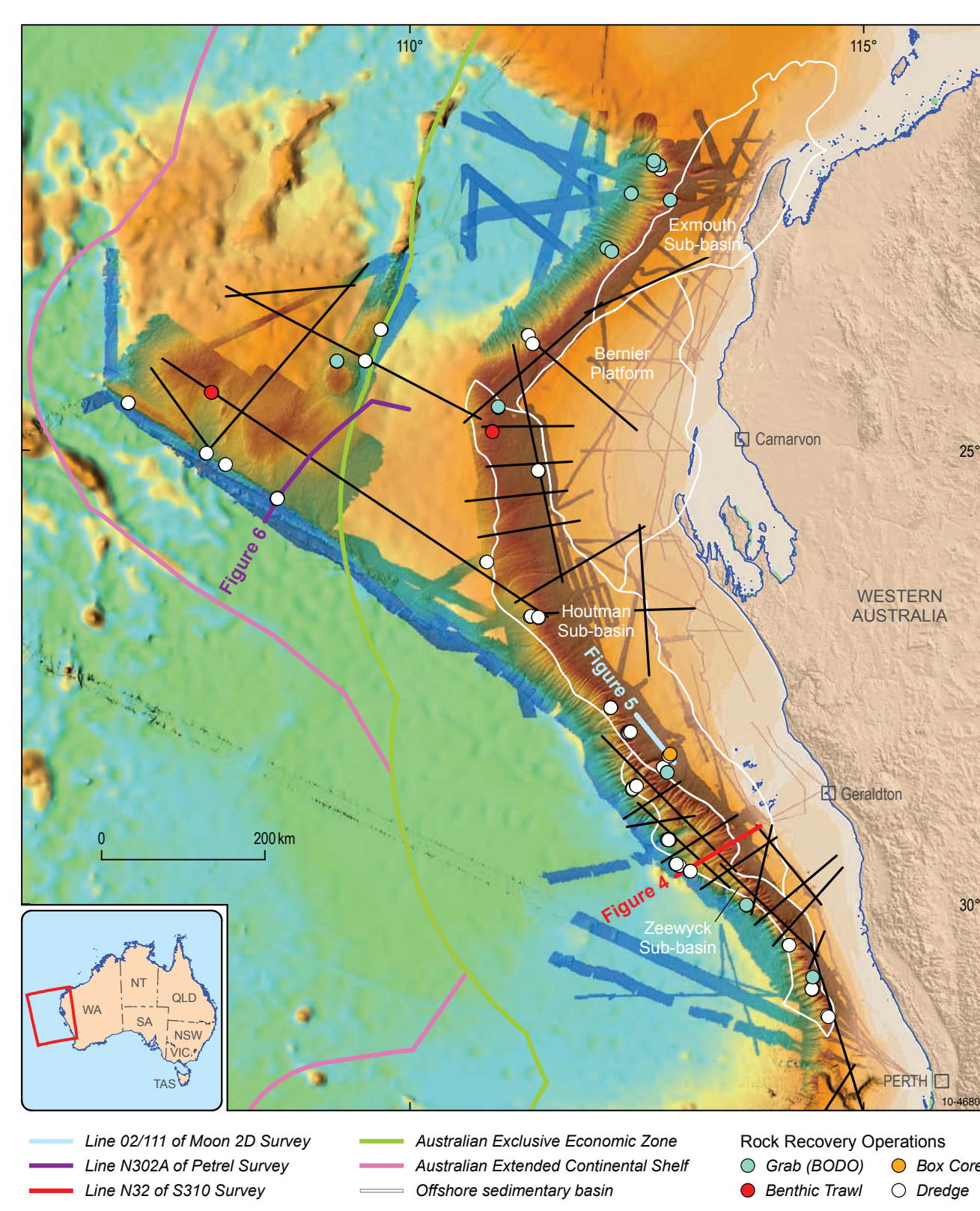


# Data from the deep: new geological results from Geoscience Australia's marine survey of frontier basins, southwest Australian margin

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## Introduction

Geoscience Australia (GA) conducted a 90-day marine reconnaissance survey (GA2476) that acquired geological and geophysical data over poorly known areas of the Zeewyck and Houtman sub-basins (Perth Basin), the southern parts of the Carnarvon Basin (southern Exmouth Sub-basin and Bernier Platform) and the Wallaby Plateau (Daniell *et al.*, 2010). Target sites for geological sampling were identified using a combination of seismic data, swath bathymetry, sub-bottom profiler records and camera tows. Sites were selected mainly to recover rocks from the pre-breakup succession (Valanginian and older) in order to determine the age and composition of the strata in these frontier deepwater basins and to identify potential source rocks. Submarine canyons provided the best opportunity for dredge and grab sampling of the pre-breakup sedimentary strata as they deeply incised into the continental slope. Other sampling targets included scarps, ridges and peak features (potentially volcanic).



