ENHANCING 3D SEISMIC DATA TO AID INTERPRETATION OF CREE SAND CHANNELS, OFFSHORE NOVA SCOTIA

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1. SUMMARY

Potential hydrocarbon reservoirs can be found within deltaic channels, these channels have the ability to form continuous transport systems for hydrocarbons. Distributary sand-filled channels (which generally have high porosity and high permeability sandstones) in particular can serve as excellent reservoirs. The study area is focused on the Penobscot field, located off of the eastern shores of Nova Scotia. The emphasis of this study is taking a detailed look into the sand channels within the Cree Sand of the Logan Canyon, creating a workflow for seismic data enhancement, as well as using similarity seismic attributes, namely outer product similarity, to delineate these features.

Extensive studies have been performed in analysis of deltaic channel systems and their ability to act as reservoirs for hydrocarbons. The research will follow an equivalent approach, with an emphasis on petrophysical analysis, 3D seismic data conditioning (through an application of a seismic mute, Prestack and Poststack Structure-oriented Filtering) and attribute-assisted interpretation, to consequently identify and map sand channels.
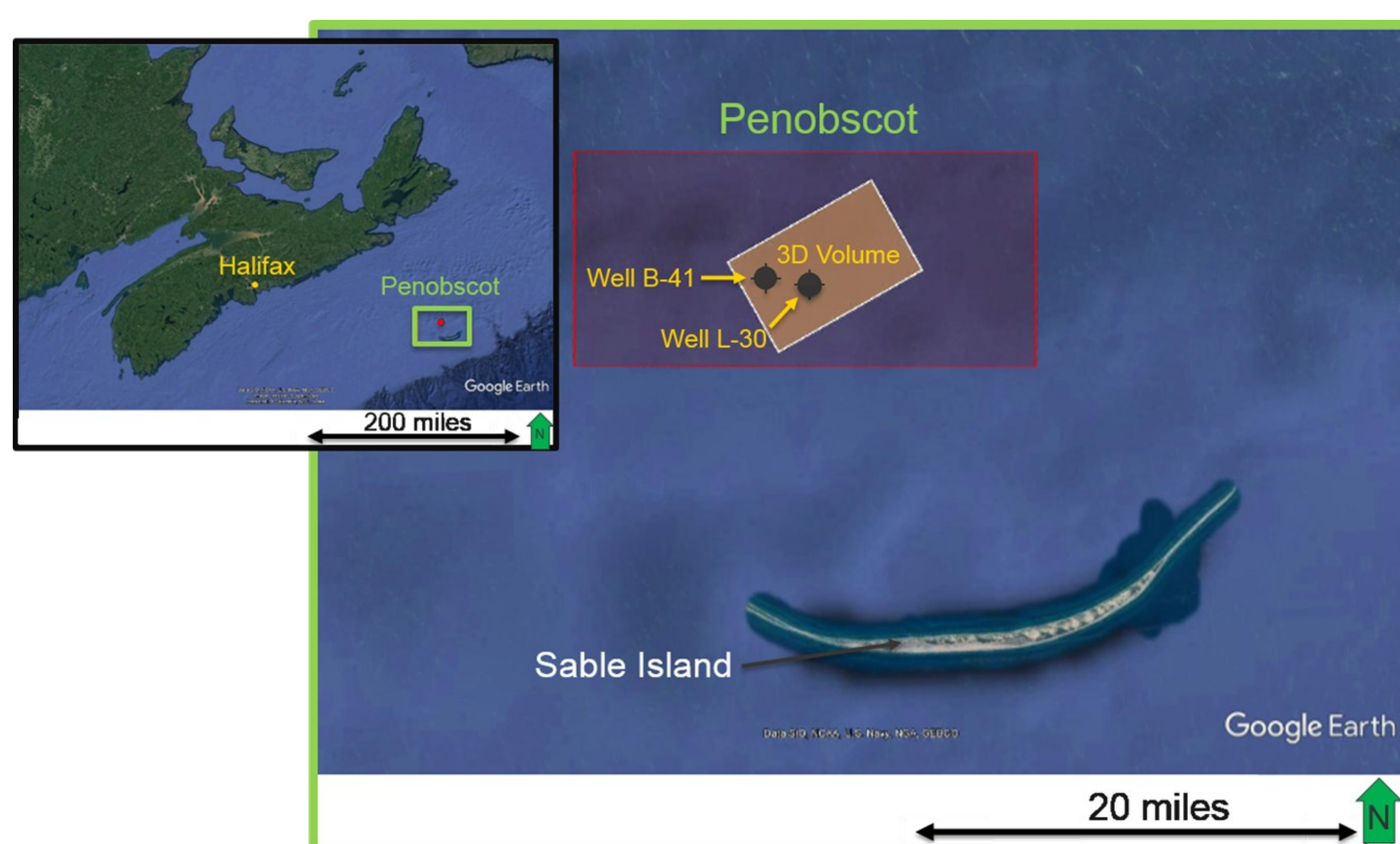
2. GEOLOGY OF THE STUDY AREA

