



Petroleum Exploration Initiatives



Petroleum Geochemistry of GSWA Barrabiddy 1A, Gascoyne Platform, Carnarvon Basin, Western Australia

K. Ameen R. Ghori

World-Wide Upper Devonian Source

North America

- Chattanooga & Ohio Shales, Appalachian, Ohio; Woodford Shale, Anadarko, Oklahoma; Antrim Shale, Michigan; Bakken Formation, Illinois; New Albany Shale, Williston

South America

- Tomachi Formation, Madre de Dios, Bolivia

Africa

- Upper Devonian Shale, Illizi & Gadammas basin

Regional Upper Devonian Source

Larapintine 3 Petroleum System

Canning Basin

- Gogo Formation, Calcareous Mudstone
- Mellinjerie Formation

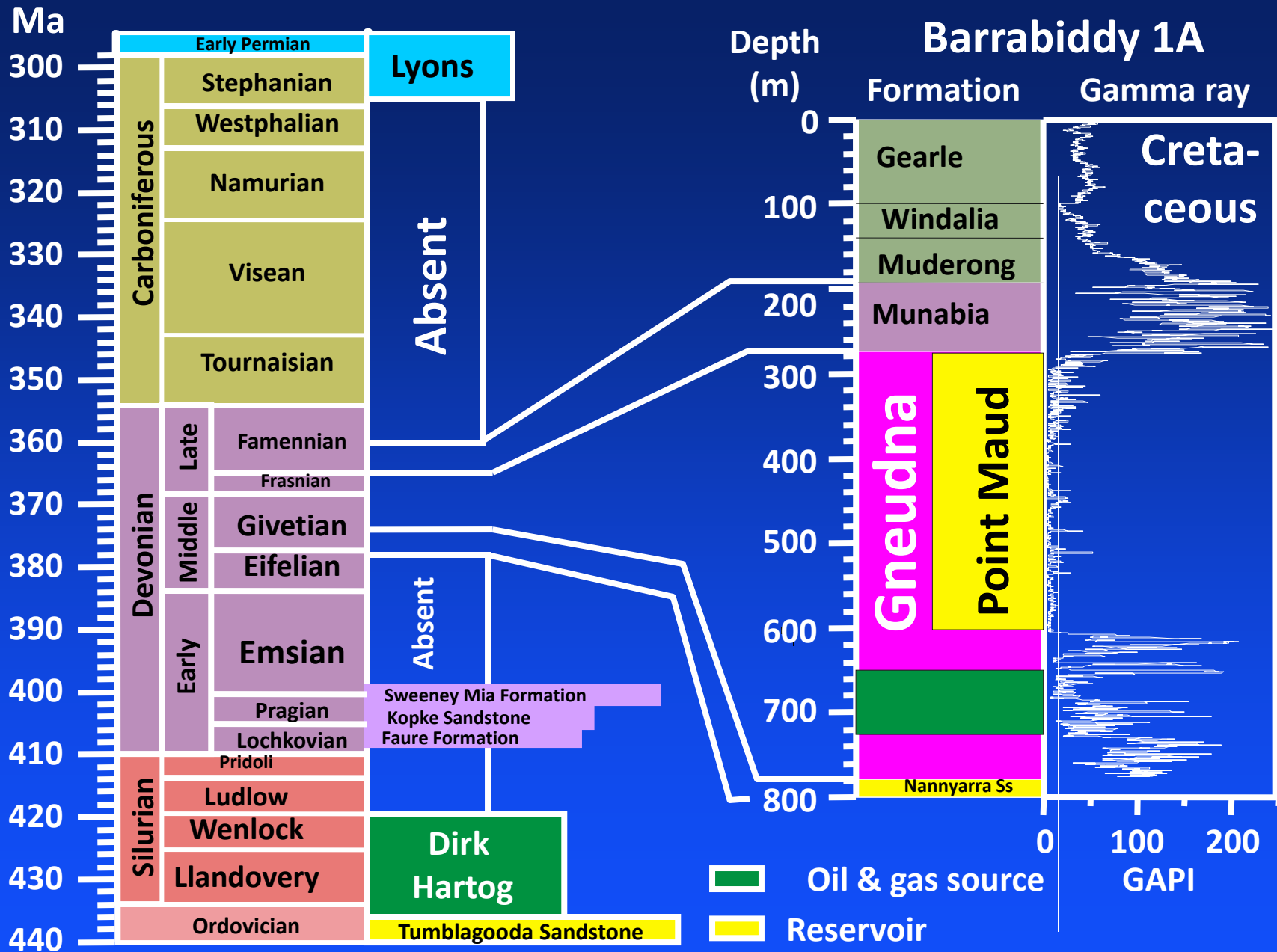
Petrel Sub-basin

- Bonaparte Formation

Arafura Basin

- Organic-rich Shale

Stratigraphy



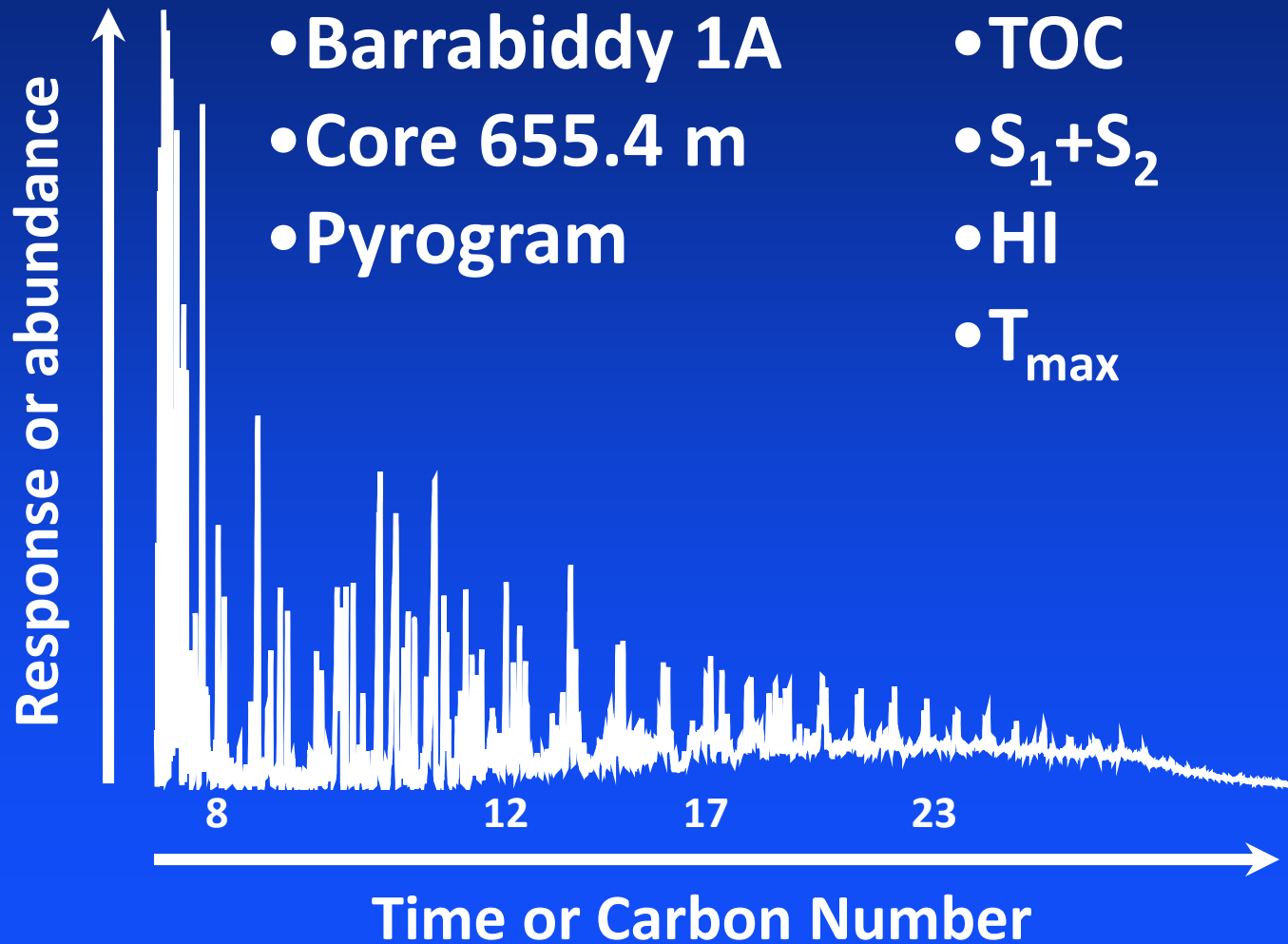
Geochemistry Database

- Total Organic Carbon = 42
- Rock-Eval Pyrolysis = 19
- Pyrolysis-Gas Chromatography = 5
- Extract-Gas Chromatography = 5
- Organic Petrology = 4
- Apatite Fission Track Analysis = 3