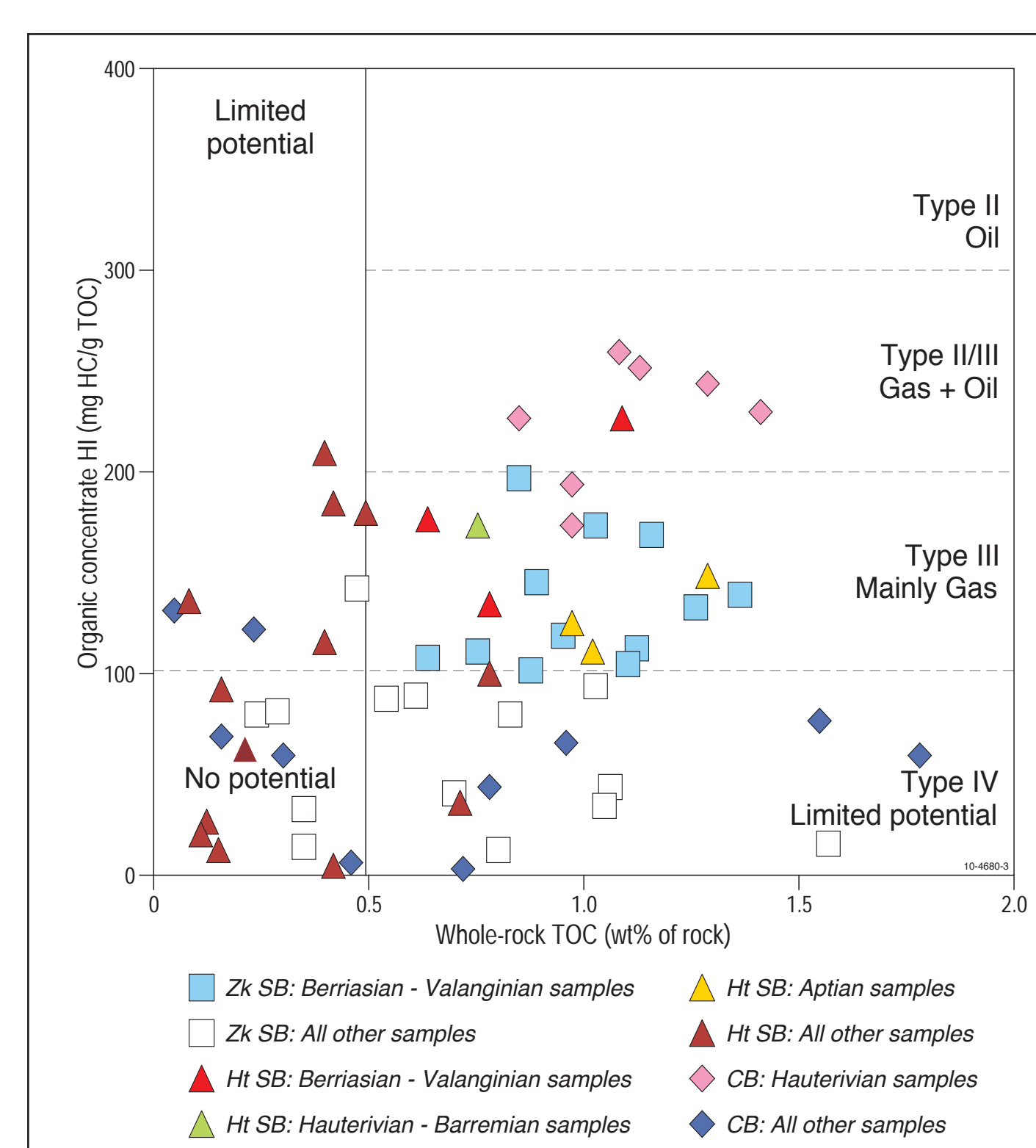
**Figure 1.** Bathymetric map showing the location of SW Marine Reconnaissance Survey GA2476 rock recovery sites in relation to GA's S310 Seismic Survey.

