ARCKARINGA BASIN

Interpretation of the GOMA seismic line

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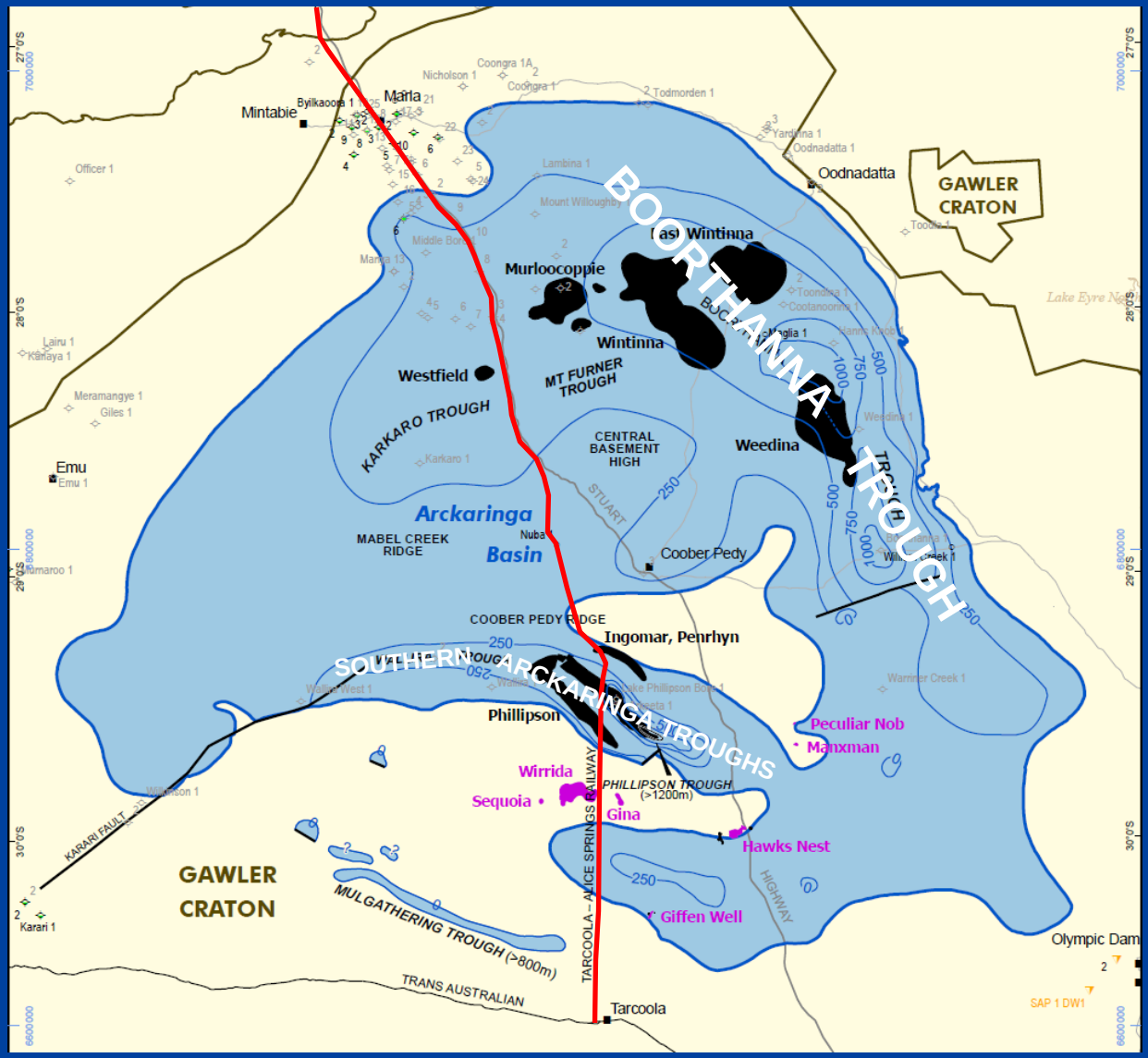
Australian Government
Geoscience Australia

AuScope

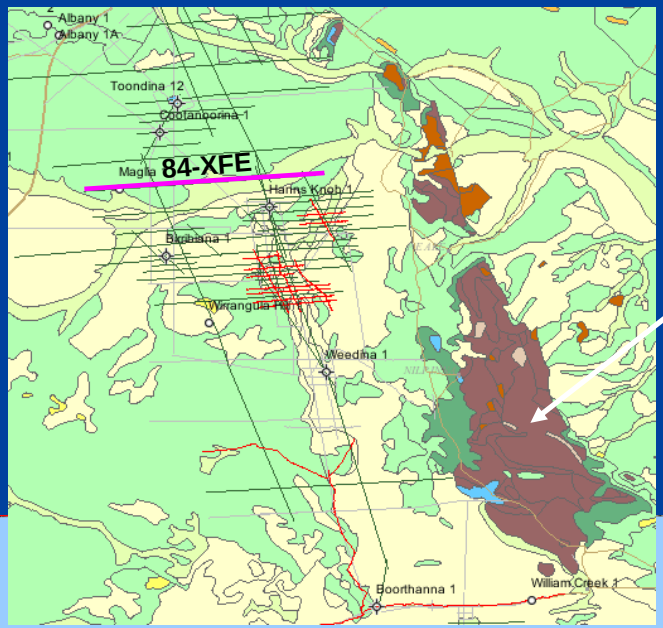
Government of South Australia
Primary Industries and Resources SA

Northern Territory Government

ARCKARINGA BASIN – ISOPACH MAP OF PERMO-CARBONIFEROUS SEDIMENTS

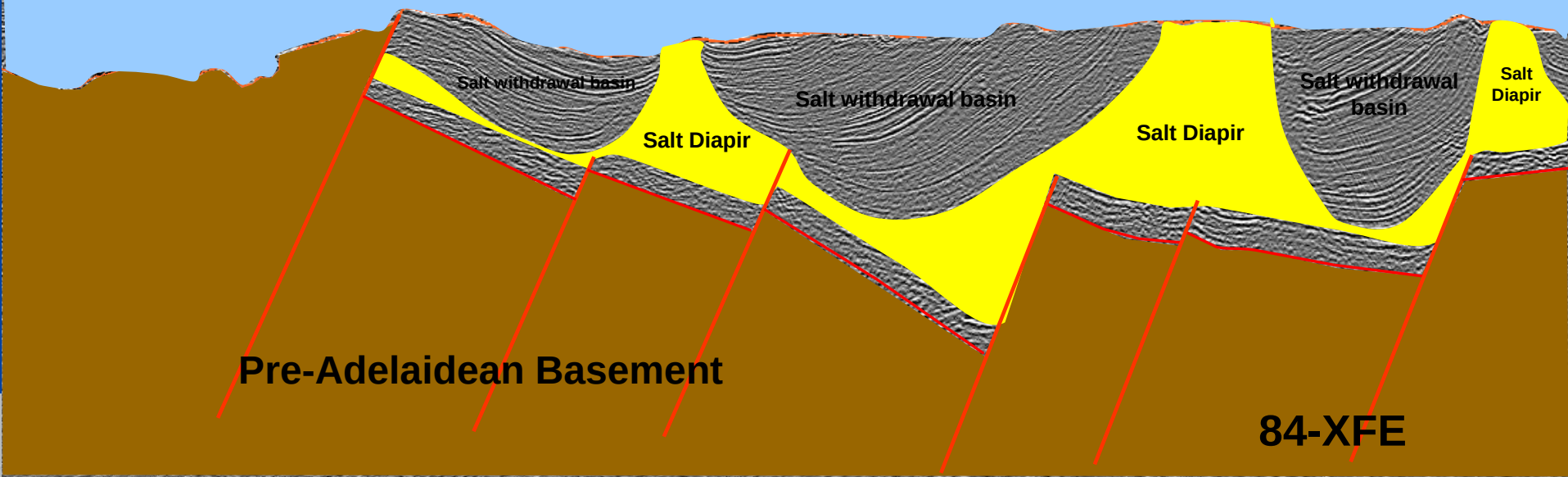


ADELAIDE RIFT AND CAMBRIAN (?) SEDIMENTS UNDERLIE THE BOORTHANNA TROUGH

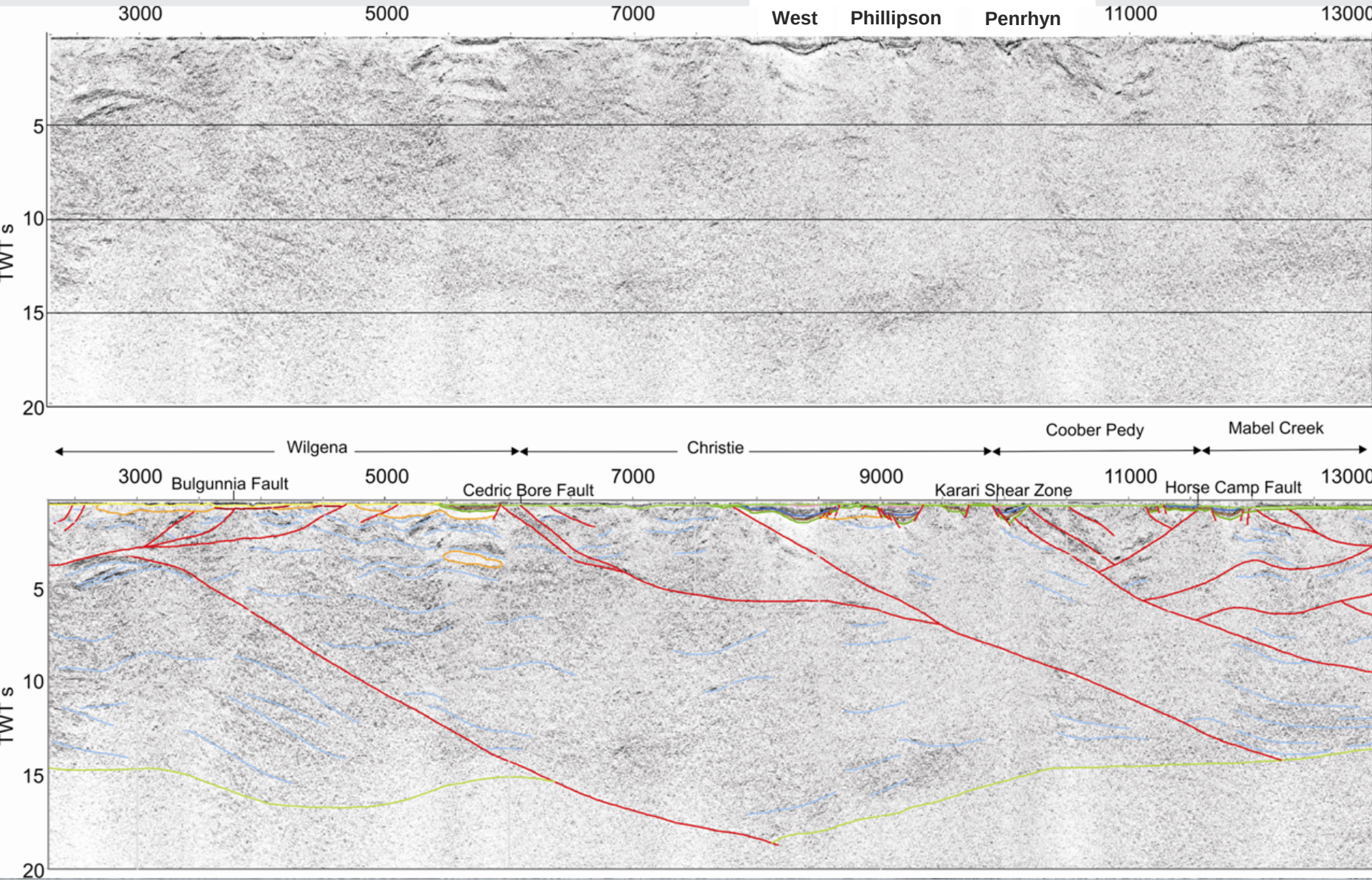


Outcrop in the central Peake and Denison Ranges comprises broad, elongate (N-S) synclines of Neoproterozoic Burra Group sediments flanked by diapiric breccia, suggesting that the synclines are mini-basins formed during salt withdrawal.

