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Deep water incursions slow offshore West Antarctic Ice Sheet expansion during its early formation

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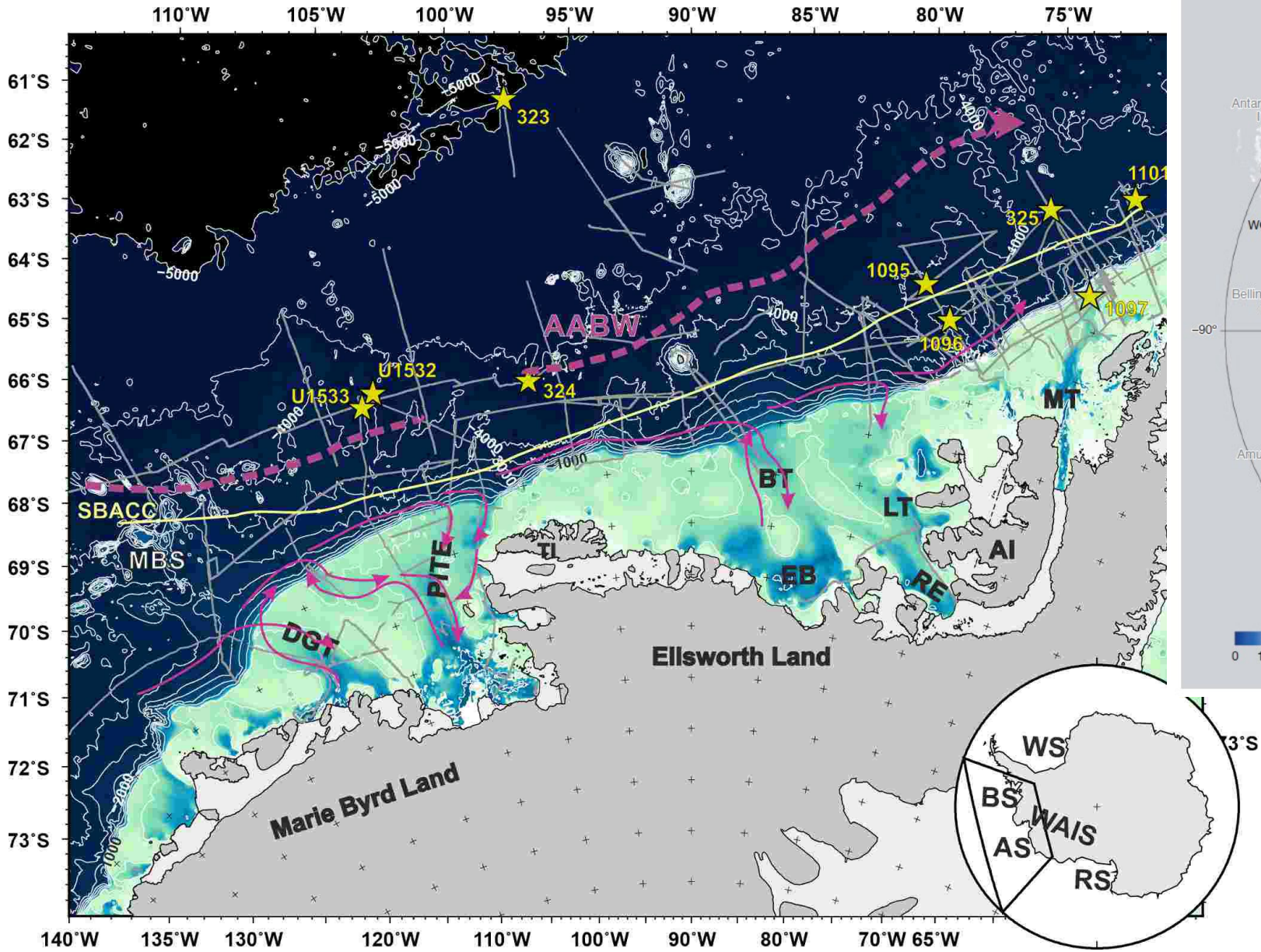

