waves, results & perspective

After interpretation QC, all the interpretations are more or less consistent with reflection data. We can now use transmitted waves for a better illumination of sub-vertical structures like faults. In this study, we used VSP data. Transmitted waves allowed us to rank interpretations from the most consistent to the less consistent with reflected and transmitted data. The image at the bottom compares ranking in model space against ranking in data space (VSP); the two rankings were found to be the same only when illumination was accounted for into misfit functions.

In the future, we will consider using transmitted waves contained within reflection data instead of the additional VSP survey.


Reference model (modified from colletta at al. 1991). The red line and green box show source-receiver pairs that illuminate the region of interest in the red box.



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Acknowledgements
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Seismic interpretations presented here were done by Christelle Butault, Guillaume Caumon and Paul Angrand.
The Madagascar software (freely available at www.ahay.org) was used to compute travel time cubes needed for depth migration.