Geochemical characteristics of Mesozoic petroleum systems in the Bonaparte Basin, NW Australia

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BHP

AGSO AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

GeoMark

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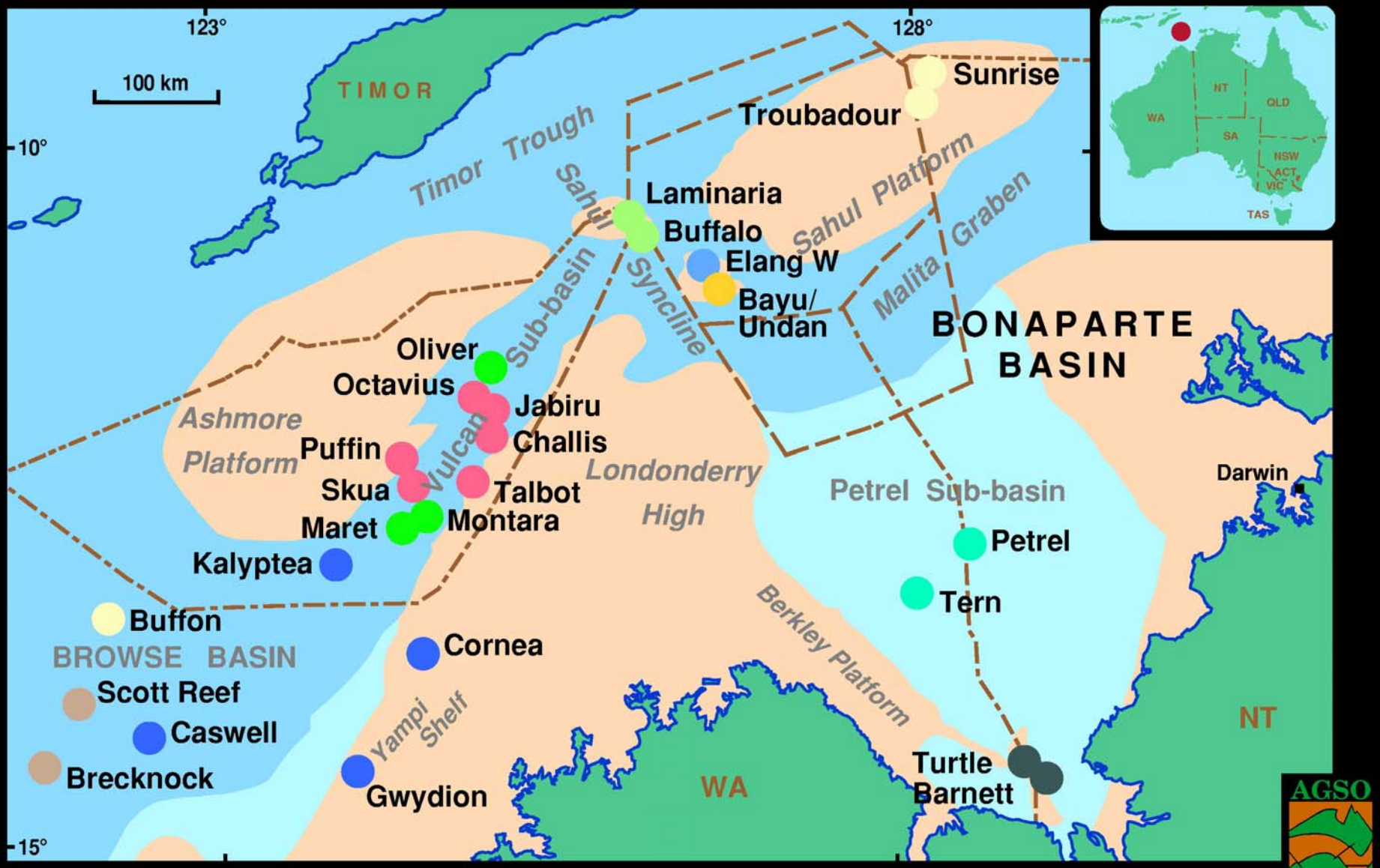
123°
128°
100 km
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TIMOR
Timor Trough
Sahul Sub-basin
Syncline
Sahul Platform
Malita Graben
BONAPARTE BASIN
Sunrise
Troubadour
Laminaria
Buffalo
Elang W
Bayu/ Undan
Oliver
Octavius
Jabiru
Challis
Vulcan
Ashmore Platform
Puffin
Skua
Talbot
Maret
Montara
Kalyptea
Londonderry High
Petrel Sub-basin
Petrel
Tern
Darwin
Berkley Platform
Buffon
BROWSE BASIN
Scott Reef
Caswell
Brecknock
Cornea
Yampi Shelf
Gwydion
WA
NT
Turtle
Barnett
WA
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QLD
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NSW
ACT
VIC
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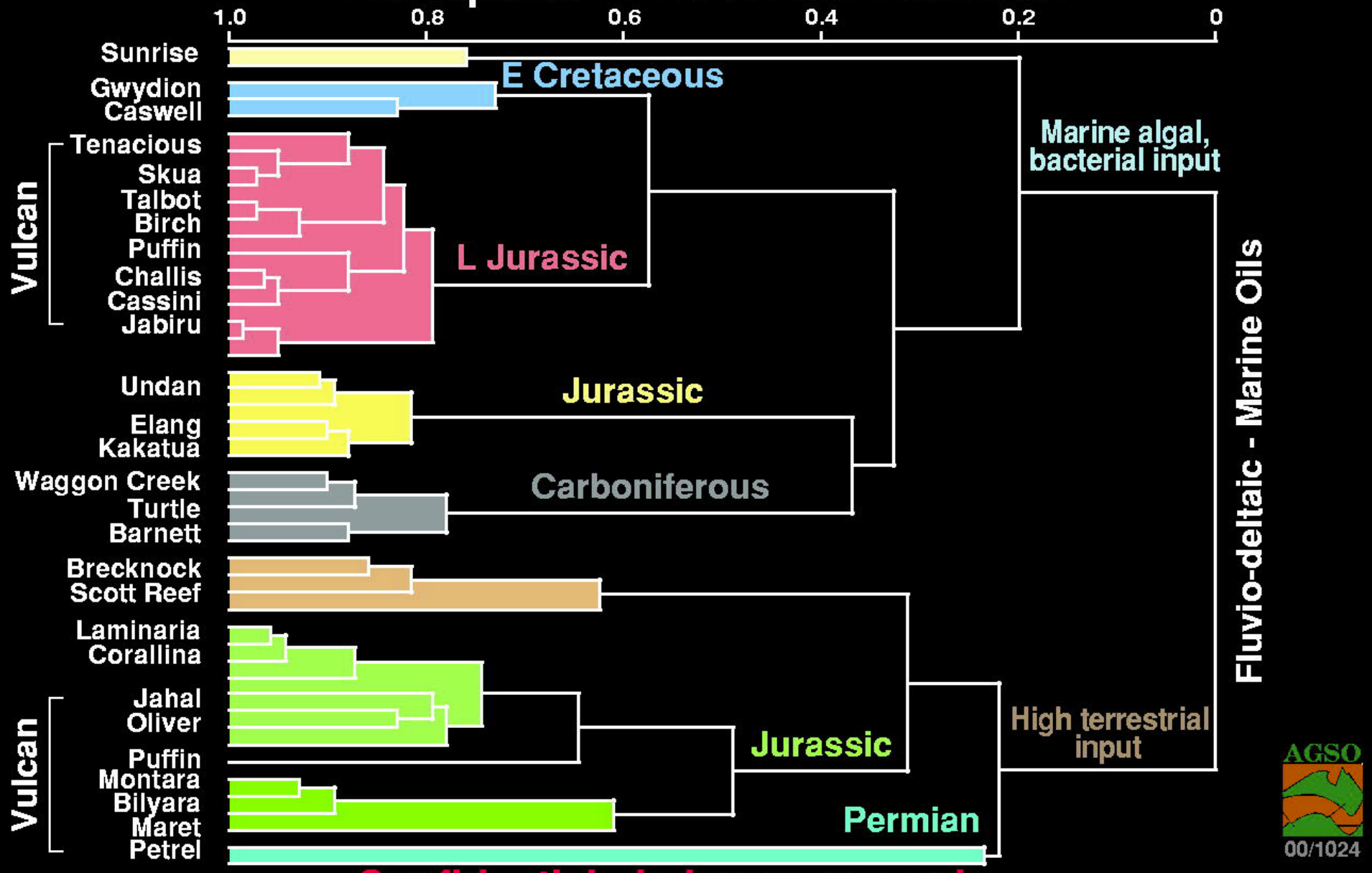
Bonaparte-Browse Oil Families



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Summary

- Bonaparte-Browse oils of Mesozoic age originate from marine and fluvio-deltaic source rocks
- Two Groups of Oils; Marine-affinity
  Terrestrial-influence
- 7 Mesozoic and 2 Paleozoic Oil Families
- Other effective source rocks besides Late Jurassic marine sediments are inferred

Talk Outline

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- Geochemistry of Vulcan Oils
- Vulcan Source Rocks
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- Bonaparte-Browse Oil Families
- Conclusions

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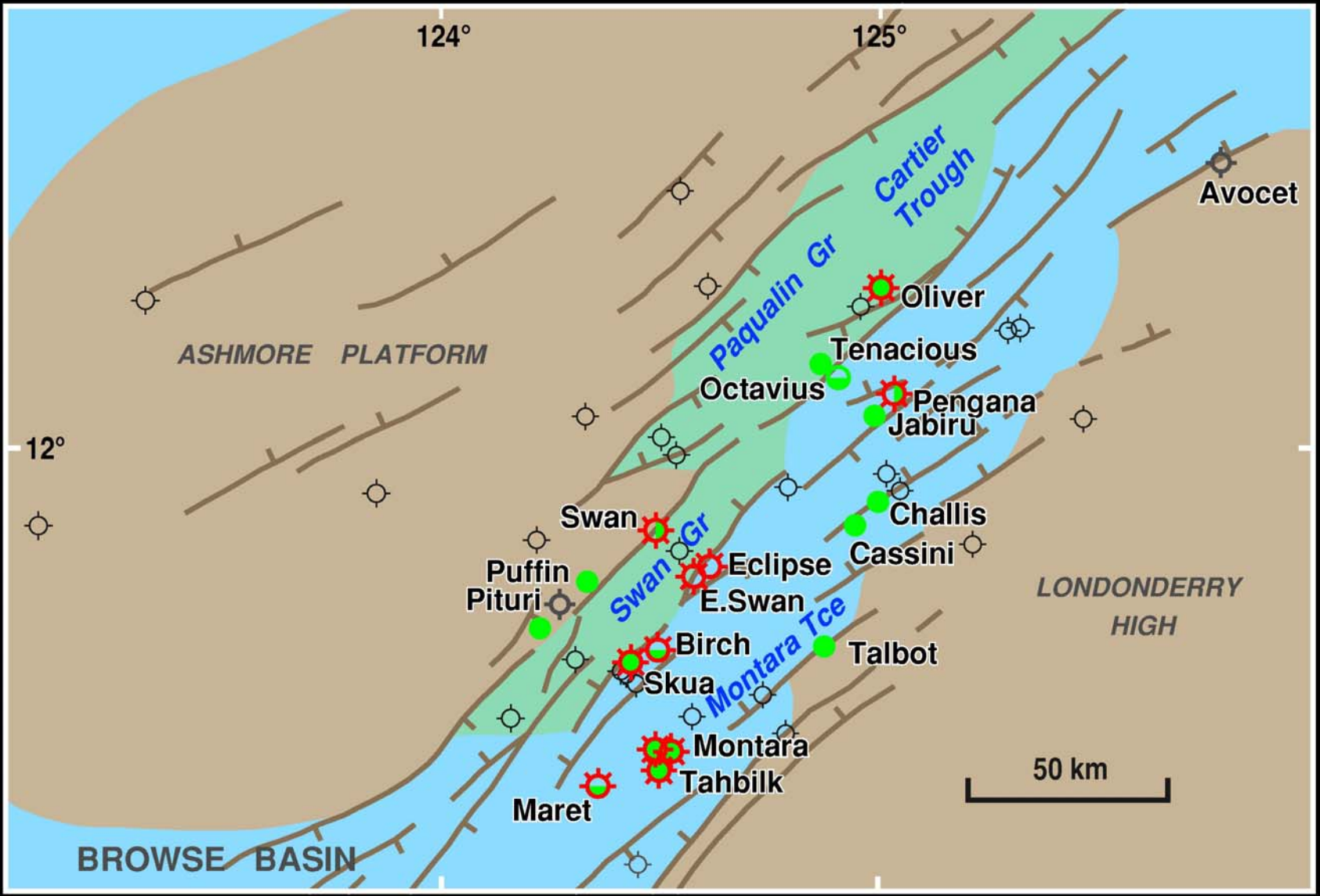
Vulcan Mesozoic oil / condensates



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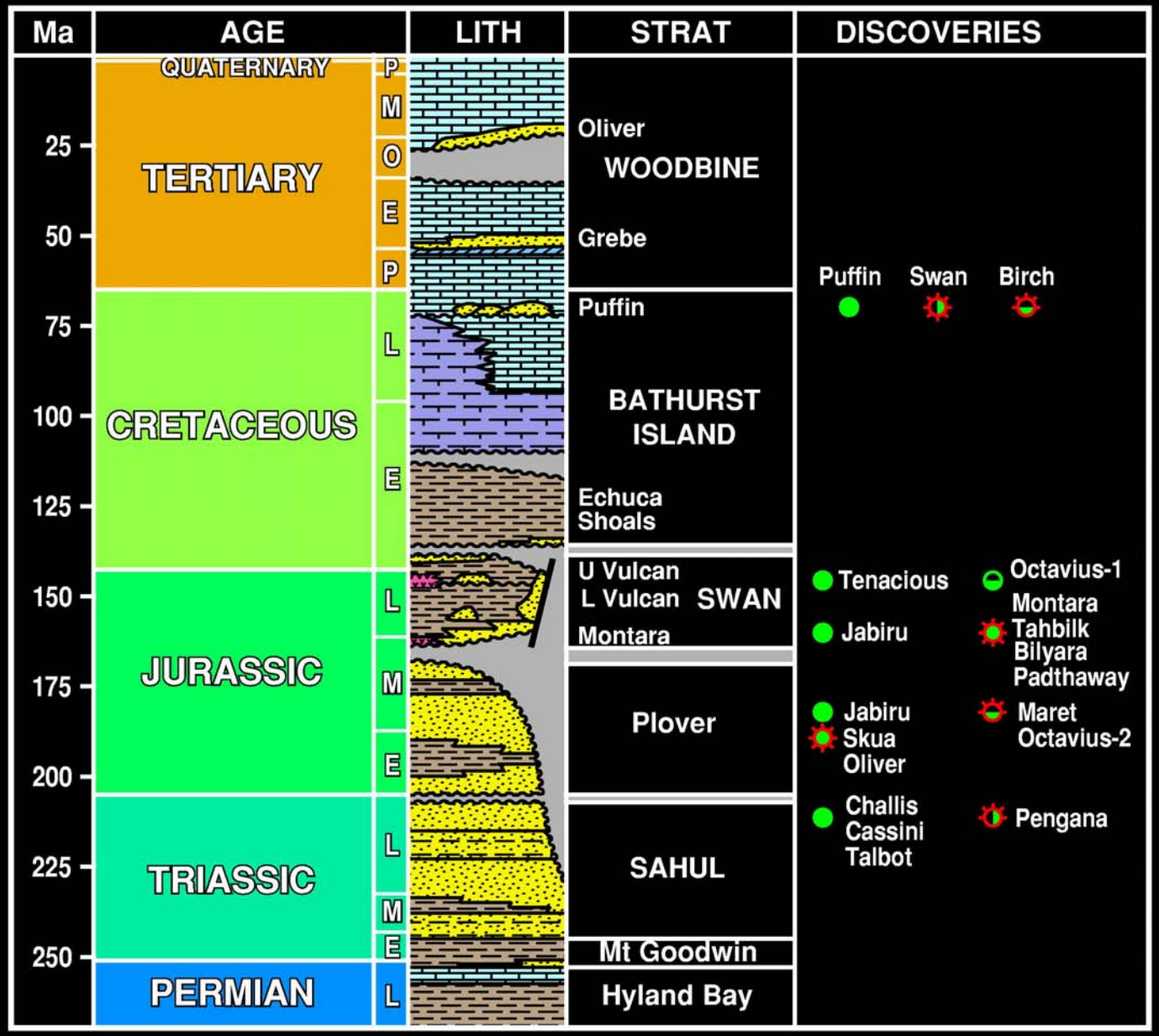