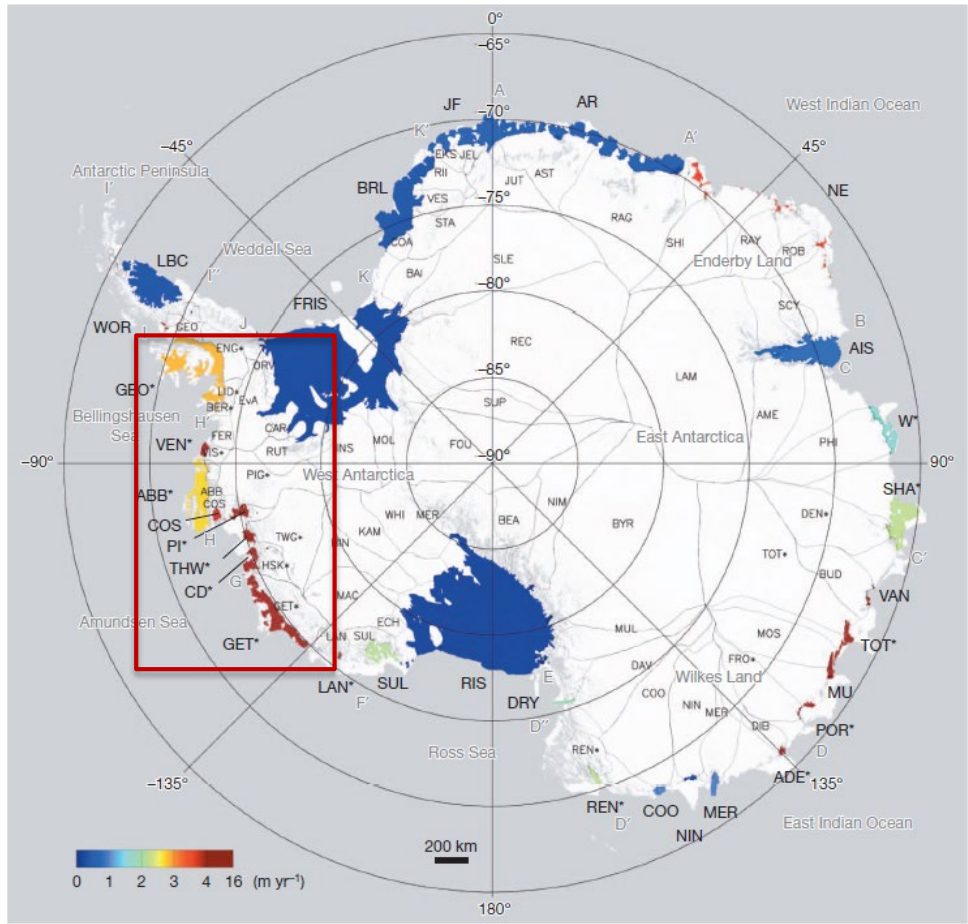

Depoorter et al., 2013

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- Continental-scale Antarctic ice sheet are reported to have reached sea level during the EOT
- influence of the ocean on formation and advance/retreat at this time is unconstrained
  - ocean circulation and location of the Southern Ocean frontal system is under debate
- bathymetry on continental shelves changed significantly
  - potential pathways of deep water inflow are unknown
- vulnerable areas in SE Pacific are unrepresented in numerical simulations of palaeoenvironmental changes across the EOT
  - too little data and information

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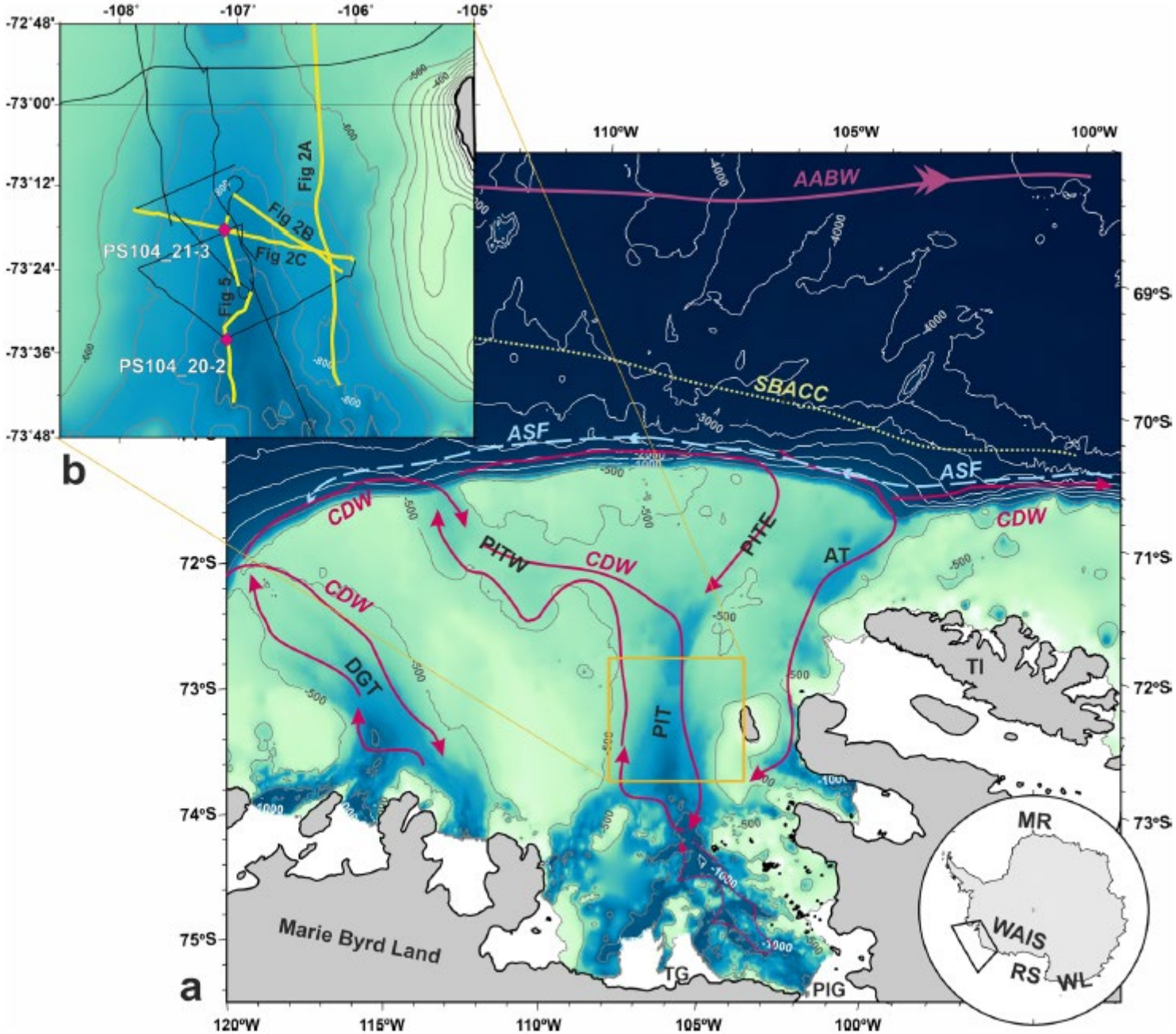