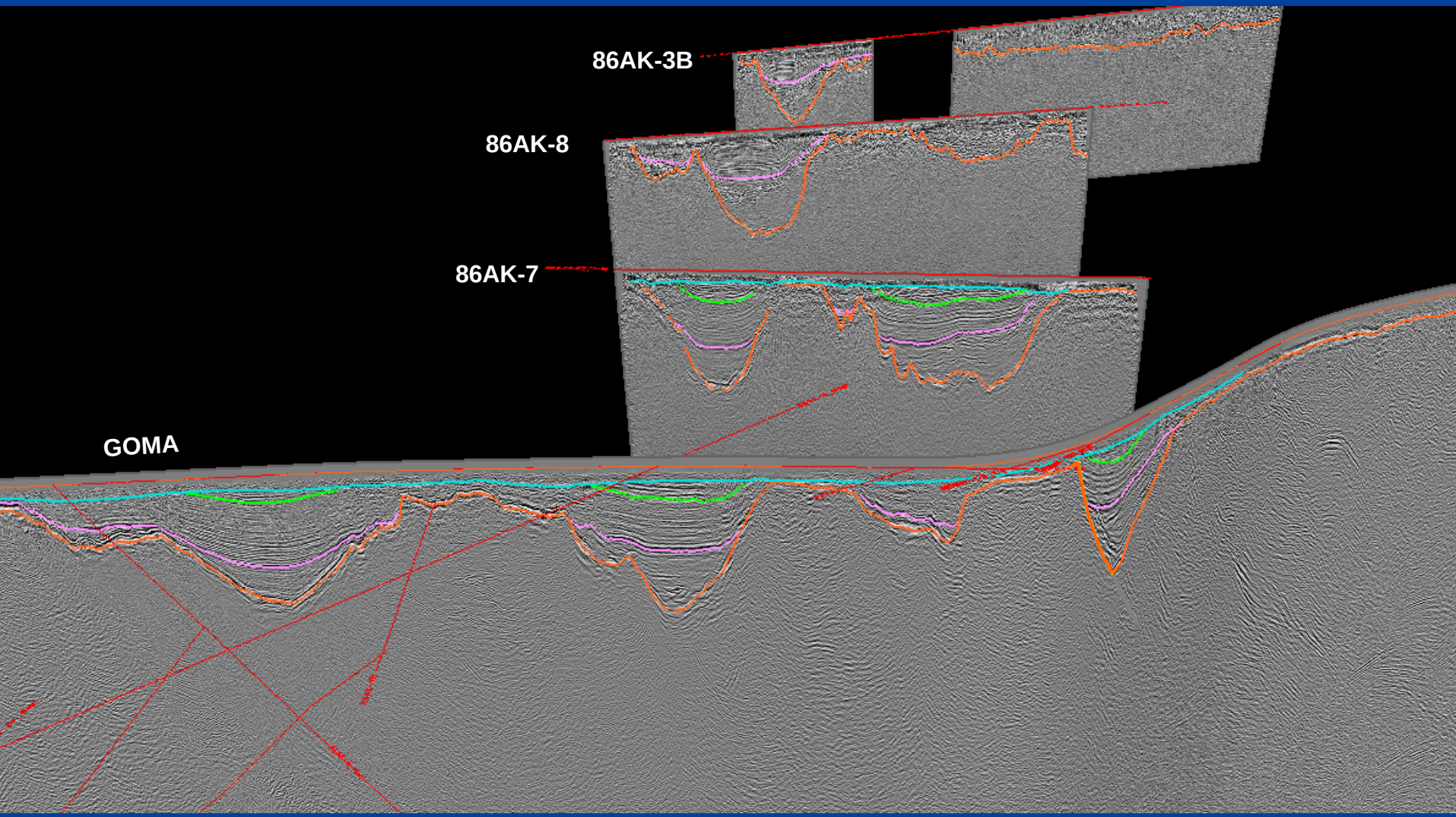
Permo-Carboniferous Arckaringa Basin



08GA-OM1 – ARCKARINGA BASIN



SOUTHERN ARCKARINGA TROUGHS – PERSPECTIVE VIEW LOOKING WEST (TrapTester image)

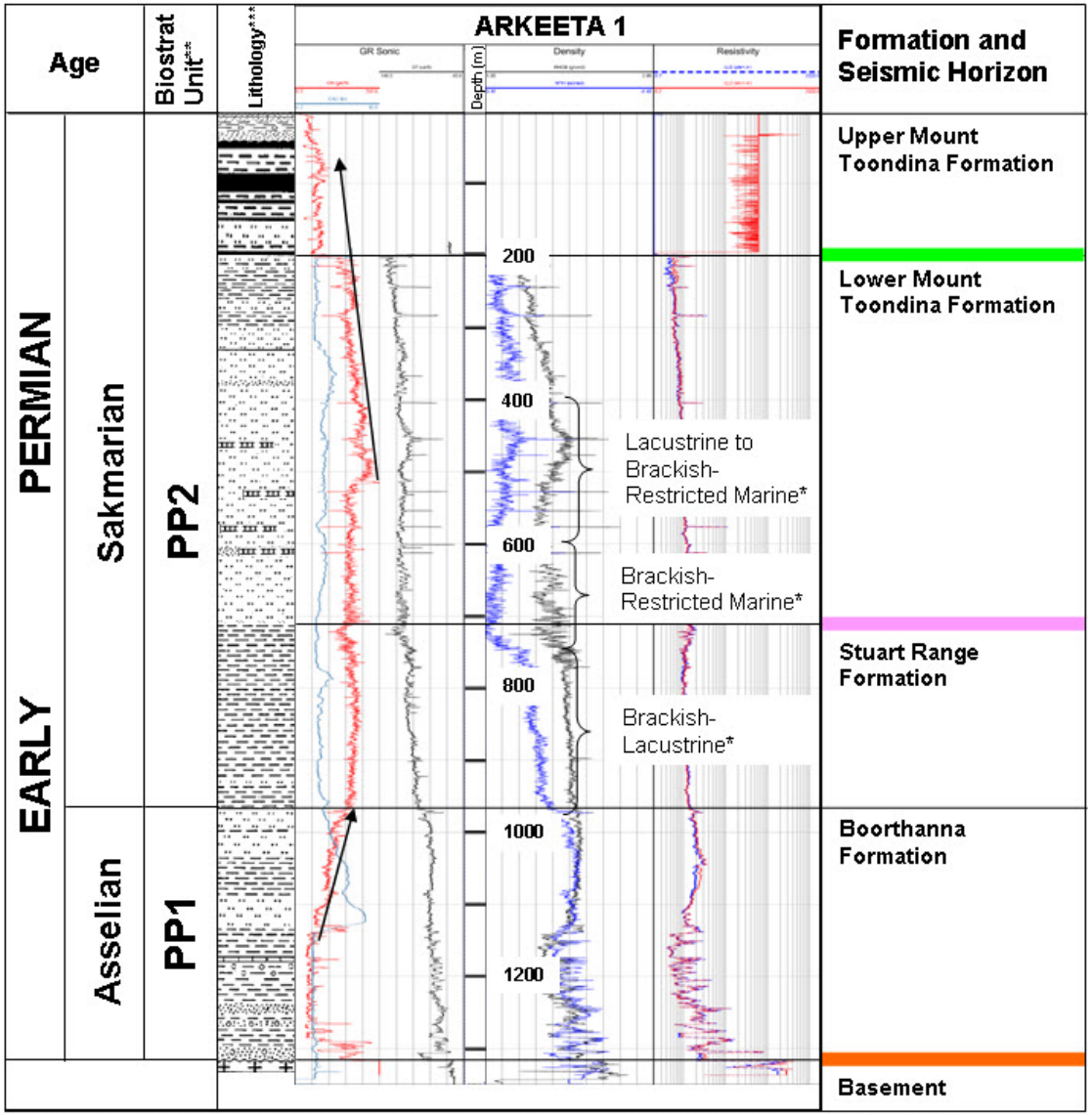


Near top Lower Mount Toondina Fm

Near top Stuart Range Fm

Basement

STRATIGRAPHIC COLUMN – SOUTHERN ARCKARINGA BASIN

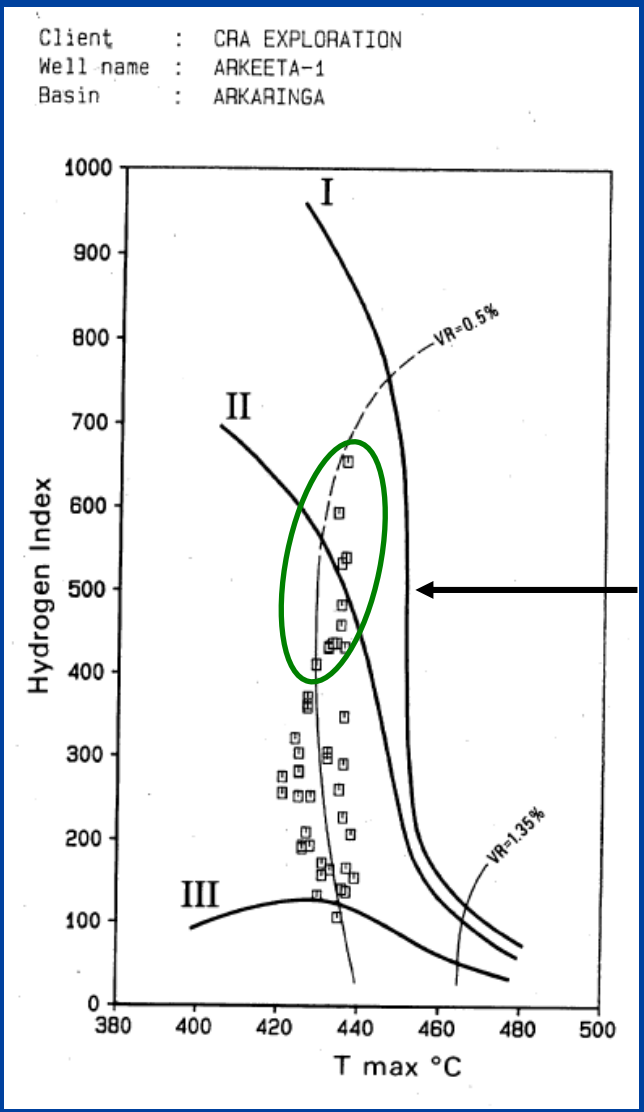


* Depositional environment interpreted from Arkeeta 1 palynological study (McBain, 1987)

** Palynological zones from Arkeeta 1 palynological study (McBain, 1987) converted to biostratigraphic units defined by Price et al, 1985

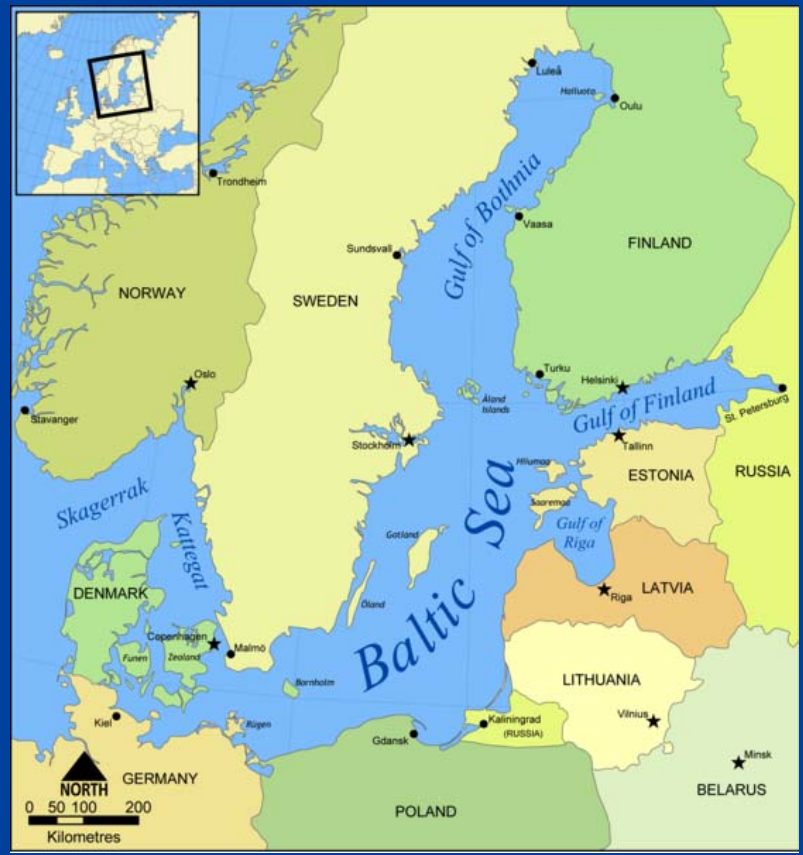
*** Lithology modified from Lake Phillipson Bore (after Hibburt, 1984, Figure 12)