Western Bonaparte Basin

Ashmore Platform Vulcan Sub-basin

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Talk Outline

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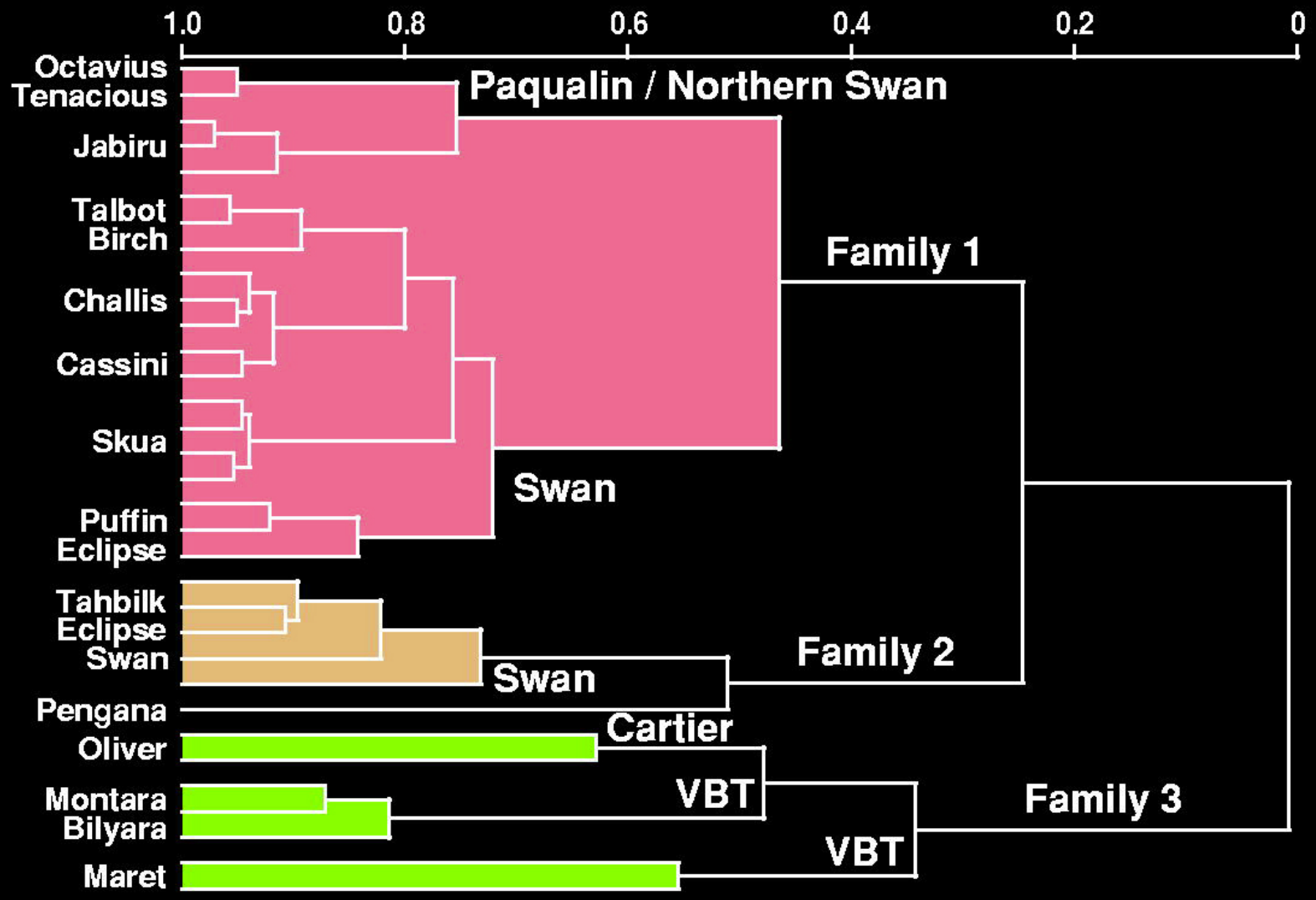
Vulcan Sub-basin Oil Families



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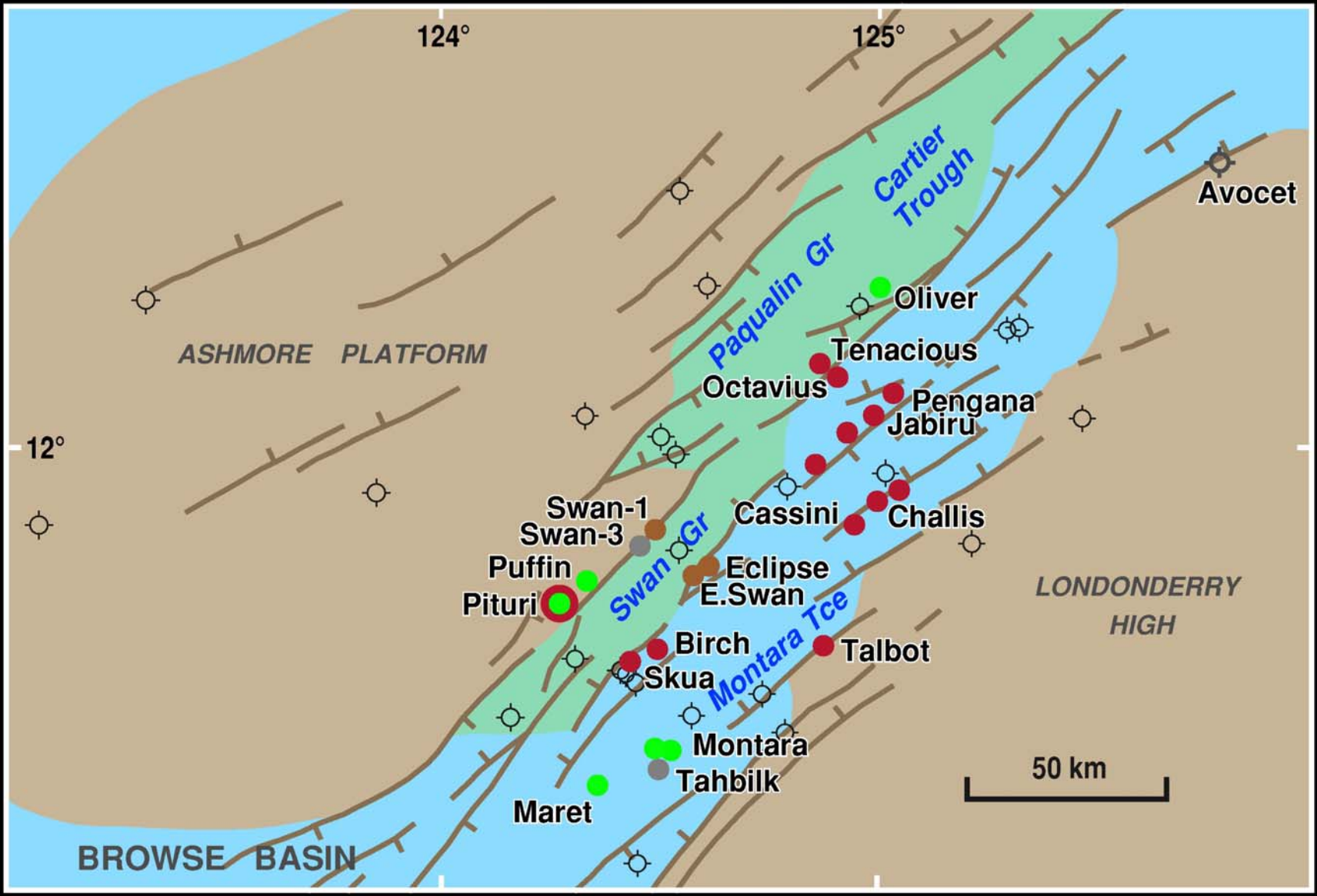
Vulcan Mesozoic oil / condensates



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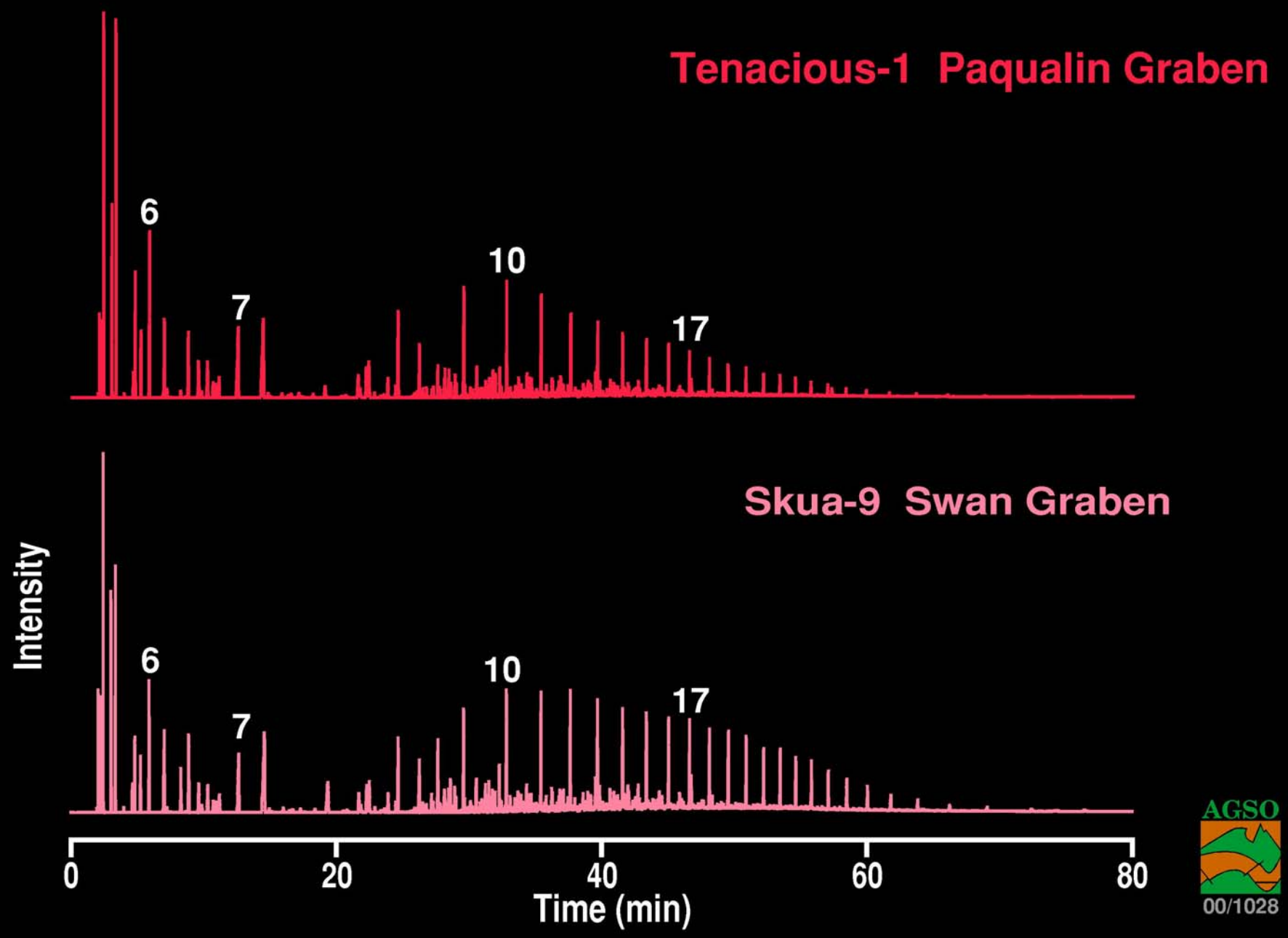
Tenacious-1 Paqualin Graben
6
7
10
17
Skua-9 Swan Graben
6
7
10
17
Intensity
0
20
40
60
80
Time (min)
AGSO
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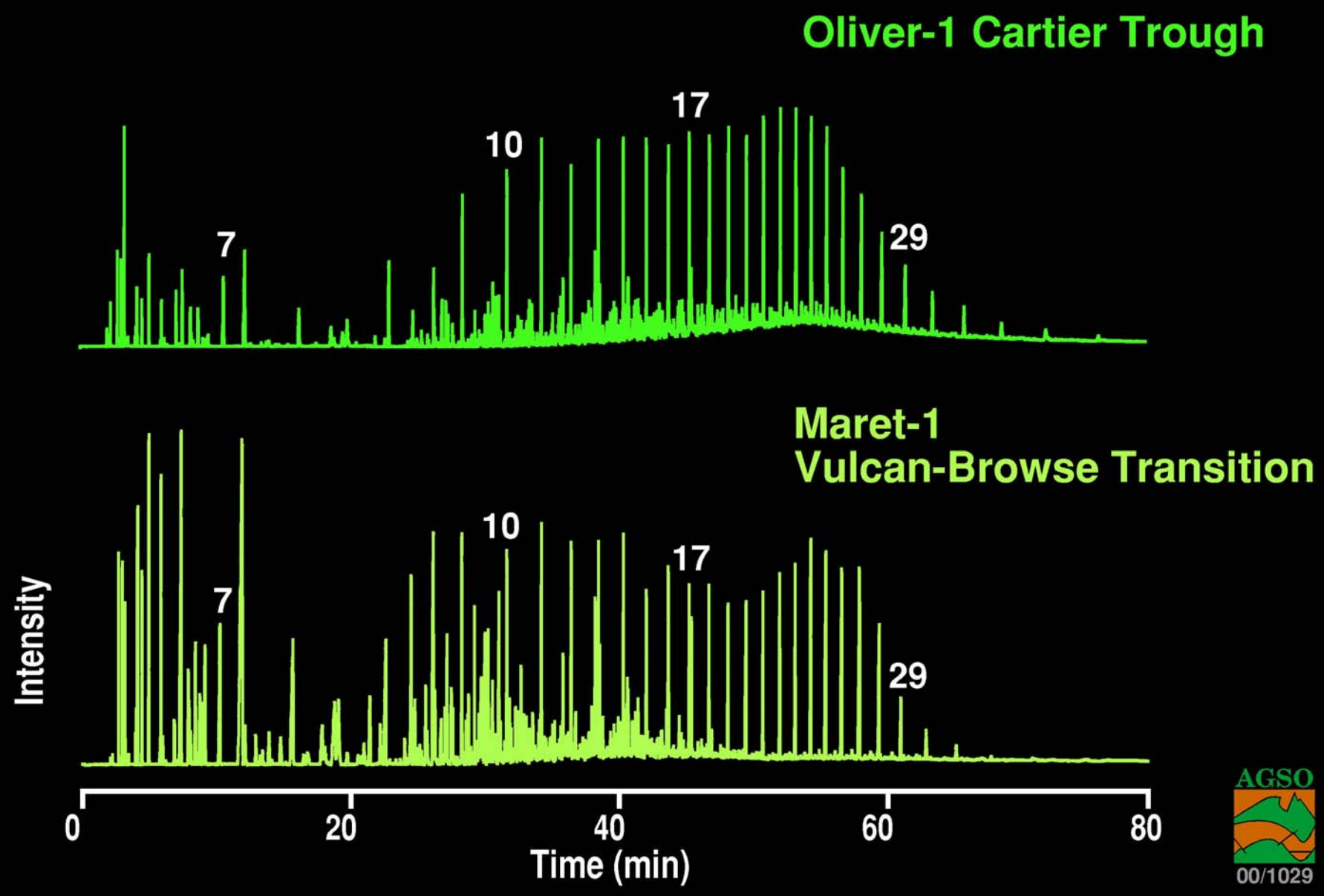
Oliver-1 Cartier Trough
7
10
17
29
Maret-1
Vulcan-Browse Transition
7
10
17
29
Intensity
0
20
40
60
80
Time (min)
AGSO
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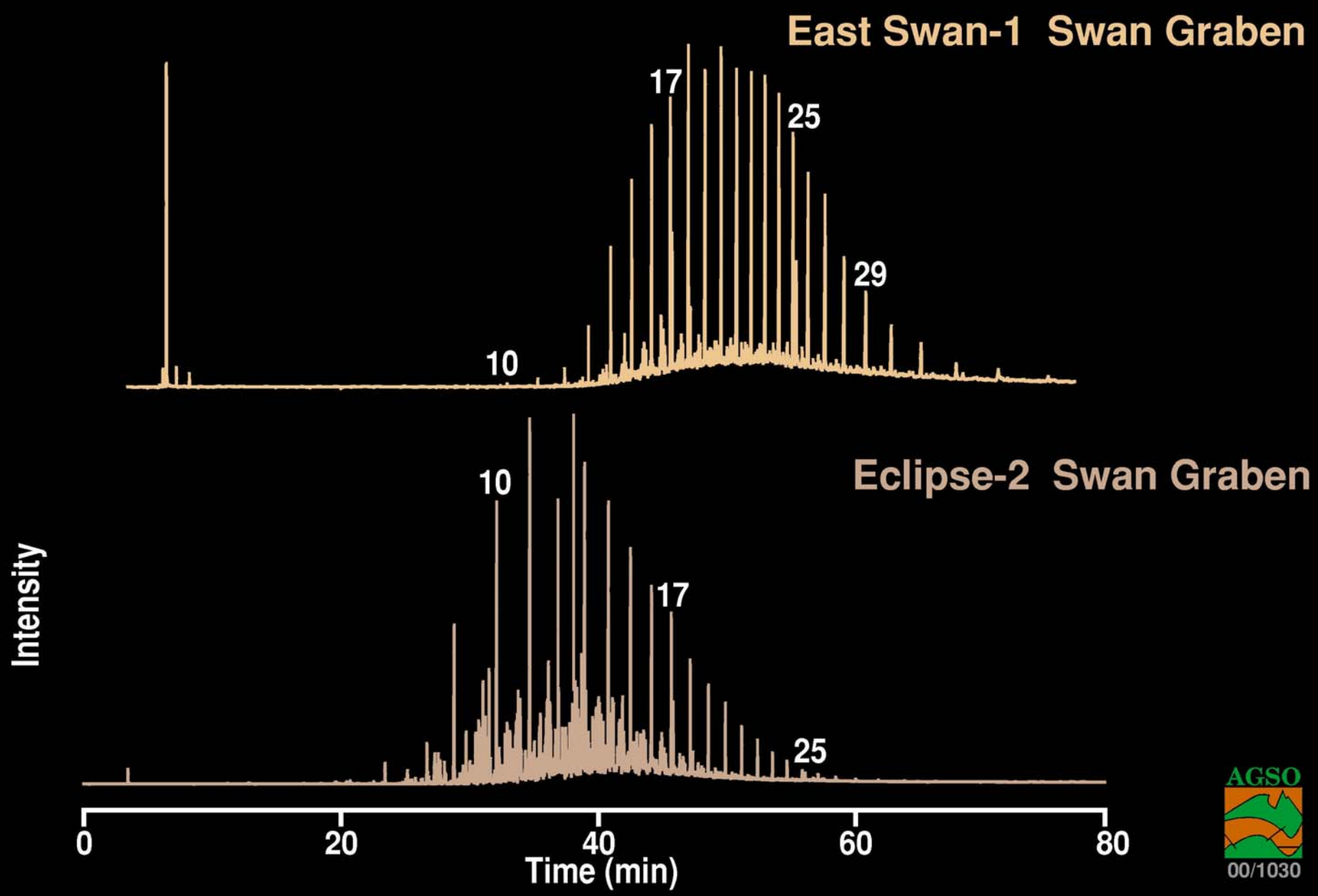
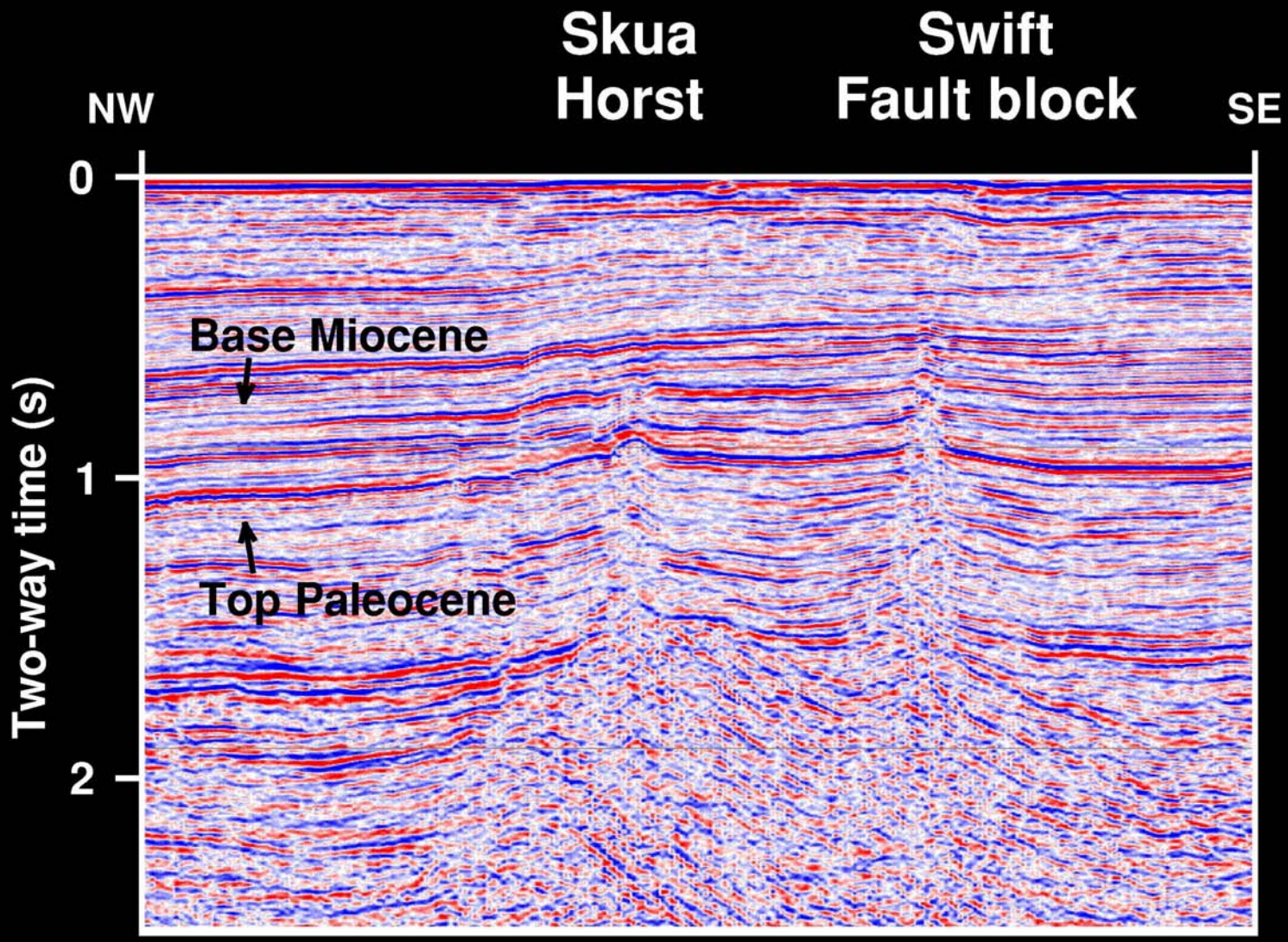

