

Structural Inversion and Channel Evolution in a Transition Zone Across the Boundary Between Passive and Active Continental Margins: An Example From Offshore Southwestern Taiwan*

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Abstract

This study analyzes both 2D and 3D seismic images in the upper reach of the Penghu Submarine Canyon to investigate sedimentary and structural processes in the transition zone from passive to active margins. The study area lies across the deformation front which separates the rifted South China Sea (SCS) continental slope to the west from the submarine Taiwan accretionary wedge to the east. West of the deformation front, features indicating basin thickening and reverse offsets are observed on 2D seismic profiles, suggesting that pre-existing extensional faults may have been inverted to reverse faults during the arc-continent collision. From 3D seismic images, several structural and sedimentary features have been identified: in the rifted SCS slope domain, besides the paleo-slope surface, buried submarine channels and mass transport deposits (MTDs), the reactivated extensional fault system is mapped; while in the accretionary wedge, the fold and thrust structures are dominate. Since the deformation front is defined as the location of the most frontal contractional structures along a convergent plate boundary, we thus suggest to move the location of the previously mapped deformation front further west to where the inverted reverse fault lies. High resolution 2D seismic and bathymetry data reveal that the path of the paleo-submarine channels ran nearly perpendicular to the slope dip direction, while the present submarine channels head down slope in the study area. We suggest that this might be the result of the structural inversion. The interactions of down-slope processes and active structural controls affect the channel paths in our study area.

References Cited

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Yu, H.S., and E. Hong, 2006, Shifting Submarine Canyons and Development of a Foreland Basin in SW Taiwan: Controls of Foreland Sedimentation and Longitudinal Sediment Transport: *Journal of Asian Earth Sciences*, v. 27/6, p. 922-932.

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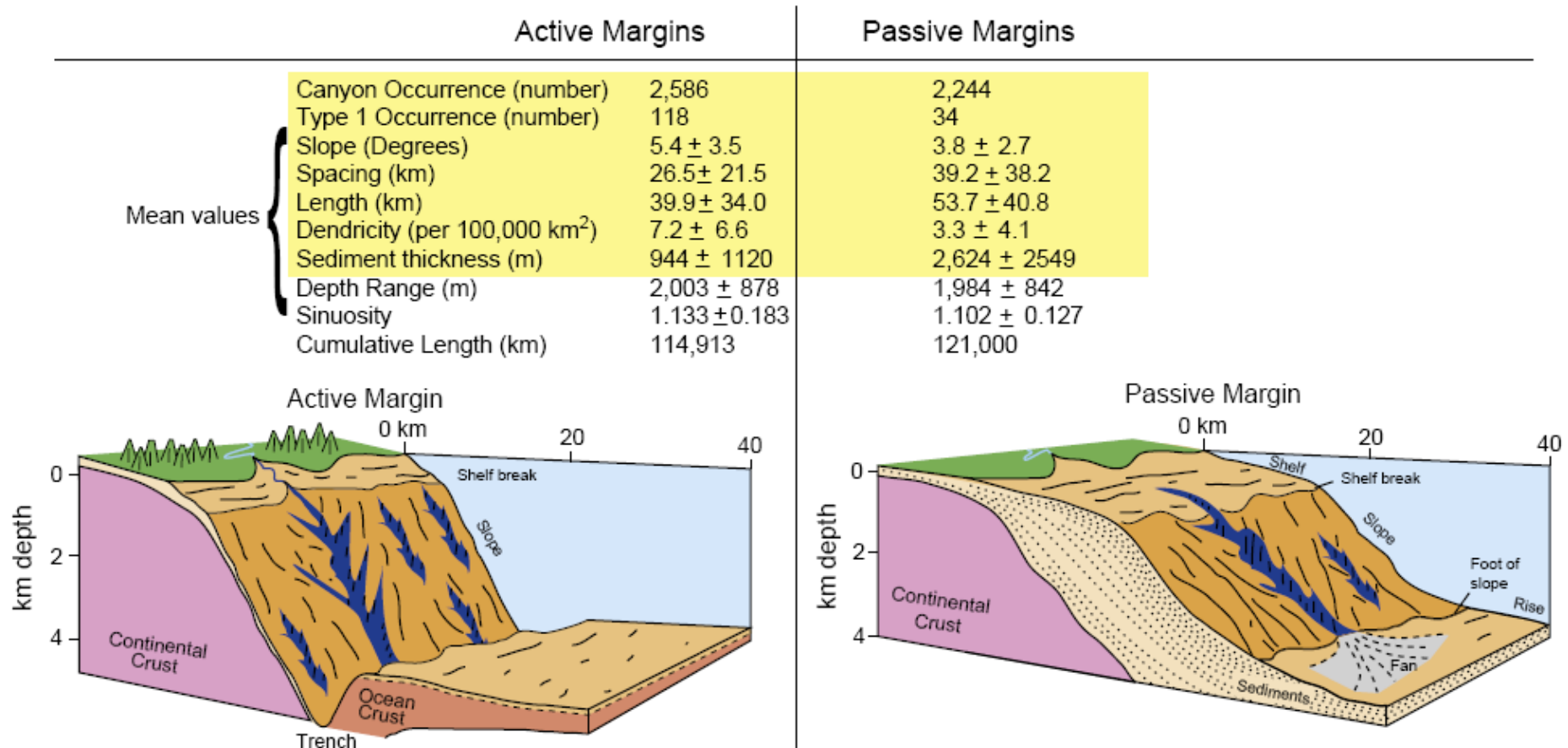
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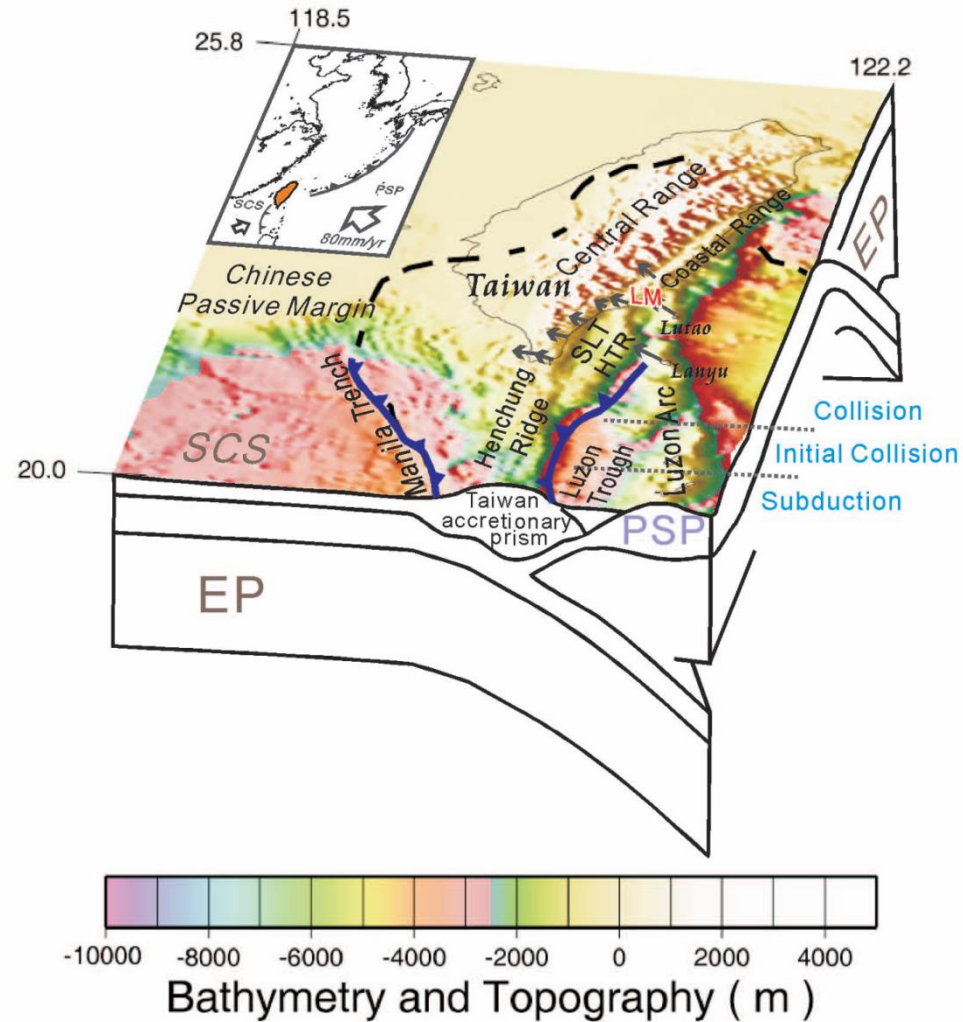
Geomorphic Differences of Large Submarine Canyons Between Active and Passive Margins

- Slope
- Sediment thickness
- Length

What role does tectonics play for canyon evolution in the transition of active and passive margins?