ORGANIC RICH ROCKS IN THE PHILLIPSON TROUGH



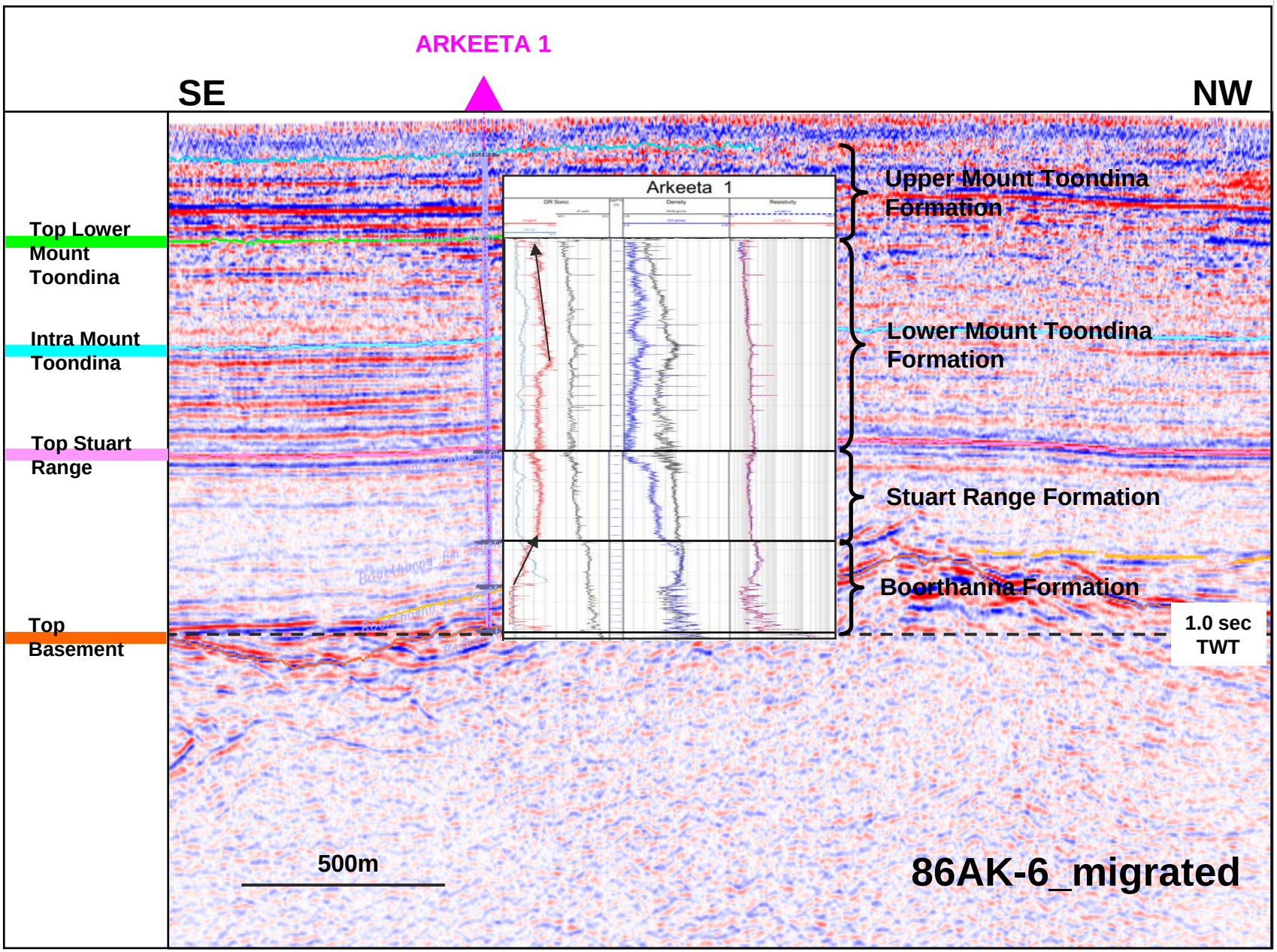
Arkeeta 1 WCR

Organic rich shales (TOC>2%, HI >400) of the lower Mt Toondina Fm and upper Stuart Range Formation are Type II source rocks at the threshold of oil generation.

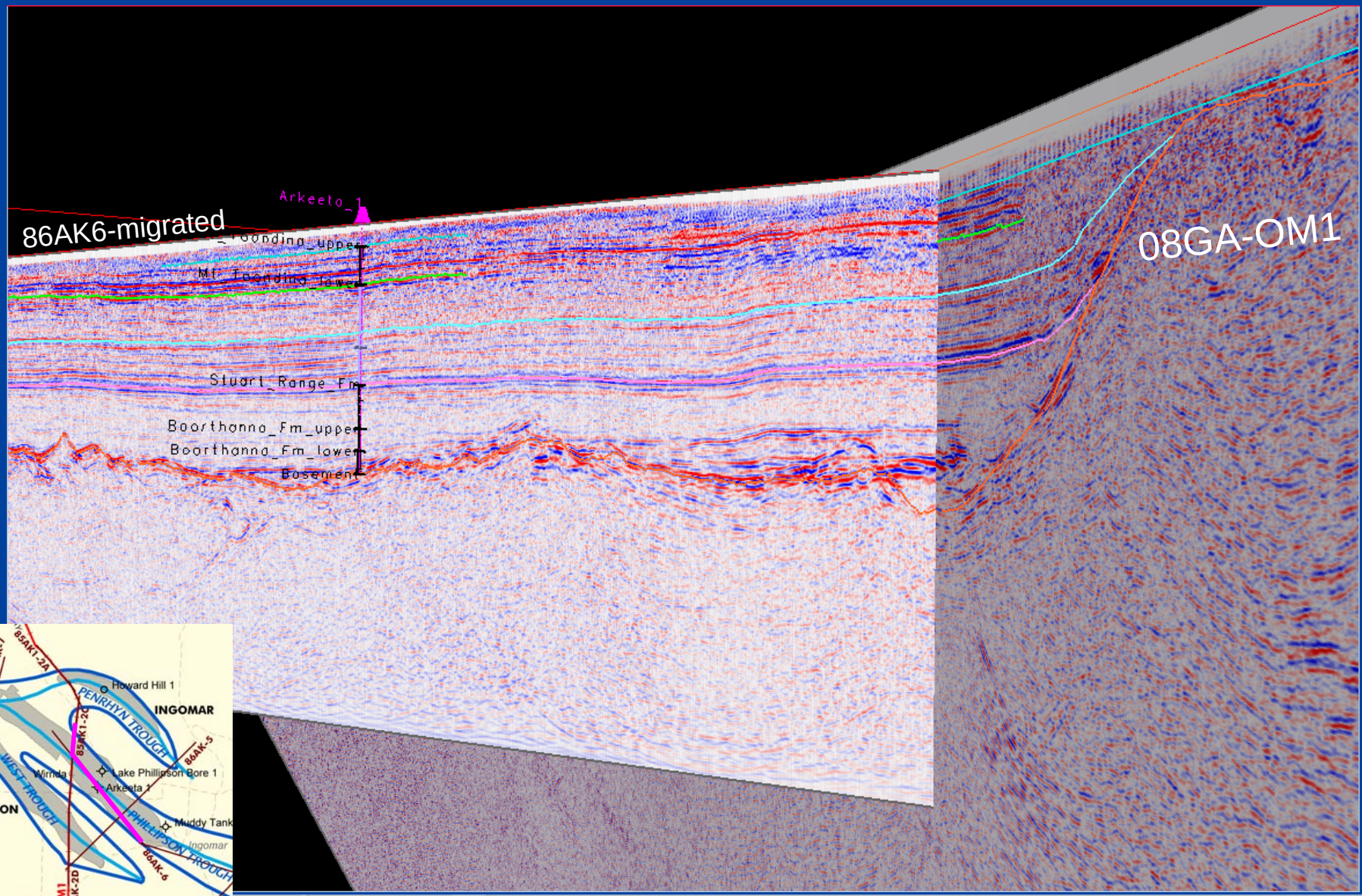


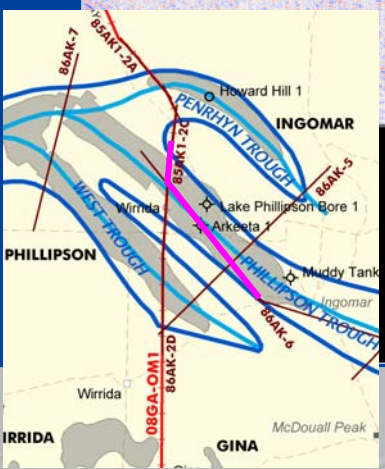
Baltic Sea analogy – Density stratification of water column due to high freshwater runoff into restricted sea-way results in anoxic bottom water conditions

ARKEETA 1 WELL TIE

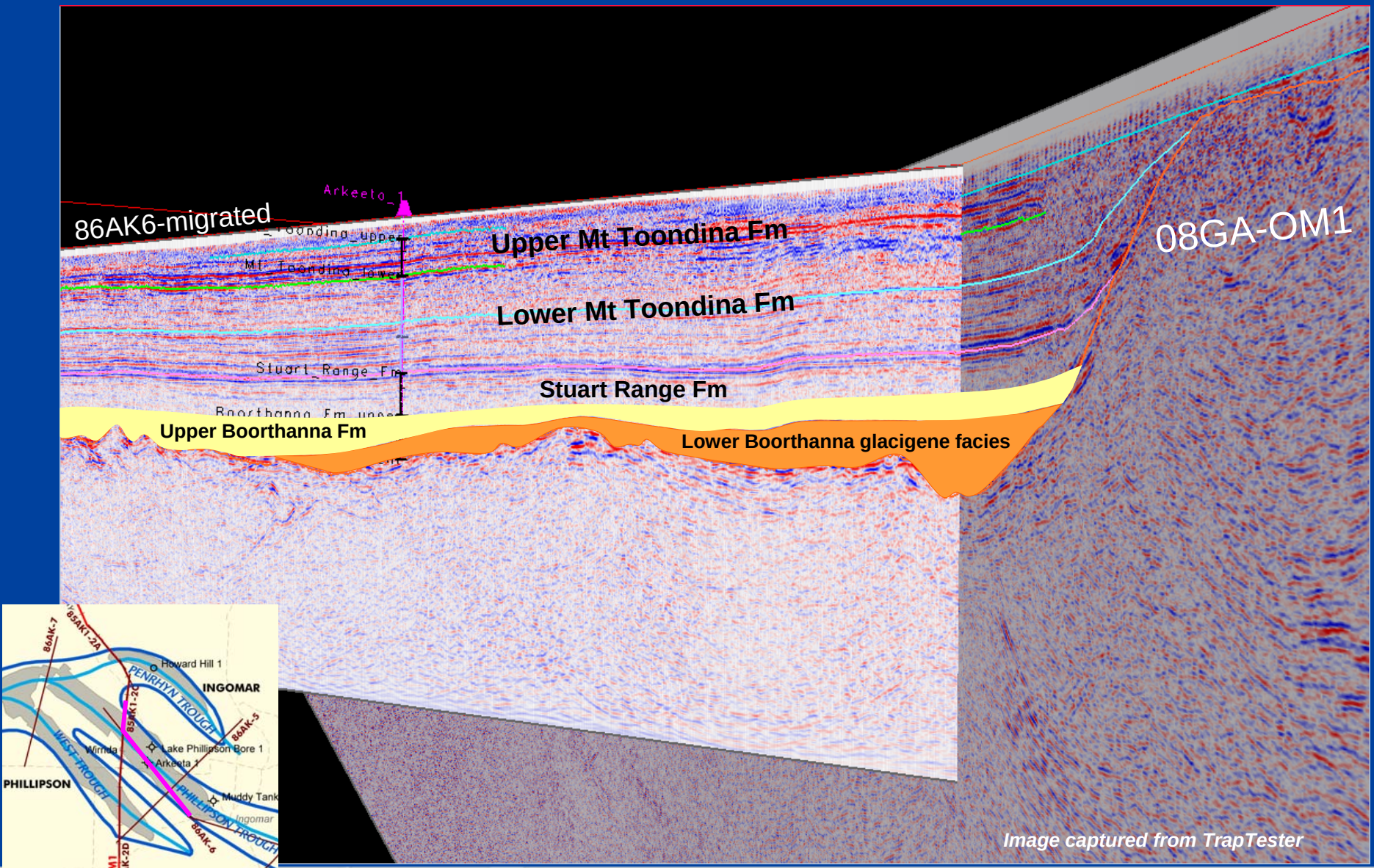


SEISMIC LINE TIE – PHILLIPSON TROUGH
3D PERSEPECTIVE VIEW LOOKING WEST

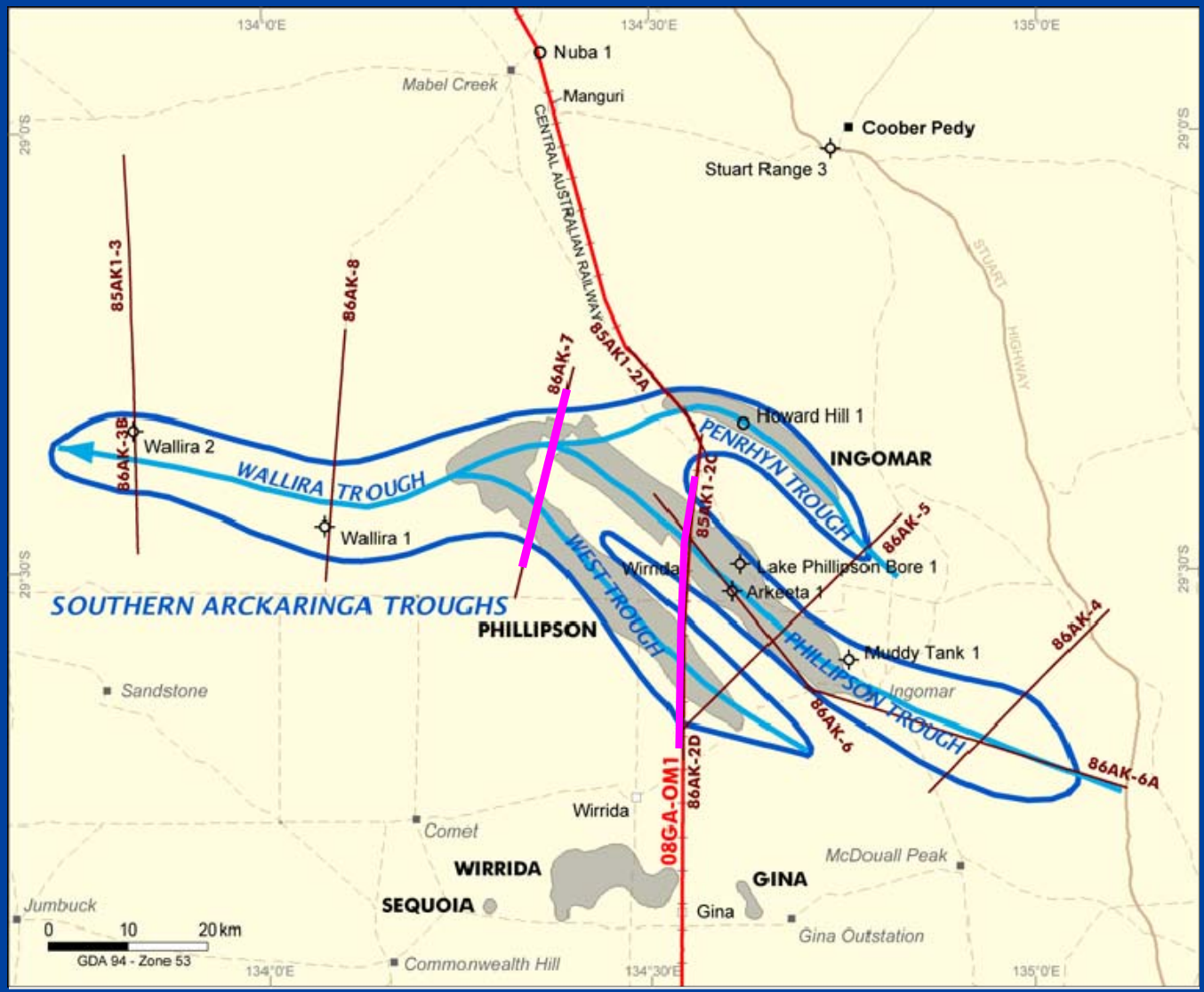




LOWER BOORTHANNA FORMATION – FAN/GLACIAL MORAINE GEOMETRY?