East Swan-1 Swan Graben
17
25
29
10
Eclipse-2 Swan Graben
10
17
25
Intensity
0
20
40
60
80
Time (min)
AGSO
00/1030


Skua
Horst
Swift
Fault block
NW
SE
0
1
2
Two-way time (s)
Base Miocene
Top Paleocene

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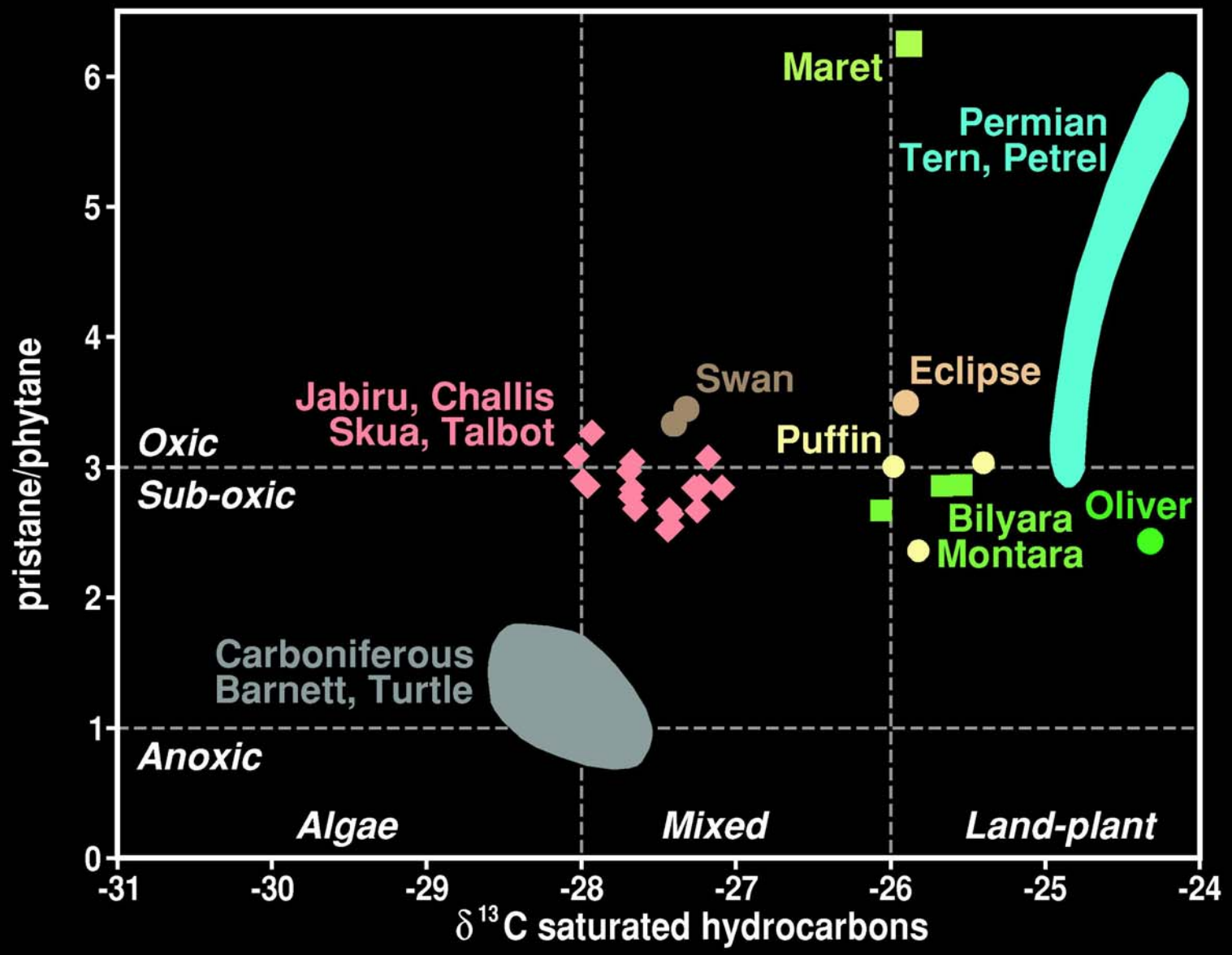
Vulcan Oil - Oil Correlation



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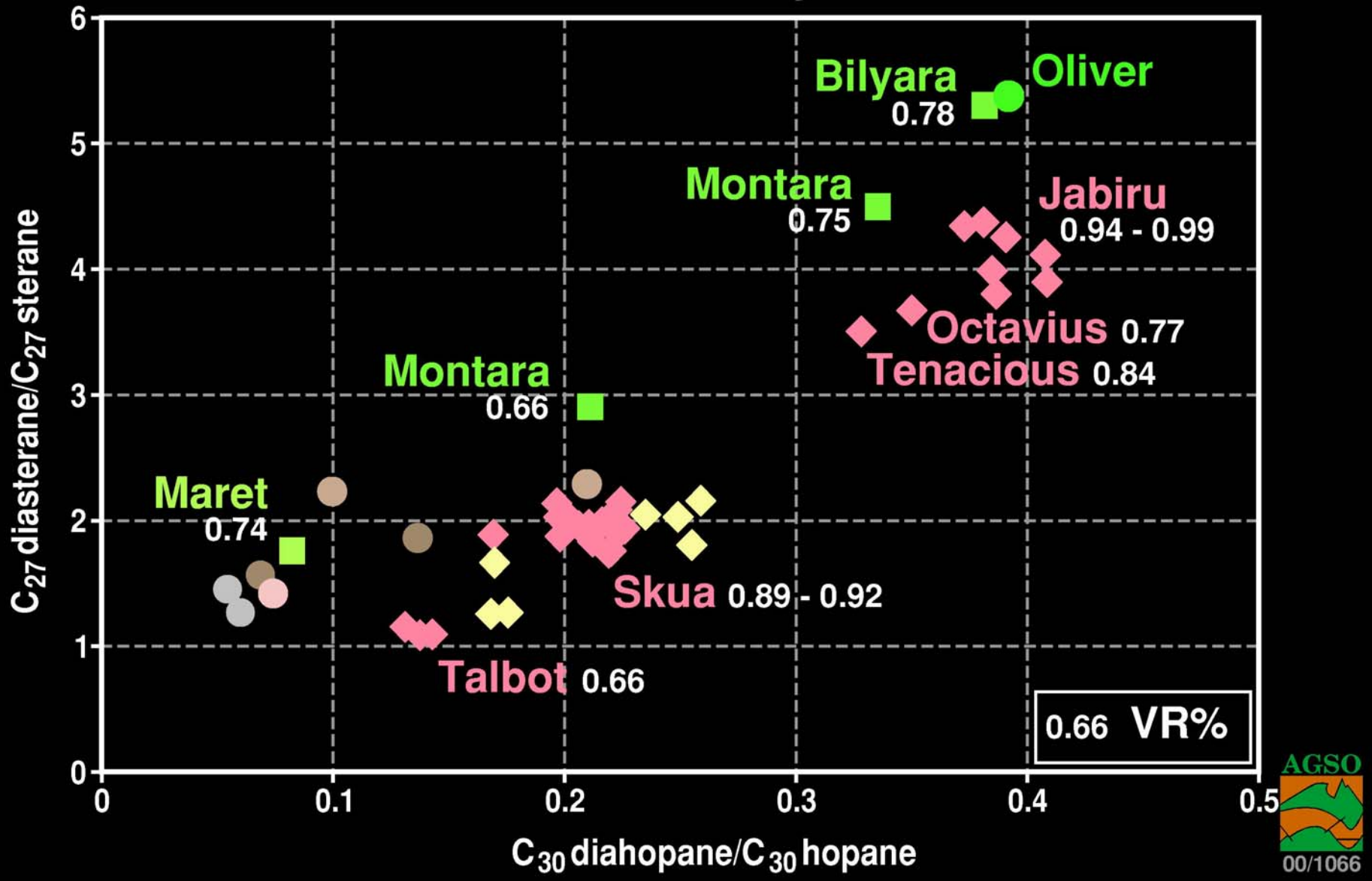
Vulcan Oil Maturity Trends



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Vulcan Oils Summary

- **Family 1 marine oils**
  Jabiru, Challis, Skua, Birch, Talbot, Tenacious
- **Family 2 condensates**
  Swan, East Swan, Eclipse
- **Family 3 marine oils with terrestrial influence**
  Oliver, Bilyara, Montara, Maret
- **Mixtures: Puffin, Pituri oils**