Figure 1. Location of the wells and the 3D survey area. Offshore Canada on the Scotian Shelf, located 15 miles off Sable Island and 170 miles from Halifax, Nova Scotia (Google Earth Maps). Well L-30 was spud in 1976 with a TD of 14,000 ft, containing an oil and gas show. Well B-41 was spud in 1977 with a TD of 11,300 ft, it was a dry hole (CNSOB, 2008).
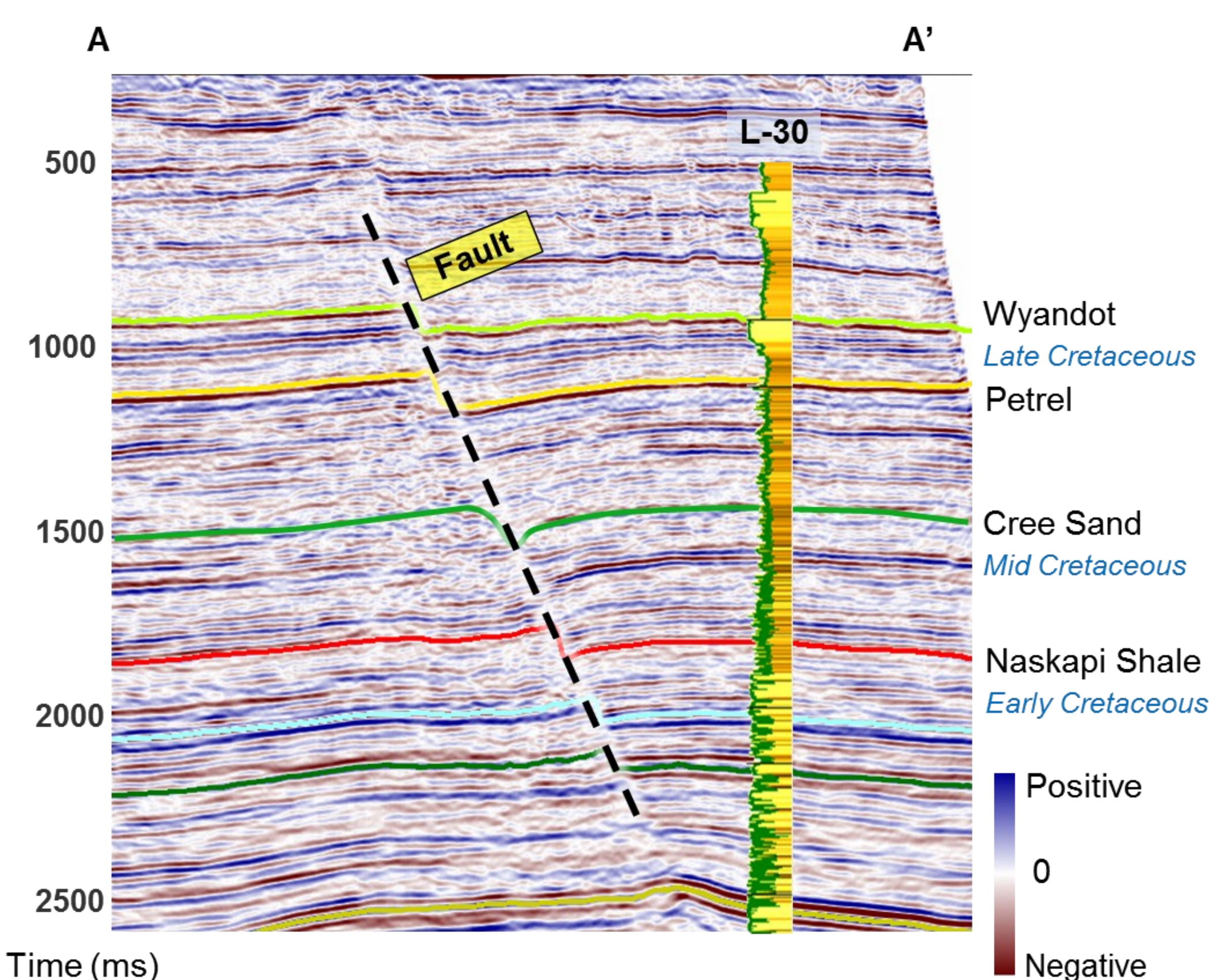