## Rock recovery

Rock samples were recovered from thirty sites in water depths 1000-5000 m: eight from the Zeewyck Sub-basin; eight over the Cuvier Plateau; five from the Houtman Sub-basin; four from the southern Exmouth Sub-basin; and one from the Bernier Platform. A total of 51 dredge, 13 grab, three benthic sled and one box core haul/s recovered several hundred individual rock samples of a diverse range of rock lithologies, which included sandstones, claystones, siltstones and limestones (complete descriptions in Daniell *et al.*, 2010).

## Results

Rock samples were correlated to seismic packages interpreted from the new GA survey 310 and existing seismic data to develop a better understanding of basin fill and evolution. Rock types and biostratigraphic results provided constraints on depositional environments and age (Fig. 2). Results from the organic geochemical analyses were used to assess organic richness (Fig. 3) and maturity of potential source rocks.



**Figure 3.** Hydrocarbon generation potential for the samples recovered from Zeewyck Sub-basin (Zk SB), Houtman Sub-basin (Ht SB) and Carnarvon Basin (CB). The samples with potential have been differentiated by location and age.

### Zeewyck Sub-basin

Constrained extent and age of major post-breakup (Valanginian) depocentre (Fig. 4); Terrestrial to estuarine/restricted marine sediments (Berriasian) deposited before the breakup - a package not previously recognised in the offshore northern Perth Basin (i.e. Parmelia Group); Accumulation of shallow marine sediments (Valanginian-Hauterivian) after breakup probably due to erosion of inboard strata; Seismic interpretation suggests that units containing potential source rocks (Berriasian-Valanginian shales - Type III, gas potential; Fig. 3), are deeply buried in places - they may reach the level of burial/thermal maturity necessary to generate and expel hydrocarbons (Fig. 4).

### Houtman Sub-basin

Claystones deposited prior to breakup in terrestrial to estuarine/restricted marine environments (Berriasian-Valanginian, Figs 2 & 5) - a package not preserved in wells from sub-basin (i.e. Parmelia Group); Hauterivian-Albian (post-breakup) basin fill dominated by a deepening sedimentary environment (i.e. shallow marine through to open marine) (Fig. 2); Potential source rocks (Fig. 3 & 5) include: in southern Houtman Sub-basin - Berriasian claystones (Type III, gas potential or Type II/III, oil and gas potential), a Berriasian-Early Valanginian claystone (Type III, gas potential) and Aptian claystones (Type III, gas potential); In northern Houtman Sub-basin - a Hauterivian-Barremian claystone (Type III, gas potential). Basaltic rocks recovered from peak features indicate that volcanism took place in recent geological time.

### Carnarvon Basin

Southern Exmouth Sub-basin: Shallow marine sediments (Hauterivian) extend the Muderong Shale (a regional seal) further seaward than previously mapped. These samples show Type III gas potential and Type II/III oil and gas potential (Fig. 3).

### Wallaby Plateau

Bulk of rock samples recovered comprises volcanic and volcanoclastic rocks, consistent with interpreted volcanic nature of the plateau; For the first time, fossiliferous sedimentary rocks were recovered from a southwestern escarpment on the margin of the plateau: 1) most of fossil assemblages suggestive of Hauterivian-Early Aptian age; and 2) one sample yielded Oxfordian foraminifera that may tie to a stratified seismic package below the breakup unconformity (Fig. 6), suggesting that the plateau at least partly comprises continental crust.

**Figure 6.** Rock samples from DR053A1 and DR047D2, which ties to a seismic package below the breakup unconformity on the Wallaby Plateau (yellow line), seismic line n302a (Petrel survey). The black line shows the approximate location of dredge DR047 and DR053 along this line.