Talk Outline

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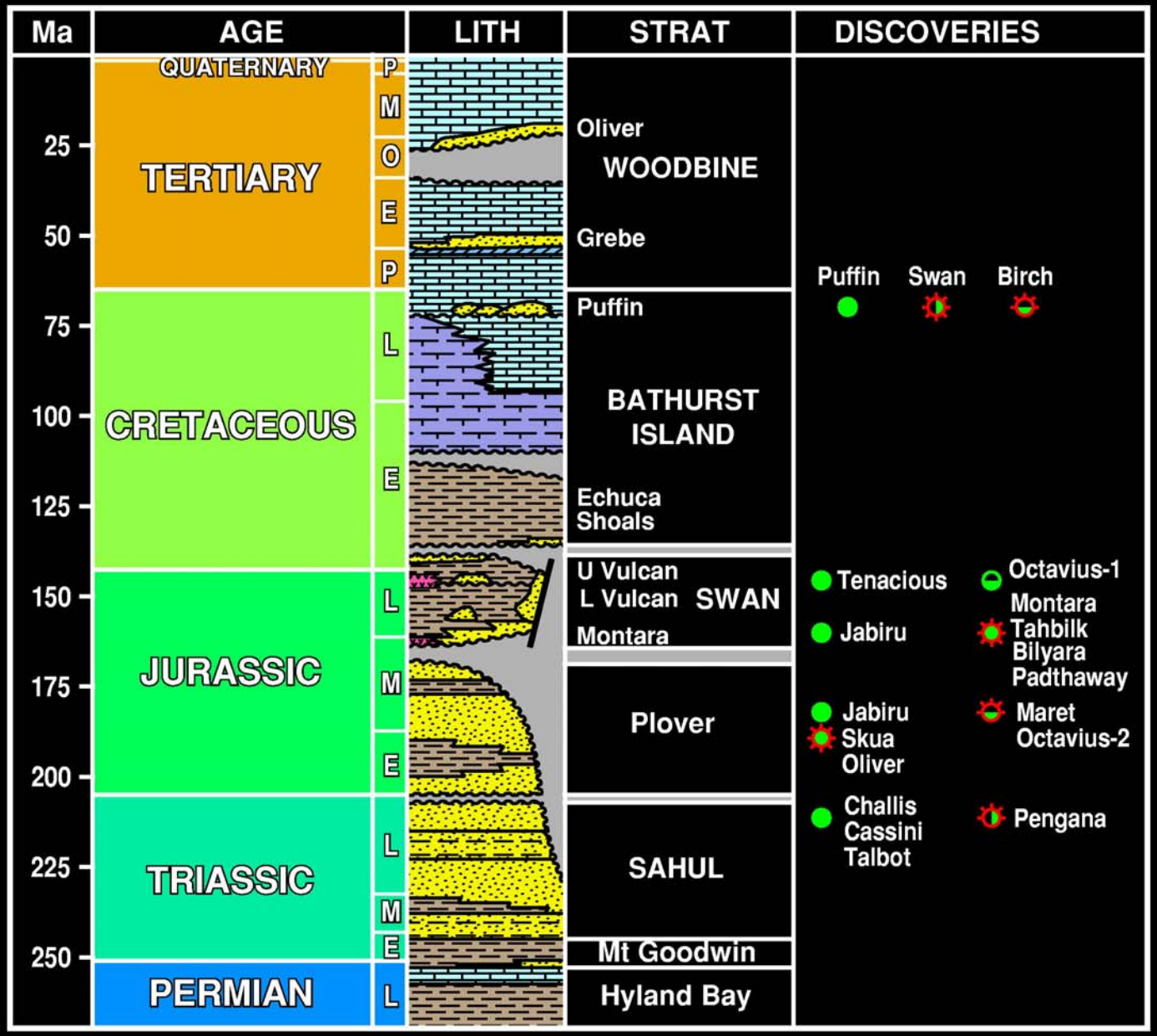

Western Bonaparte Basin

Ashmore Platform Vulcan Sub-basin

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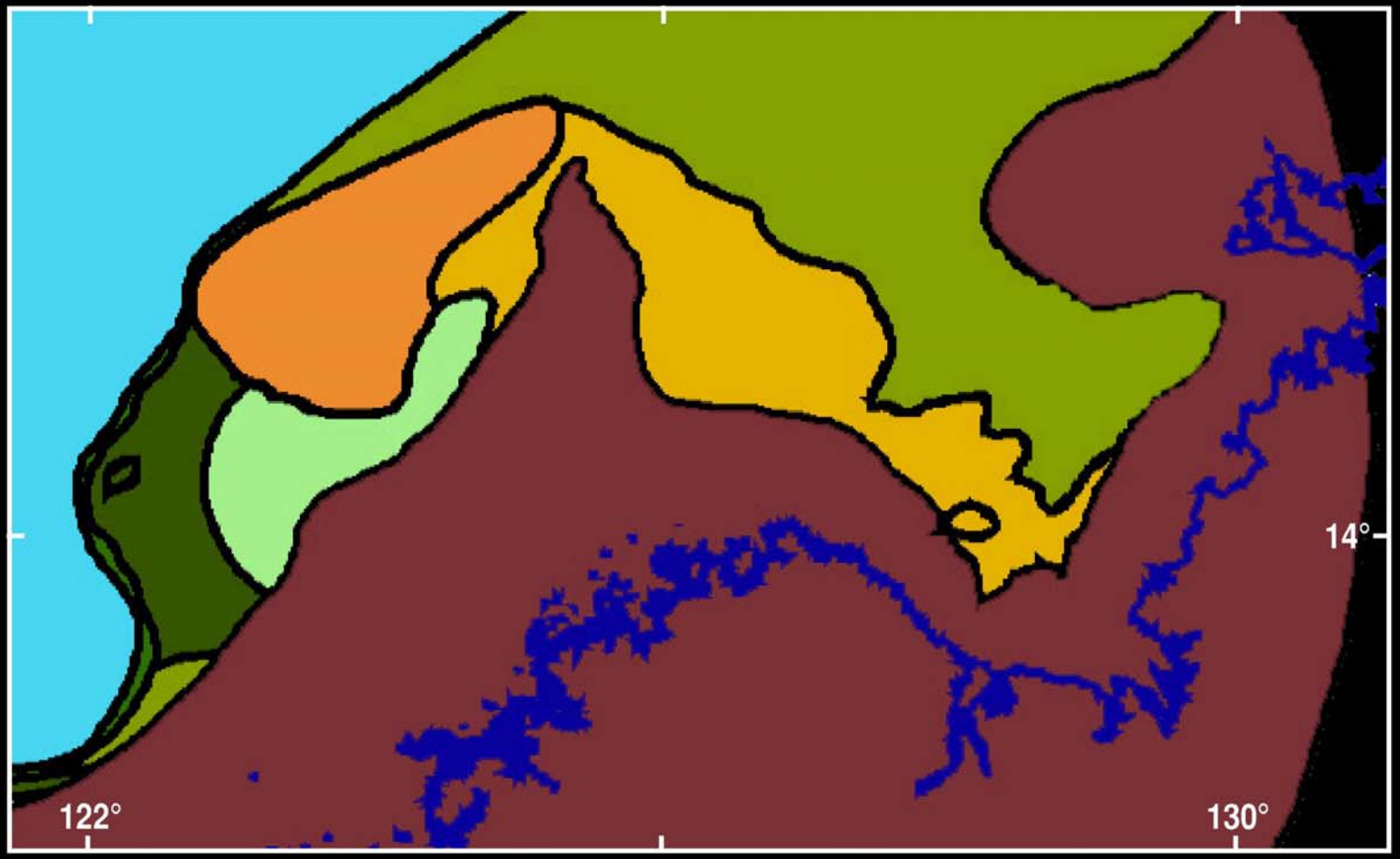
Early Jurassic Paleogeography



Marine - shallow

Coastal - lower delta plain

Coastal - upper delta plain

Coastal - paralic

Land - fluvial

Land - erosional

Land

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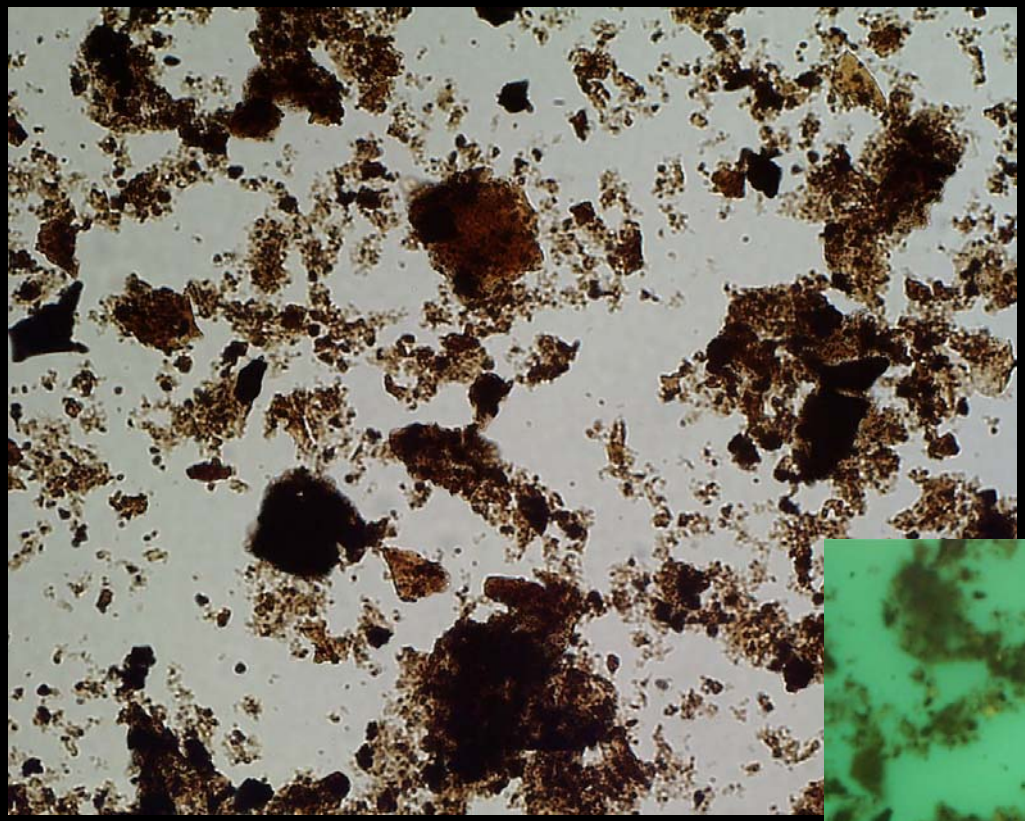
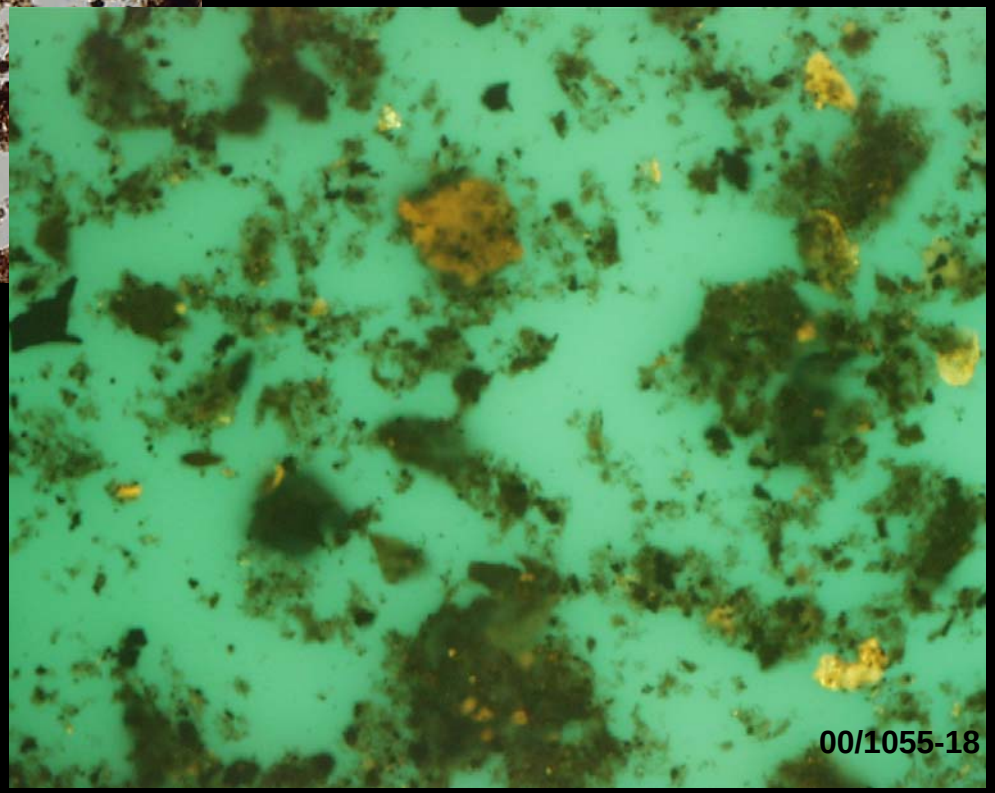
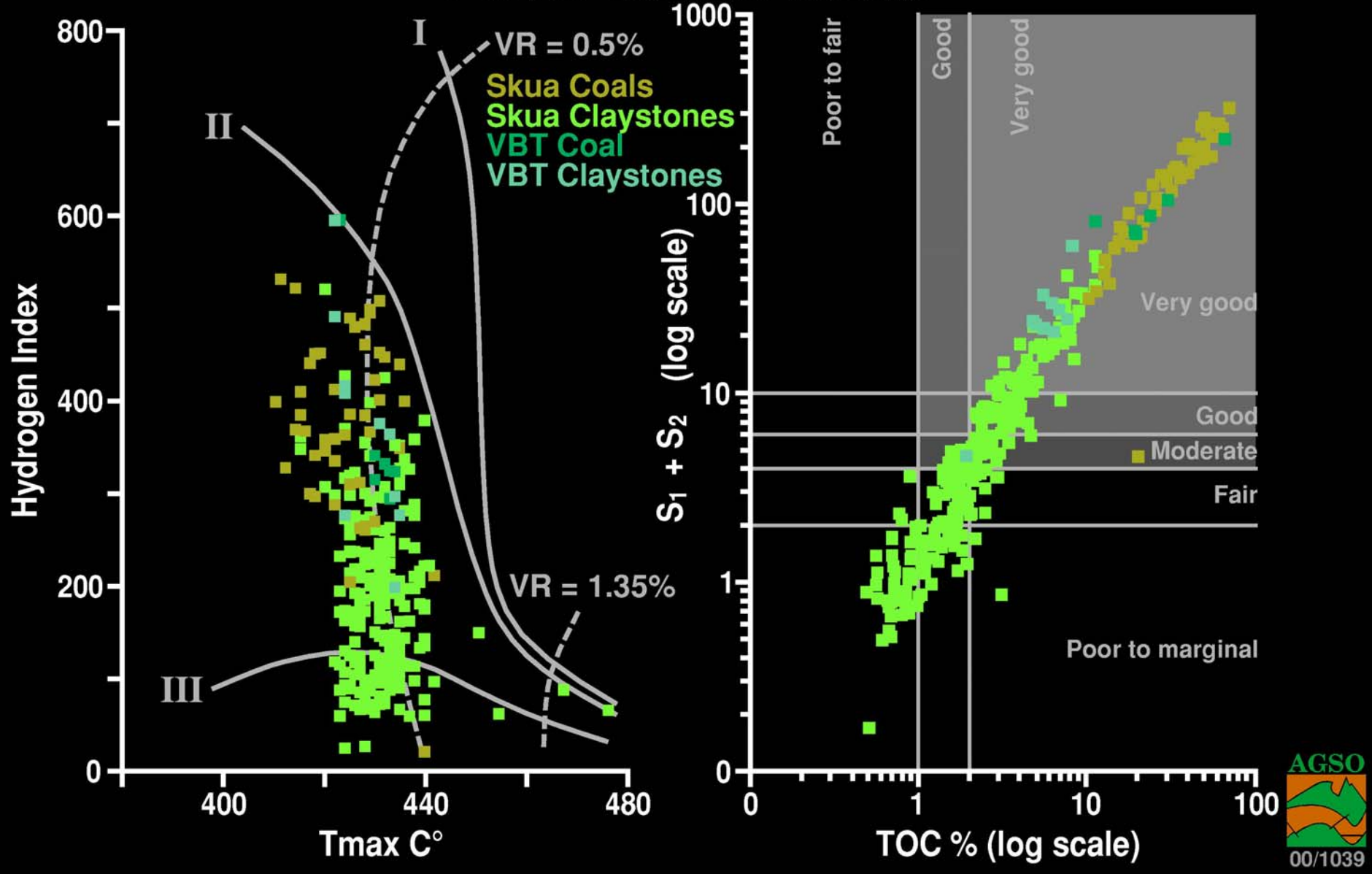