Source Characteristics

Core TOC (m)	S ₁ +S ₂ (%)	HI (mg/g)	T _{max} (°C)	
655.4	9.88	22.80	198	444
678.2	5.22	12.44	207	444
679.2	13.56	40.09	267	443
705.5	7.53	17.16	194	446
713.4	5.78	10.85	156	448

Pyrolysis-GC Kerogen Typing



- Barrabiddy 1A
- Core 655.4 m
- Pyrogram

- TOC = 9.9%
- S_1+S_2 = 22.8 mg/g
- HI = 198
- T_{max} = 44°C

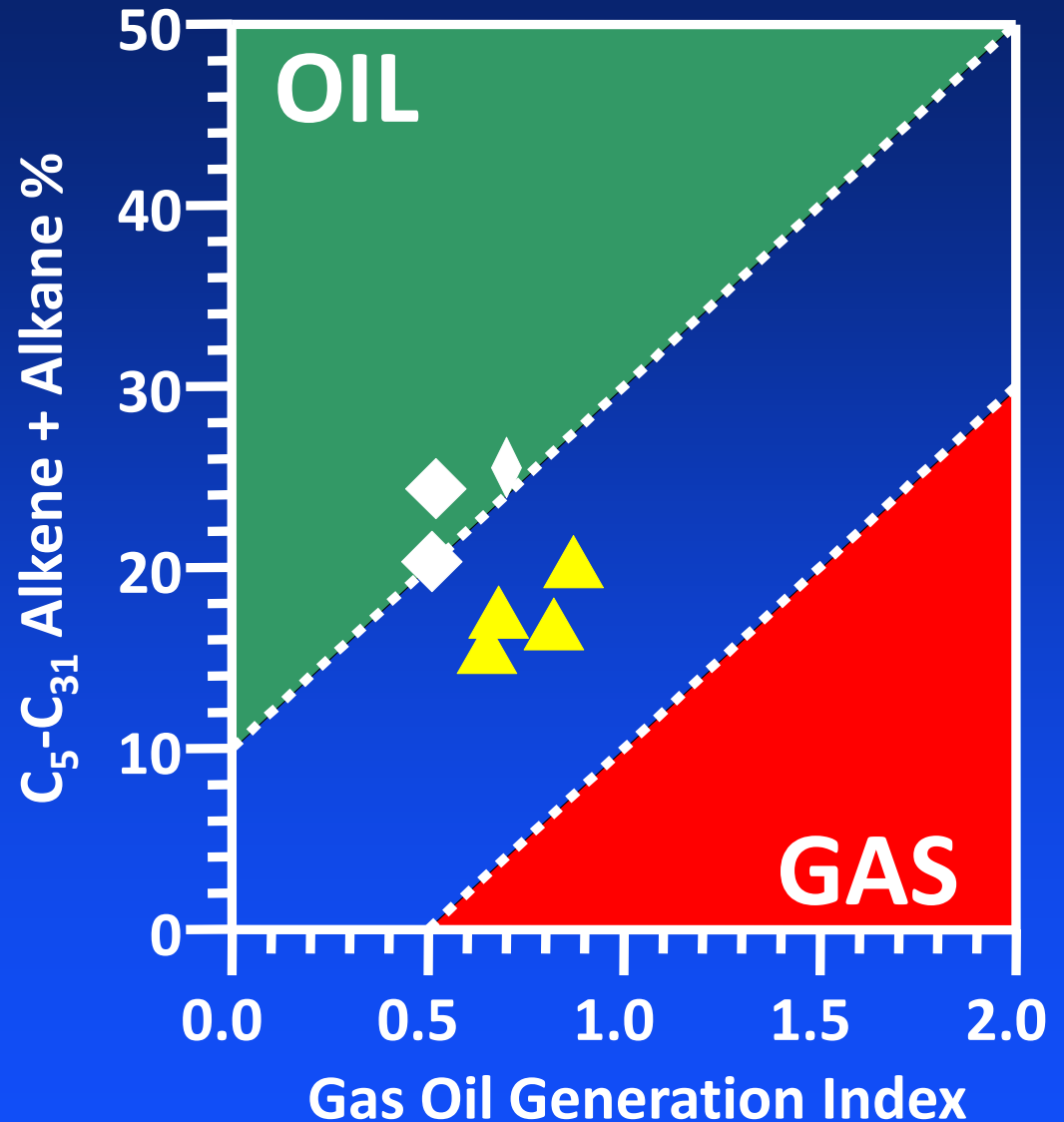