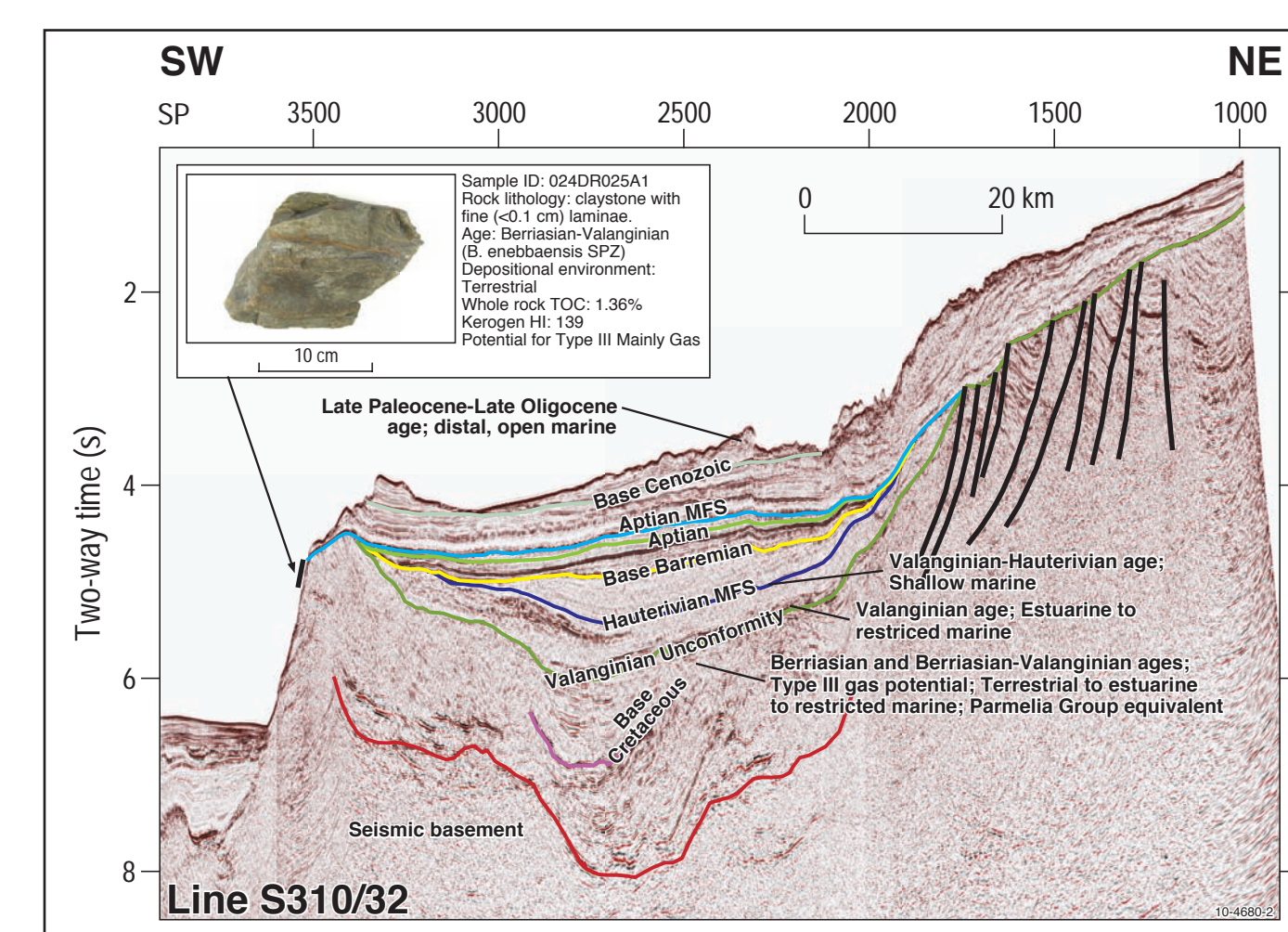
## Summary

Rock samples recovered provide some of the first physical geological evidence of the rock types and important age constraints for the sedimentary successions in the deepwater outboard parts of these provinces. The samples provide valuable insights into the nature of basin fill and the evolution of these basins, particularly immediately before and after breakup. Biostratigraphic results will be used to help in developing a tectonostratigraphic framework for the outer part of the Perth and Carnarvon basins. Geochemical results from selected organic-rich samples confirmed the presence of potential source rocks in both the pre- and post-breakup strata. The first insight into potential petroleum system elements in these frontier basins will help with future assessment of petroleum prospectivity of these areas.