SEISMIC INTERPRETATION
08GA-OM1 AND 86AK-7



Glacier flow

Coalfields

Seismic lines

GOAMA seismic line

Seismic lines – 1980 to 1989

Petroleum wells

Dry hole

Pending

08GA-OM1

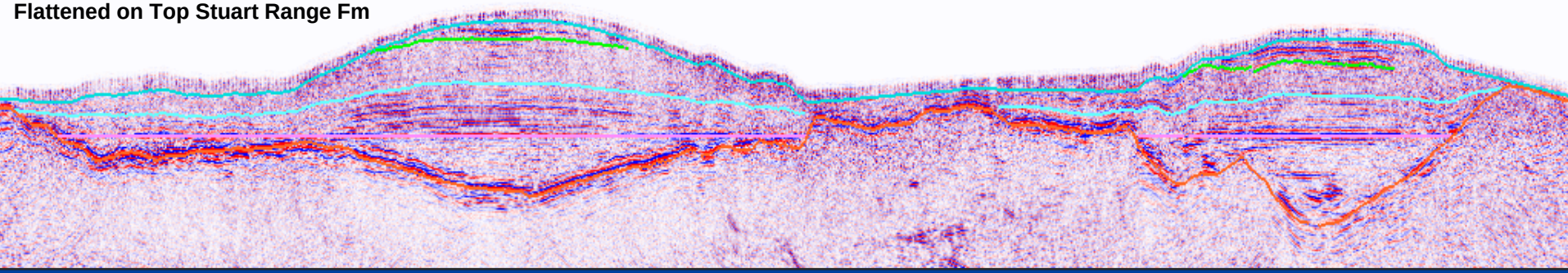
South

North

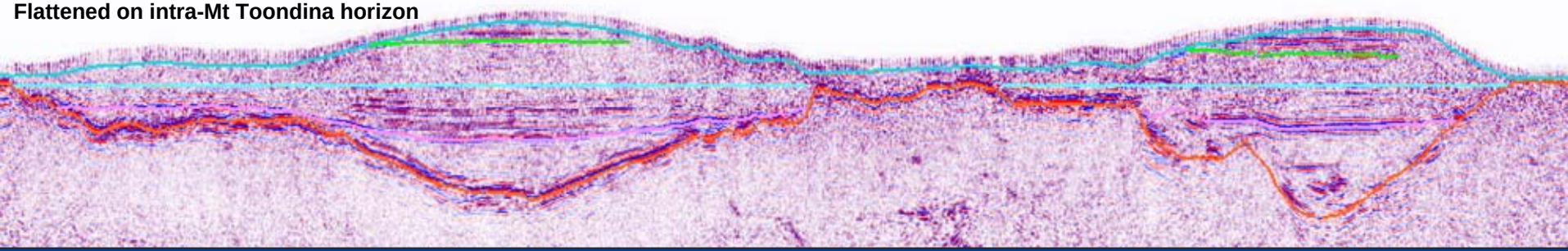
WEST TROUGH

PHILLIPSON TROUGH

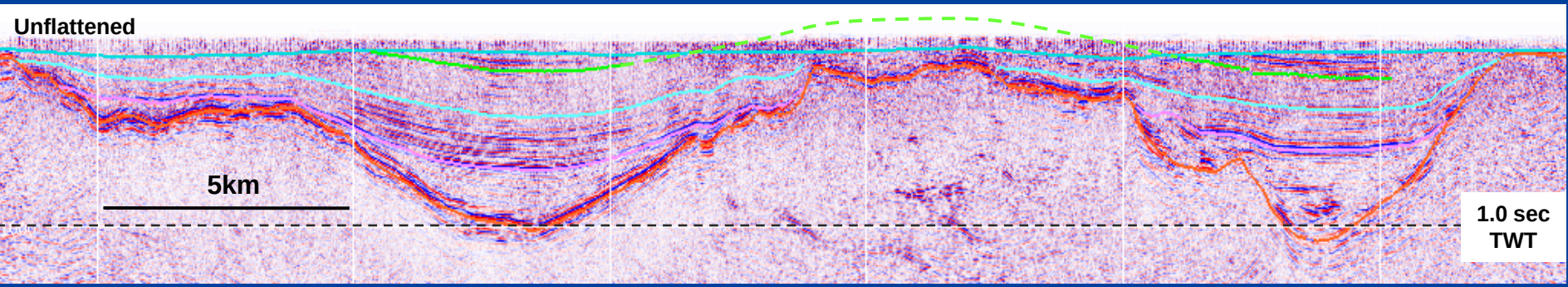
Flattened on Top Stuart Range Fm



Flattened on intra-Mt Toondina horizon

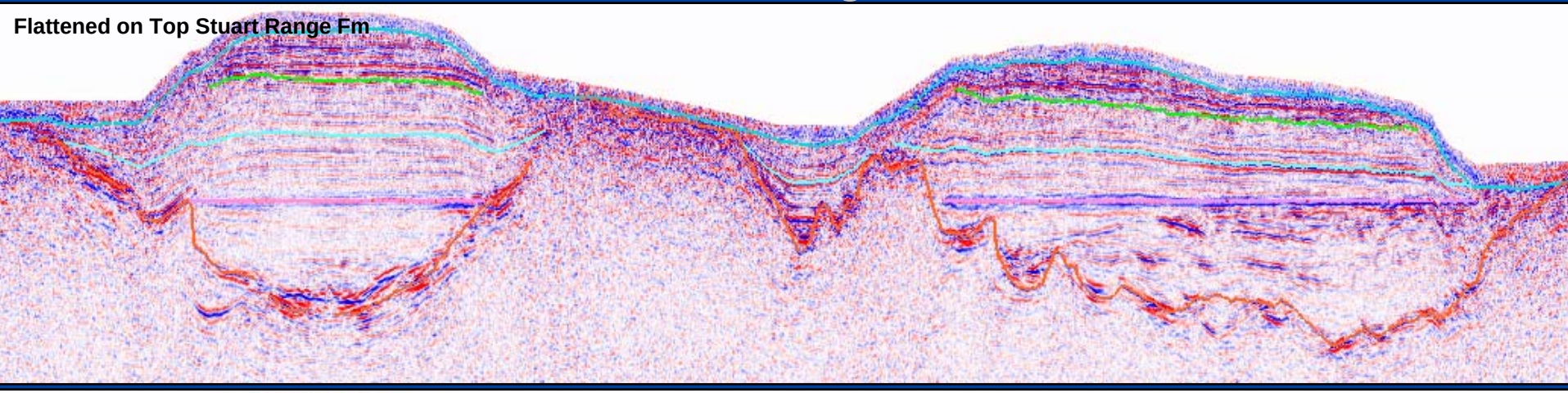


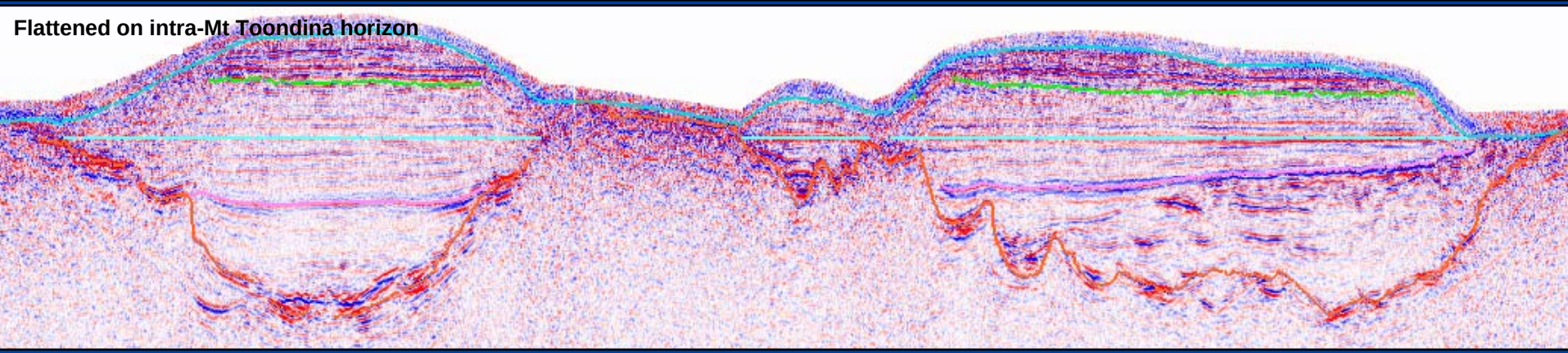