Figure 2. Seismic amplitude section AA'. Gamma ray log from well L-30 is transposed onto a seismic cross-section and provides an indication of the well-to-seismic tie. Annotations on the right hand side indicate the name of the formation tops (in black regular font) and their ages (in light blue italics font) (Khoudaiberdiev et al, 2017). Well L-30 generated a 70% correlation, providing a good quality match with the seismic data.

Wyandot — *Late Cretaceous*
Petrel
Cree Sand — *Mid Cretaceous*
Naskapi Shale — *Early Cretaceous*

3. SEISMIC DATA CONDITIONING, ATTRIBUTE STUDY AND INTEPRETATION

Figure 3. Workflow steps during data conditioning.

Figure 4. Original and Structure-oriented Filtering iterations 1-2 seismic amplitude gathers panels. From left to right: original gather panel (uncropped and unmuted), cropped original gather panel (time 1,400 to 1,860 ms), Prestack SOF iteration 1 (muted), Prestack SOF iteration 2 (muted).

As a result of the filtering, reflectors are stronger and laterally continuous (shown in blue arrows) and noise is removed, however cross-cutting reflectors are still present (shown in yellow arrows). Prestack SOF iteration 2 improvements are not noticeable in gather display.

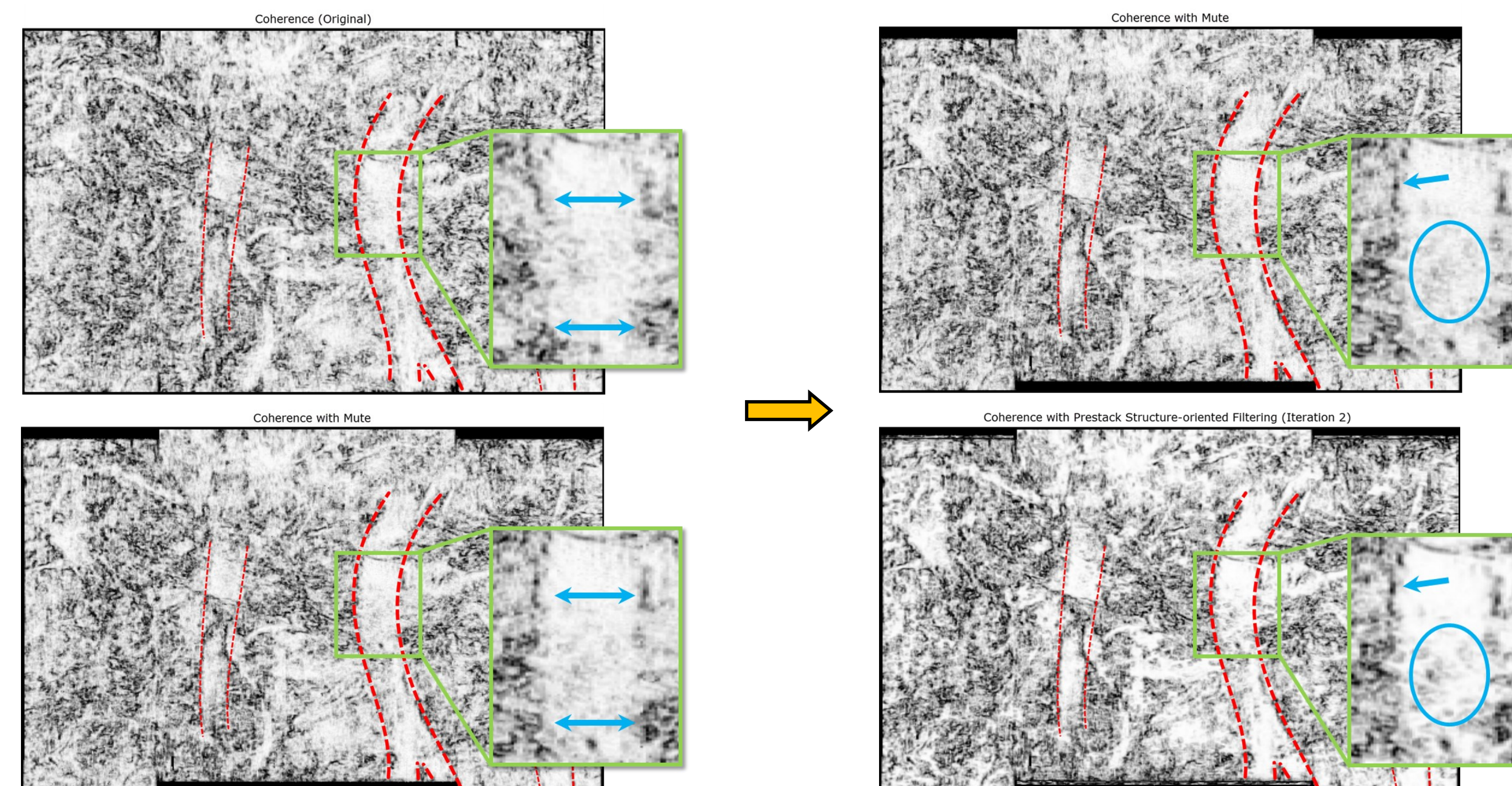Figure 5a. Blue arrows indicate channel edge improvements. Channel interpretations are shown as a red dashed line.