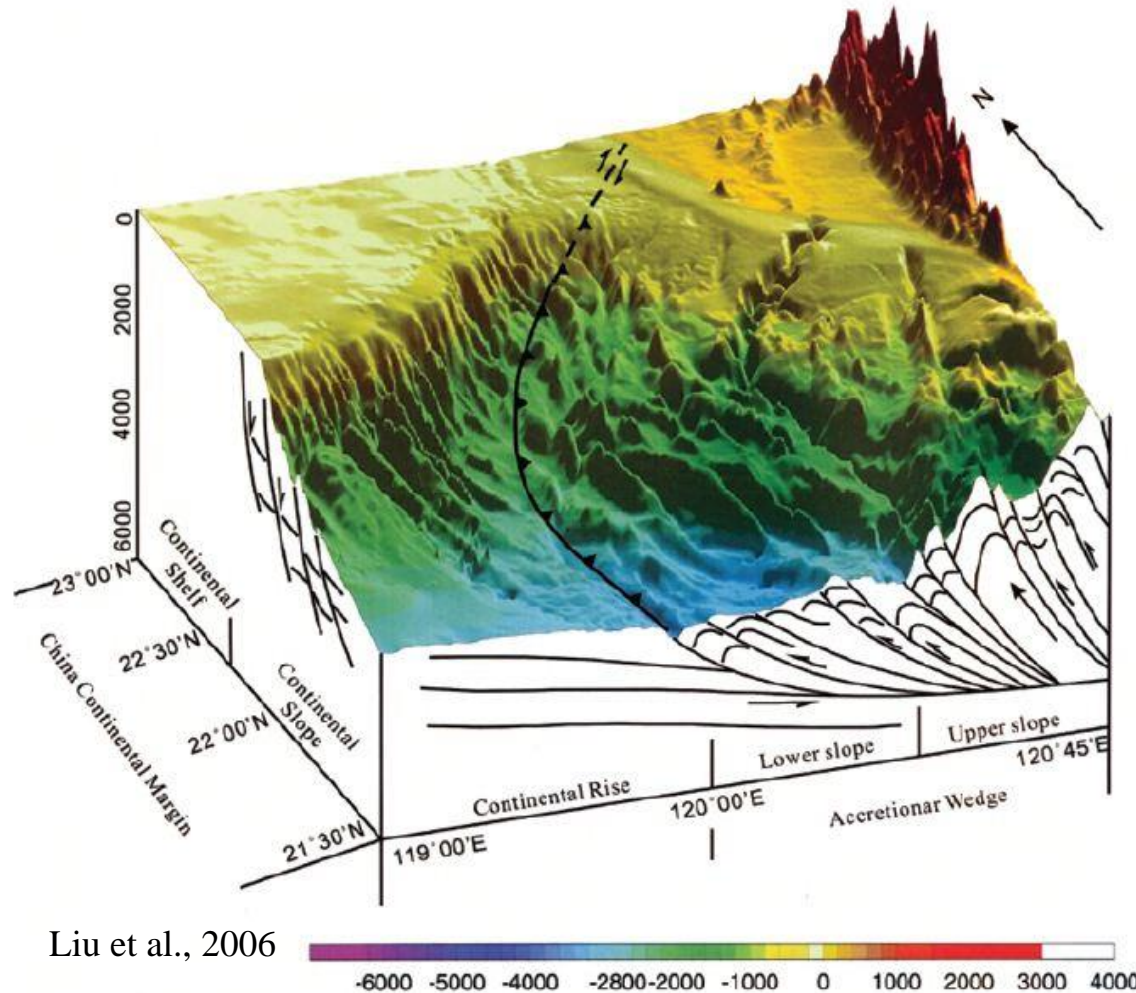
Eurasia Plate



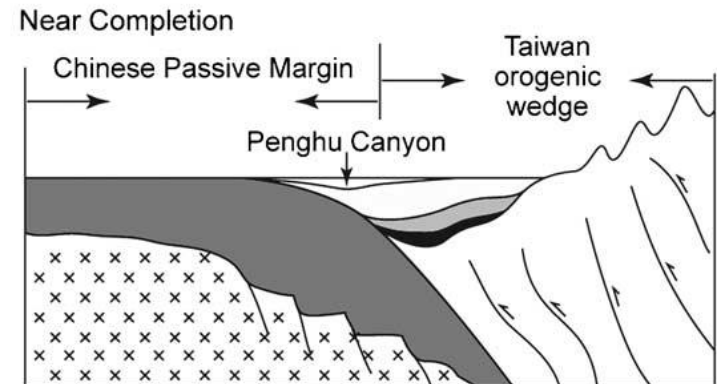
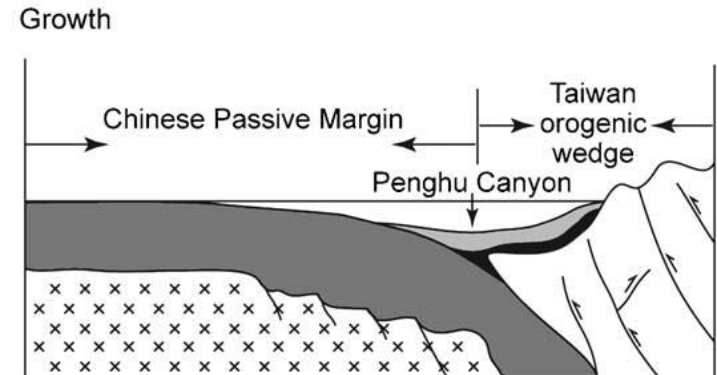
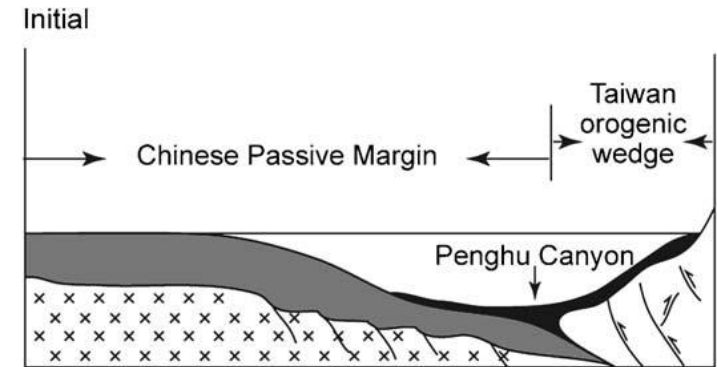
Geologic Setting and Canyon Migration in Offshore SW Taiwan

West of Deformation front:
Extensional domain –
Normal faults

East of Deformation front:
Contractional domain -
Thrusts and folds

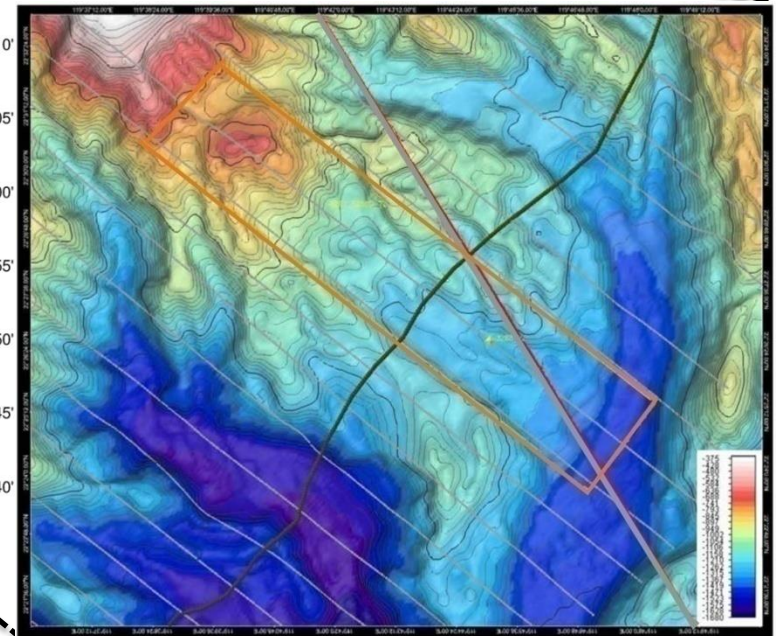
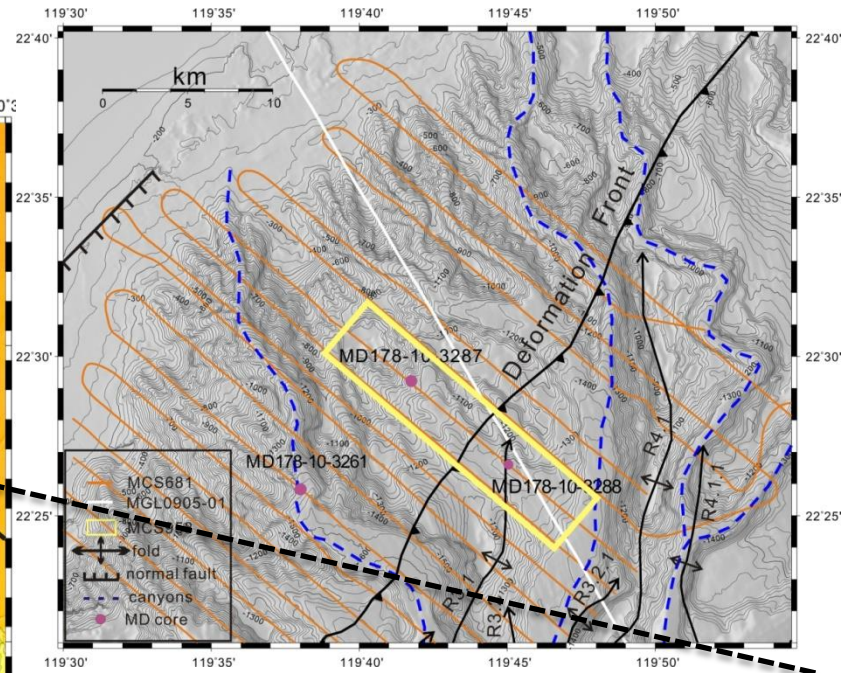
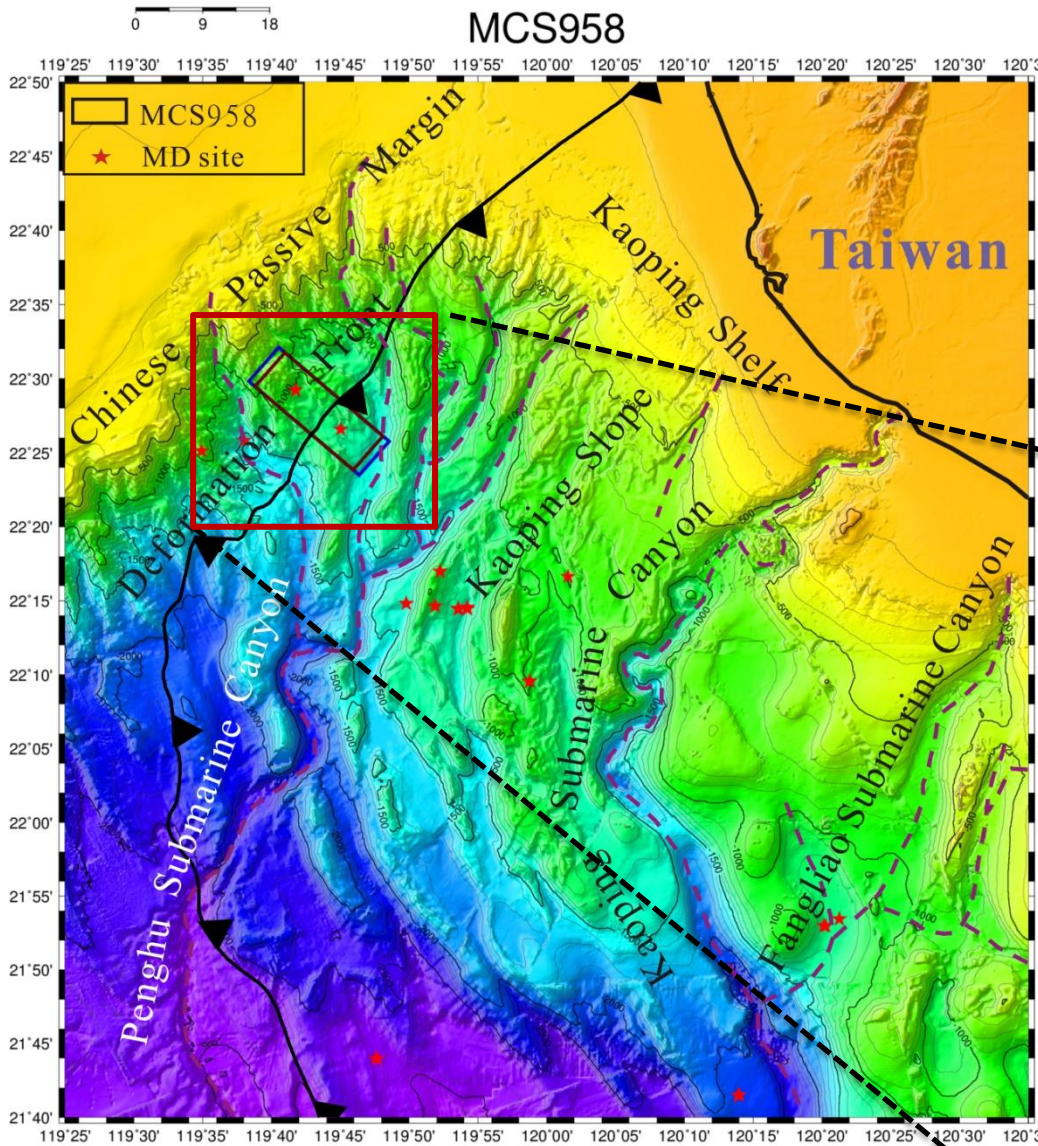