Pyrolysis-GC Kerogen Typing

Upper Devonian
Gneudna Fm

▲ Barrabiddy 1A

◆ Gneudna 1

◆ Uranerz CDH 8

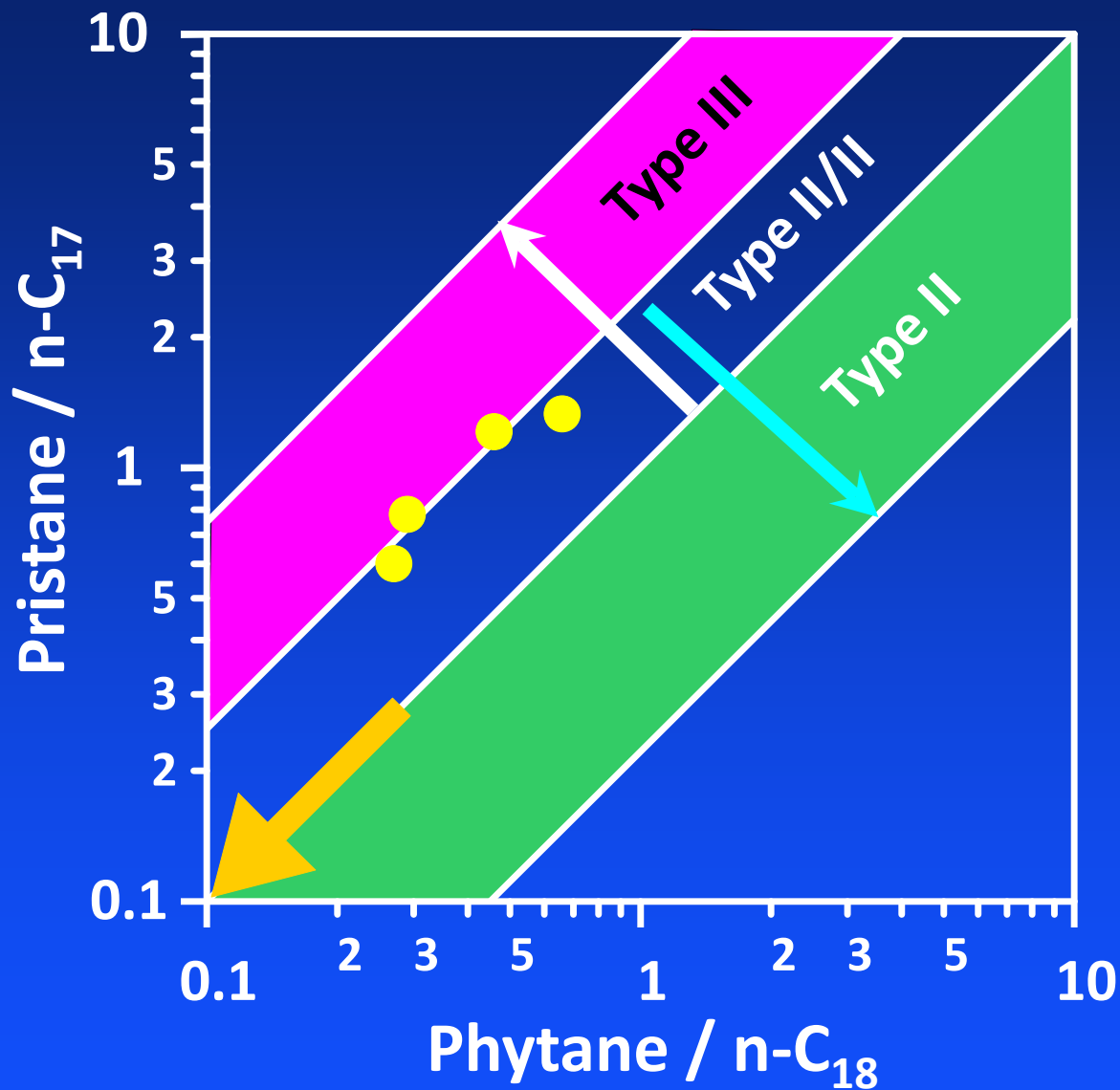


Source Characteristics

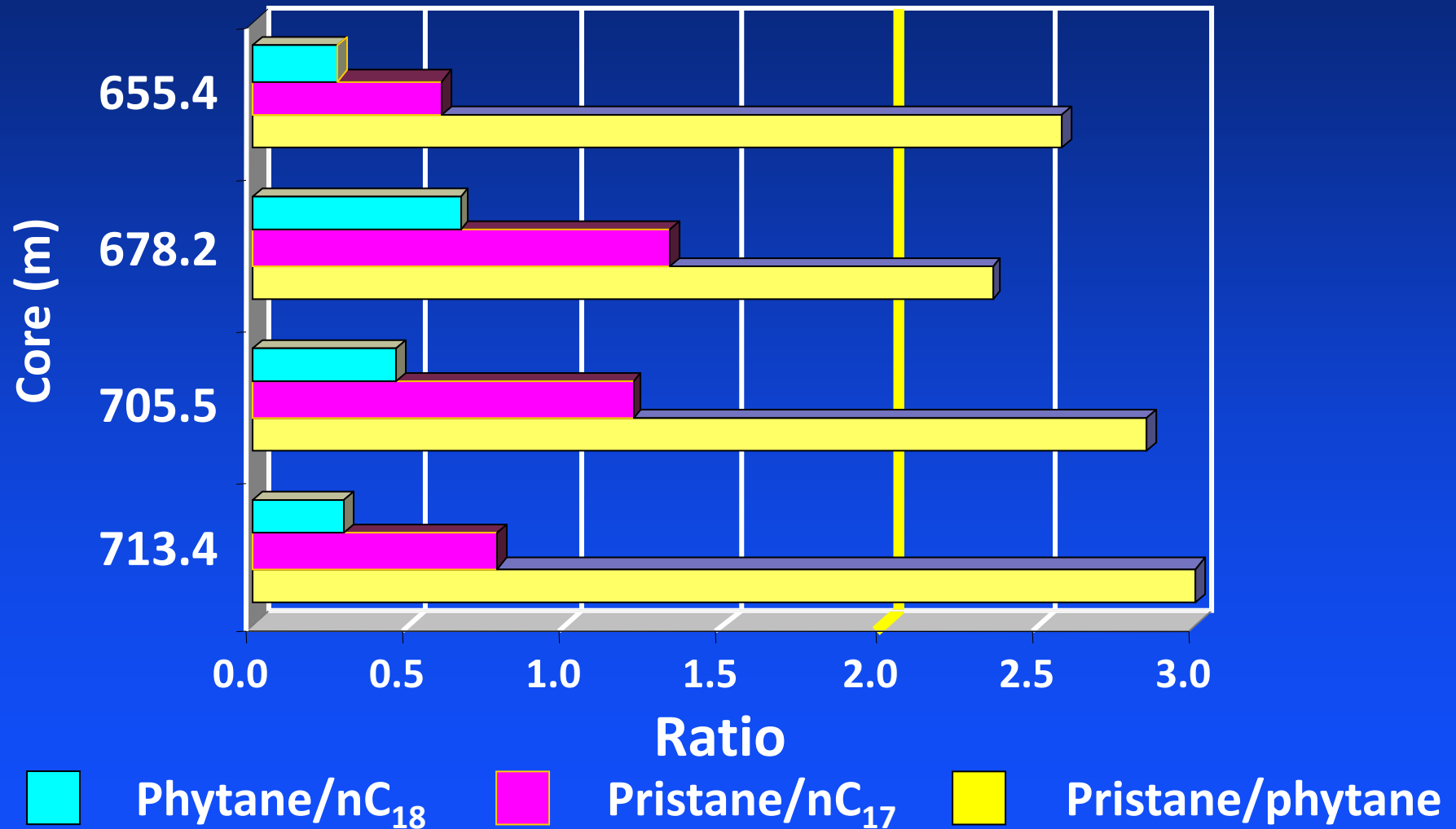
Core Extract (ppm)	HCs (ppm)	Non-HC (ppm)	(m)
655.4	4835.8	2865.7	1970.1
678.2	2940.7	1101.8	1155.0
705.5	3861.8	1775.1	1598.9
713.4	2698.1	1213.4	1049.3