Uenzelmann-Neben et al., 2022

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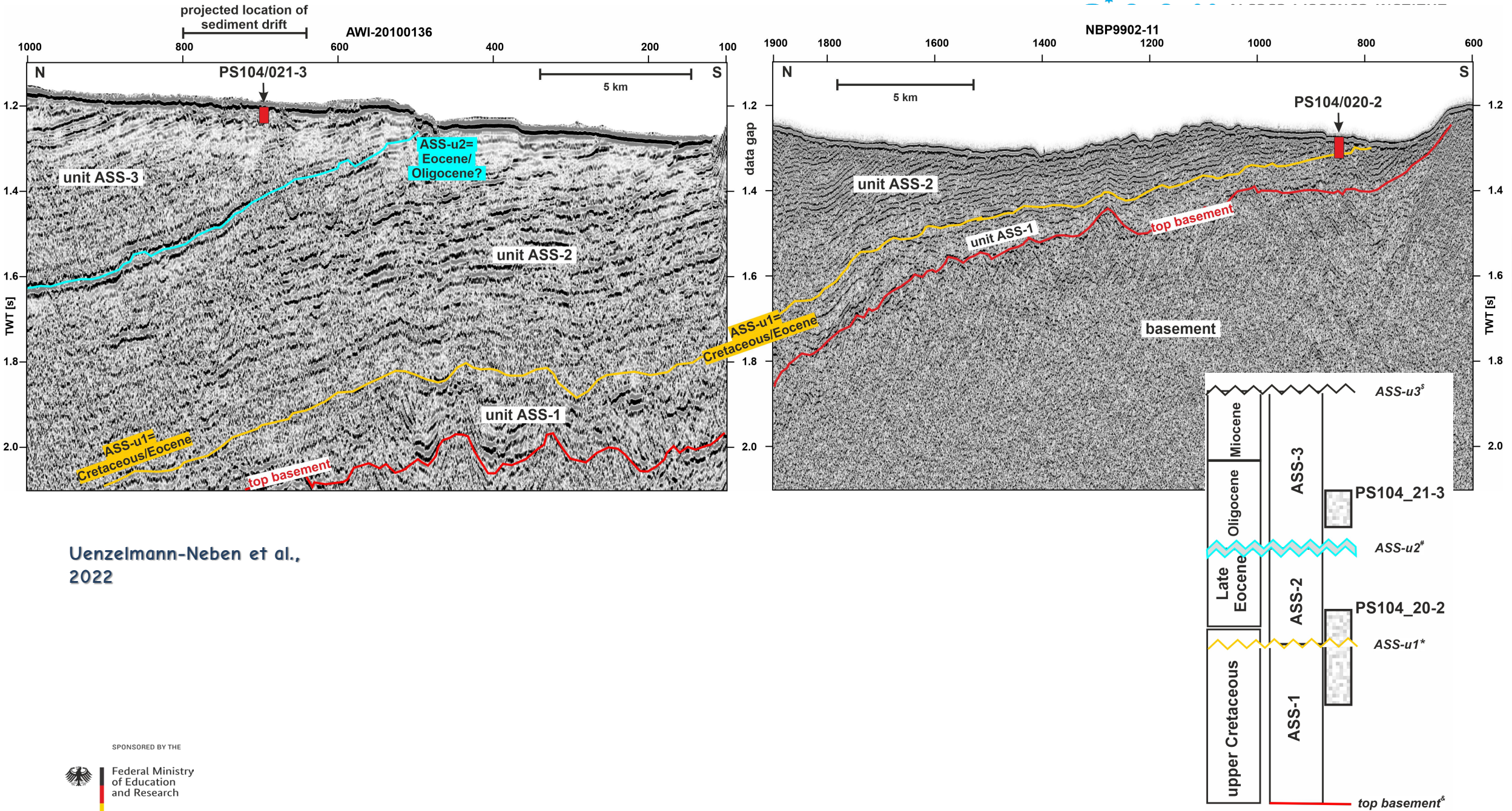