Figure 5b. Improvement in channel coherence seen in the blue oval and cleaner channel edges seen with the blue arrow.
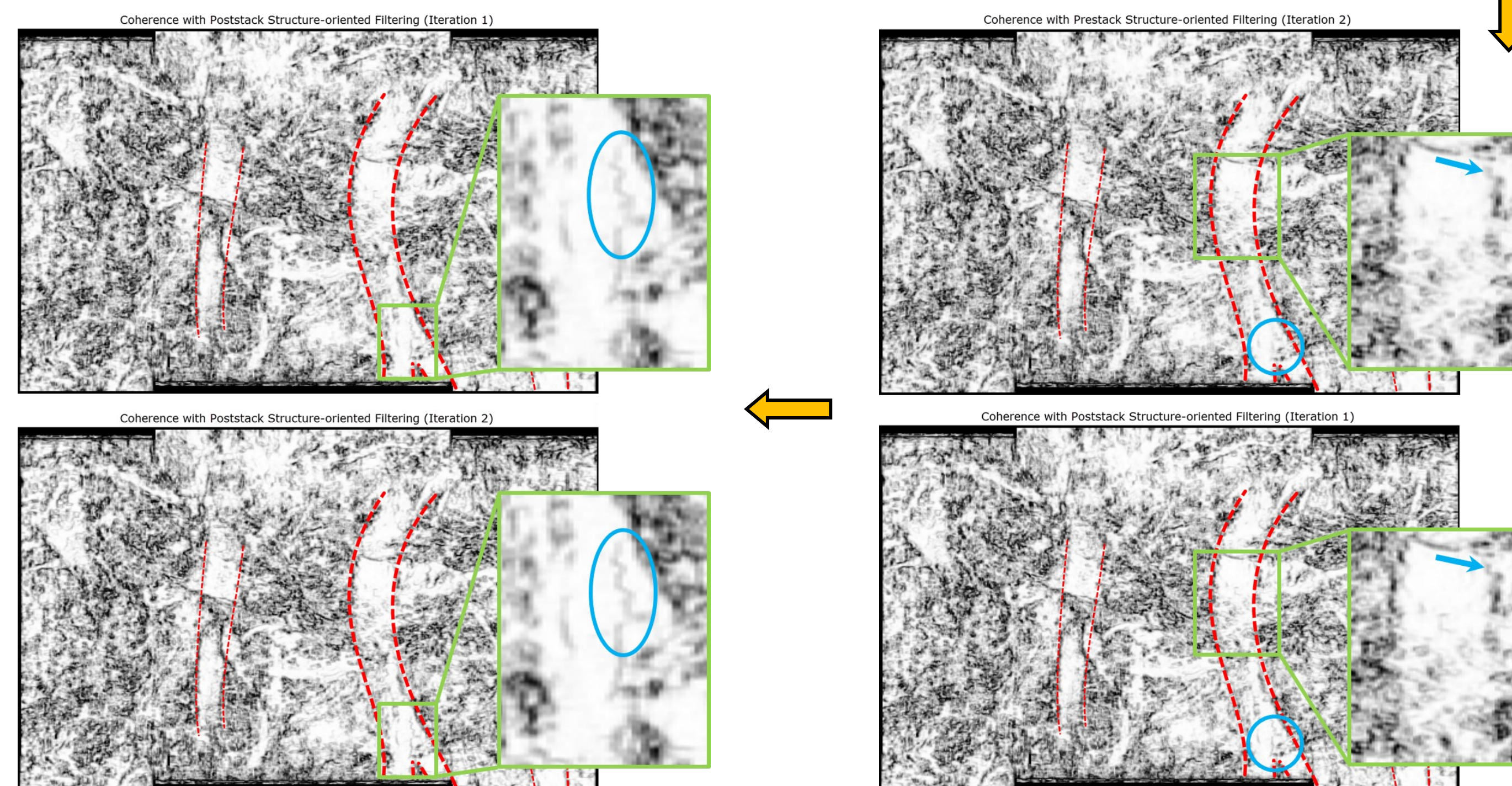