Extract-GC Kerogen Typing

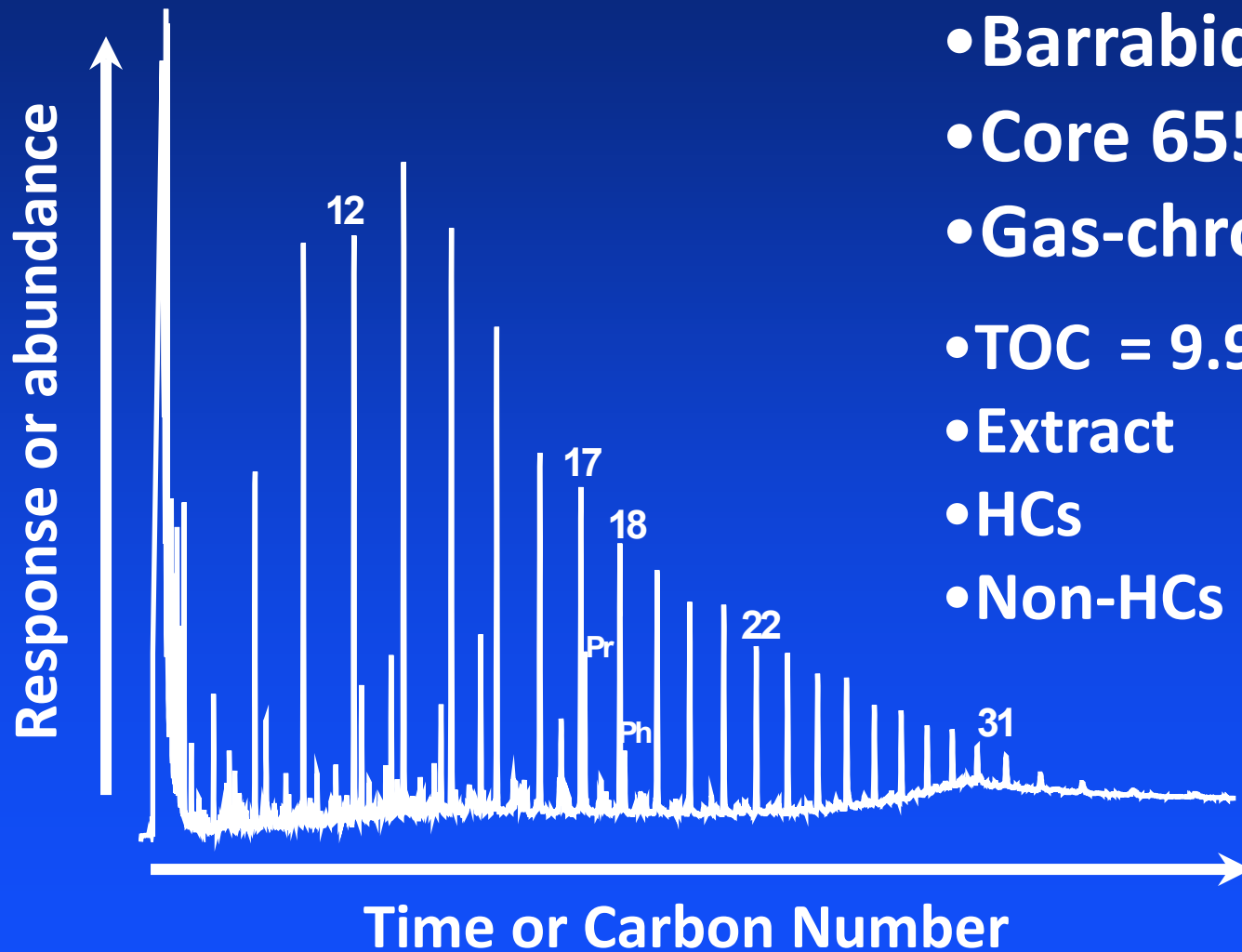
- ➔ Reducing
- ➔ Oxidising
- ➔ Maturation



Gas Chromatography

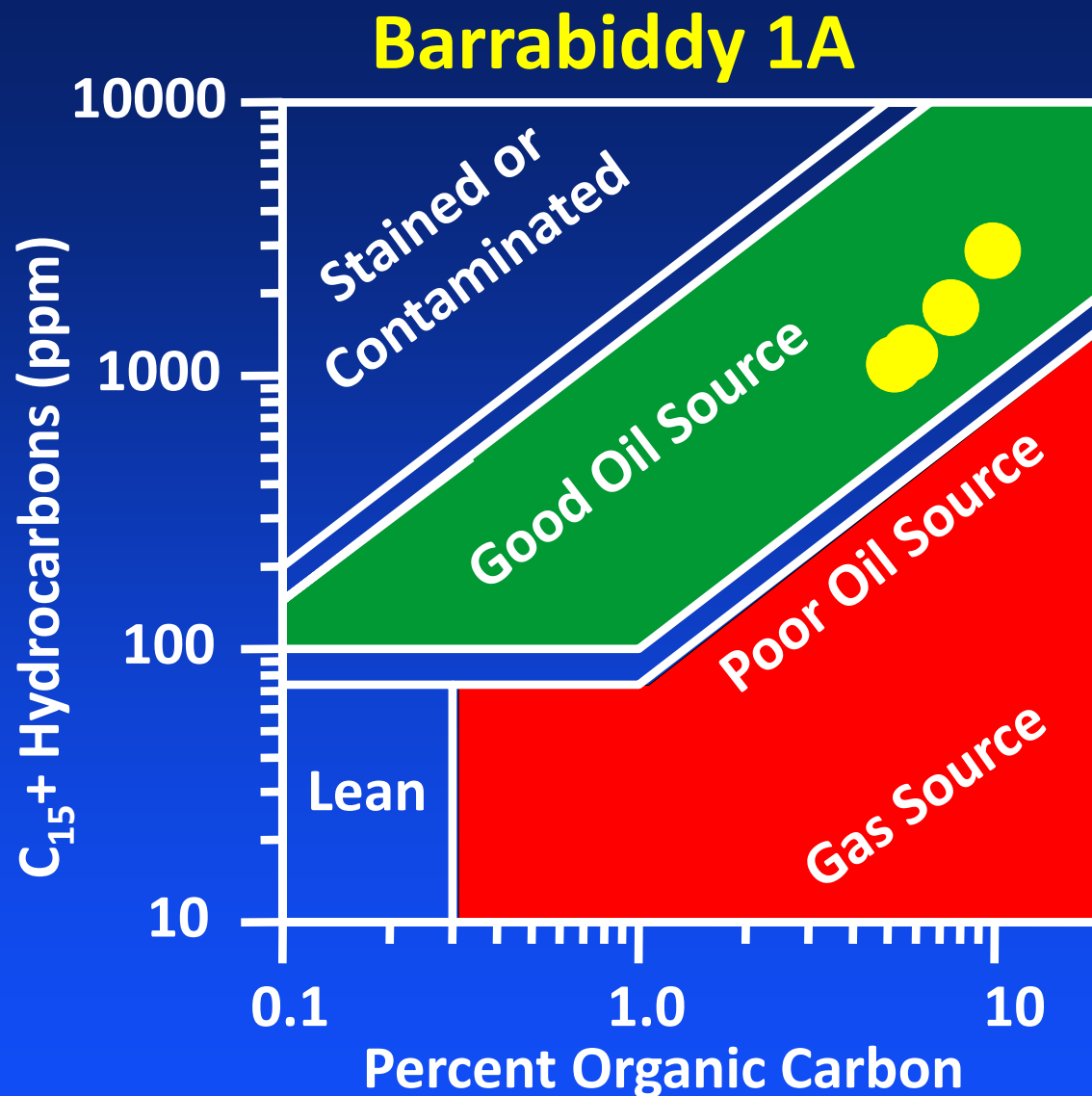


Extract-LC Source Rock Rating



- Barrabiddy 1A
- Core 655.4 m
- Gas-chromatogram
- TOC = 9.9%
- Extract = 4835.8 ppm
- HCs = 59.3%
- Non-HCs = 40.7%

Extract-LC Source Rock Rating



● Gneudna Formation

Apatite Fission Track Analysis

Apatite fission track length is regarded as a maximum-reading thermometer for those samples which have been heated between about 50°C and 120°C. This temperature range depends on apatite composition and heating rate.

Apatite Fission Track Analysis

Basic Interpretative Data:

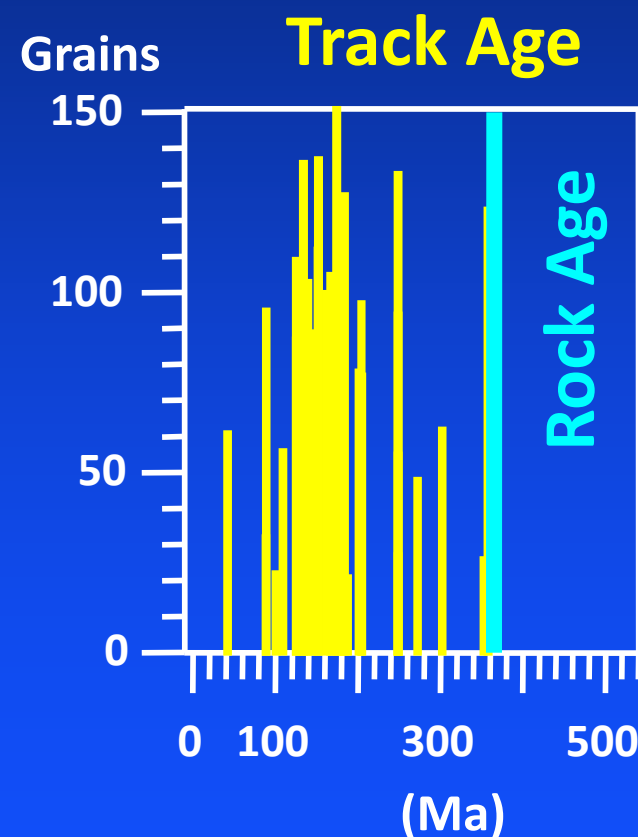
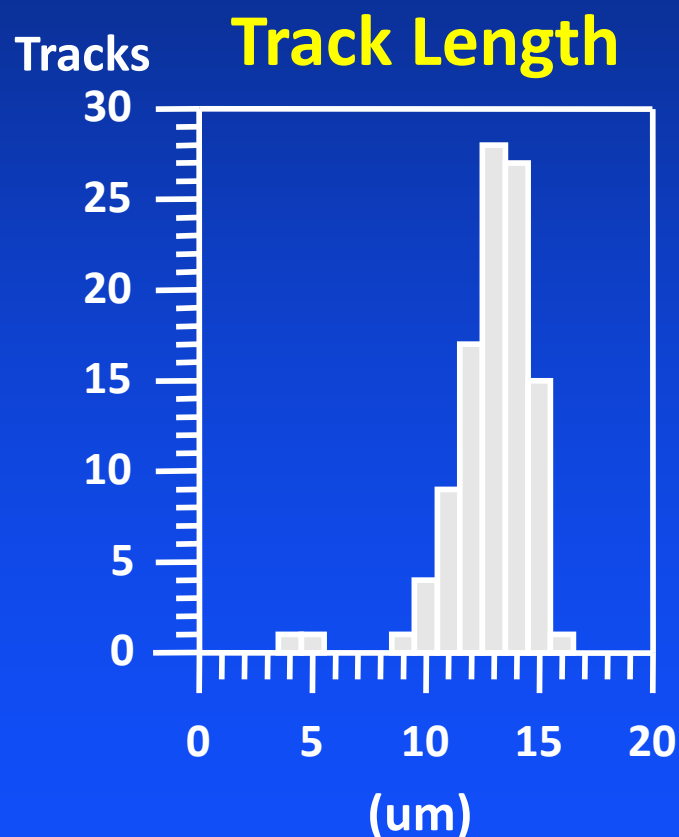
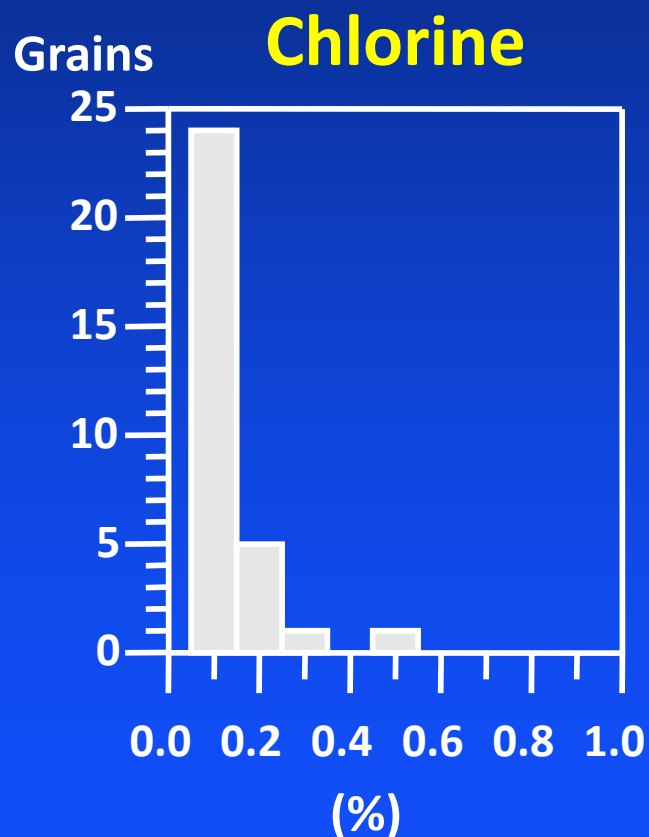
Apatite Grains

- Chlorine Weight %
- Uranium Content
- Fission Track Length
- Fission Track Age

Vitrinite Reflectance Data

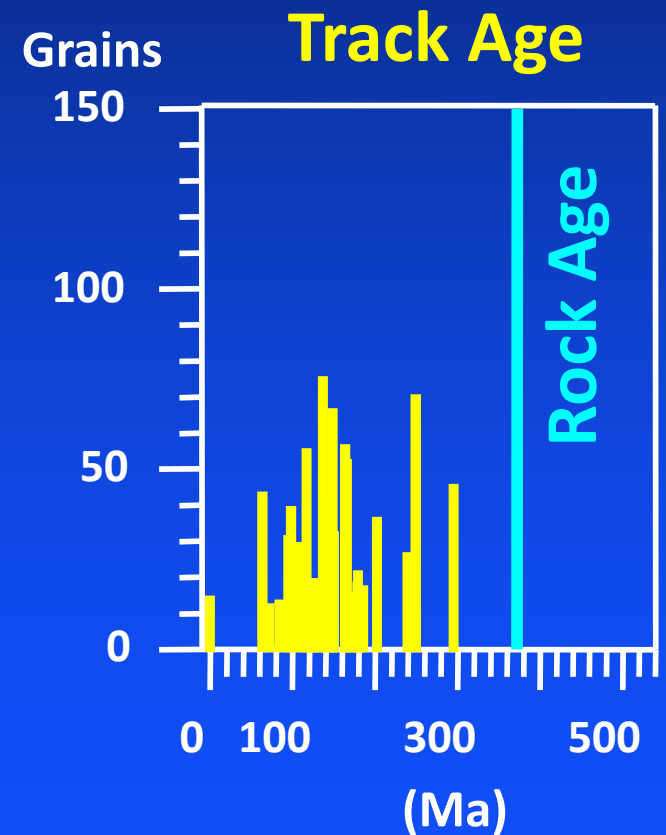
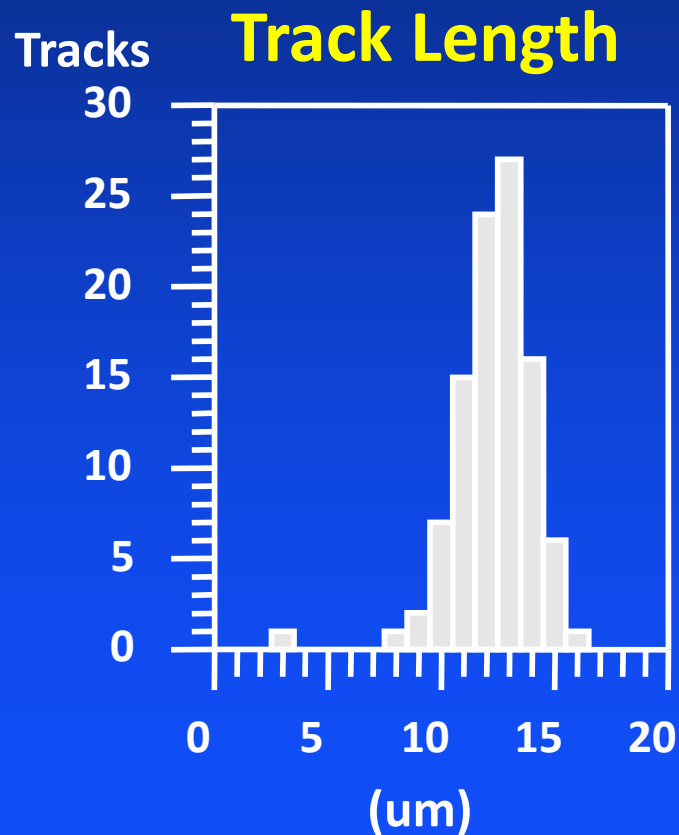
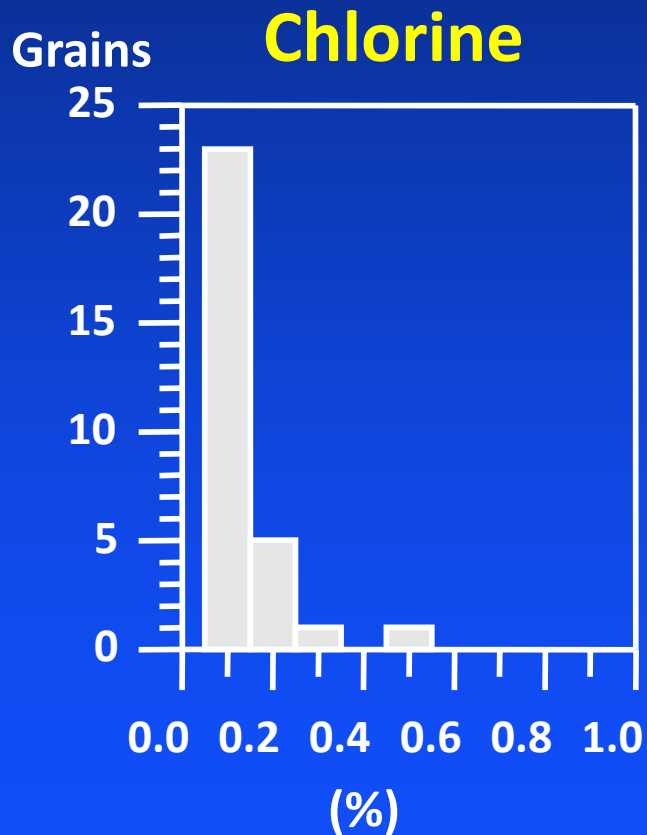
Munabia Formation