Liu et al., 2006

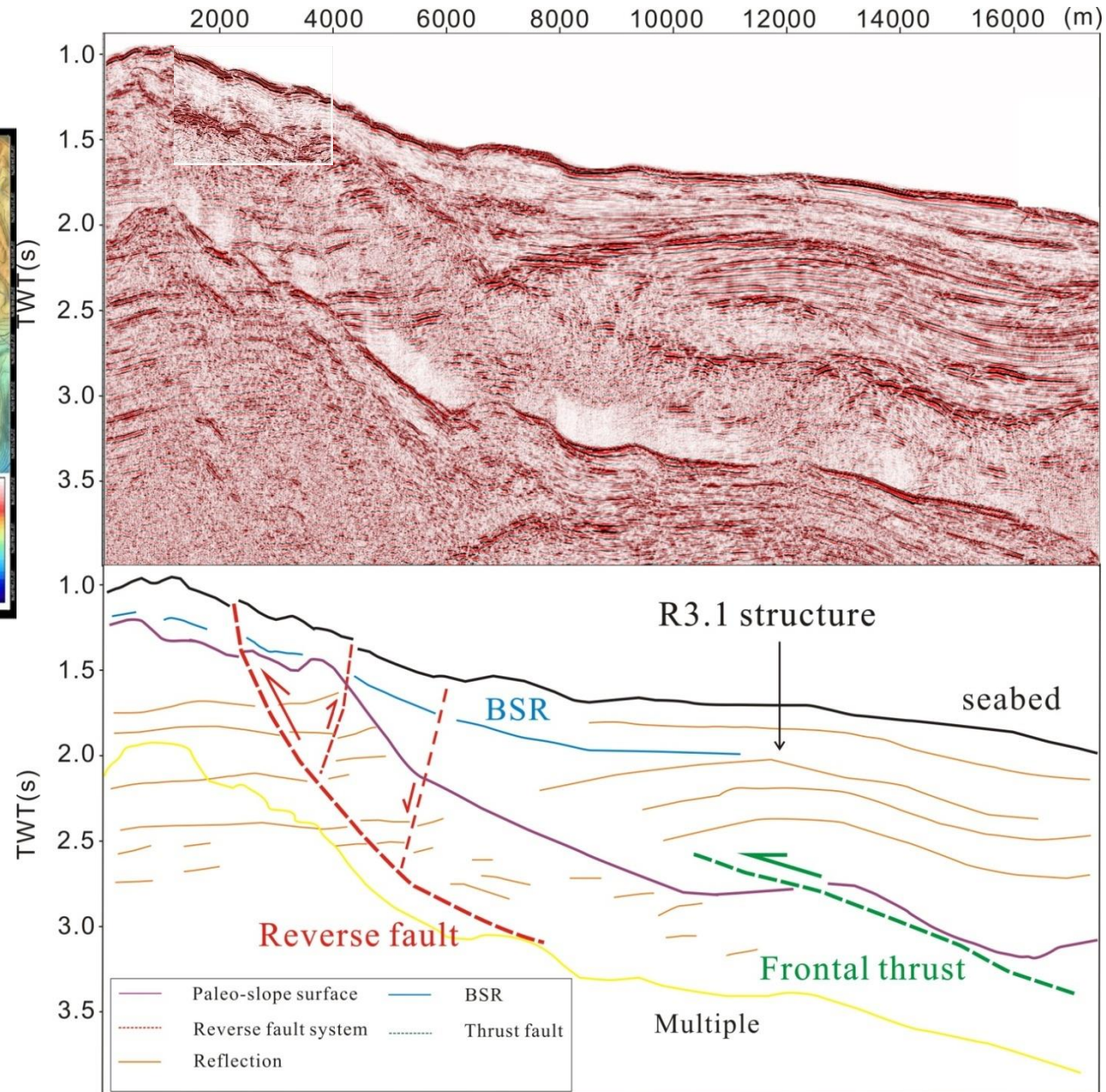
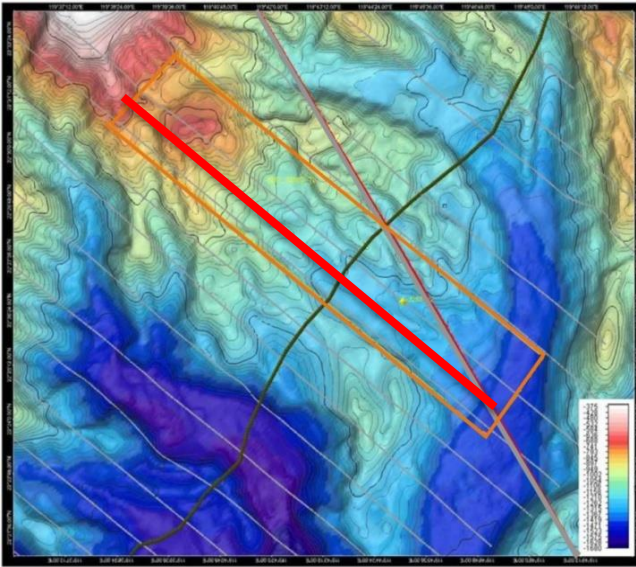