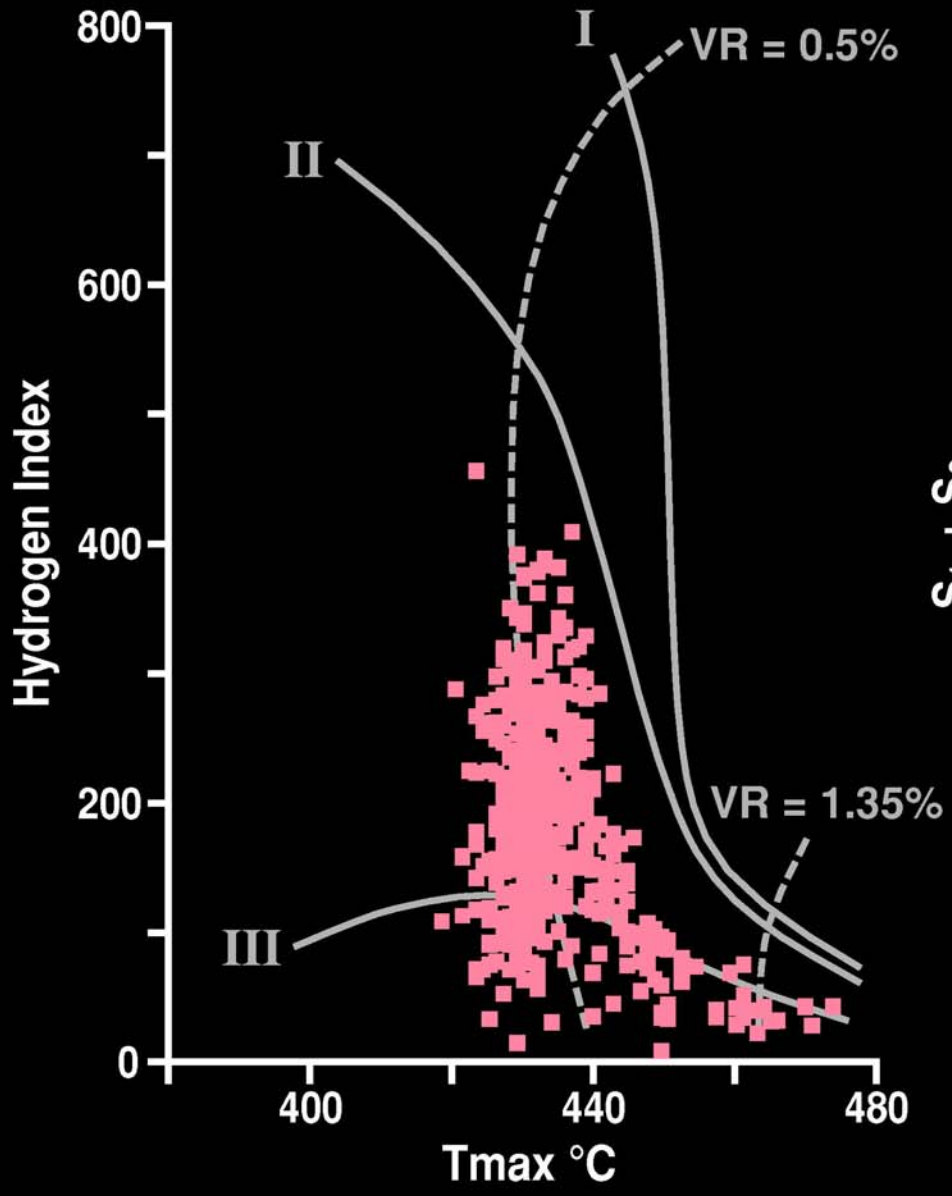
Middle Jurassic: Bajocian
Montara-1 3175.5m swc 225
Plover Fm
D. caddaensis



Plover Source Rocks



Lower Vulcan Source Rocks



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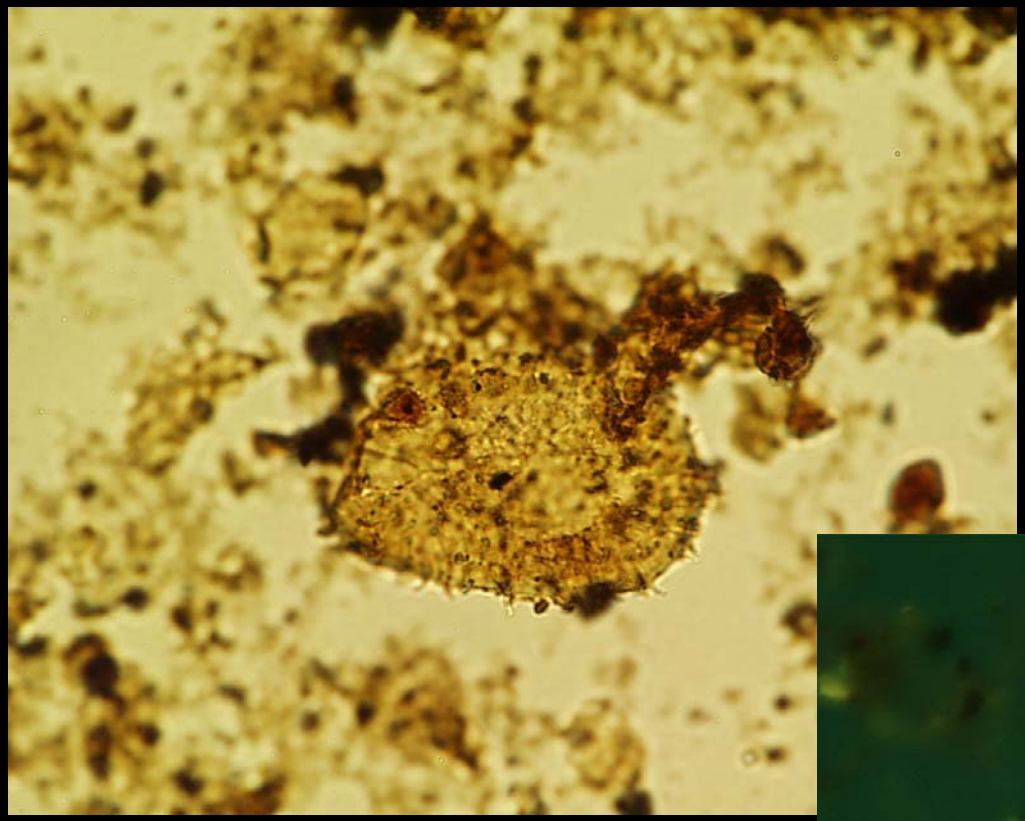
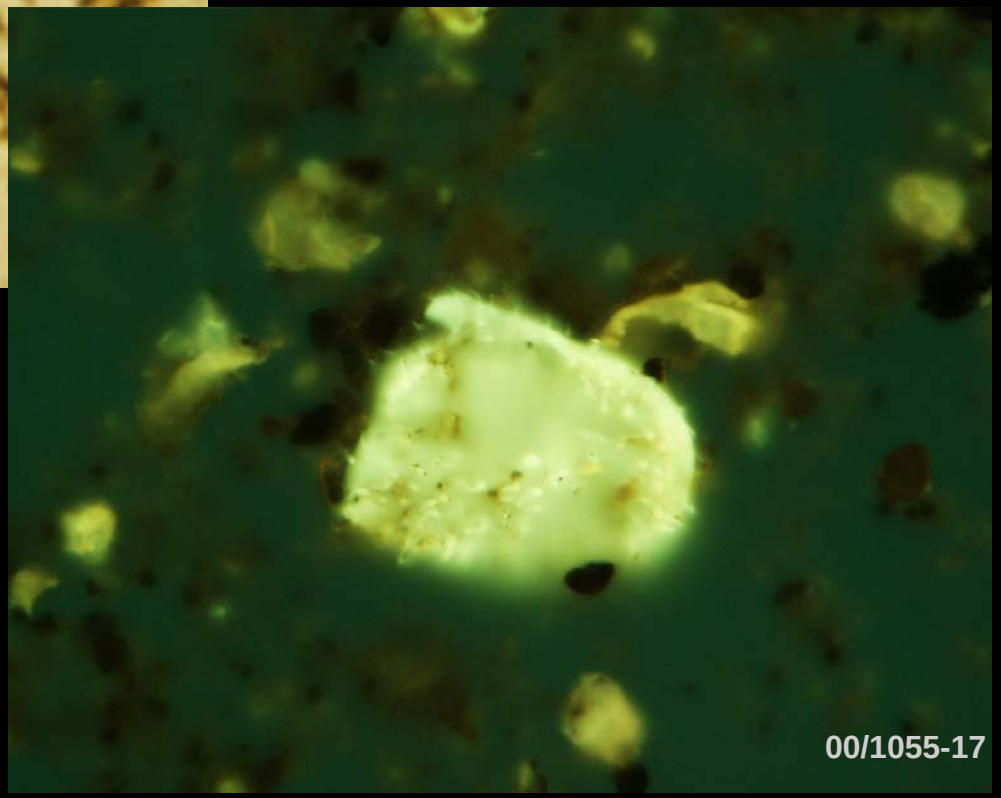
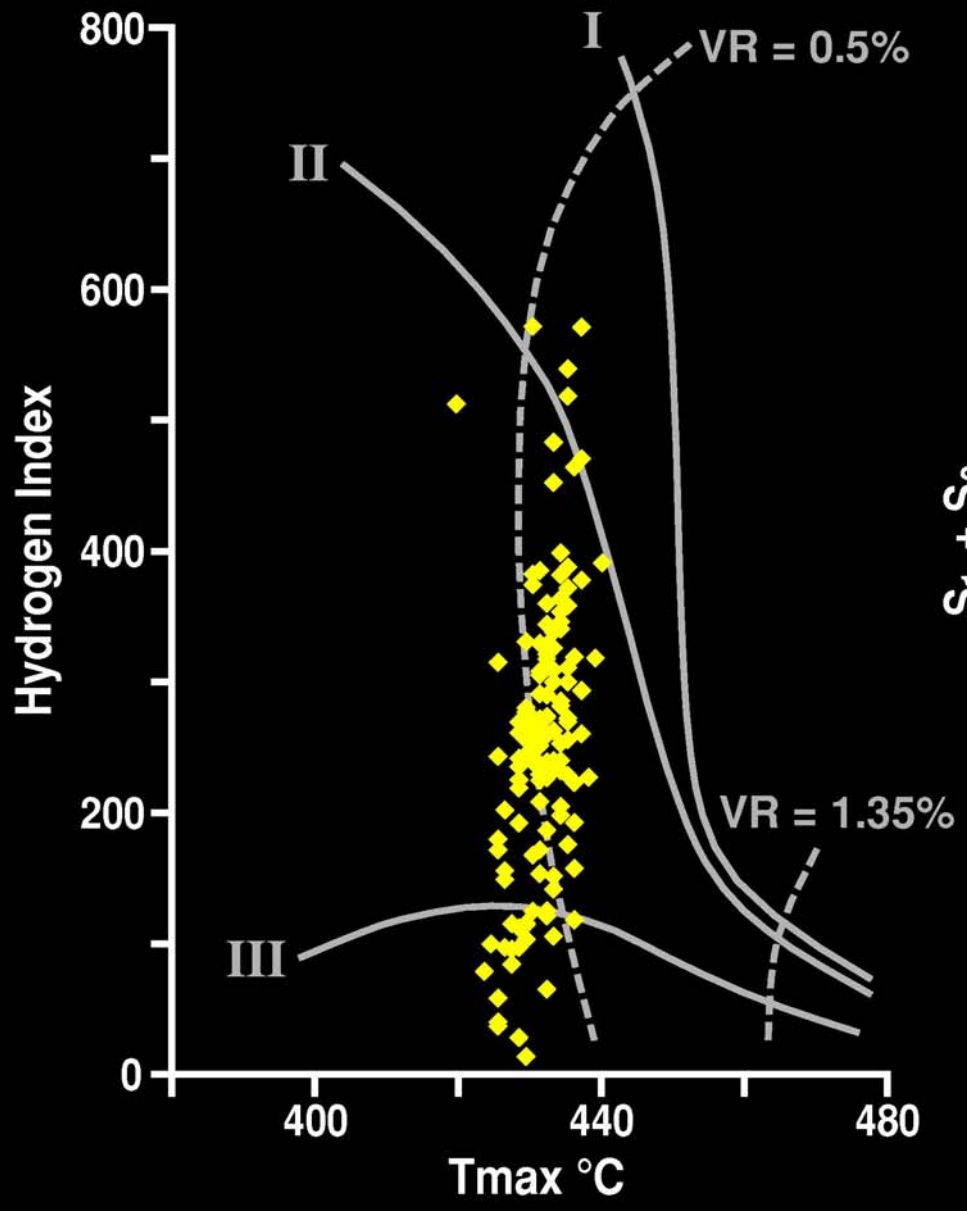
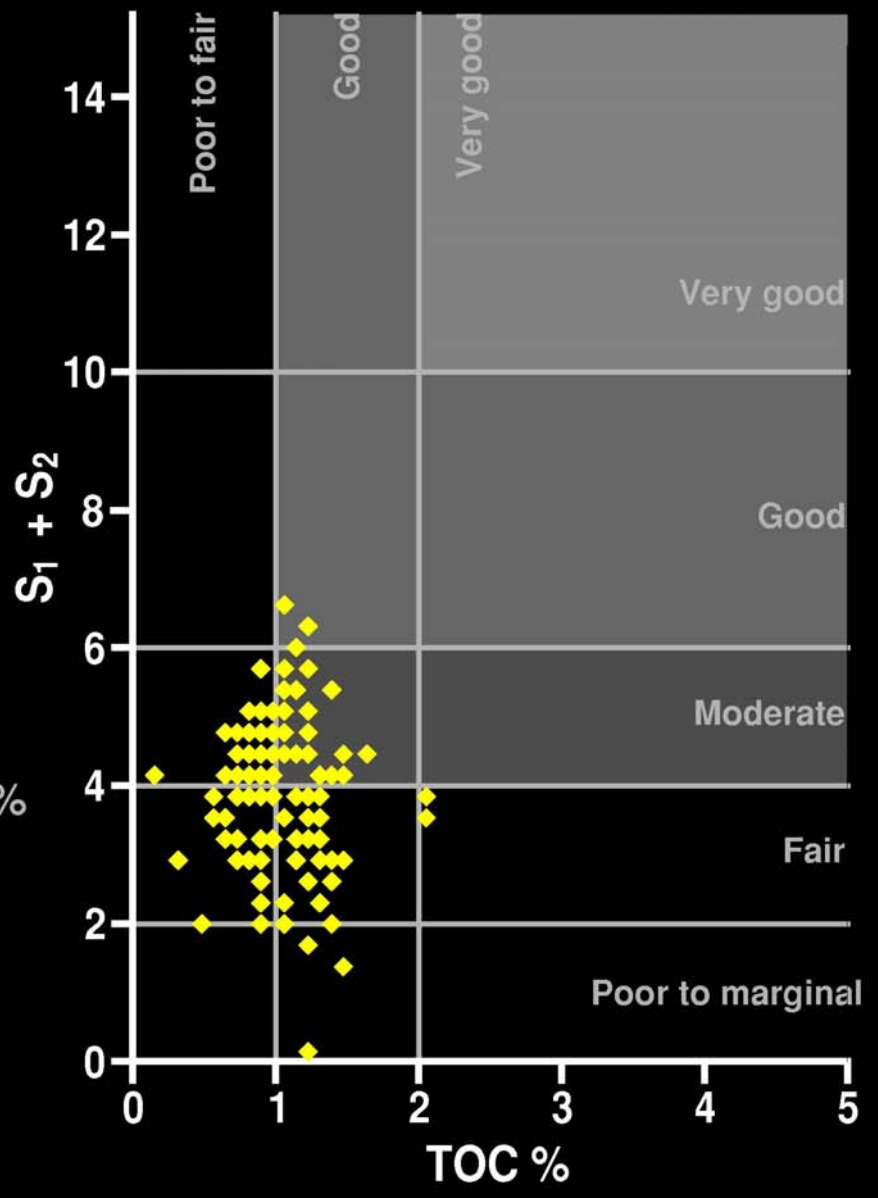


Late Jurassic: Oxfordian
Lower Vulcan Fm
East Swan-2 2328 m swc 40
W. spectabilis