AFTA Data – Core 194.7 - 195.4 m

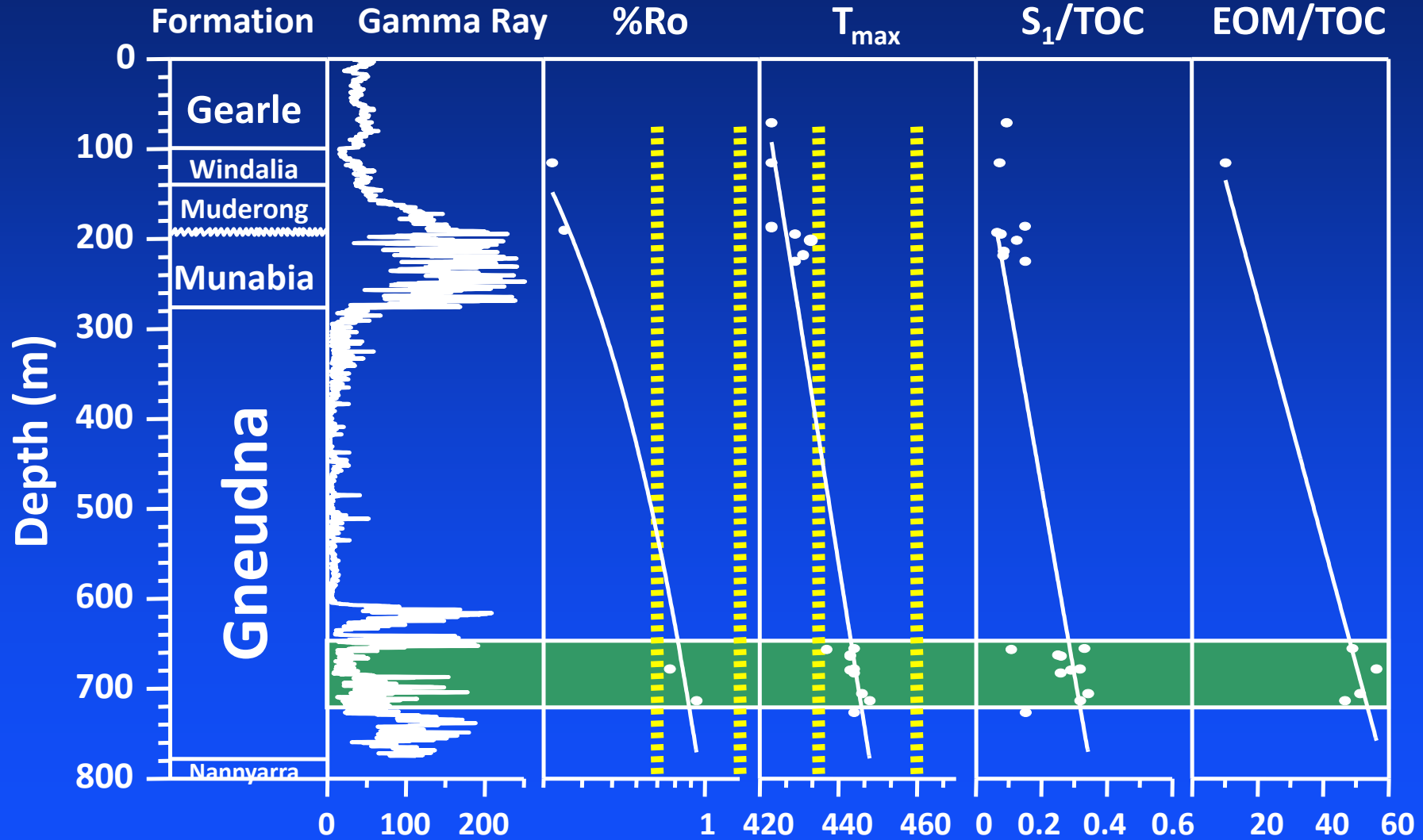


Gneudna Formation

AFTA Data – Core 777.2 - 778.1 m



Source Maturation

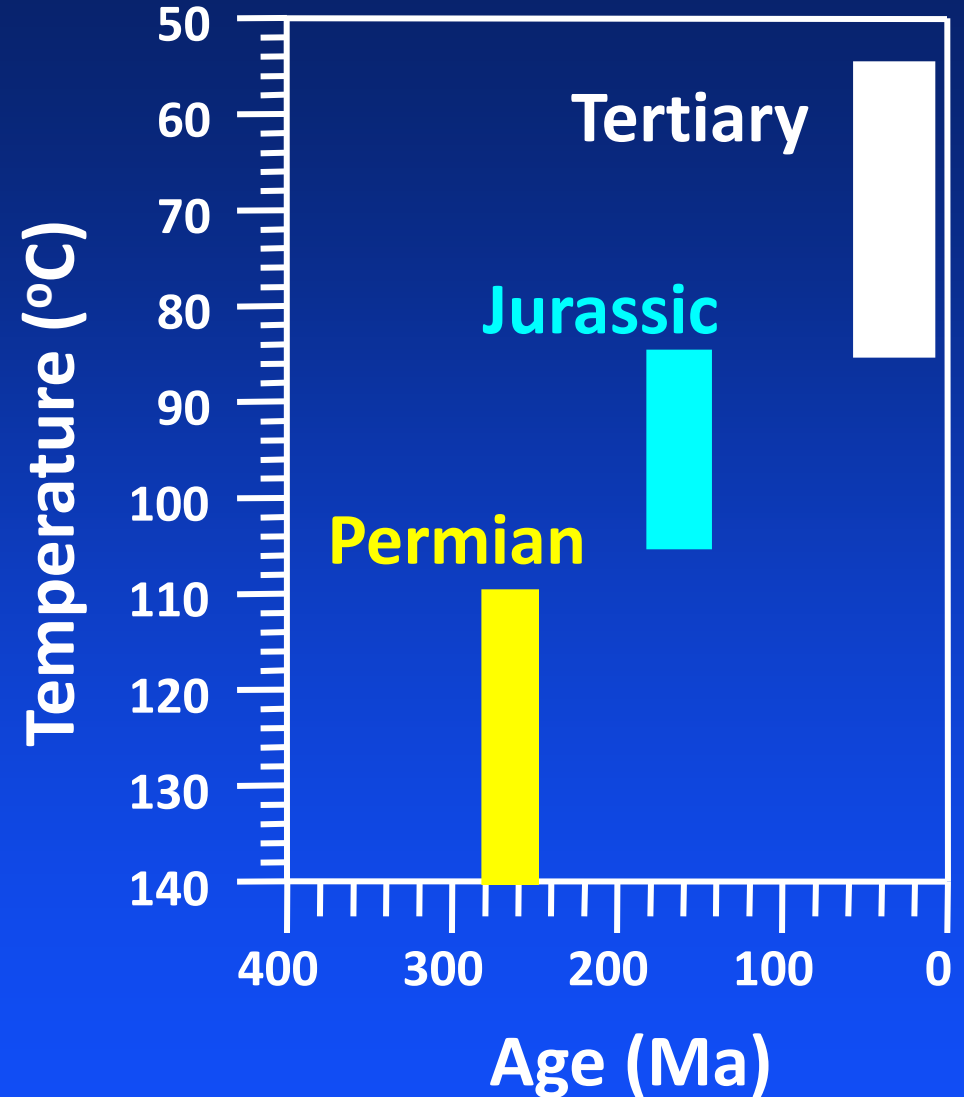


Time of Cooling (AFTA)