Yu et al., 2006

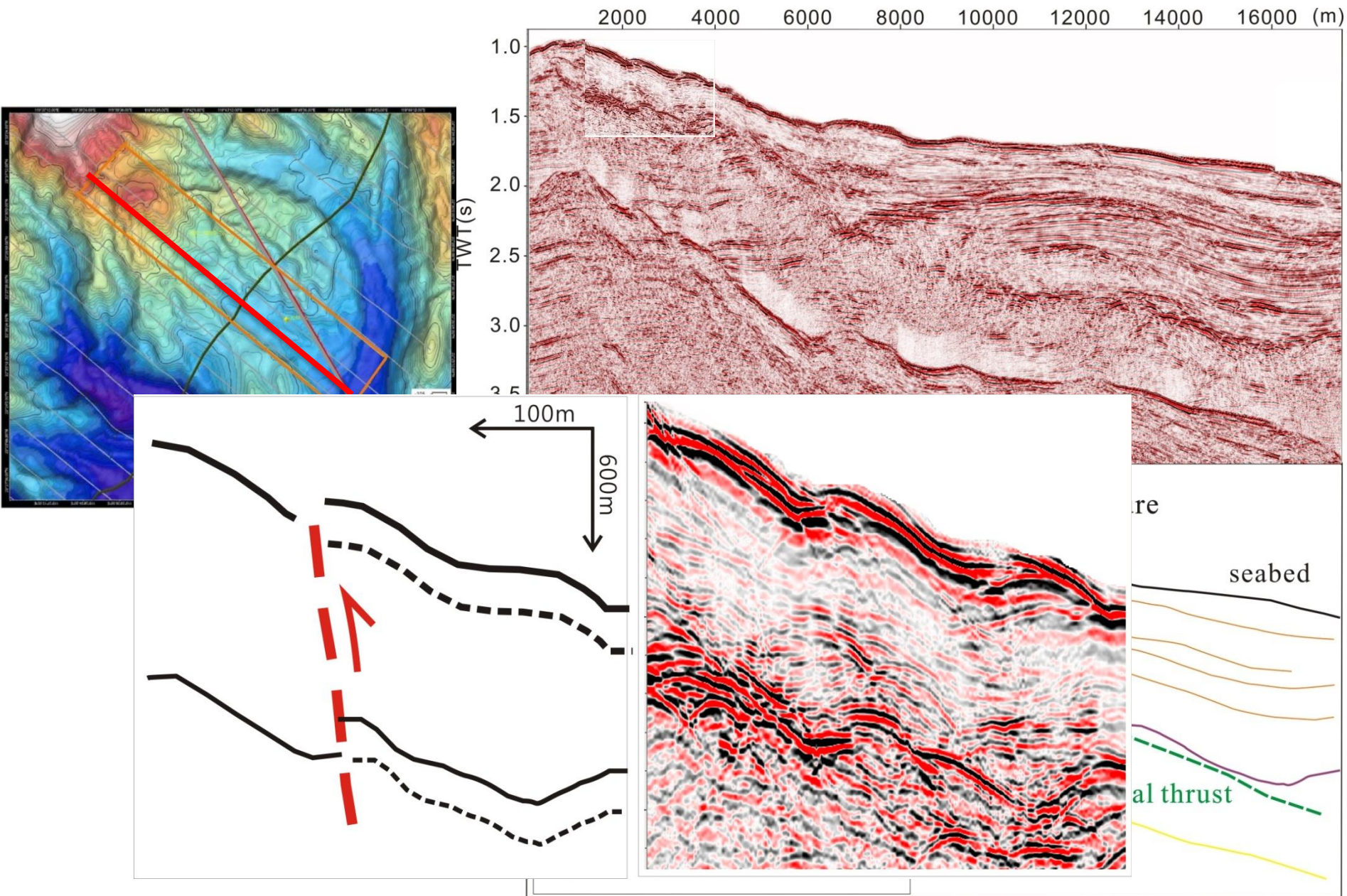
Data and Bathymetry



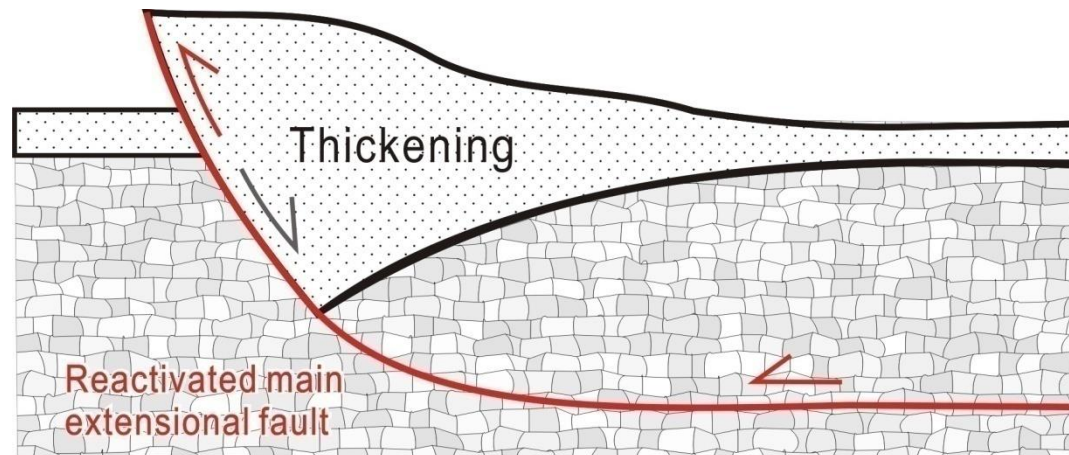
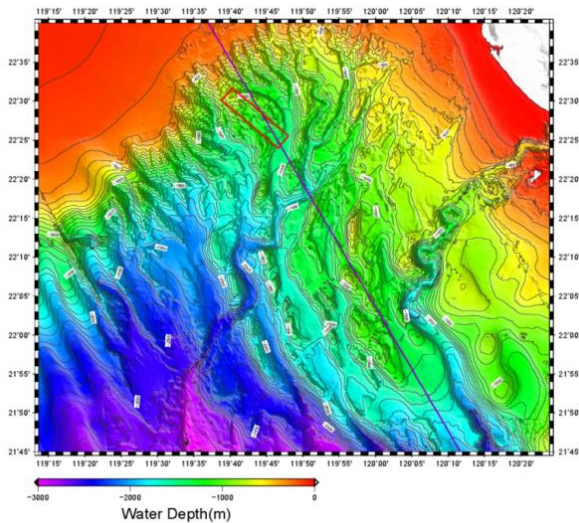
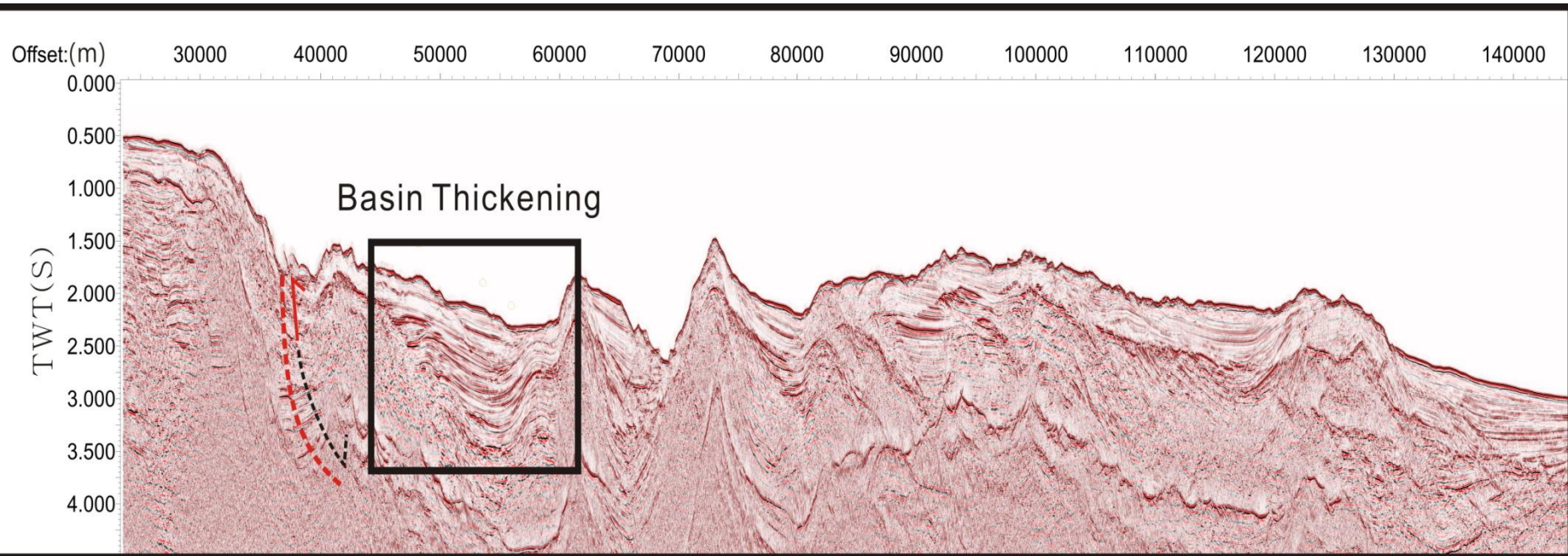
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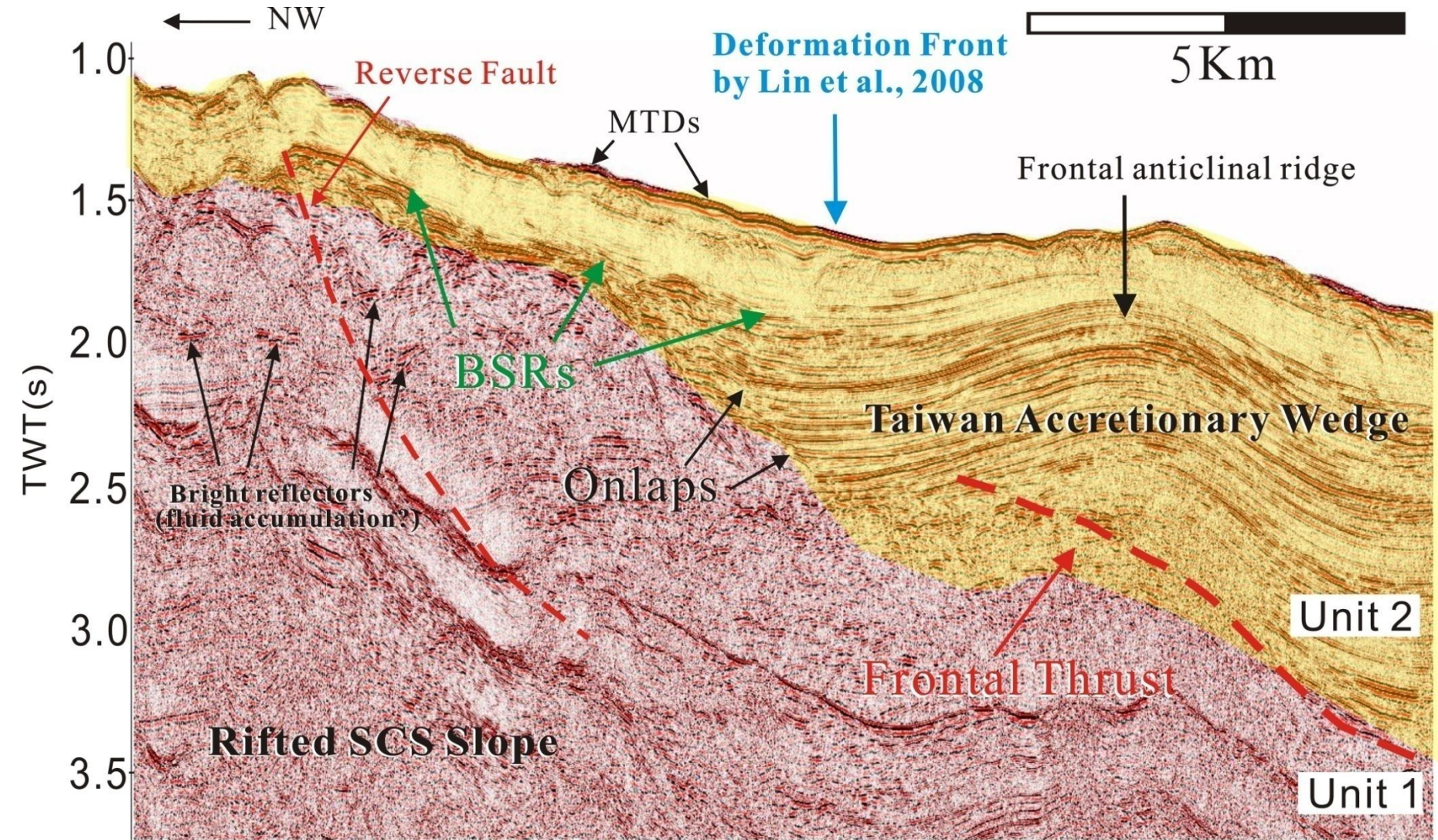
Evidences for Structural Inversion