Upper Vulcan Source Rocks





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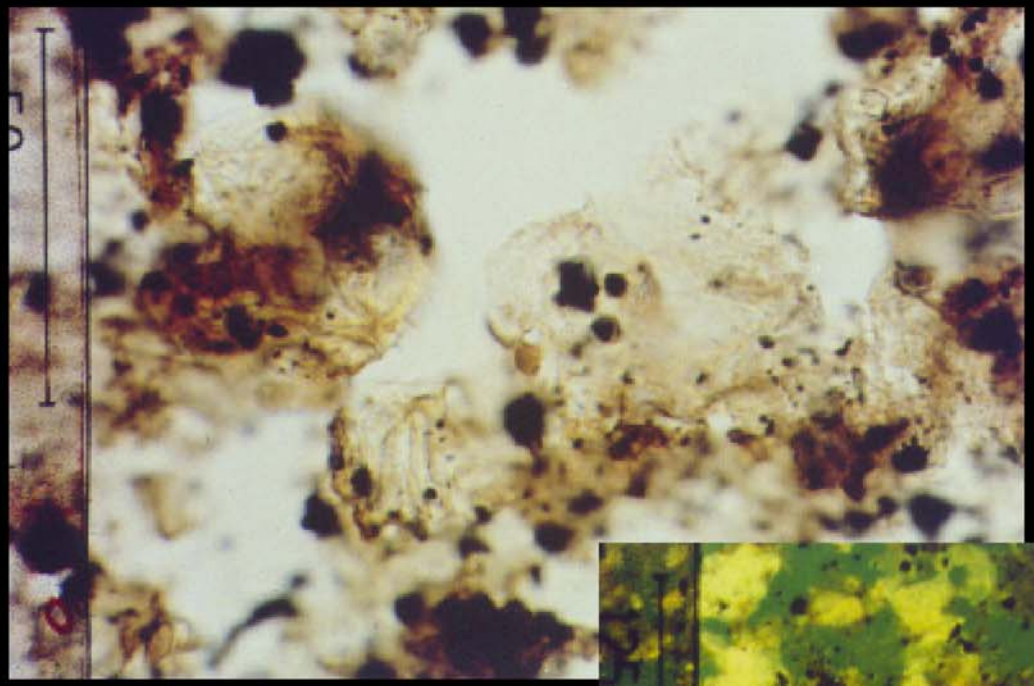

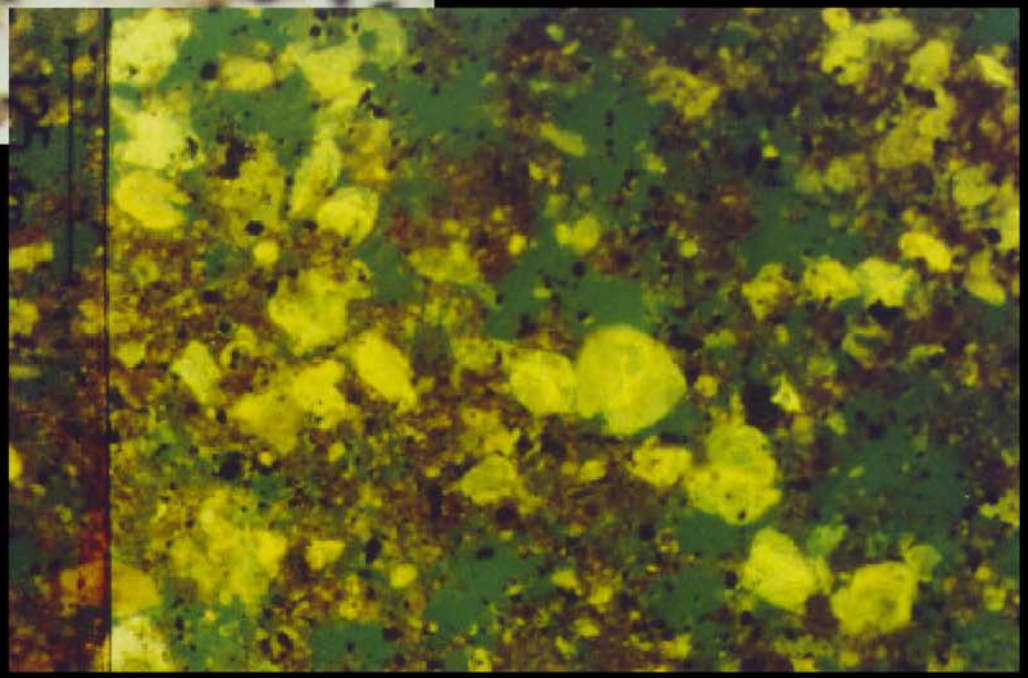

Early Cretaceous Berriasian
Upper Vulcan Fm
Octavius-1: 2566m swc 6
HC potential mod-high

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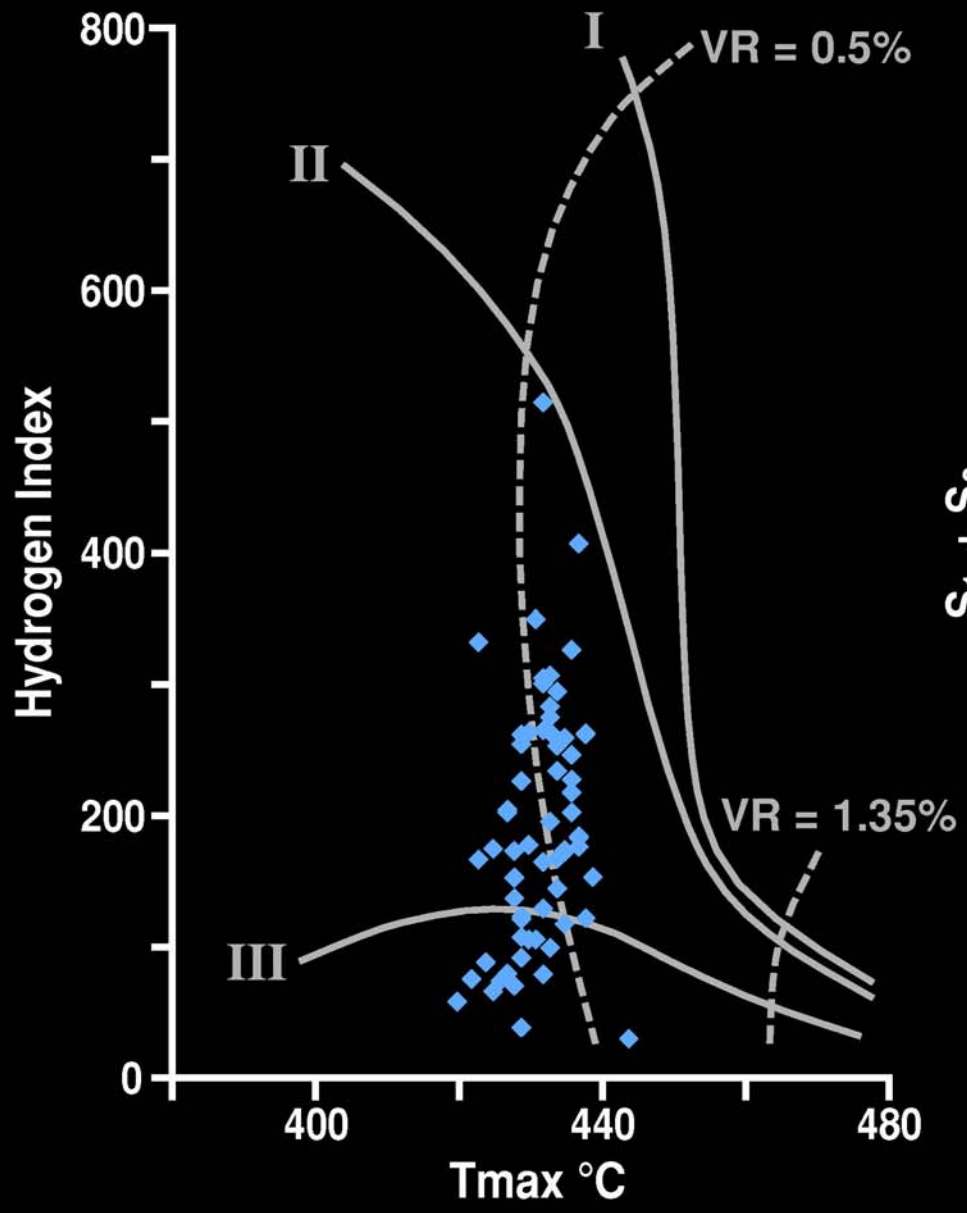
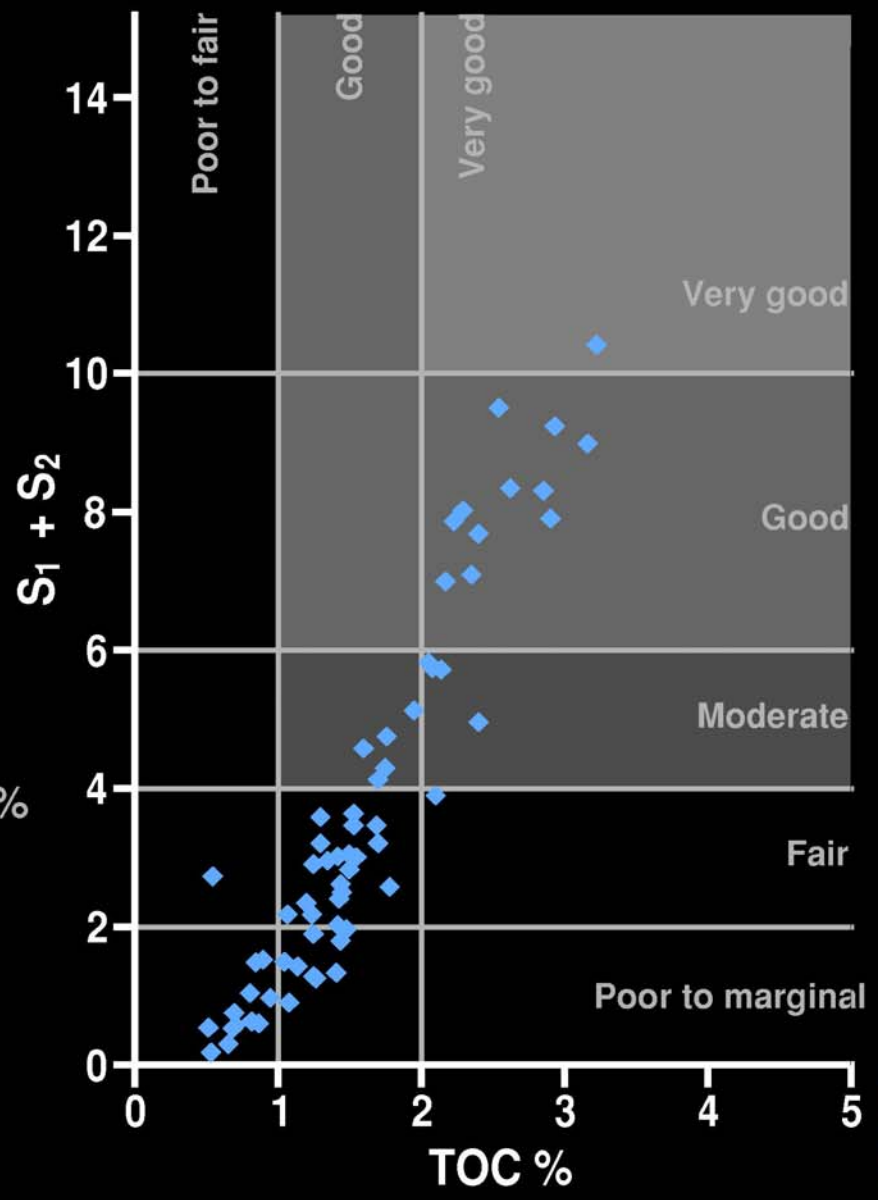
Echuca Shoals Source Rocks





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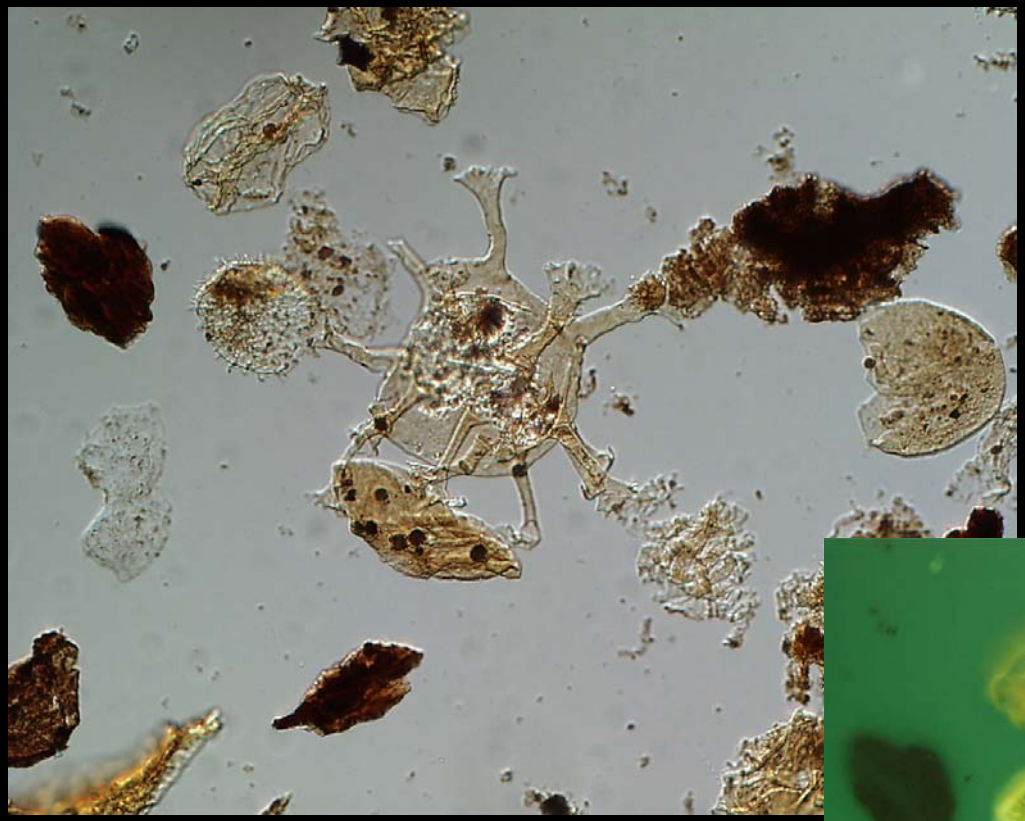
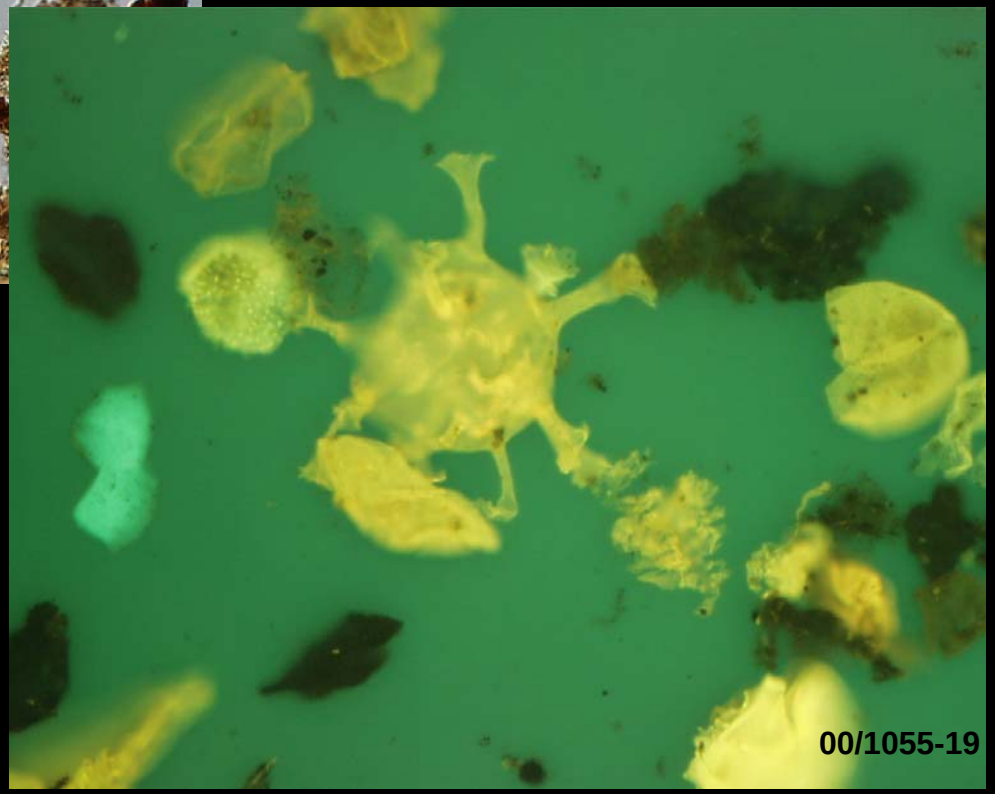