Unflattened

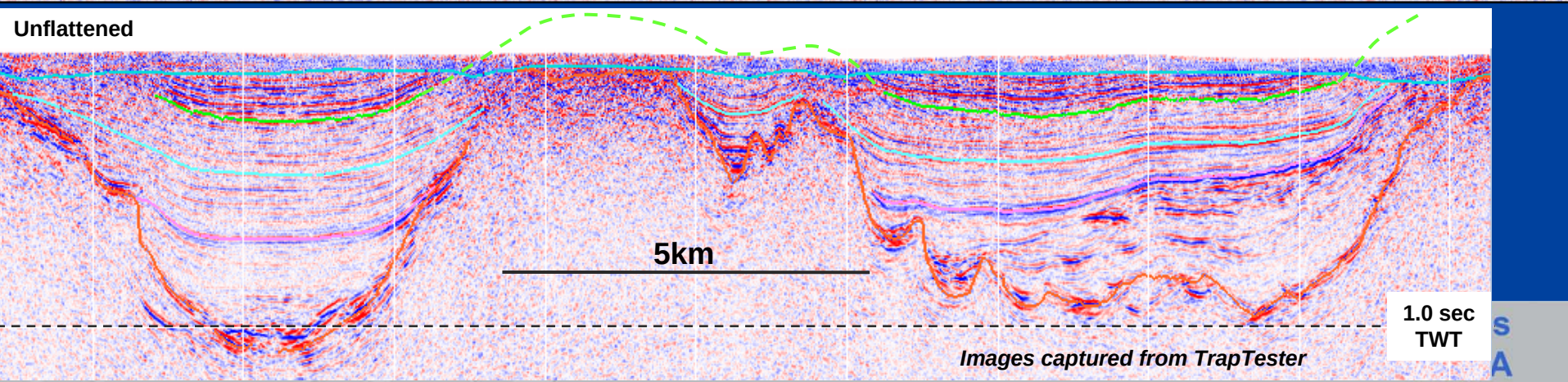


Images captured from TrapTester

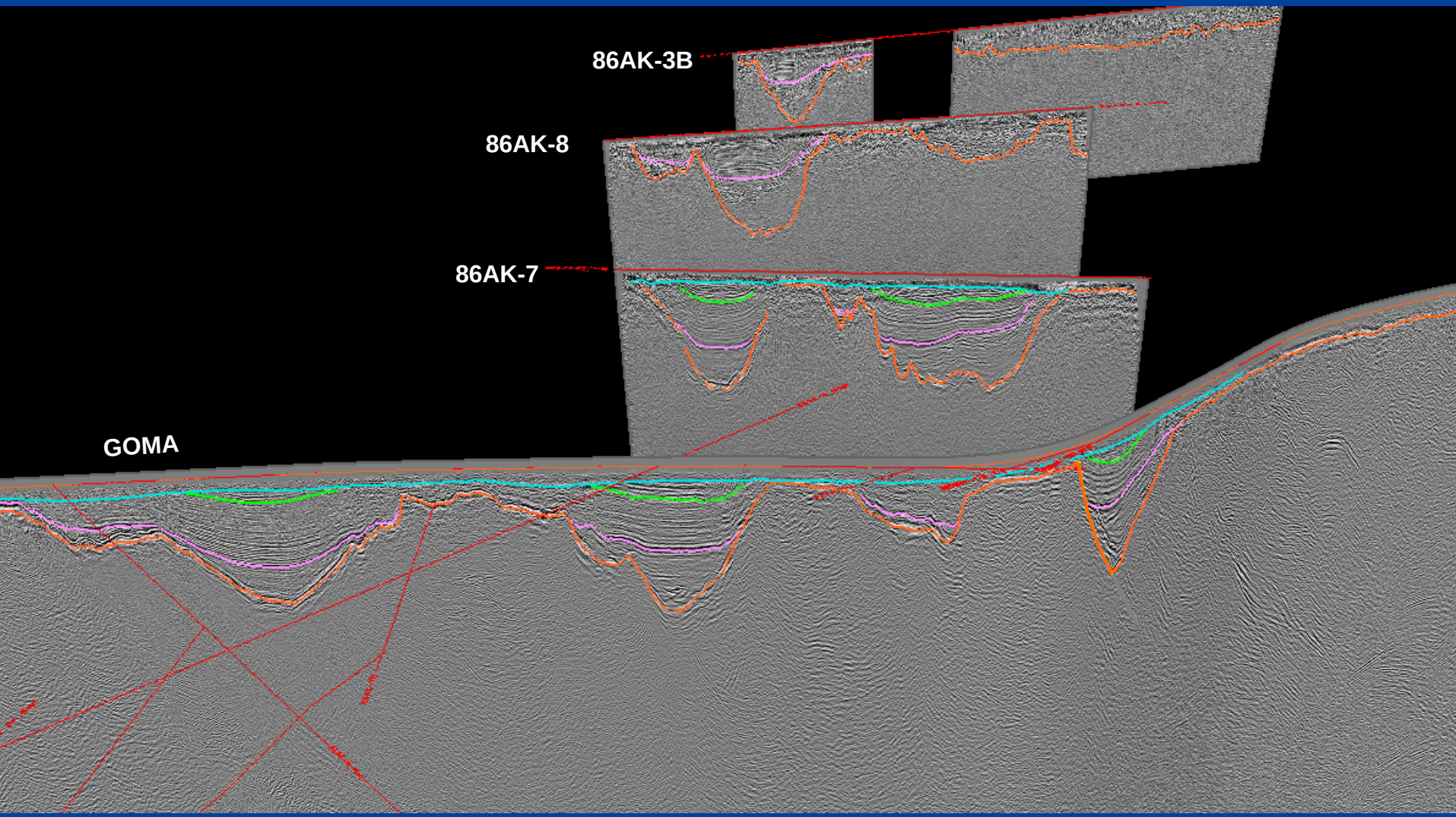
S WEST TROUGH **86AK-7_migrated** PHILLIPSON TROUGH N







SOUTHERN ARCKARINGA BASIN SEISMIC LINES – PERSPECTIVE VIEW LOOKING WEST (TrapTester image)

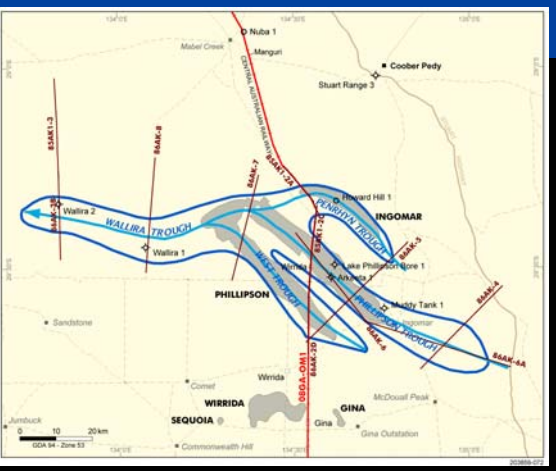


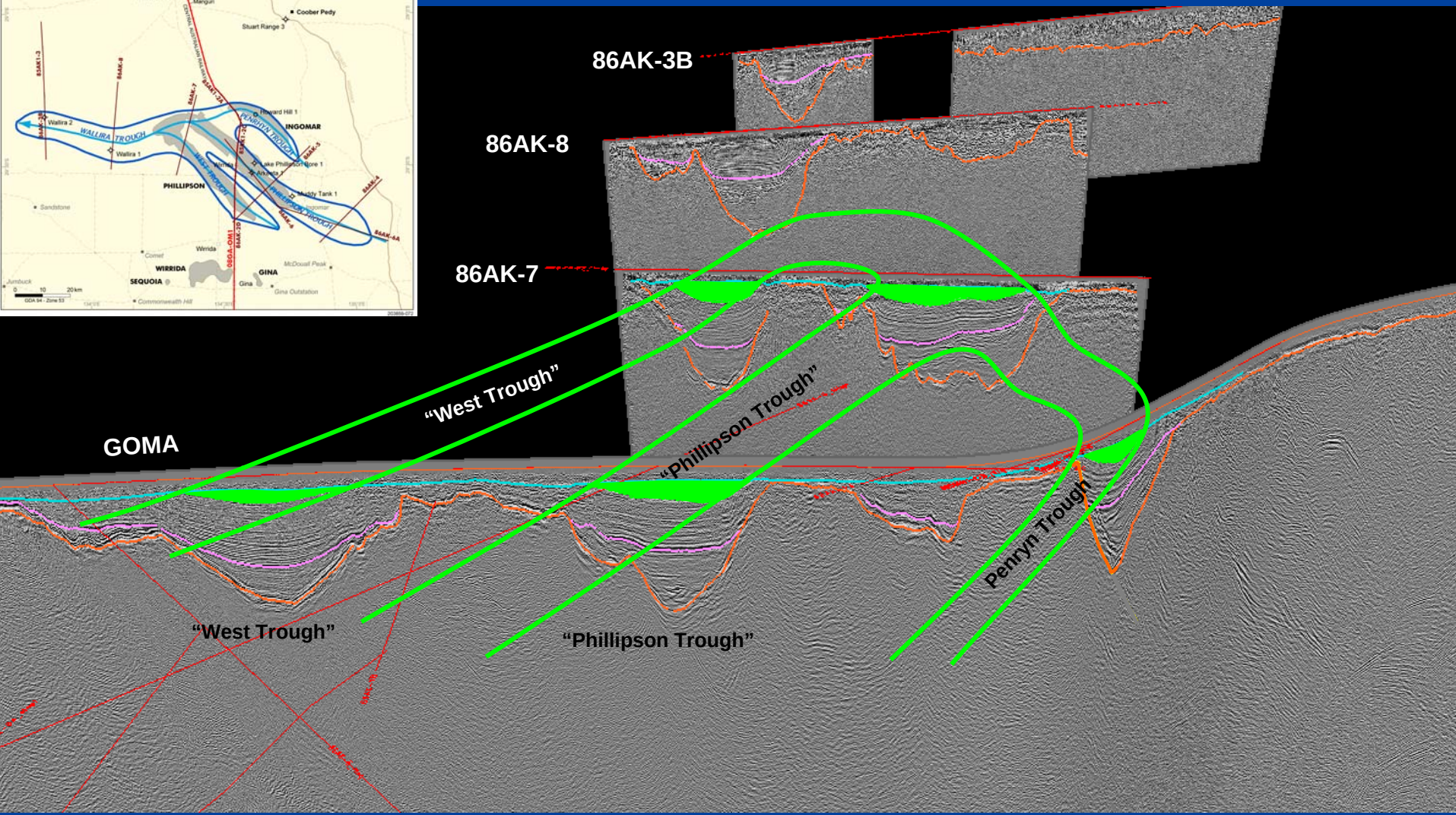
Near top Lower Mount Toondina Fm

Near top Stuart Range Fm

Basement

EARLY PERMIAN COAL DEPOSITS
(TrapTester image)