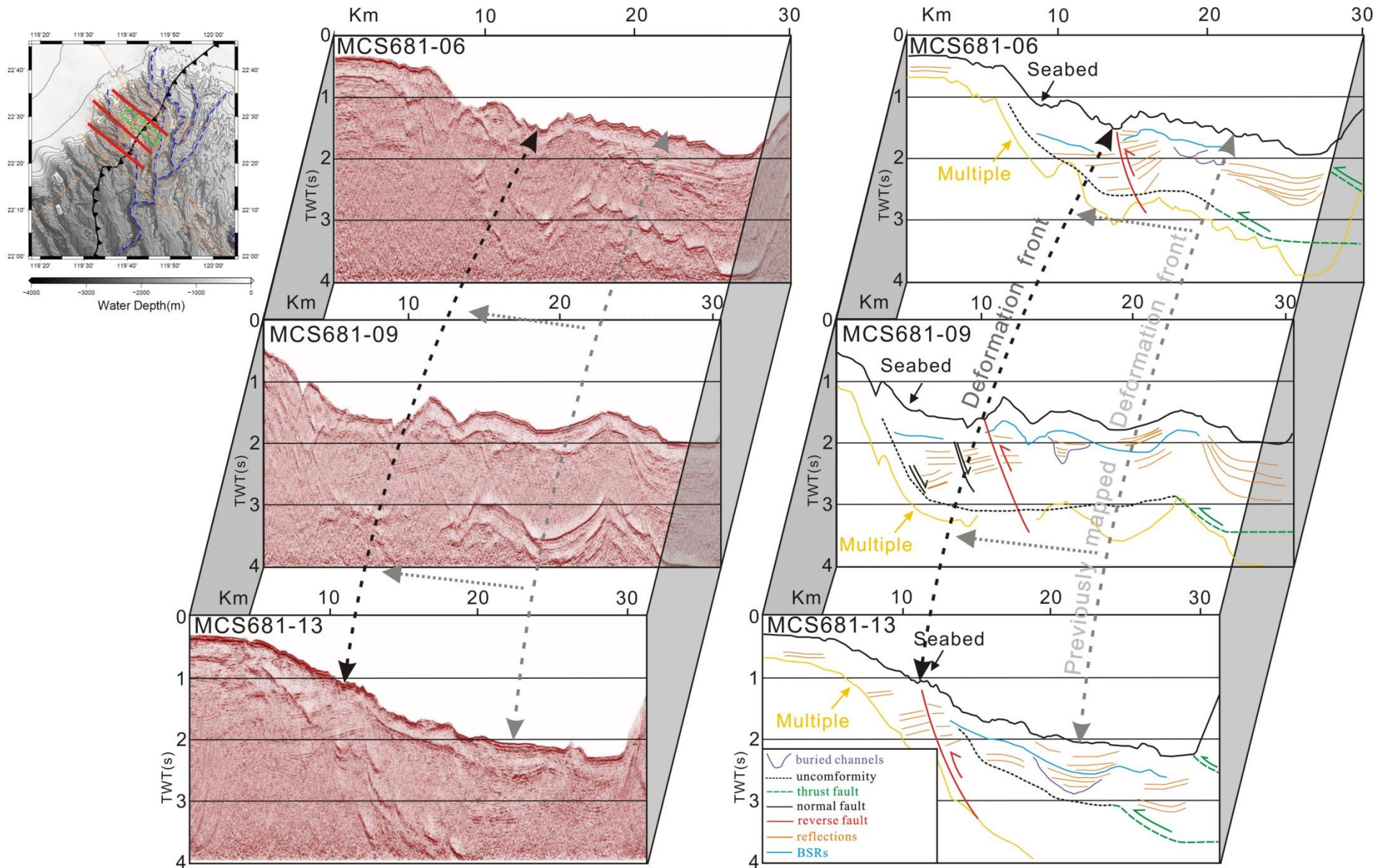
Evidences for Structural Inversion



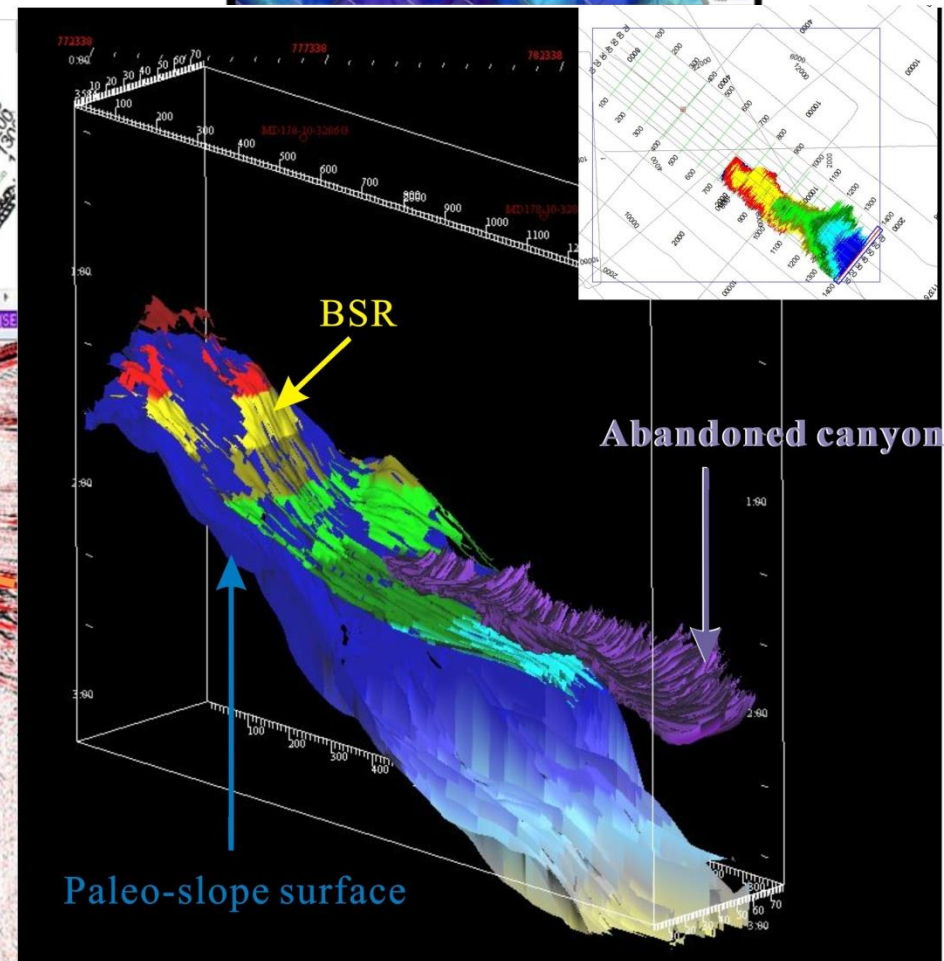
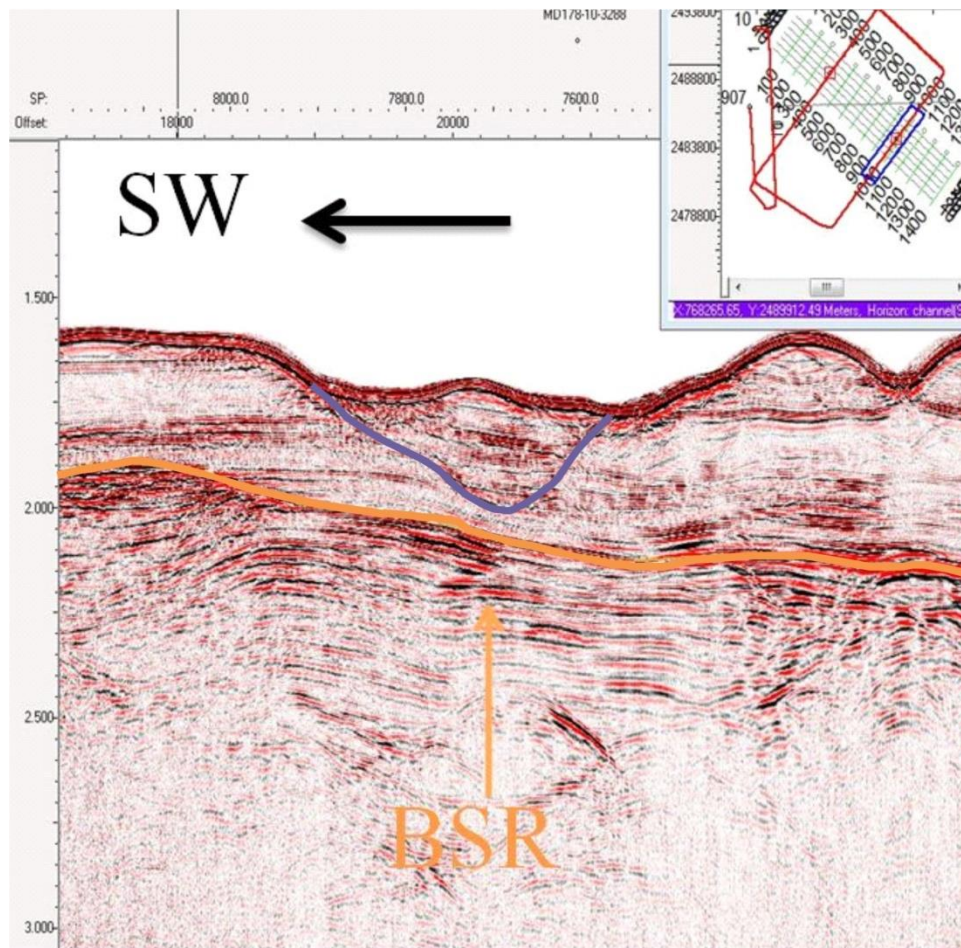
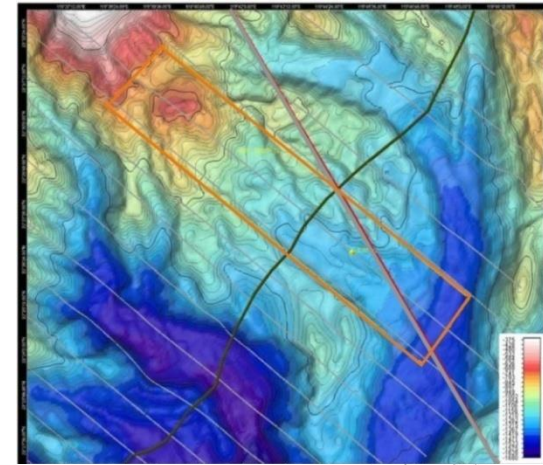
Structural Features