Permian: 280–250 Ma

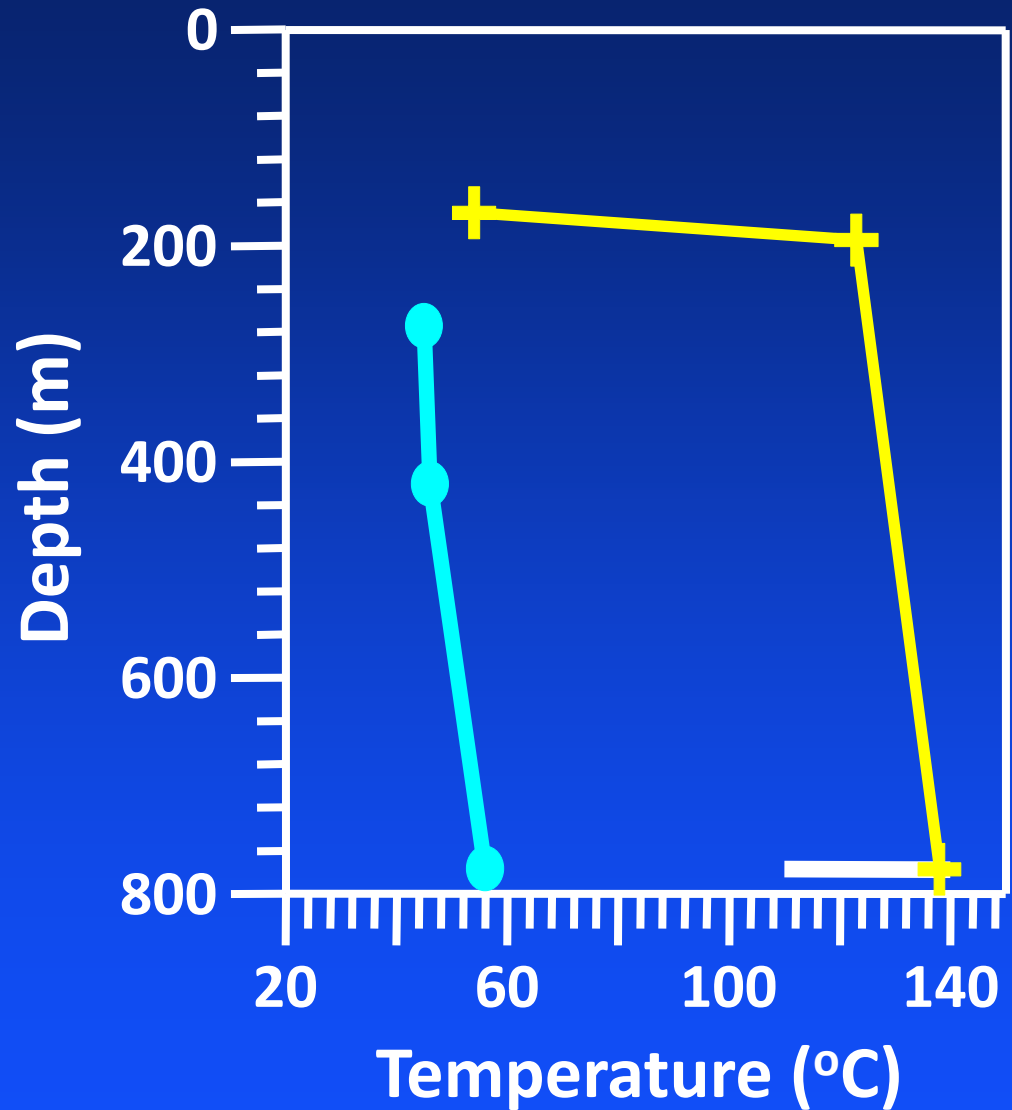
Jurassic: 180–145 Ma

Tertiary: 55–10 Ma

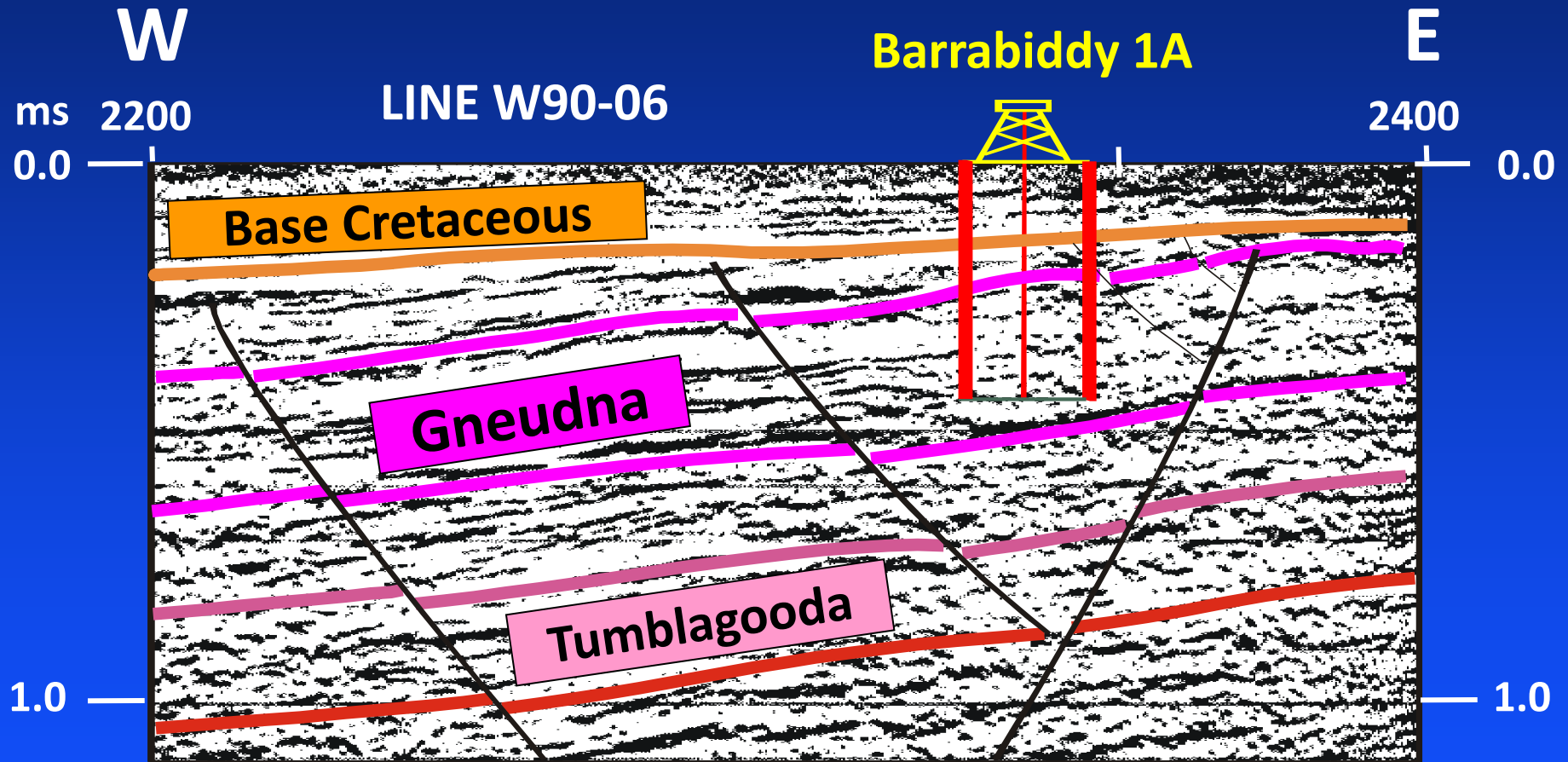


Present-Day & Palaeo-temperatures

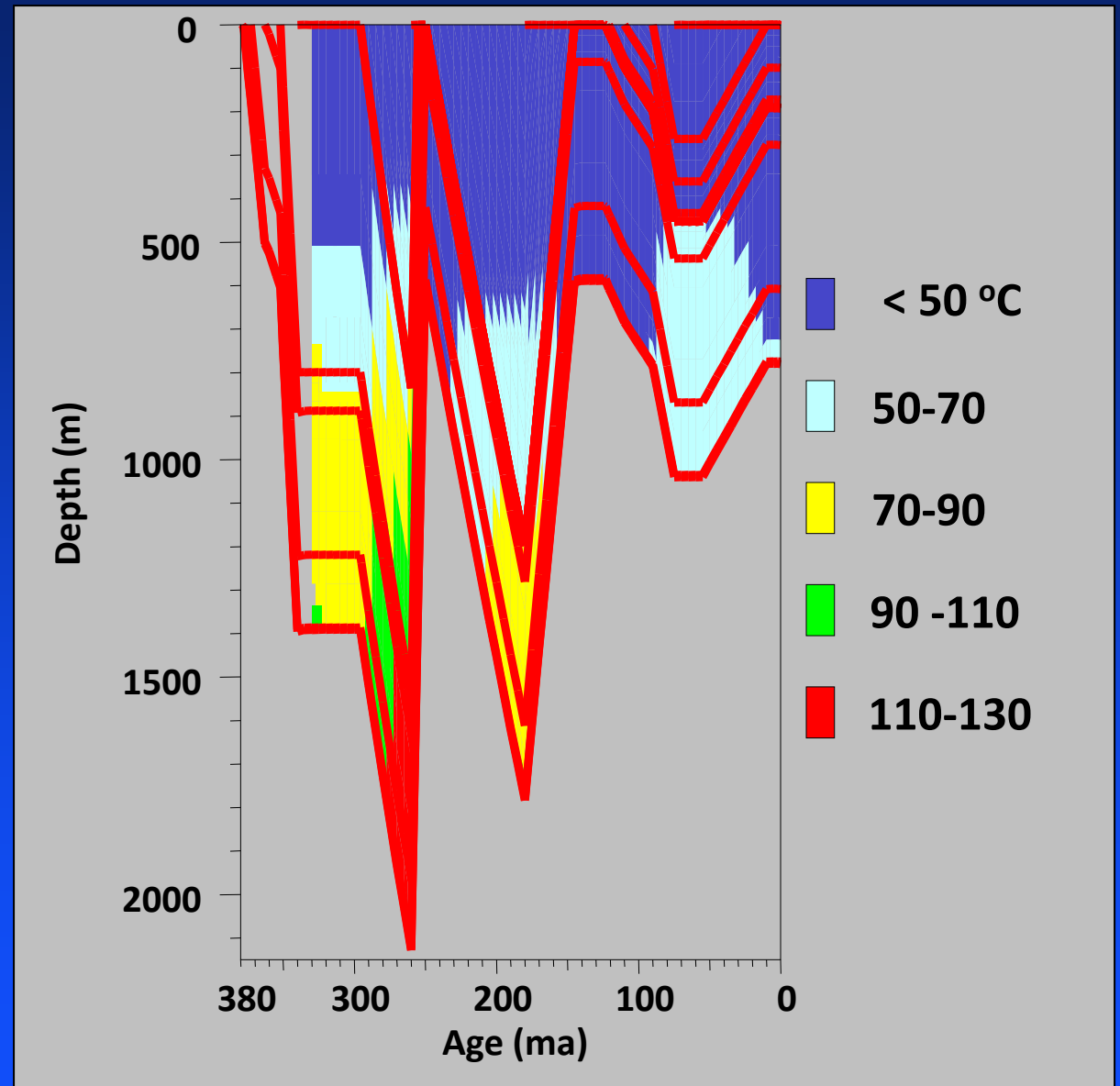
- Present-day Temperature (BHT)