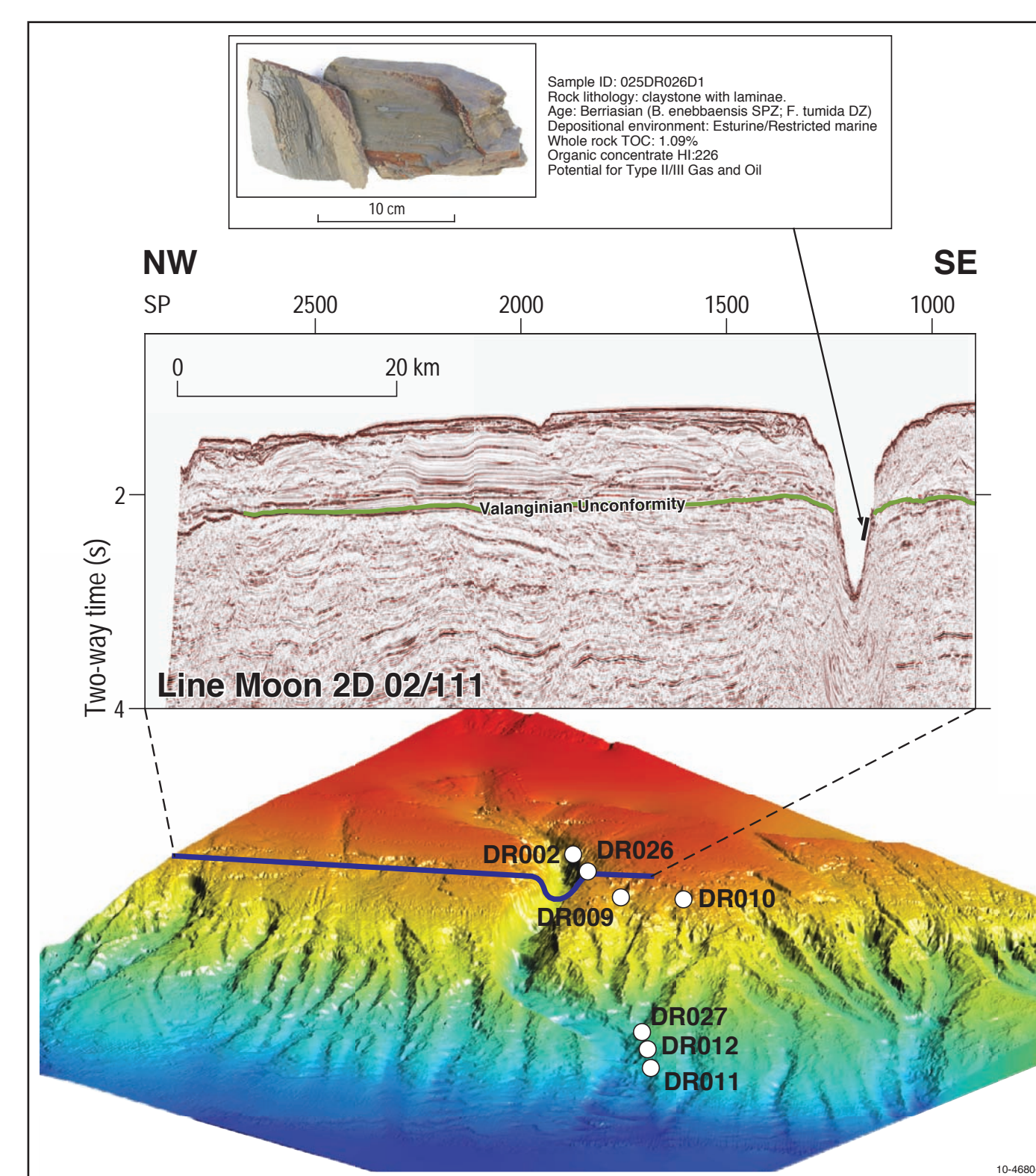
## References

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NB: Free Resources download at <https://www.ga.gov.au/products>

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**Figure 4.** Preliminary seismic interpretation of seismic line GA310/32 from the Zeewyck Sub-basin with information summarised from sample data throughout the sub-basin. The black line shows the approximate location of dredge DR025 which ties to this line. Rock sample DR025A1 (gas potential) ties to the sedimentary succession underneath the Valanginian unconformity (green line) and may reach the level of burial/thermal maturity necessary to generate and expel hydrocarbons.



**Figure 5.** Multi-beam swath bathymetry and Moon 2D seismic line 02/111 showing the Houtman Canyon incising into the pre-breakup succession of the Houtman Sub-basin. The black line shows the approximate location of dredge DR026 which ties to this line. Rock sample DR026D1 ties to the pre-breakup strata.