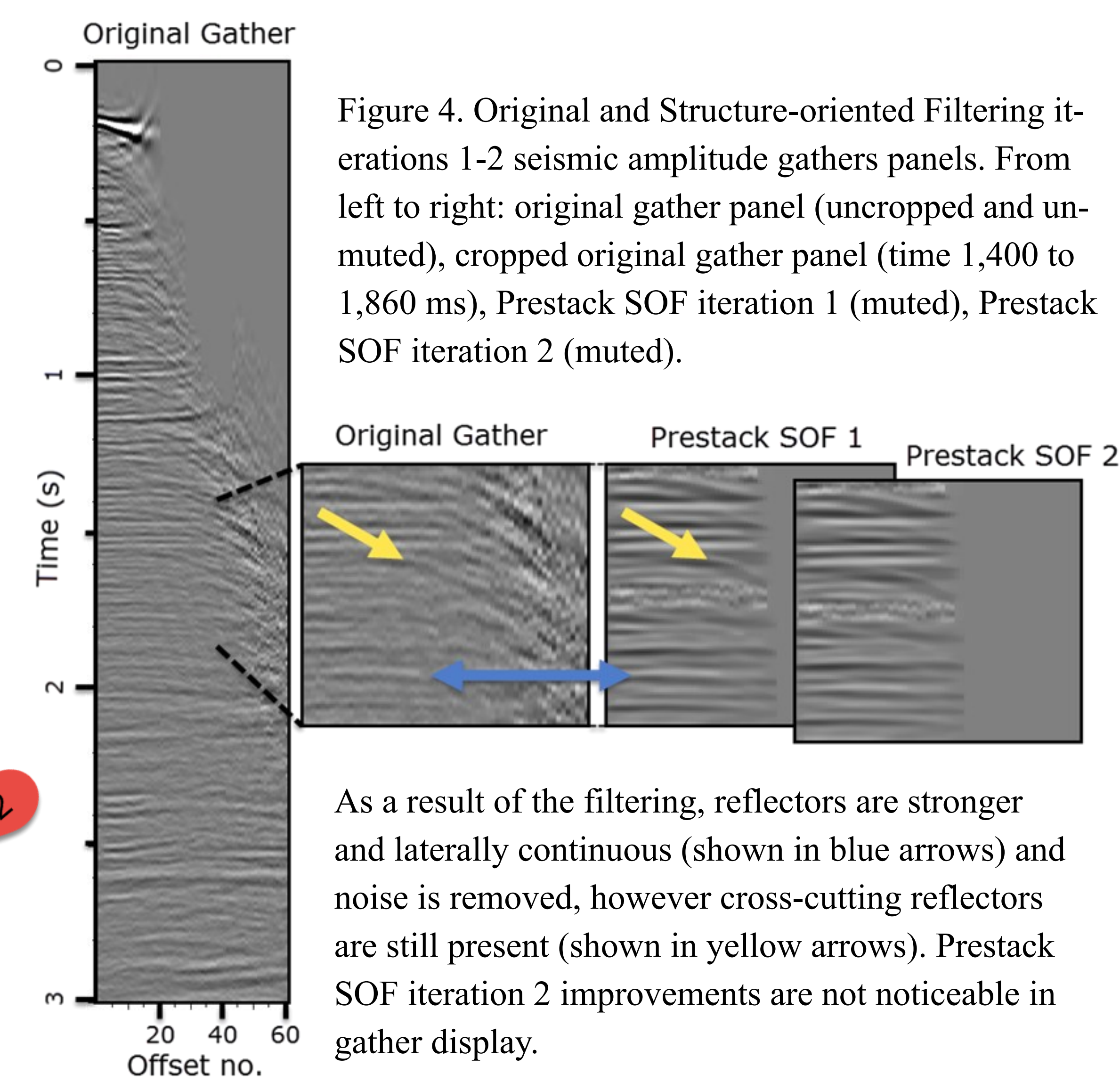
Figure 5d. Notably edge detection and internal channel detail seen with the blue oval. Continued iterations result in miniscule edge improvement.