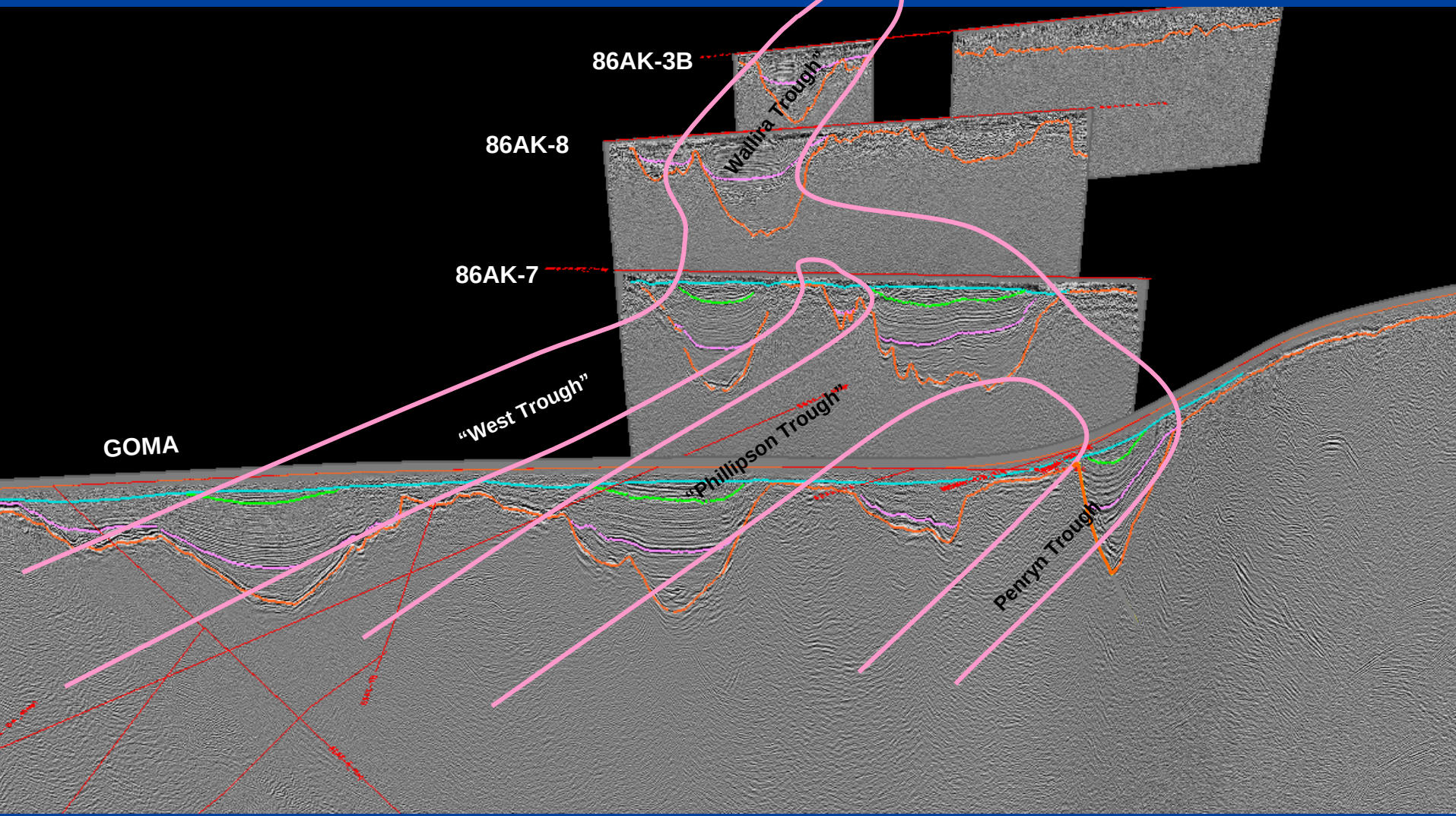


Near top Lower Mount Toondina Fm

Near top Stuart Range Fm

Basement

MAIN GLACIAL VALLEYS – SOUTHERN ARCKARINGA BASIN

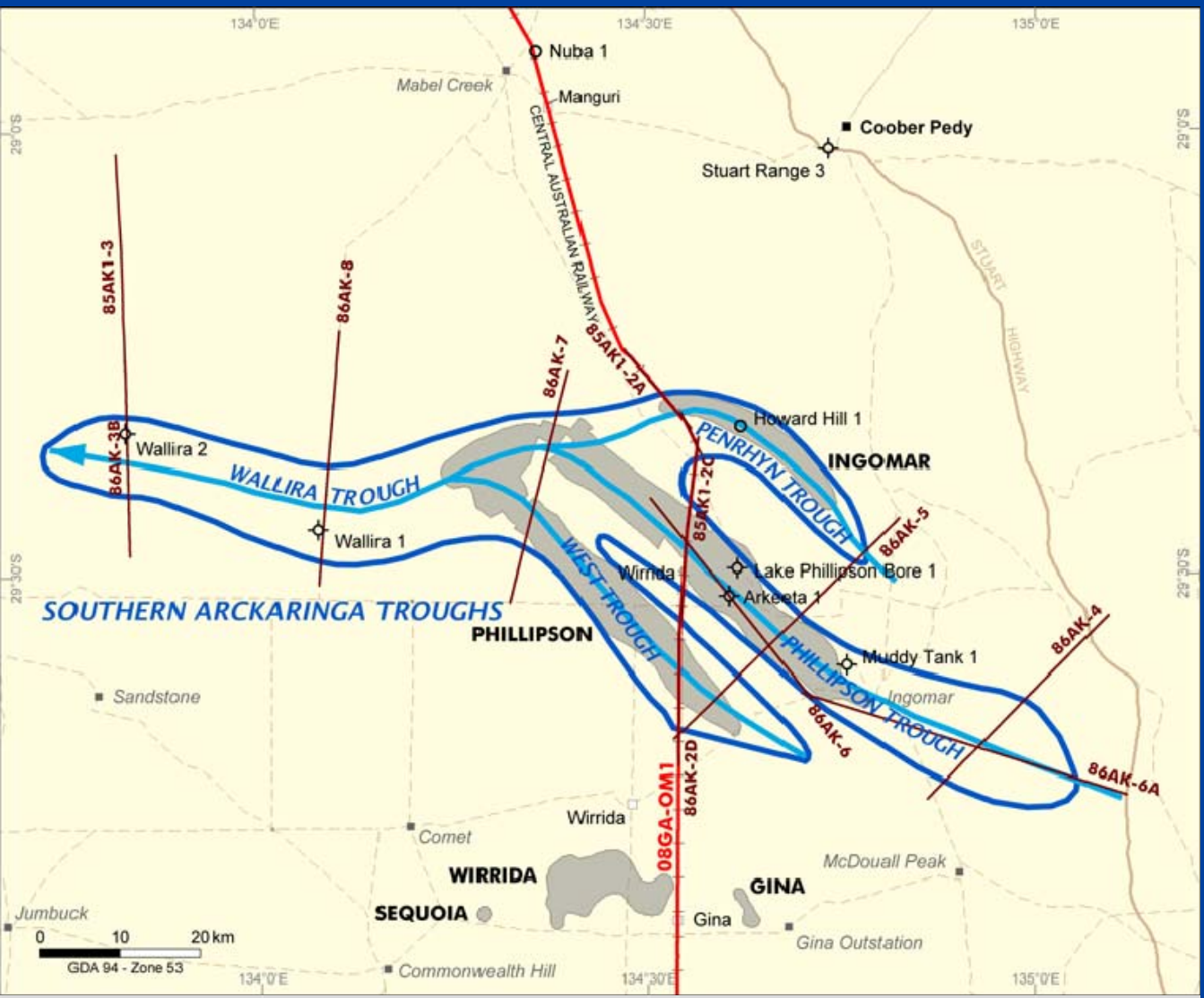


Near top Lower Mount Toondina Fm

Near top Stuart Range Fm

Basement

SOUTHERN ARCKARINGA TROUGHS SHOWING INTERPRETED DIRECTION OF GLACIER FLOW



Glacier flow

Coalfields

Seismic lines

GOAMA seismic line

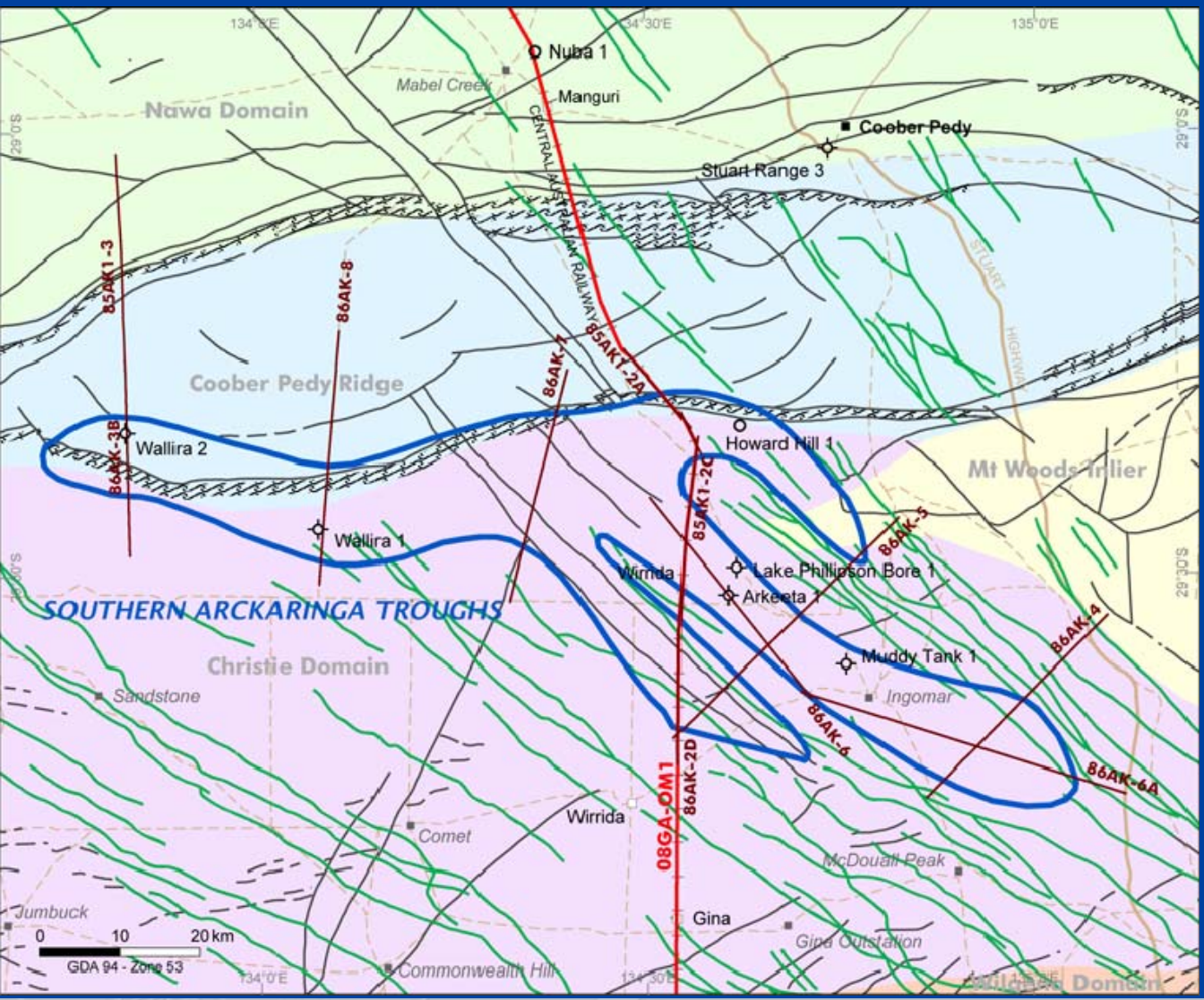
Seismic lines – 1980 to 1989

Petroleum wells

Dry hole

Pending

RELATIONSHIP OF THE SOUTHERN ARCKARINGA TROUGHS WITH BASEMENT



Gairdner Dolerite

Archaean-Early Mesoproterozoic faults

- Fault
- Fault approximate
- Mylonite zone

Seismic lines

- GOAMA seismic line
- Seismic lines – 1980 to 1989

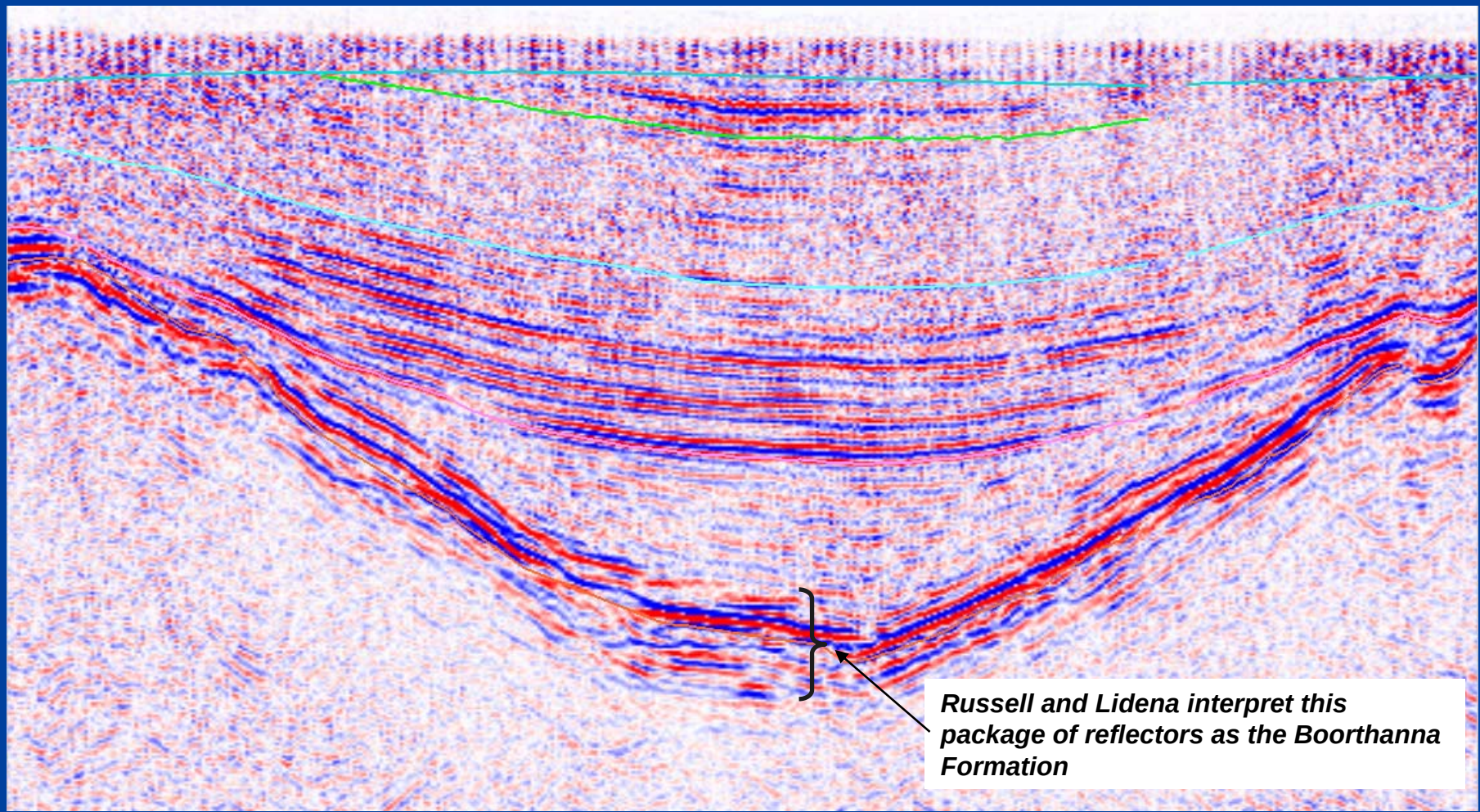
Basement domains

- Christie Domain
- Coober Pedy Ridge
- Mt Woods Inlier
- Nawa Domain
- Wilgena Domain