Early Cretaceous: Barremian
Echuca Shoals Fm
Octavius-2: 2460.1m swc 45
M. australis



Source Rock Summary

Mixed Type II/III, oil/gas-prone OM throughout, upward decrease in land-plant influence

- **Echuca Shoals Fm: marine, immature**
- **Upper Vulcan: marine, immature, limited extent**
- **Lower Vulcan Fm: marine, mature**
  TOC = 2%, HI = 250
- **Plover Fm: marine + land-plant, mature**
  shales av TOC = 2%, HI = 200
  coals av TOC = 35% HI = 400

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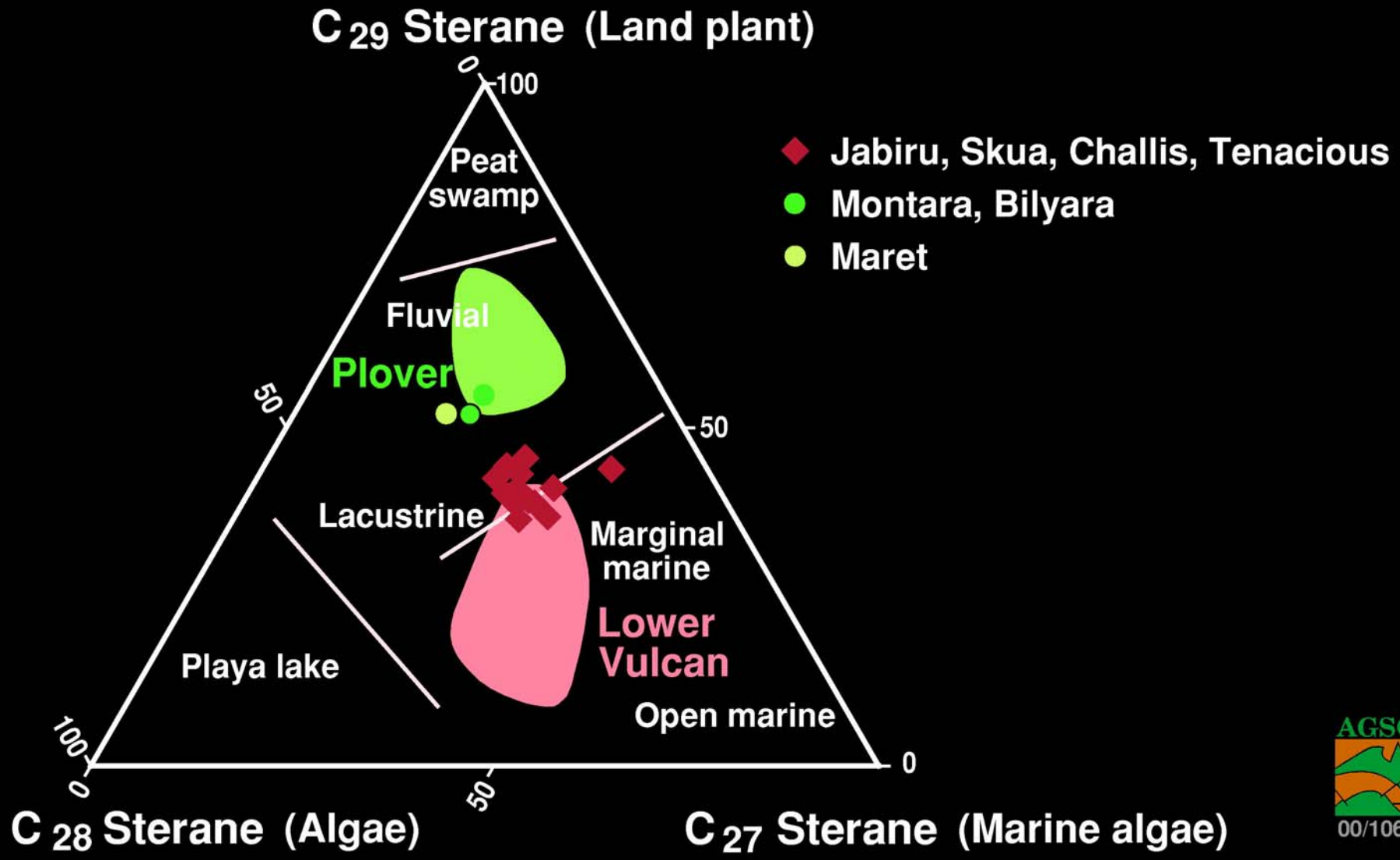
Diasterane Distribution Vulcan oils and Source Rocks



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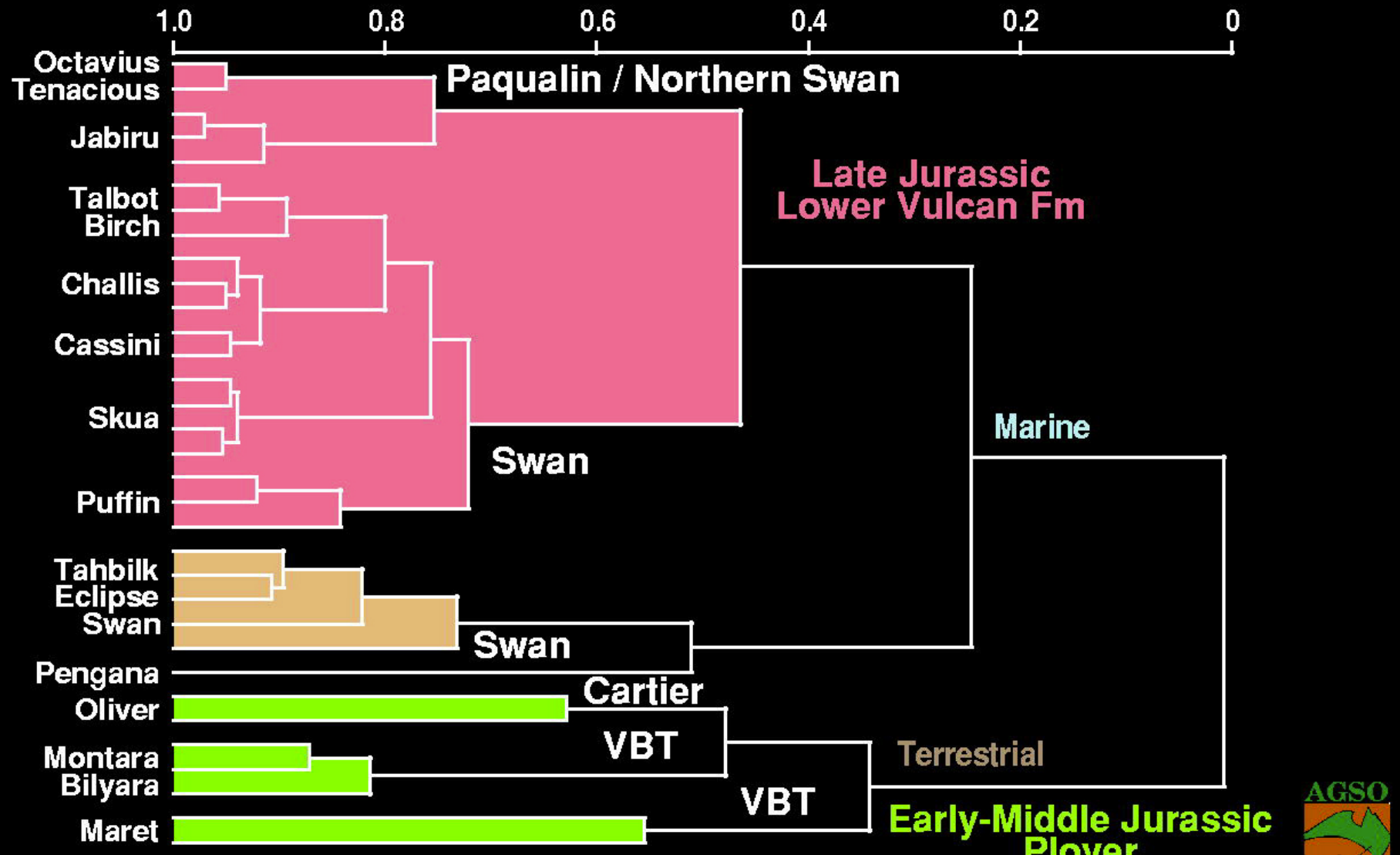
Vulcan Sub-basin Oil Families



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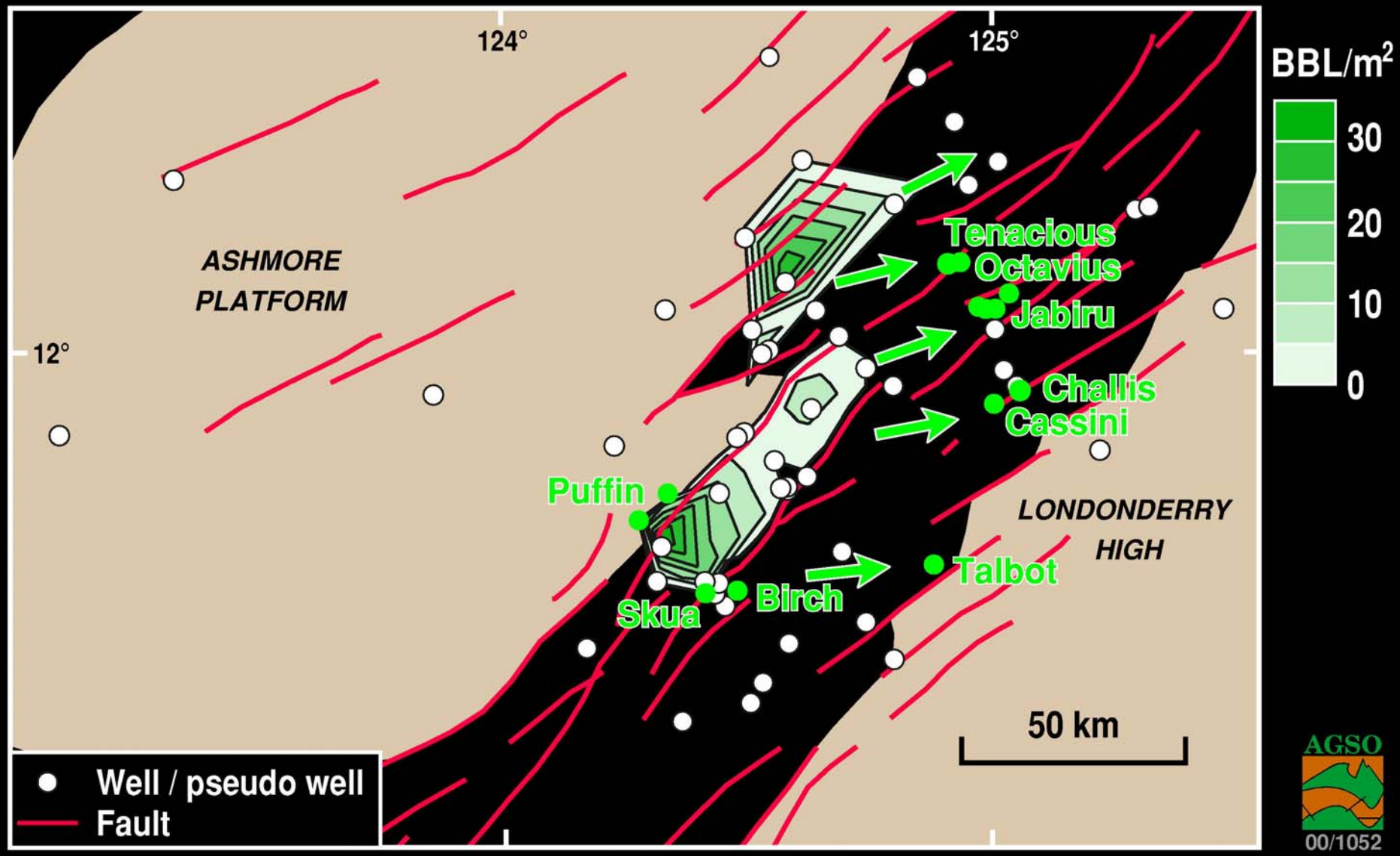
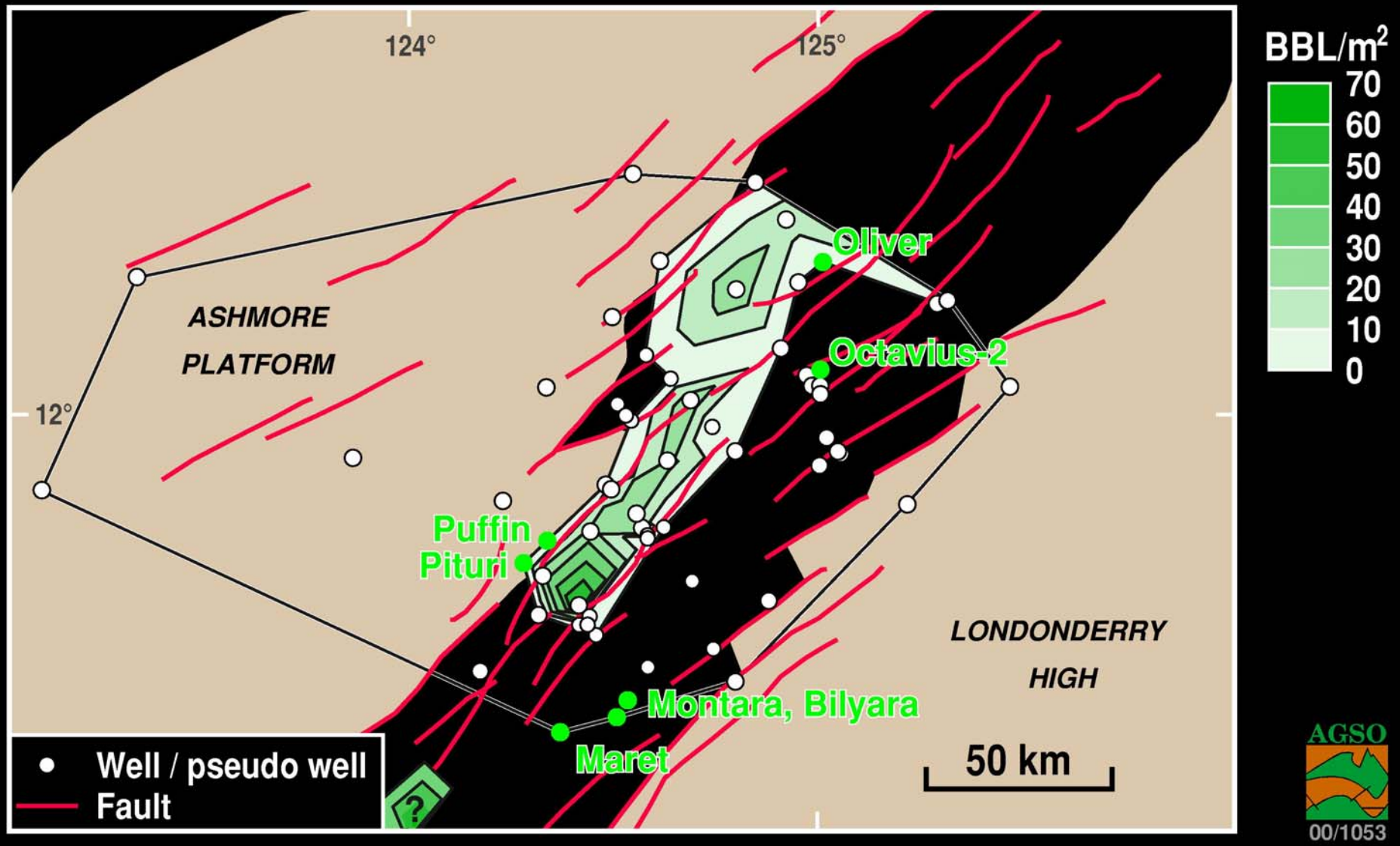
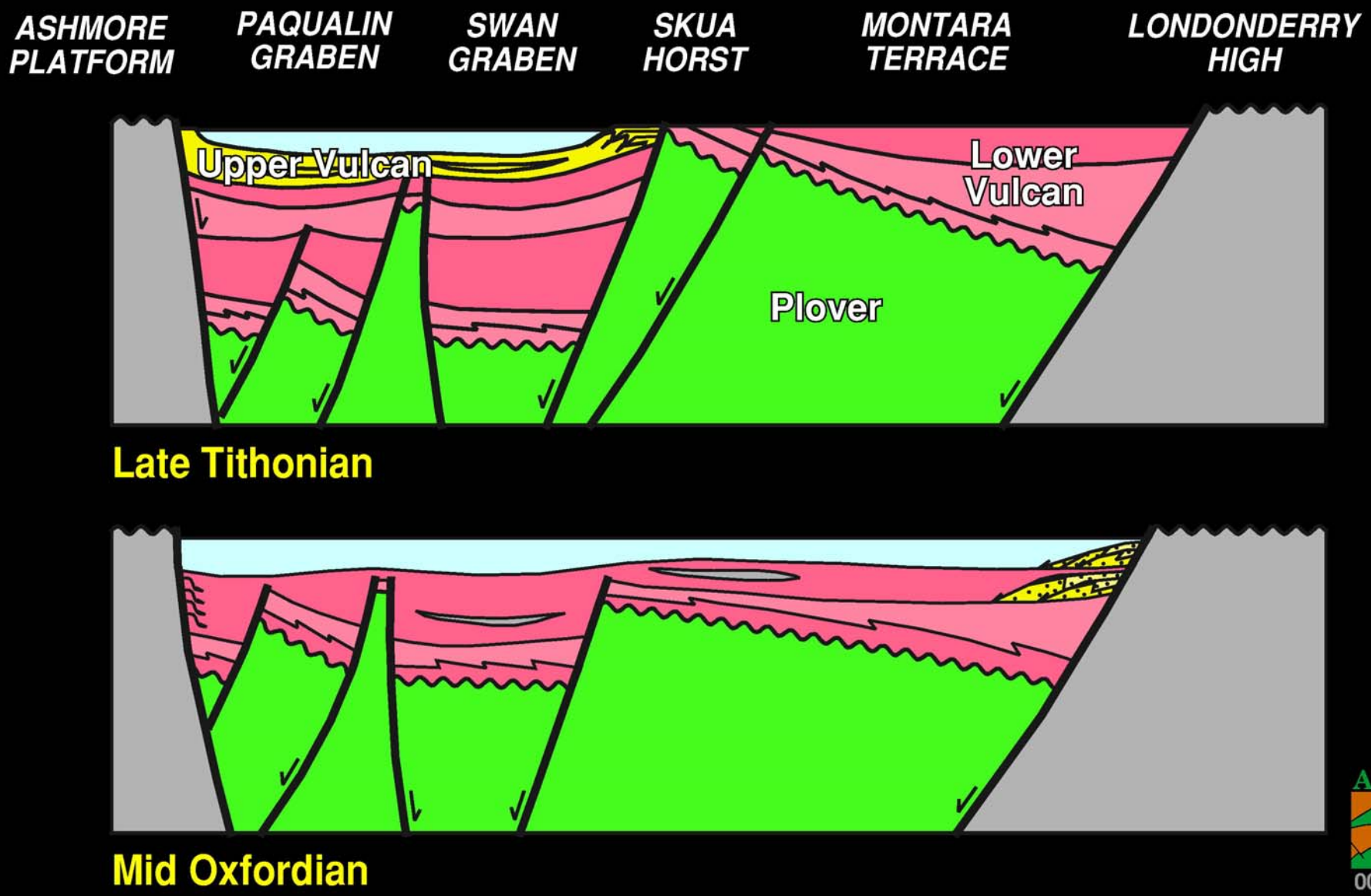
Expelled Oil - Vulcan Fm