Figure 5c. Minor improvement in channel edges seen with the blue arrows, and greatly increased internal channel detail seen with the blue circle.
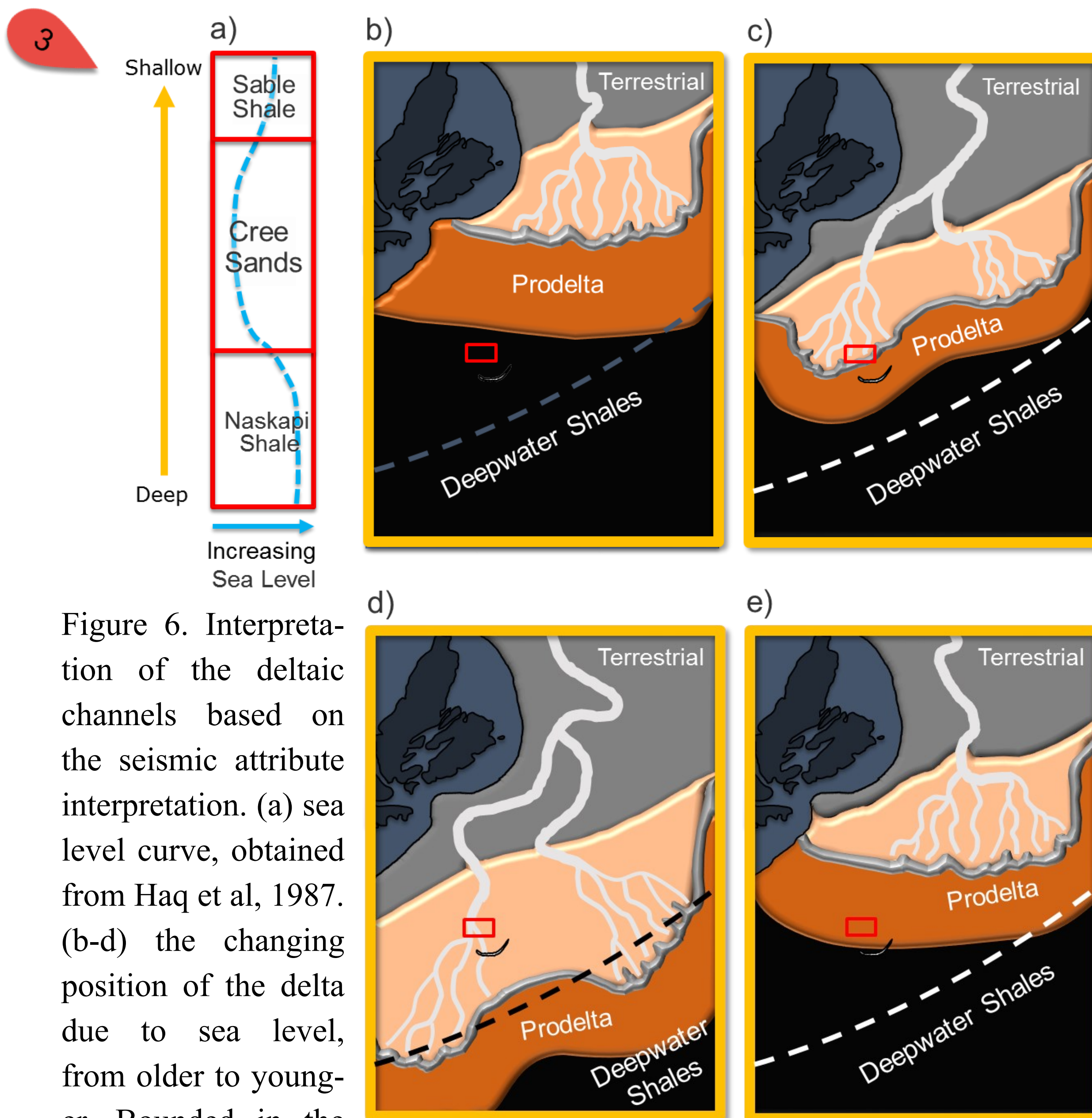

Figure 6. Interpretation of the deltaic channels based on the seismic attribute interpretation. (a) sea level curve, obtained from Haq et al, 1987. (b-d) the changing position of the delta due to sea level, from older to younger. Bounded in the red rectangle is the survey location shown in the Figure 1. The dashed line represents the Aptian paleo shelf break (Khoudaiberdiev et al, 2017).

4. CONCLUSIONS

Through an application of a mute, pre and post stack structure-oriented filtering, channel delineation is improved to the benefit of an interpreter. Additionally, coherence attribute provides a potent tool for channel mapping and subsequent characterization.

5. REFERENCES

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Haq, B.U., J. Hardenbol, and P.R. Vail, 1987, Chronology of fluctuating sea levels since the Triassic: Science, 235, 1156-1187.
Khoudaiberdiev, R., C. Bennett, P. Bhatnagar, S. Verma, 2017, Seismic Interpretation of Cree Sand Channels on the Scotian Shelf. SEG Technical Program Expanded Abstracts 2017, 2008–12, 2017. doi.org/10.1190/segam2017-17742372.1.

6. ACKNOWLEDGEMENTS