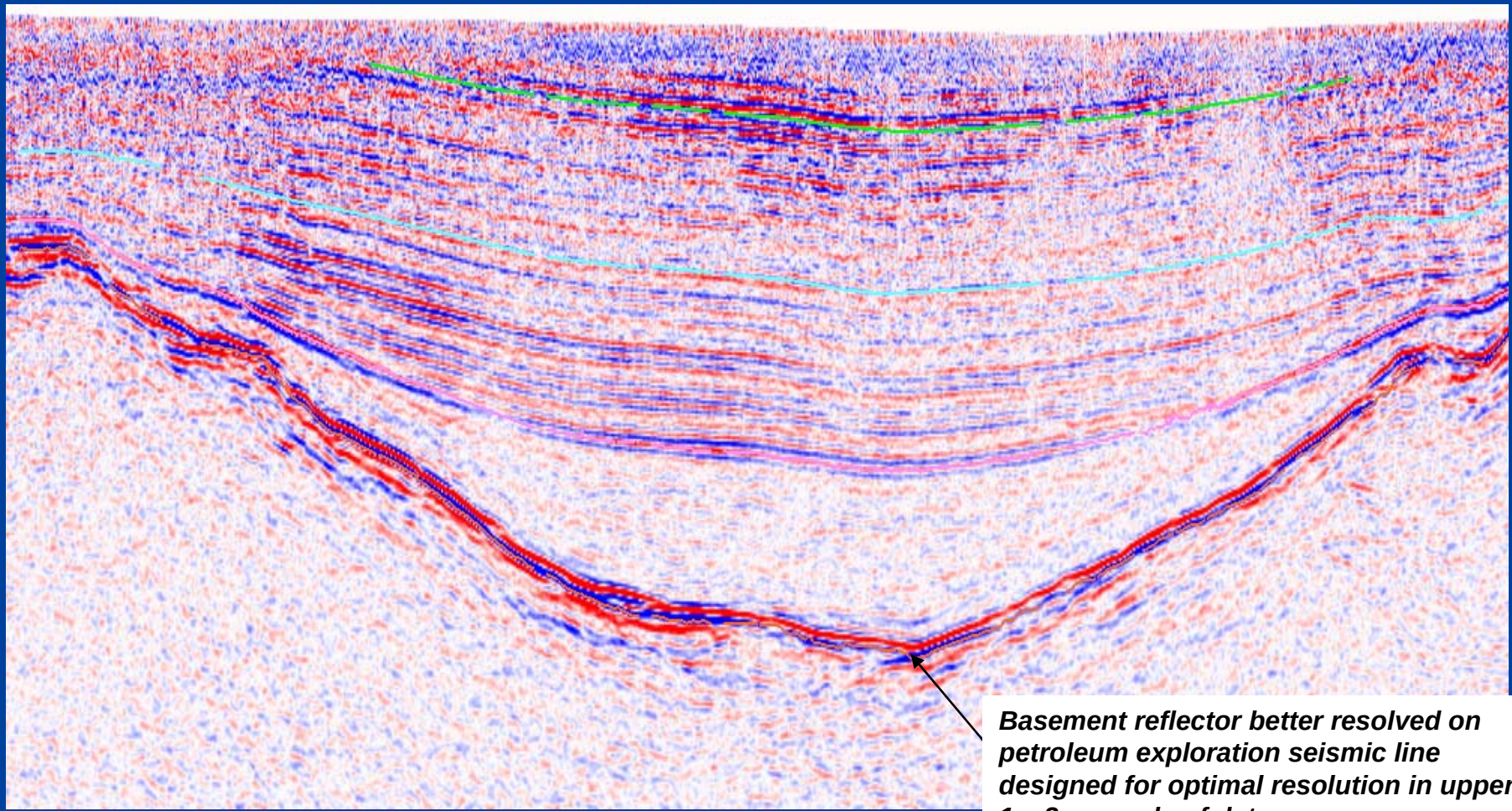
Petroleum wells

- Dry hole
- Pending

GOMA LINE – WEST BASIN

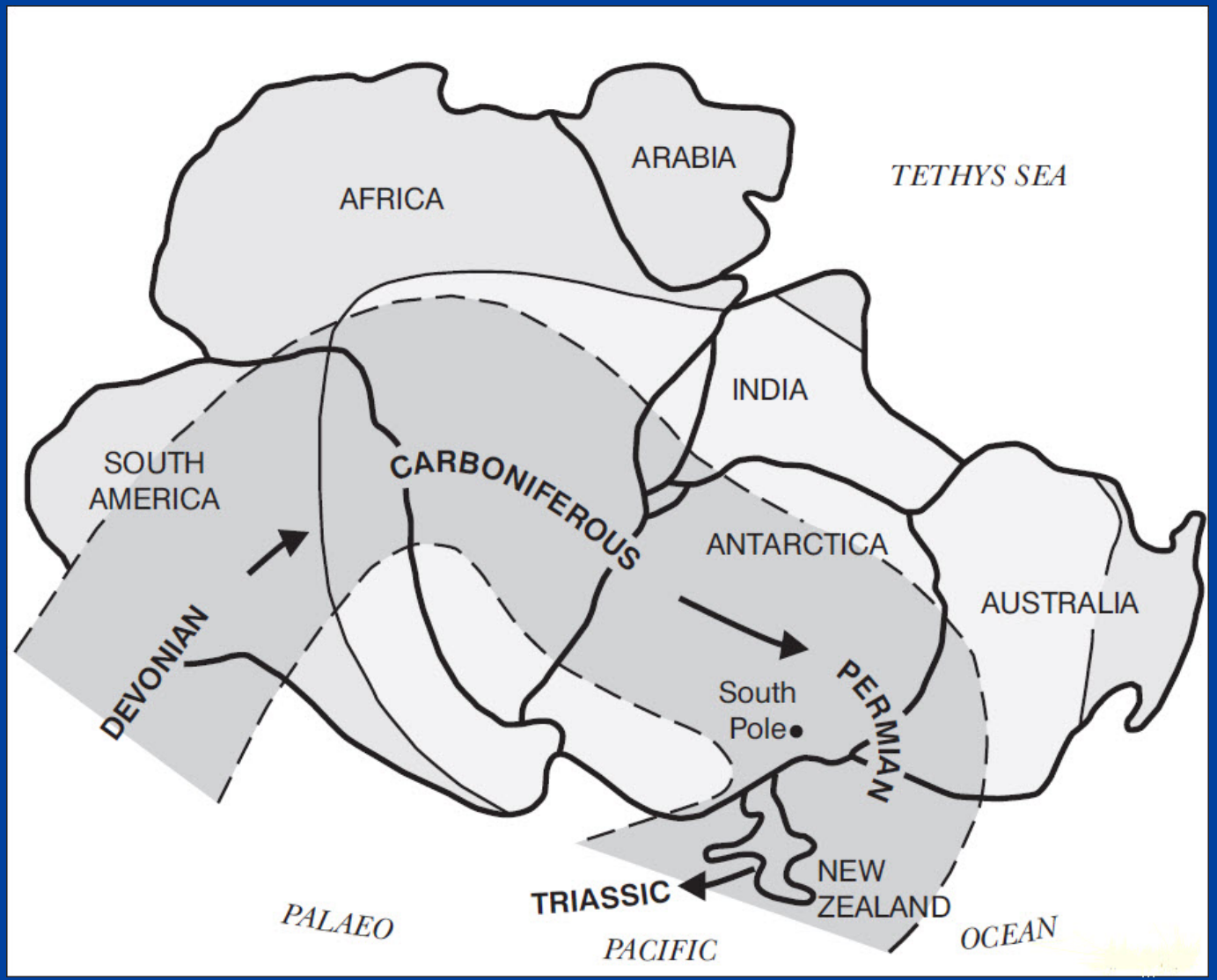


86AK-2D – WEST BASIN



Basement reflector better resolved on petroleum exploration seismic line designed for optimal resolution in upper 1 – 2 seconds of data.

Devonian to Permian migration of major ice centres across Gondwana. The position of the South Pole at the Permo-Carboniferous boundary is shown (from Alley, 1995, and references therein)

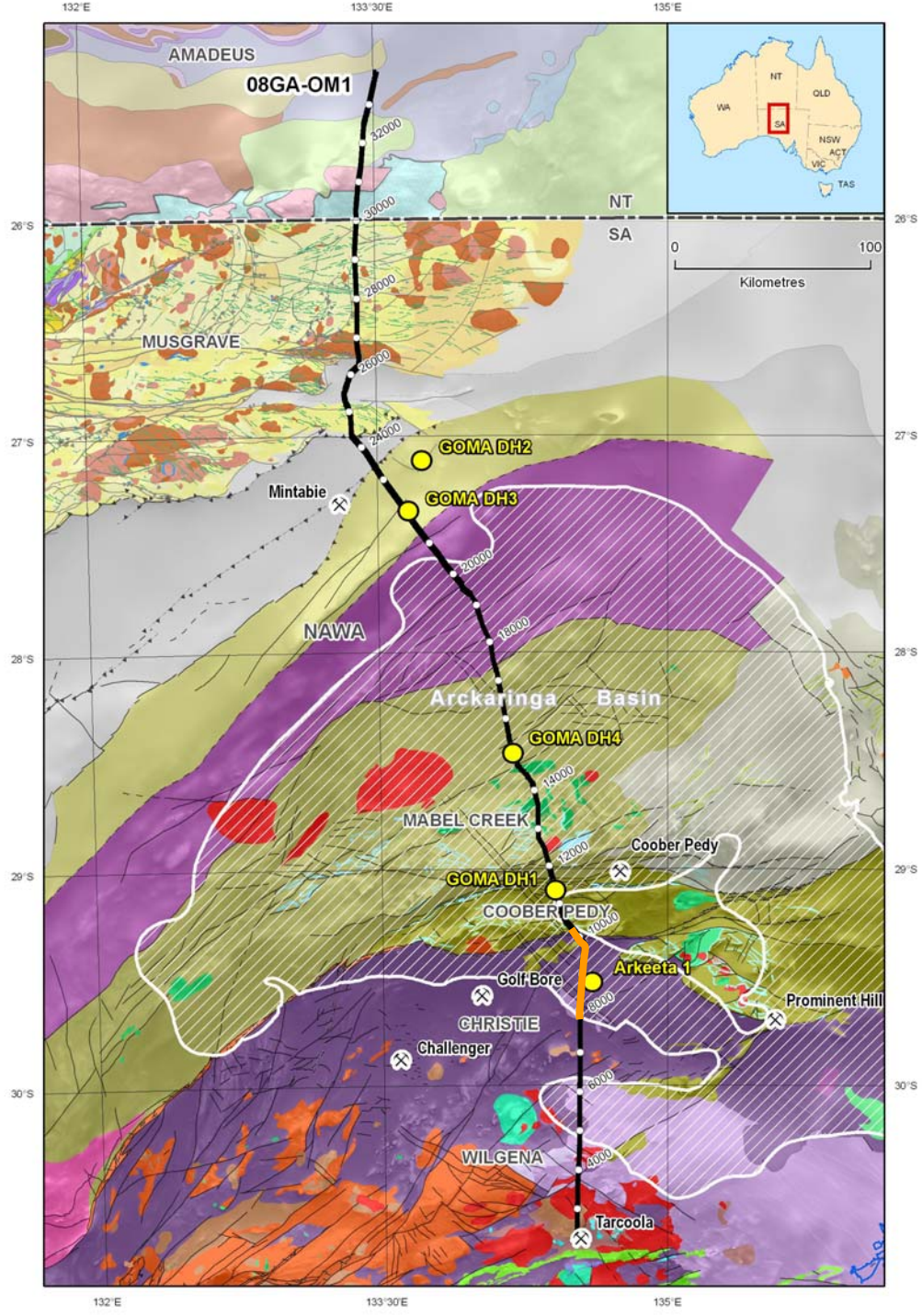


Non-glacial interpretation

Russell Korsch & Lidena Carr

Arckaringa Basin – mostly thin platform cover over Gawler Craton and Officer Basin

In south, West, Phillipson and Penrhyn Troughs allow interpretation of subsidence history of the basin