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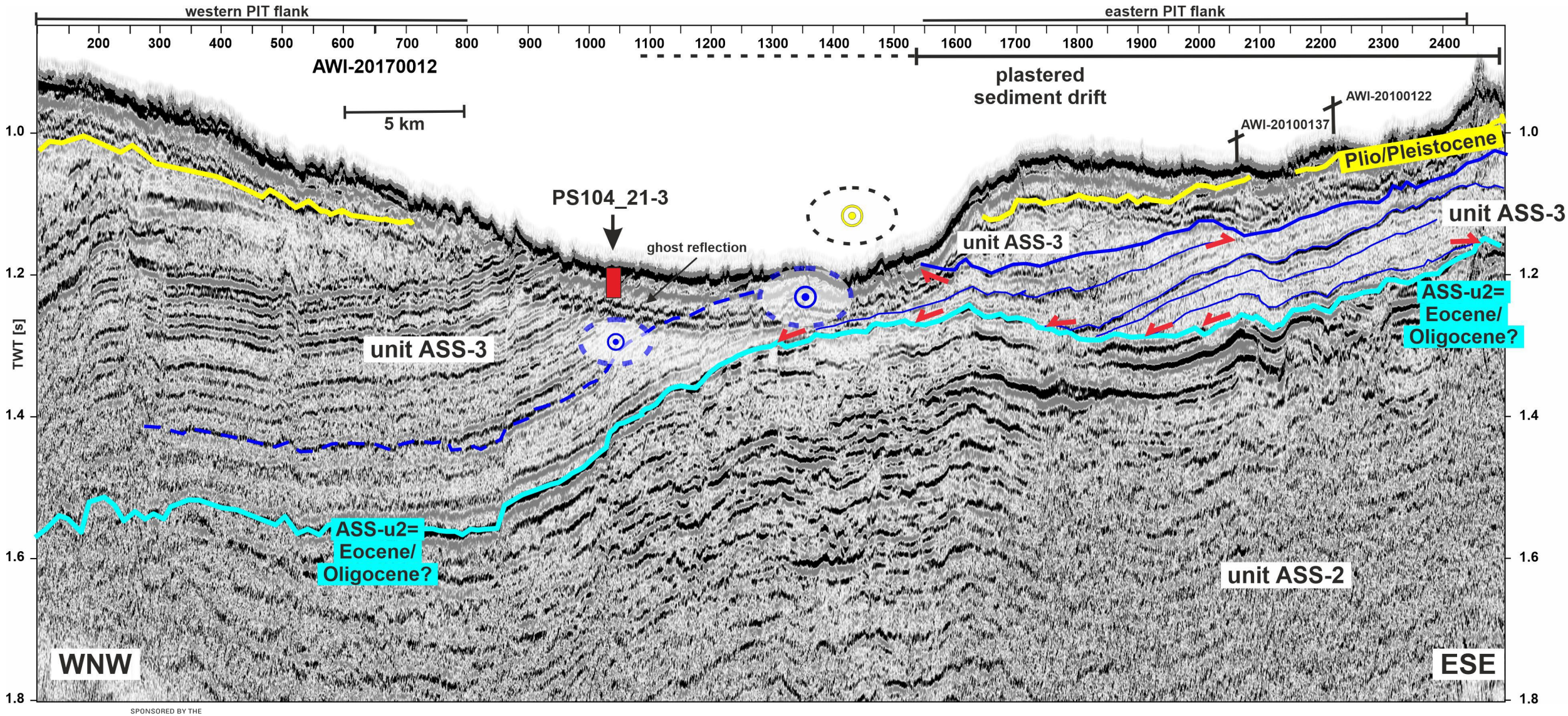