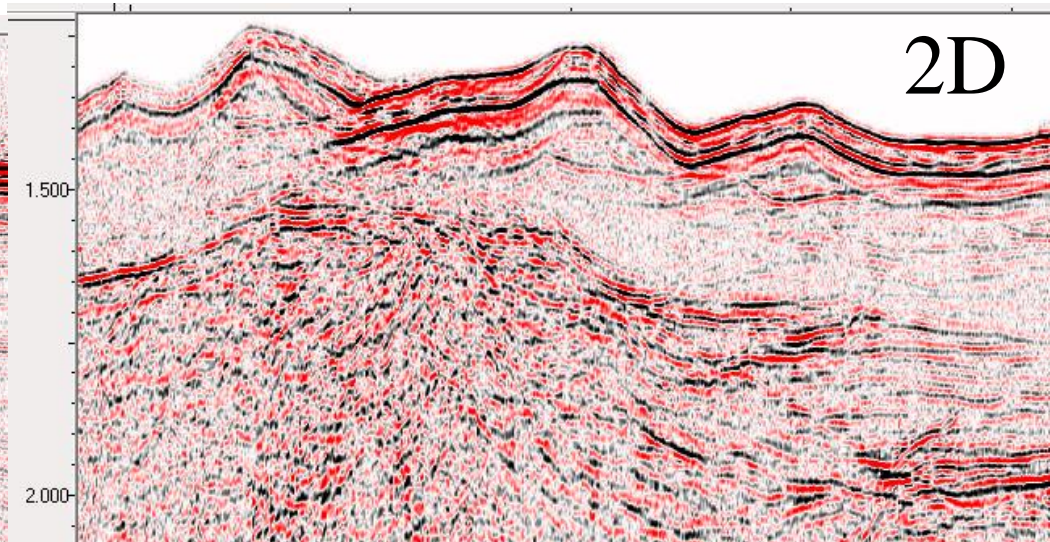
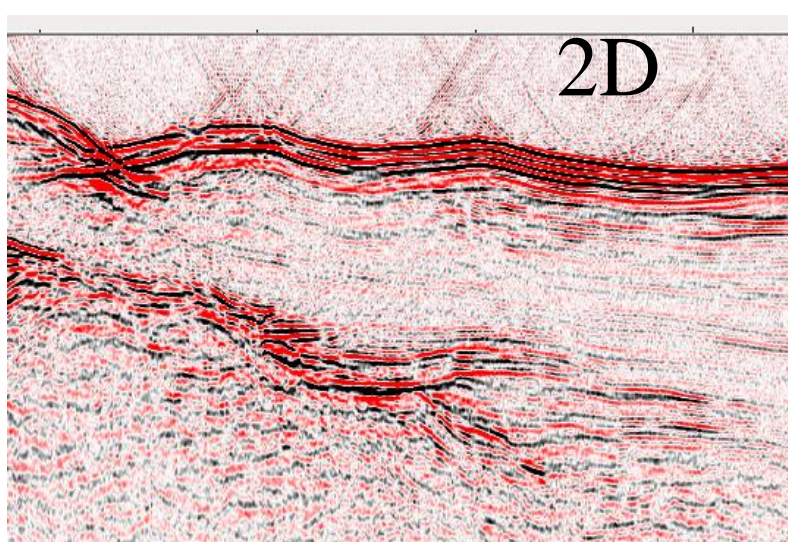
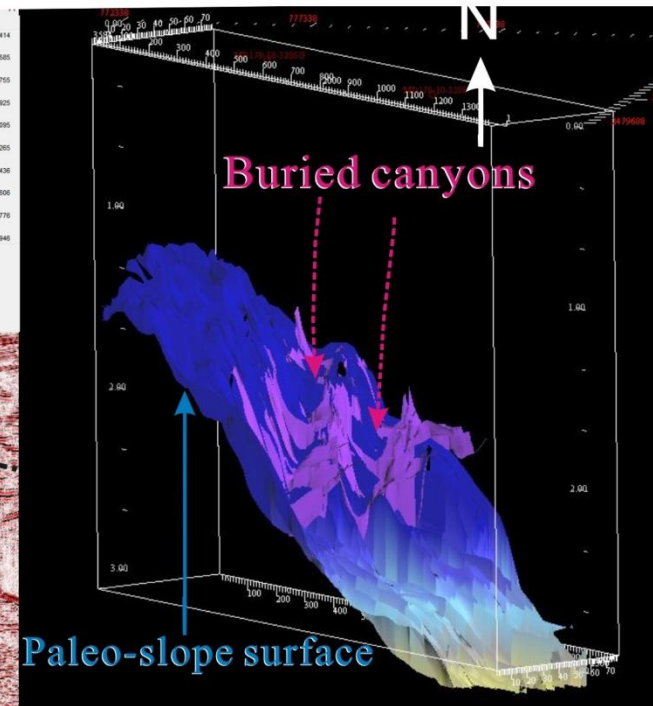
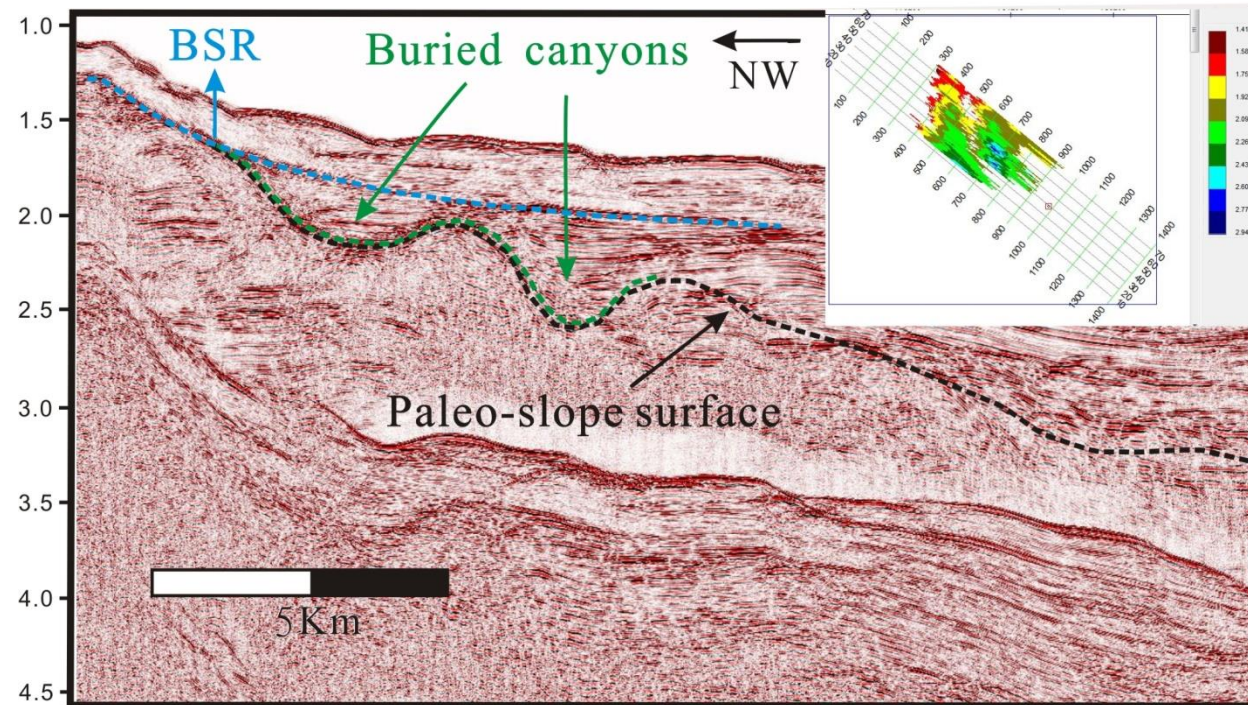
The Location of the Deformation Front