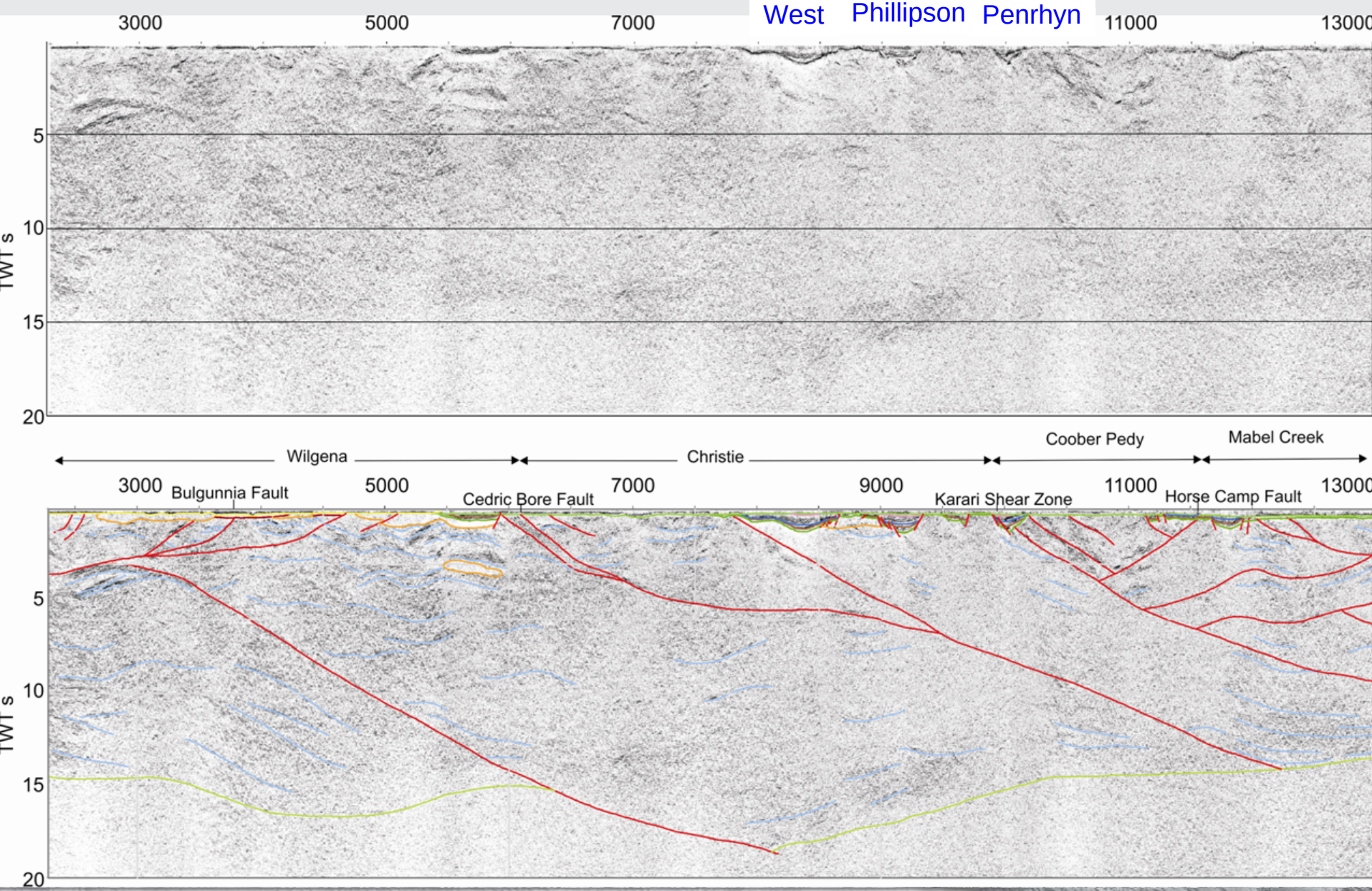
Arckaringa Basin

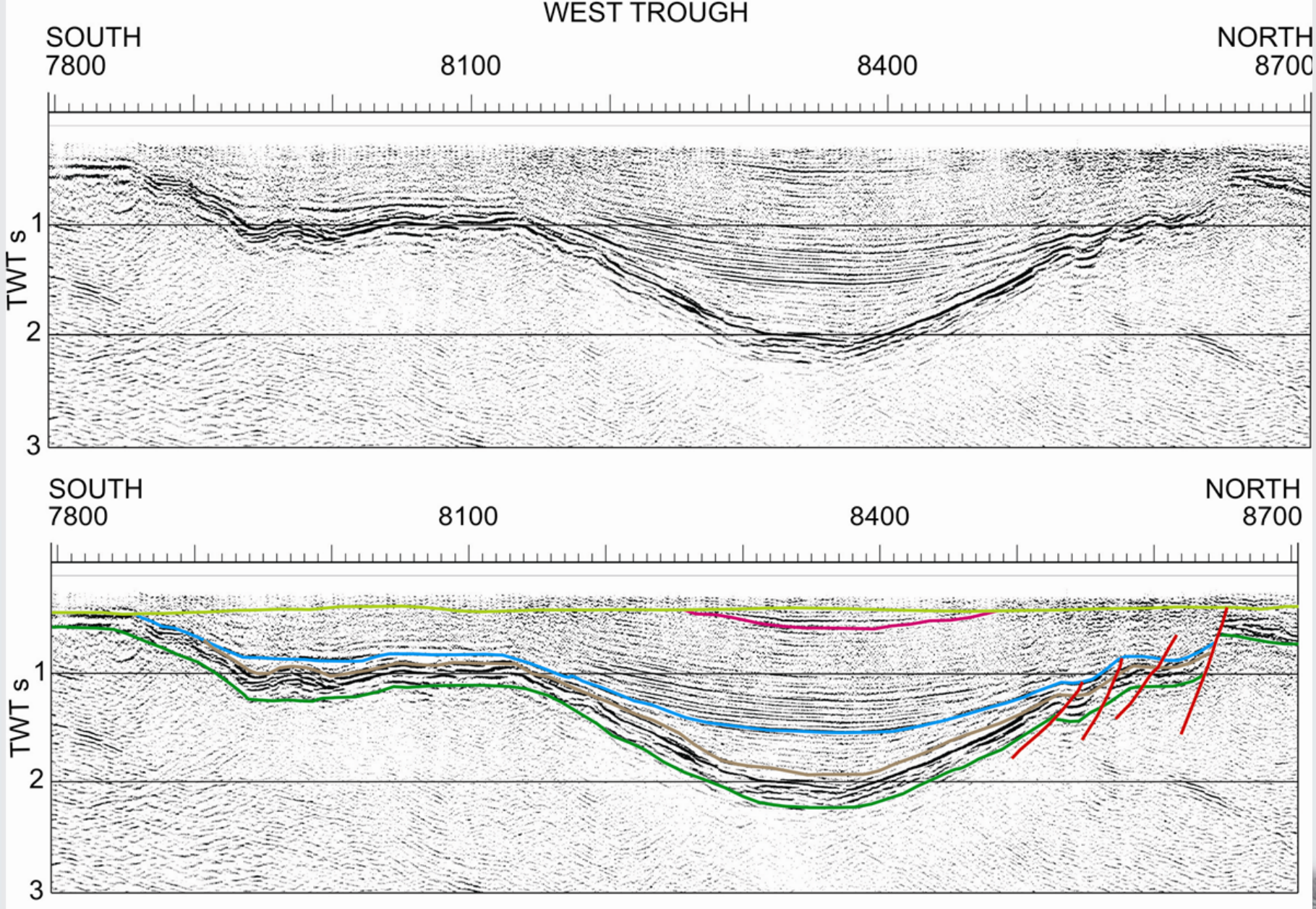
Locations of West, Phillipson and Penrhyn Troughs

GEOSCIENCE AUSTRALIA

Arckaringa Basin

West Phillipson Penrhyn




WEST TROUGH
SOUTH
NORTH
7800
8100
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8700
TWT s
1
2
3
SOUTH
NORTH
7800
8100
8400
8700
TWT s
1
2
3
Base Eromanga Basin
Base Upper Mount Toondina Formation
Base Lower Mount Toondina Formation
Base Stuart Range Formation
Base Boothanna Formation
Faults

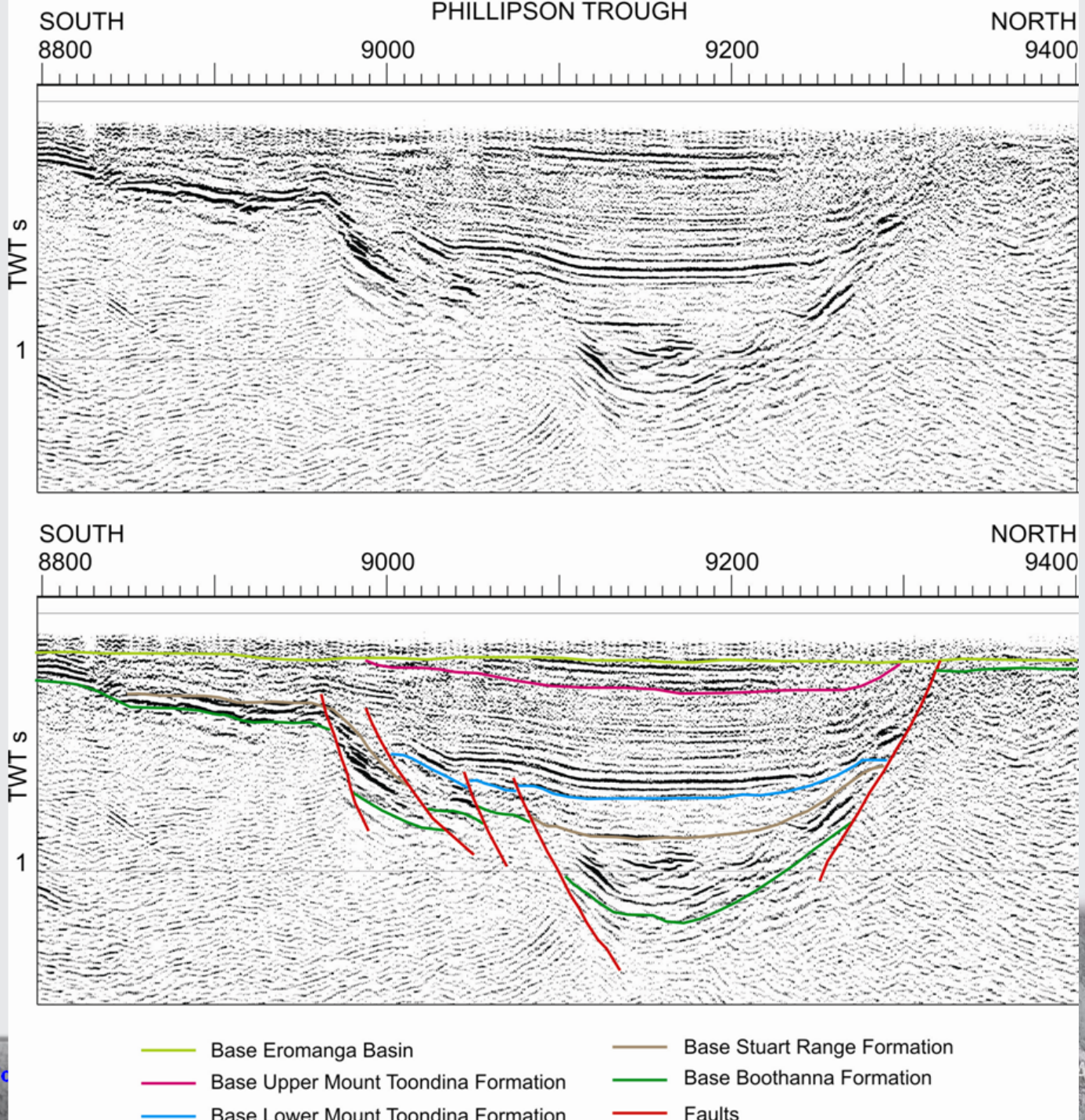
West Trough

Boorthanna Formation – strong, irregular reflections, relatively constant thickness, deposited on relatively flat surface, walls of trough too steep for deposition (must have subsided after deposition)

Stuart Range and lower Mount Toondina Formations – SR weakly reflective (marginal marine shale-dominated package) onlap ⟶ subsidence driven by thermal relaxation

Upper Mount Toondina Formation – lacustrine, meandering rivers, coal swamps, subparallel reflections, deposition on relatively flat surface

Post deposition – northern margin, minor thrust faults with hangingwall anticlines


PHILLIPSON TROUGH
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SOUTH
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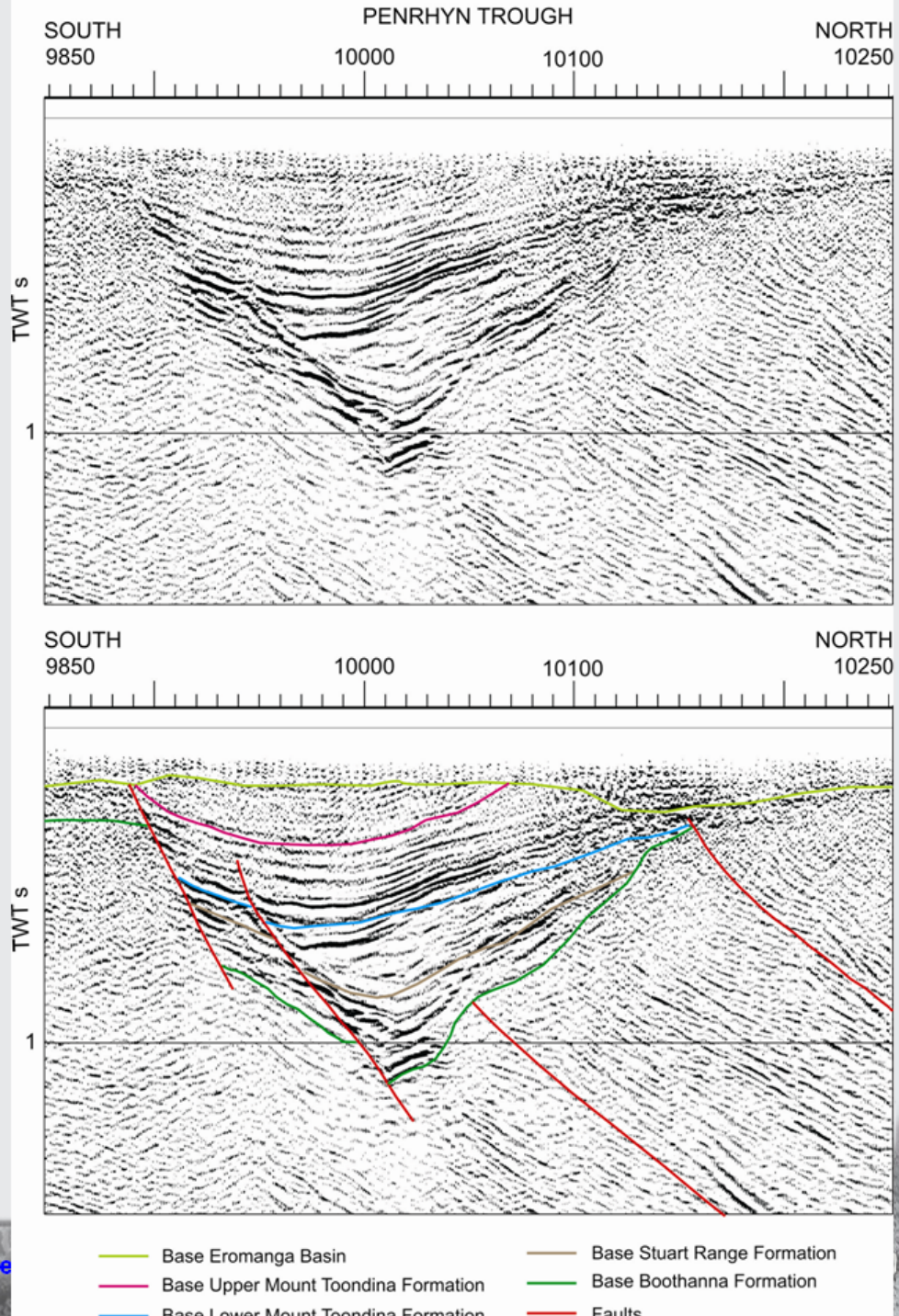
9400
TWT s
1
Base Eromanga Basin
Base Upper Mount Toondina Formation
Base Lower Mount Toondina Formation
Base Stuart Range Formation
Base Boothanna Formation
Faults

Phillipson Trough

Upper section – similar to West Trough, onlap followed by subparallel reflections

Boorthanna Formation – variable thickness, thinning to north, bounded by extensional faults. Basal part may be glacial valley - but max. 200 ms TWT (~250 m)


PENRHYN TROUGH
SOUTH
NORTH
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10000
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10250
TWT s
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SOUTH
NORTH
9850
10000
10100
10250
TWT s
1
Base Eromanga Basin
Base Upper Mount Toondina Formation
Base Stuart Range Formation
Base Boothanna Formation
Faults

Penrhyn Trough

Faults - Two basin-bounding faults on southern side

Sediment fill – asymmetric, thins to the north, extensional half graben

Conclusions

Arckaringa Basin – three sedimentary packages, distinct seismic character

West Trough – basal Boorthanna Formation - relatively constant thickness, deposited on relatively flat surface

Stuart Range and lower Mount Toondina Formations – onlap ⟶ subsidence ?driven by thermal relaxation

Upper Mount Toondina Formation – subparallel reflections, deposition on relatively flat surface

Phillipson and Penrhyn Troughs – extensional, fault-controlled origin

Post deposition – minor shortening, angular unconformity before deposition of Eromanga Basin

Incision of deep glacial valleys not supported by geometry seen in GOMA seismic line