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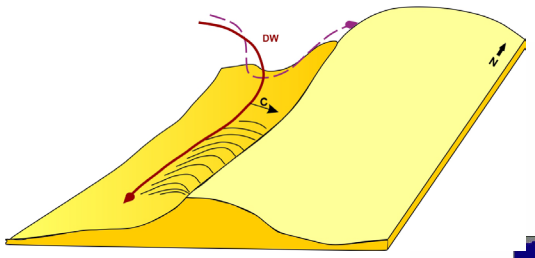

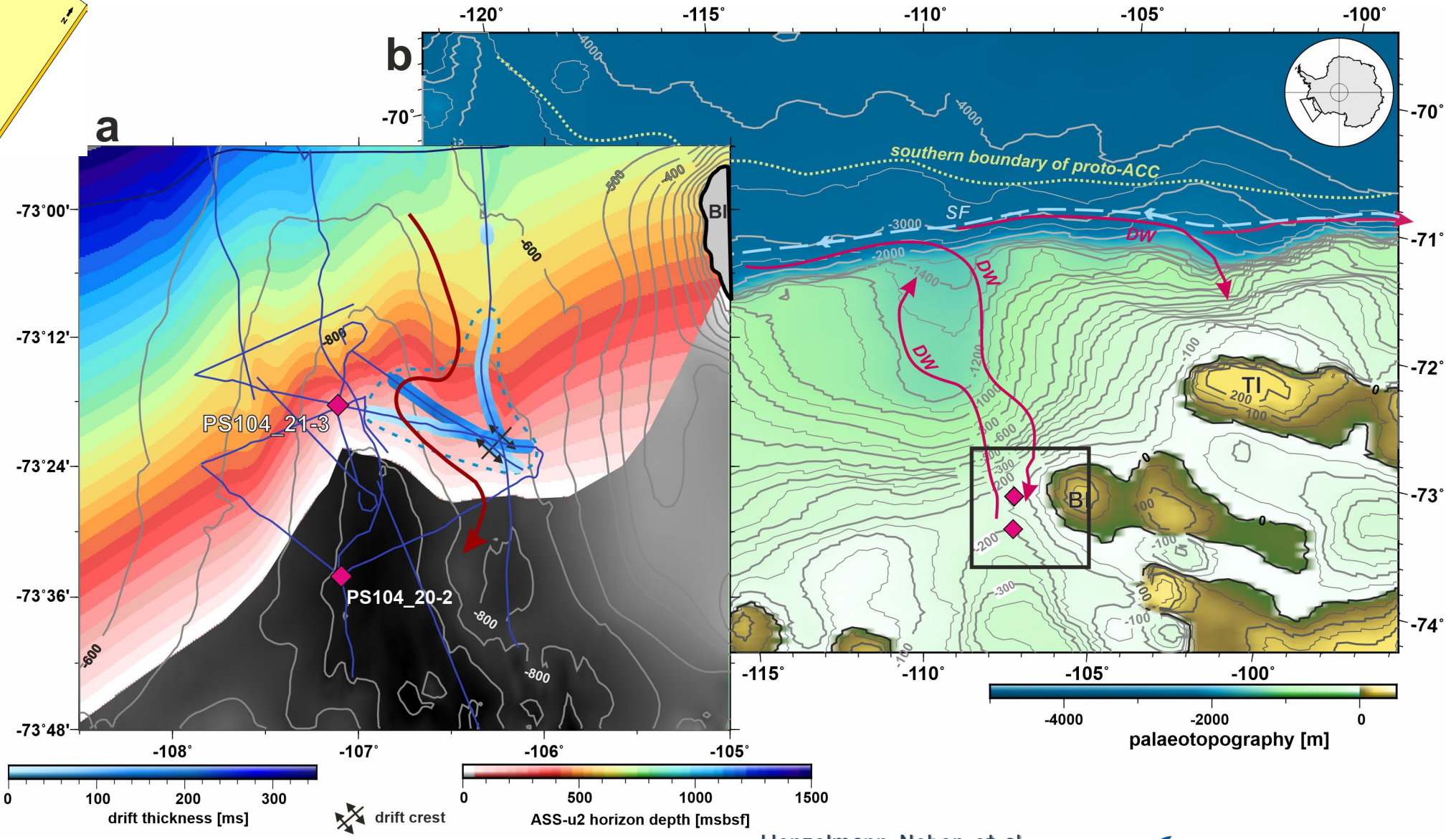