Canyon Filling

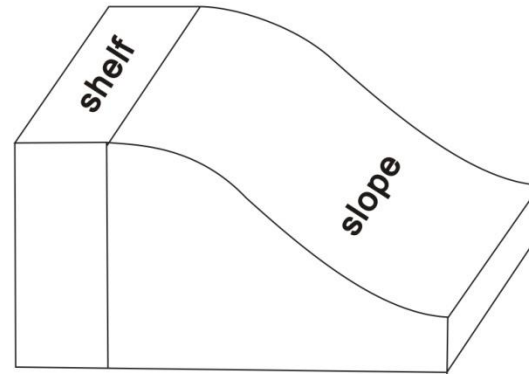


Buried Canyons

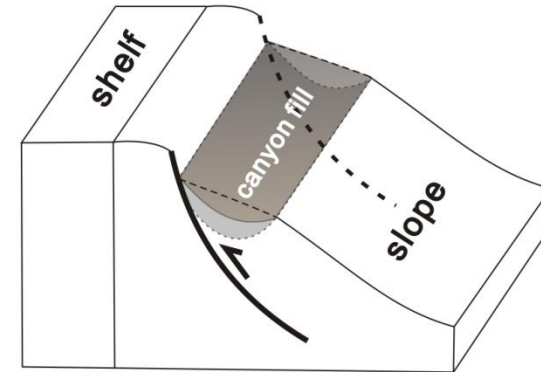


Canyon Migration Model

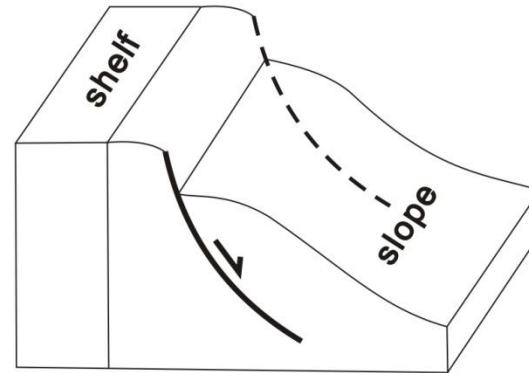
Initial stage



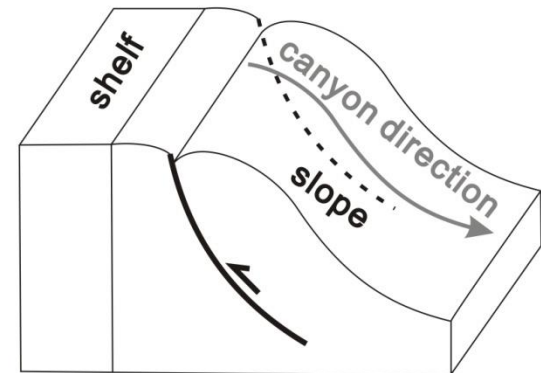
4th stage:
Uplift, canyon fill



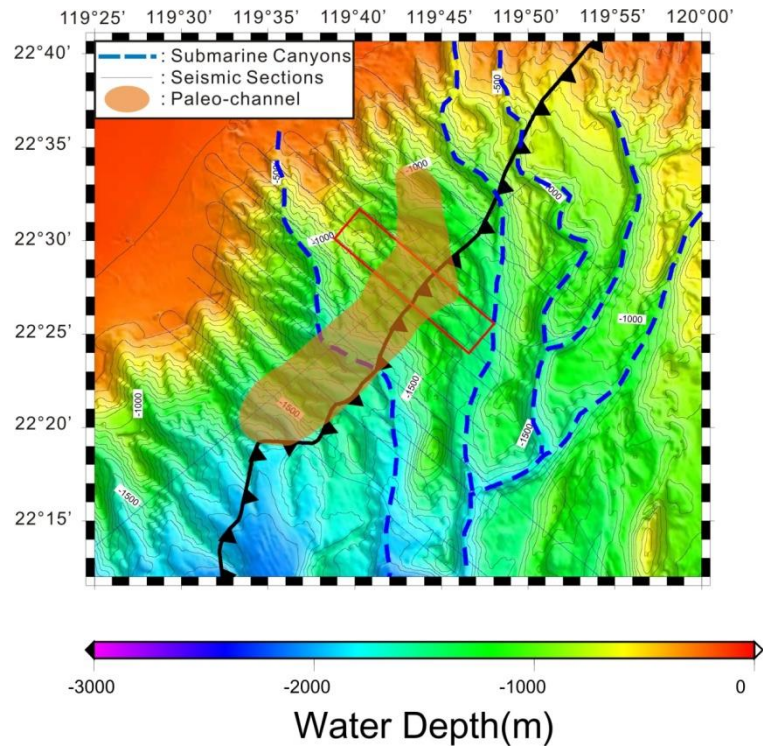
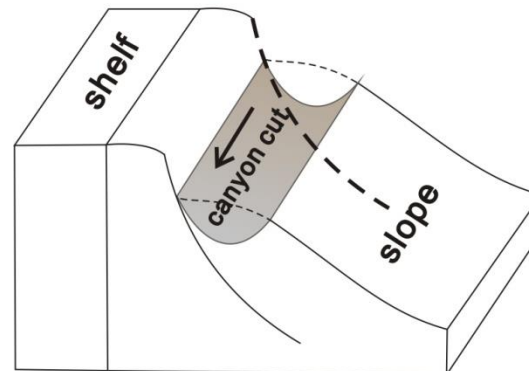
2nd stage: Down slip



Present

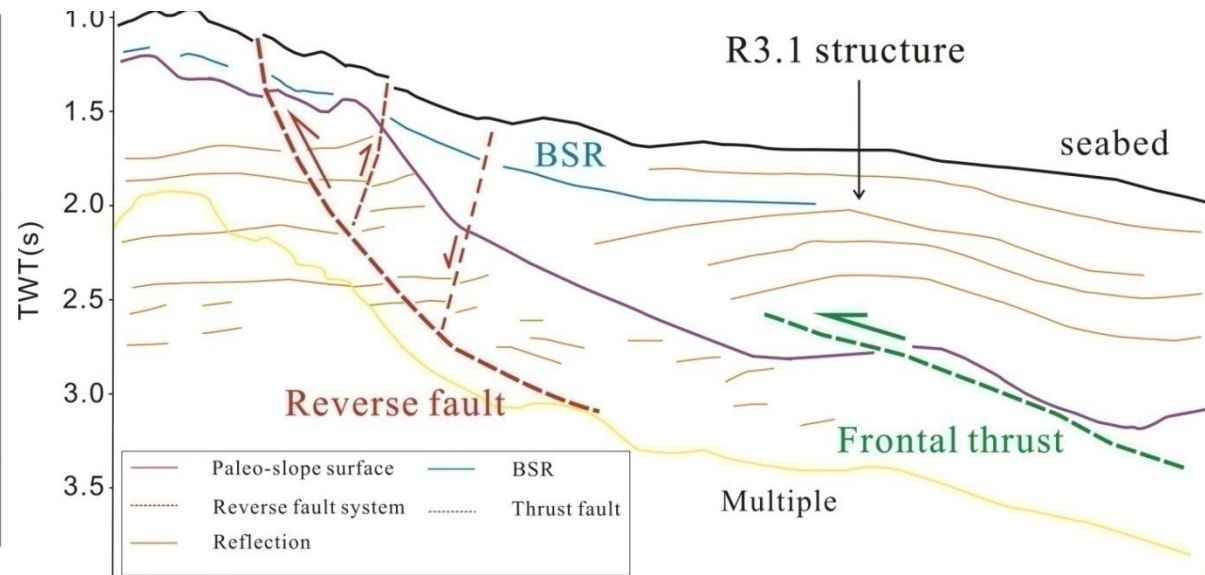
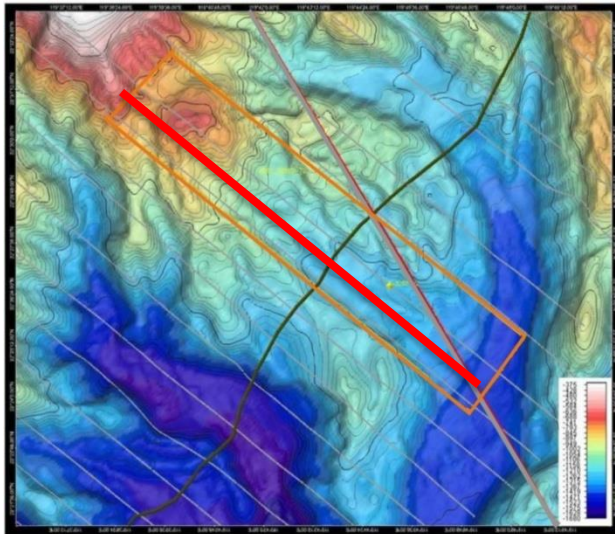