Expelled Oil - Plover Fm




ASHMORE PLATFORM
PAQUALIN GRABEN
SWAN GRABEN
SKUA HORST
MONTARA TERRACE
LONDONDERRY HIGH
Upper Vulcan
Lower Vulcan
Plover
Late Tithonian
Mid Oxfordian
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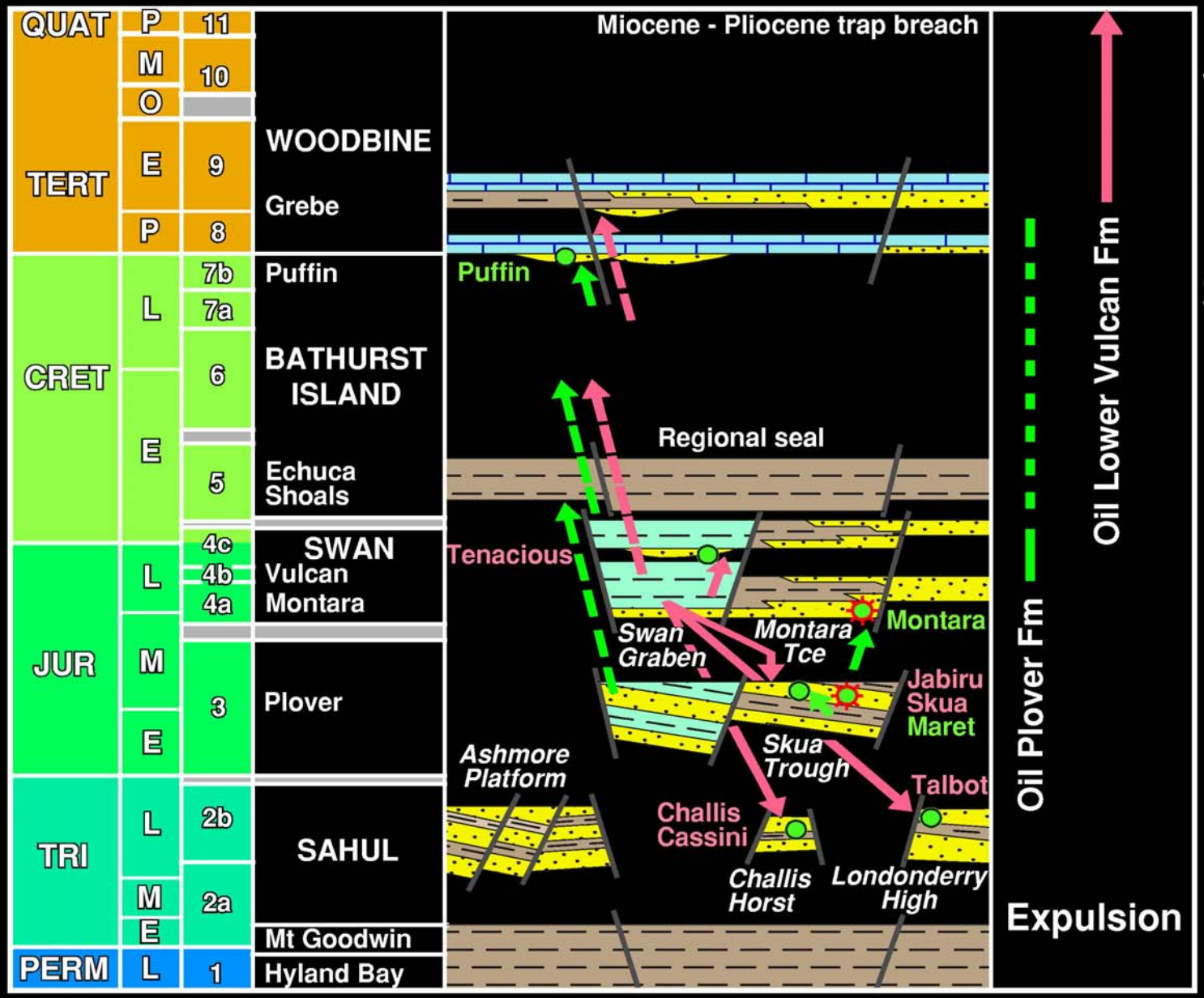
Vulcan Mesozoic Petroleum Systems



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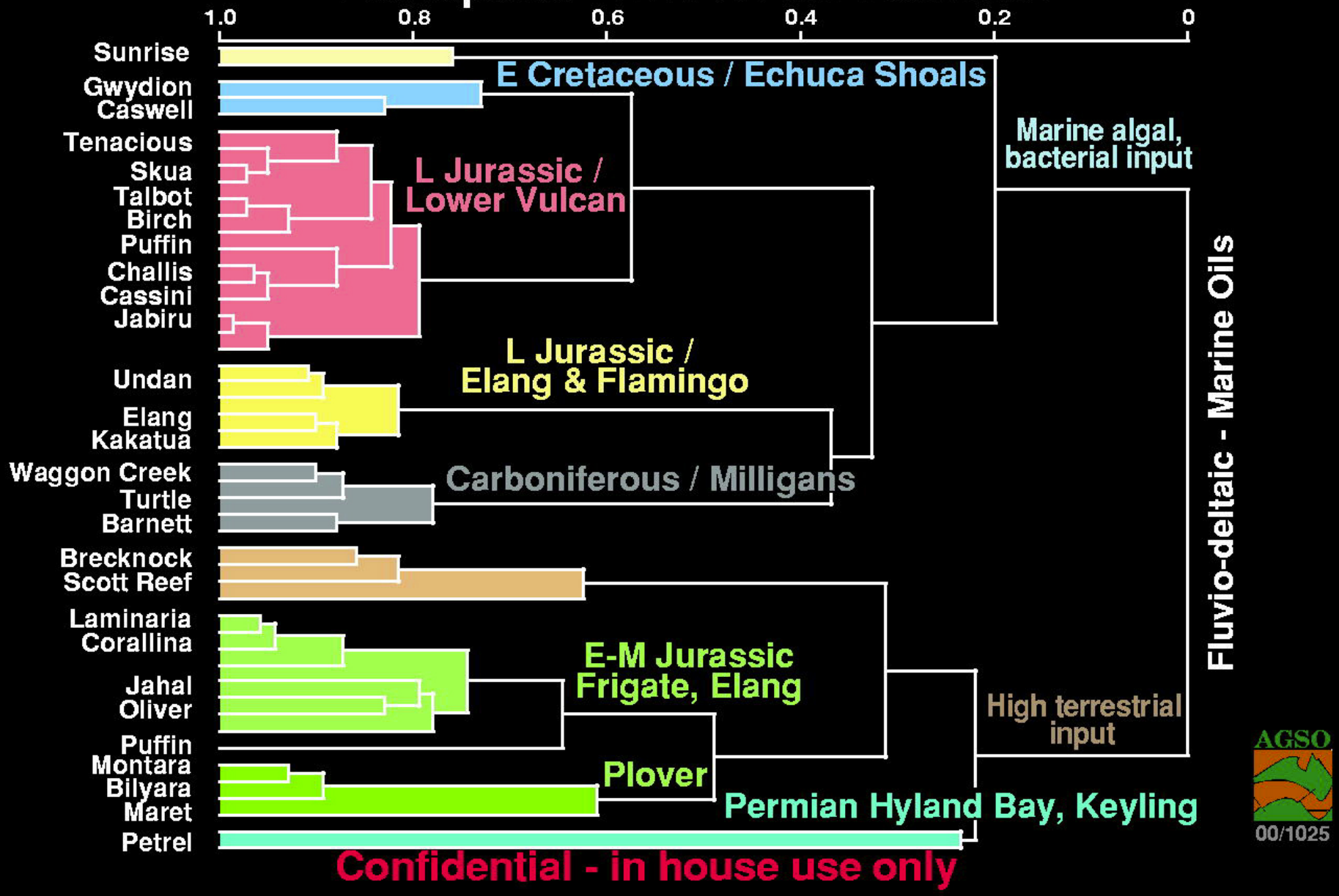
Bonaparte-Browse Oil Families



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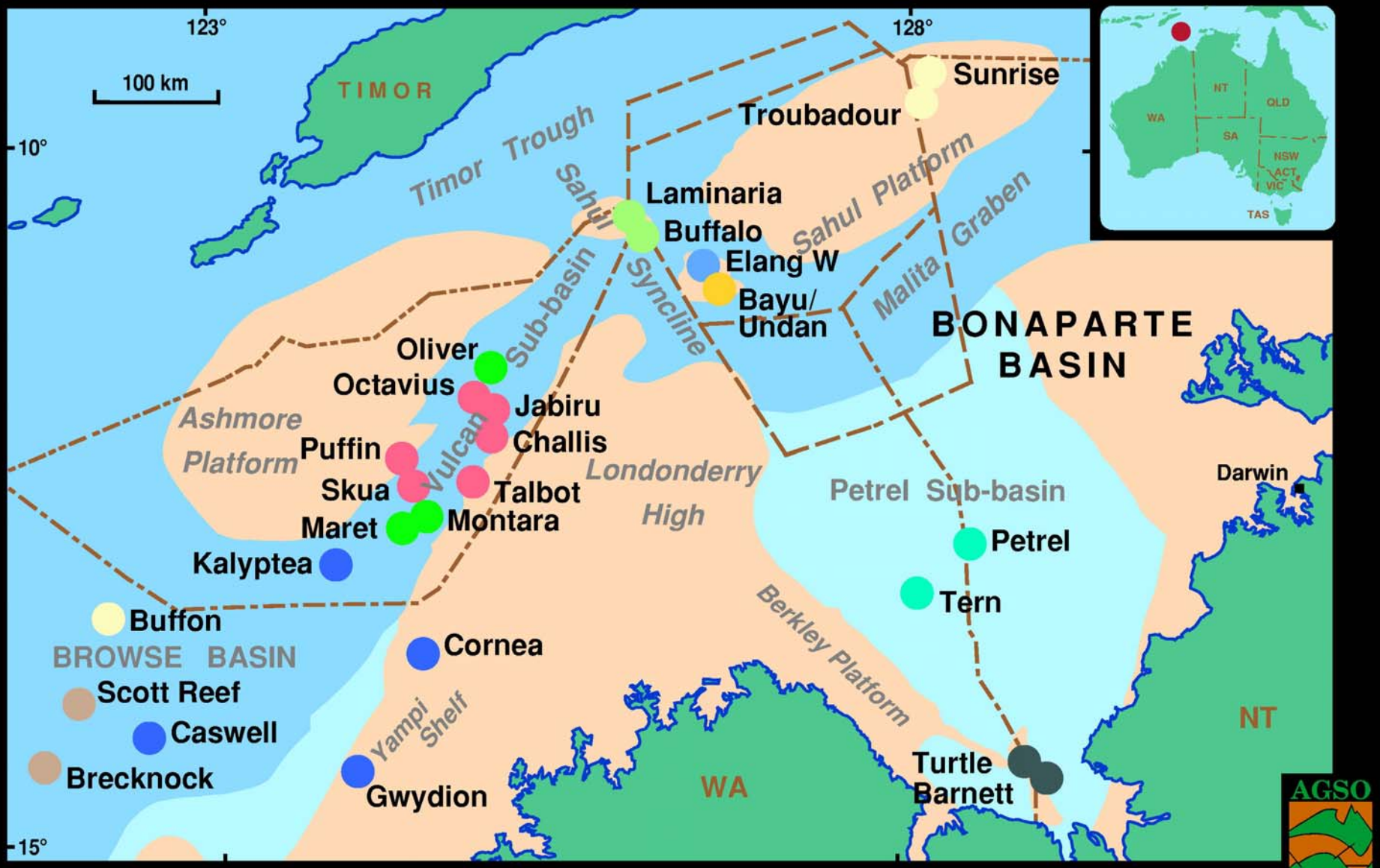
123°
128°
10°
15°
100 km
TIMOR
Timor Trough
Sahul Sub-basin
Sahul Syncline
Sahul Platform
Malita Graben
Sunrise
Troubadour
Laminaria
Buffalo
Elang W
Bayu/
Undan
BONAPARTE
BASIN
Oliver
Octavius
Jabiru
Challis
Vulcan
Ashmore
Platform
Puffin
Skua
Talbot
Maret
Montara
Kalyptea
Londonderry
High
Petrel Sub-basin
Petrel
Tern
Darwin
Berkley Platform
Buffon
BROWSE BASIN
Scott Reef
Caswell
Brecknock
Cornea
Yampi
Shelf
Gwydion
WA
NT
Turtle
Barnett
WA
NT
QLD
SA
NSW
ACT
VIC
TAS
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Conclusions

- Late Jurassic Lower Vulcan sourced economic oil accumulations
- Early-Middle Jurassic Plover Fm sourced oils in Bonaparte (Oliver, Laminaria), Browse (Maret)
- Early Cretaceous Echuca Shoals sourced oils in northern Bonaparte (Elang West) and Browse (Caswell, Cornea)

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Conclusions

- Early-Middle Jurassic Plover Fm least understood petroleum system
- Very good source potential
- Many, inhomogeneous source units
- Sourced oils in the Vulcan, Flamingo/Sahul Syncline, Browse
- Further undiscovered potential

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