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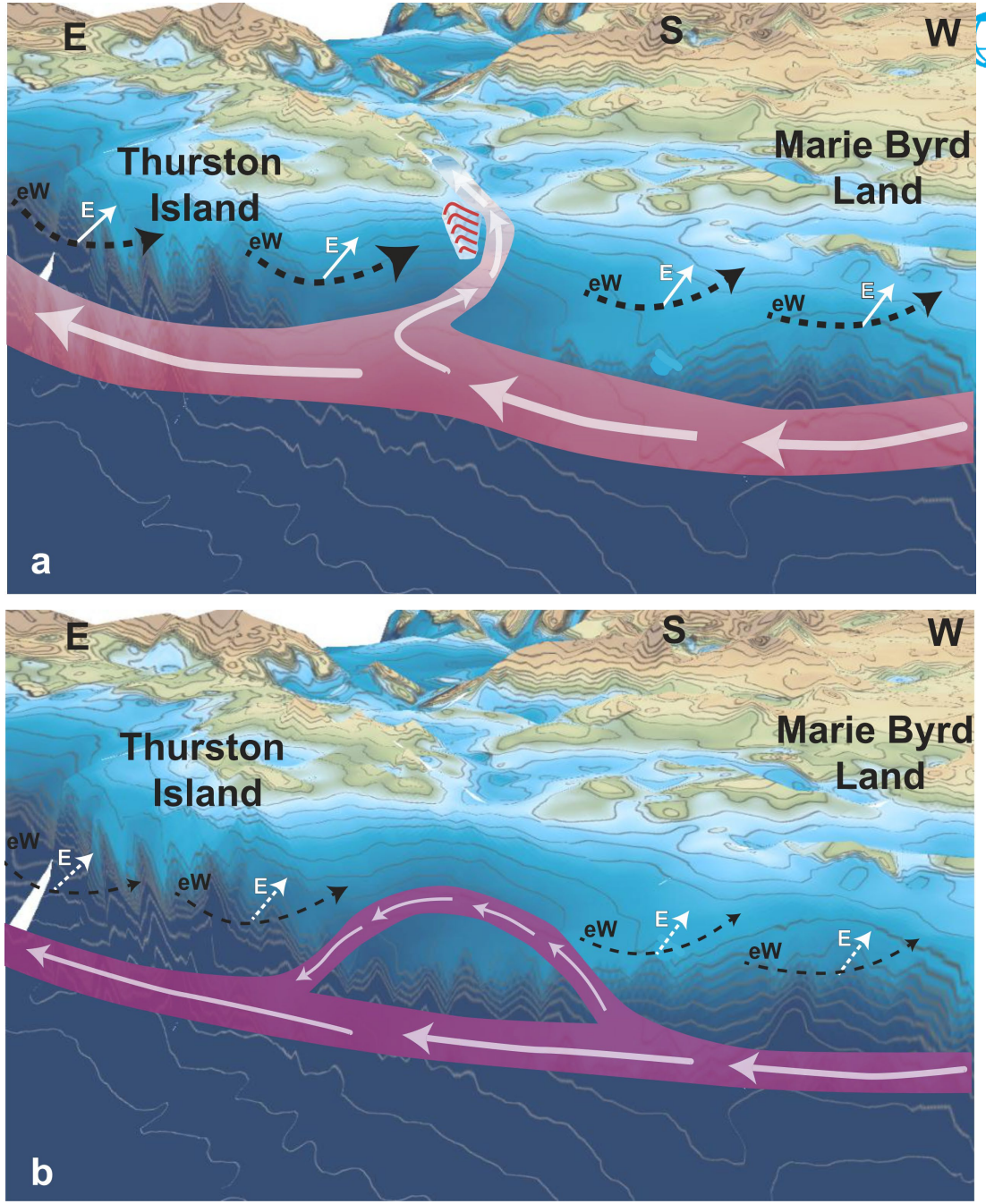