3rd stage: Canyon cut



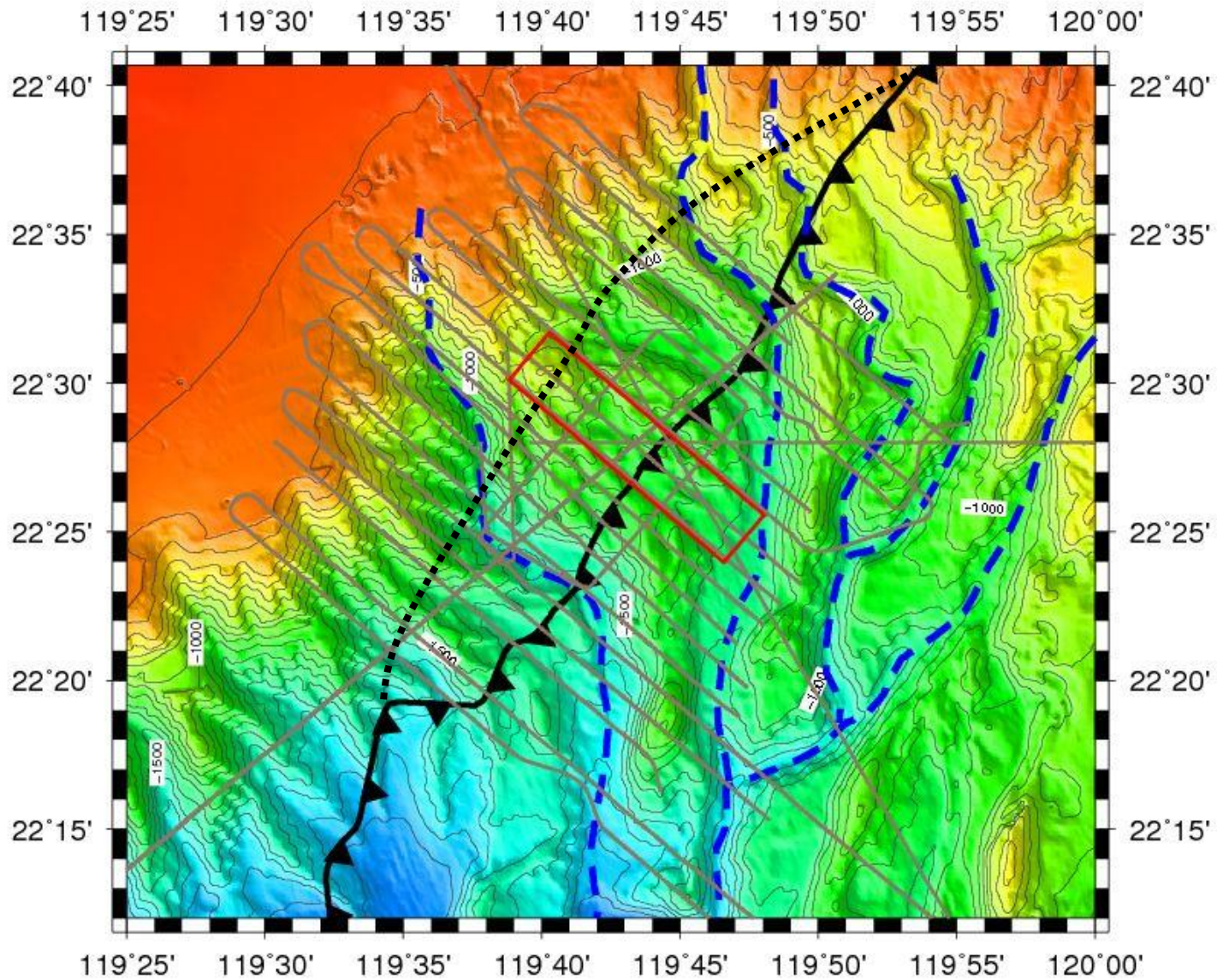
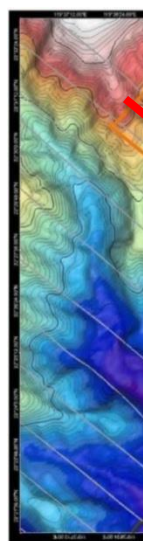
Summary

- 3-D seismic analysis results reveal the **present canyon filling** and it is probably a result of the uplifting of the **frontal anticline**.
- A reverse fault system is recognized west of the previously mapped deformation front. We thus suggest to move the location of the deformation front to where the reverse fault lies.

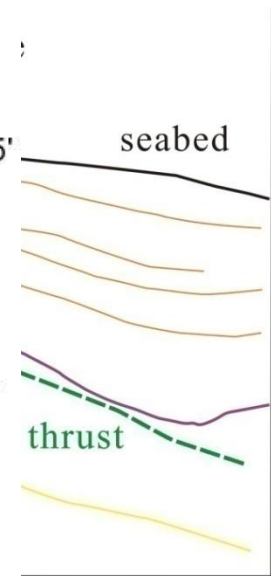


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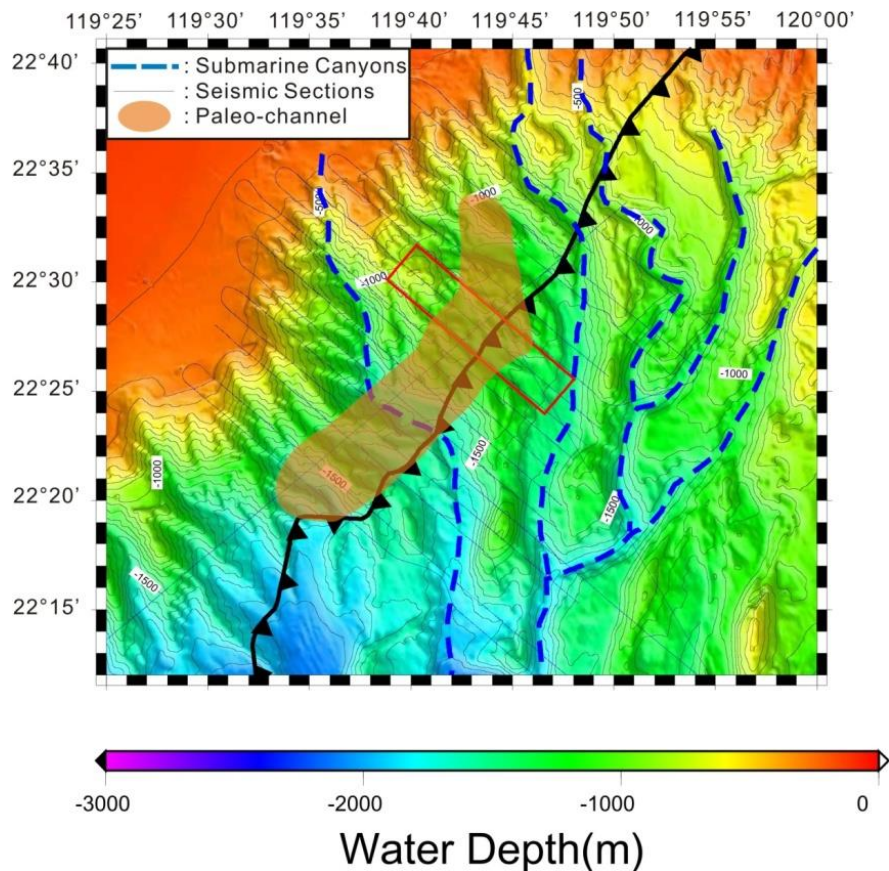


Water Depth(m)

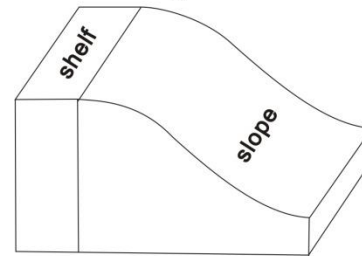


Summary

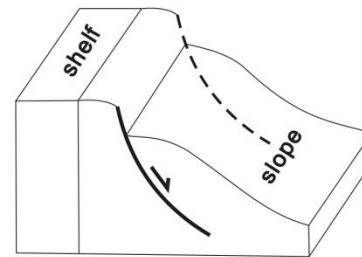
- **Paleo-canyons** (transverse to the slope dip) show drastically different direction from the **present canyons** (down-slope). We suggest that the canyon directions are a result of **tectonic activities** and the down-slope processes in the study area.



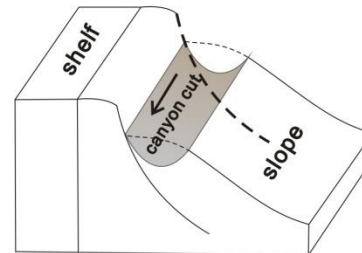
Initial stage



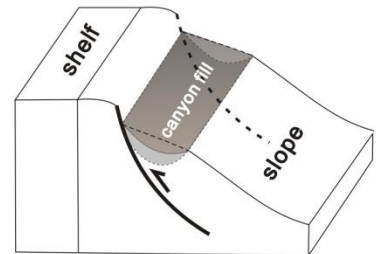
2nd stage: Down slip



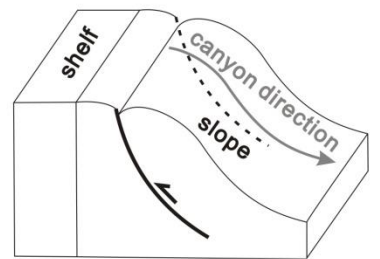
3rd stage: Canyon cut



4nd stage: Uplift, canyon fill



Present



Thank you for your attention