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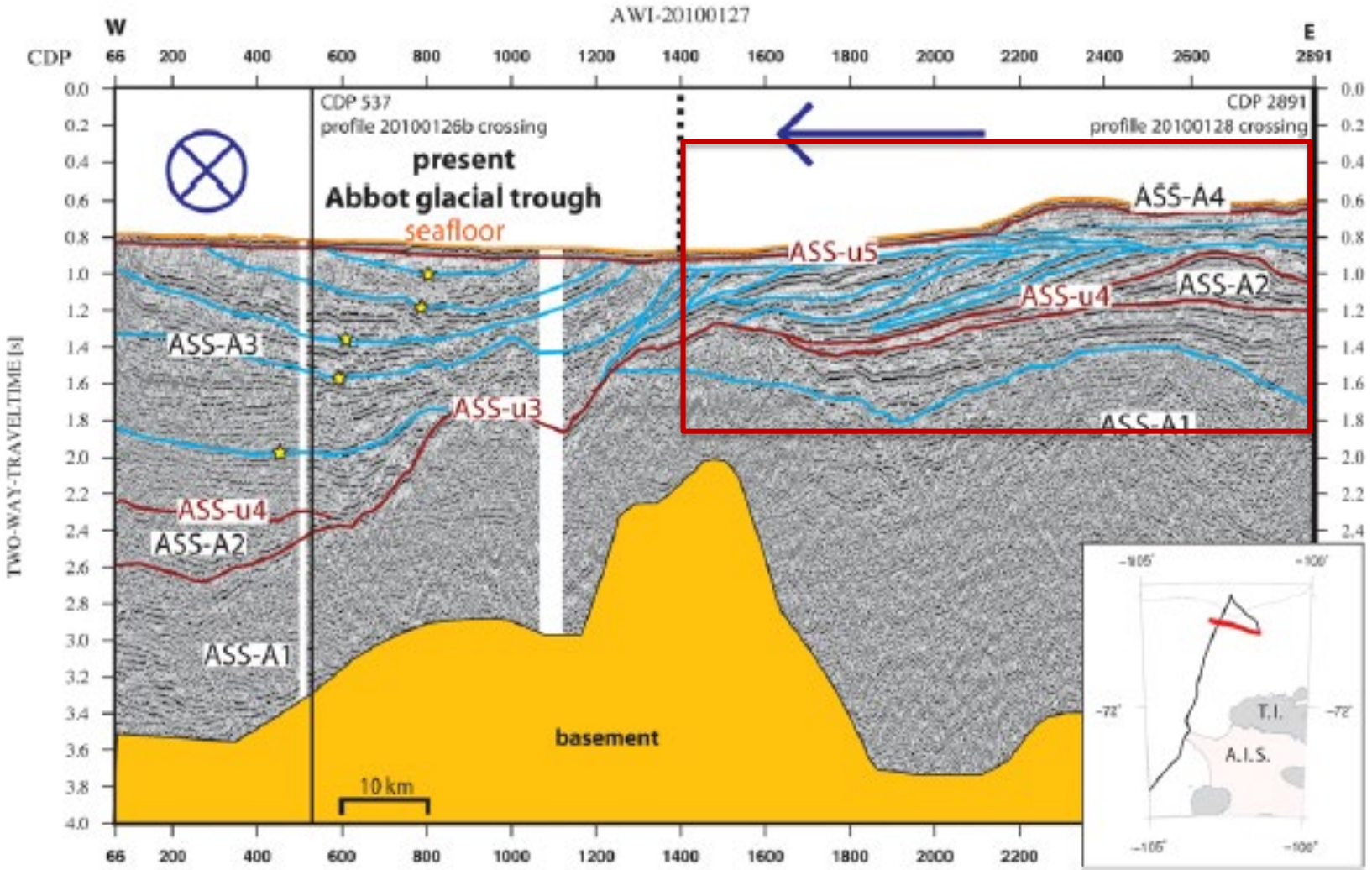

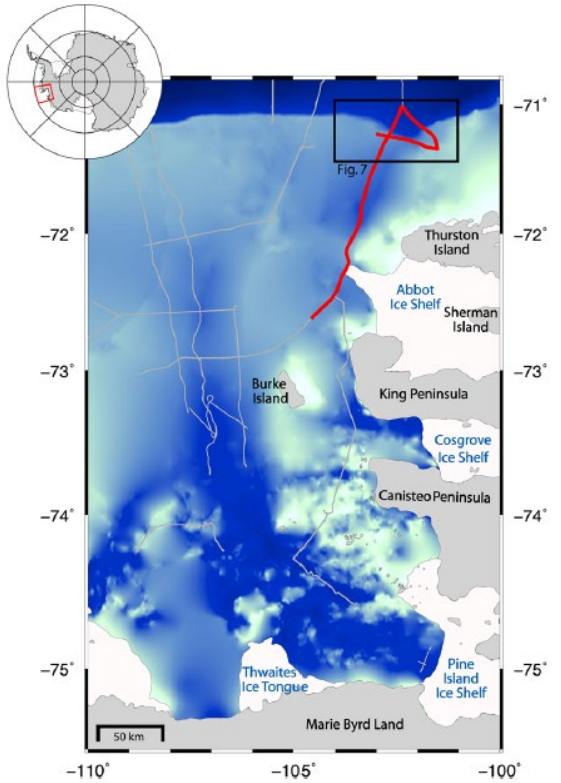

Hochmuth and Gohl, 2013

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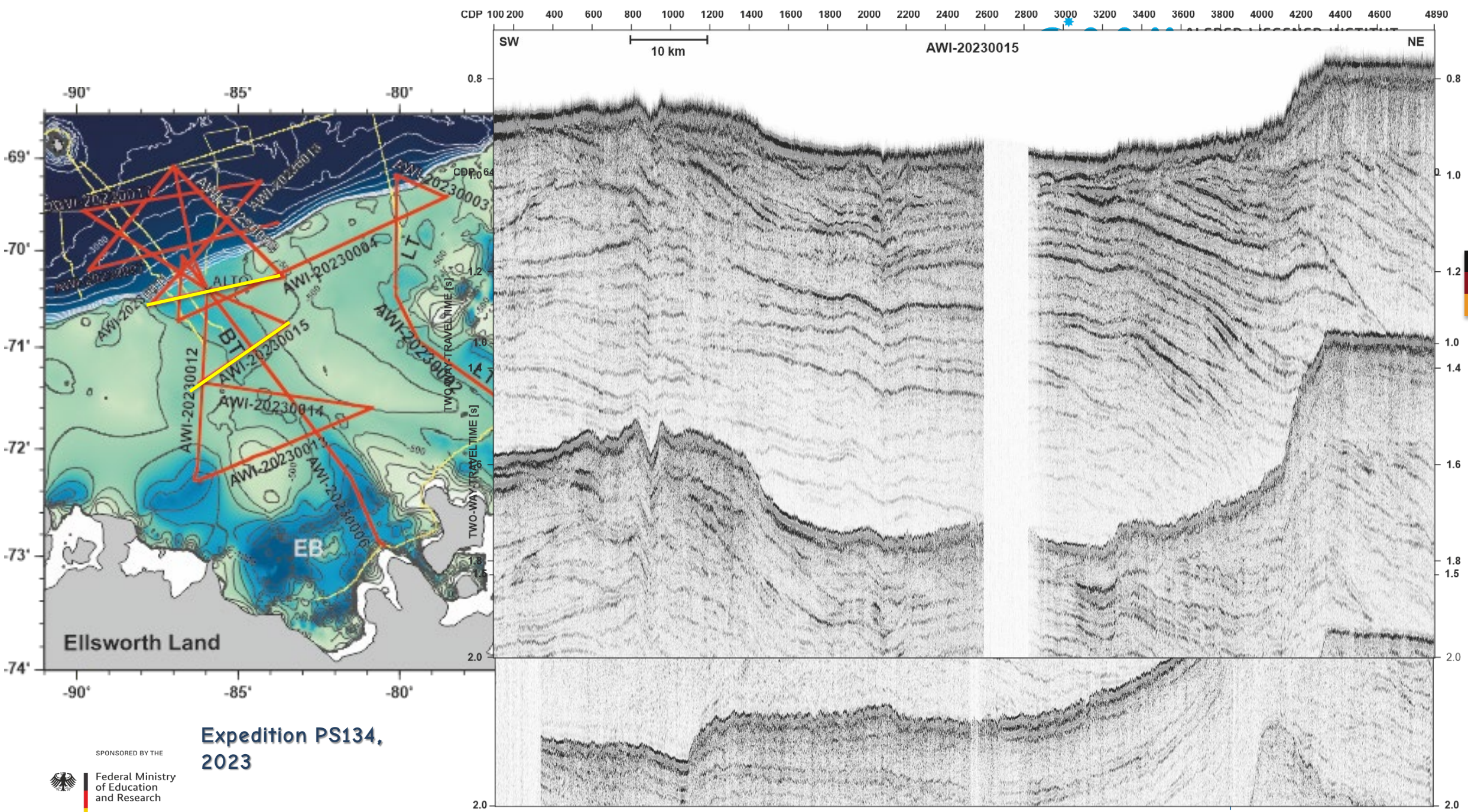

Expedition PS134, 2023

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Conclusions

- seismic data have revealed a mounded structure interpreted as a sediment drift resulting from deep water upwelling onto the ASE shelf in the latest Eocene/earliest Oligocene
- this upwelling was probably related to a southerly location of the ACC fronts during a warm phase
- the upwelling of deep waters far onto the shelf was most likely further enhanced by the presence of a trough/channel in the ASE shelf break ⇒ steered by the south-eastward rising seafloor and shaped the sediment drift picking up coastal/estuarine or biogenic material
- the intrusions of potentially warm deep water prevented a cooling of shelf waters and thus an advance of an ice sheet onto the ASE shelf during the globally observed cooling in conjunction with the EOT by buffering heat on the shelf
- increasing global cooling will later have relocated the westerly wind system northwards and influenced the intensity of upwelling ⇒ end of formation of the observed sediment drift
- the bathymetric/topographic setting in the ASE is different from the other sectors of Antarctica. Paxman, et al. (2019) 's minimum reconstruction for 34 Ma shows much higher elevations for East Antarctica while the Ross Sea area and the ASE are largely located below sea level. A cooling in East Antarctica thus will have had a stronger effect enabling the growth of larger ice sheets as has been suggested for the Ross Sea sector of Antarctica
- ASE shelf thus may have been the last Antarctic sector that experienced full glaciation since here oceanic circulation influenced by bathymetry appears to have delayed advance of the WAIS during the EOT
- our results highlight the importance of oceanic forcing for the evolution of the WAIS since the onset of Antarctic glaciation
- similar observation for Abbott Trough, eastern Amundsen Sea shelf
- Belgica Trough, Bellingshausen Sea appears to show different structure

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