- Palaeotemperature (AFT analysis)
- + Palaeotemperature (Vitrinite Reflectance)



Geological Section Modelled



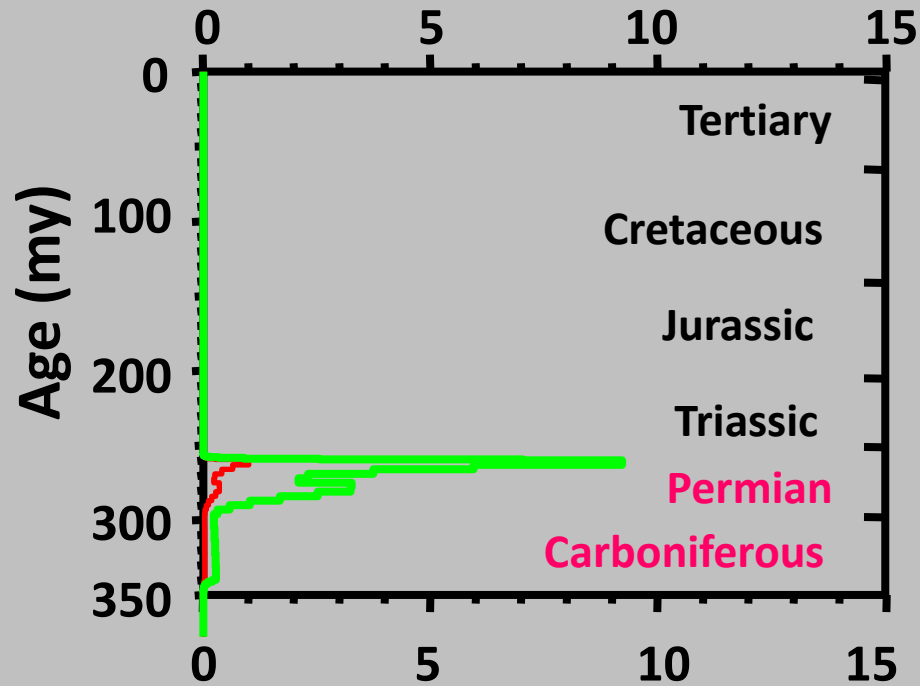
Barrabiddy 1A Temperature Calibration (2D-Modelling)



Generation Timing

Type I

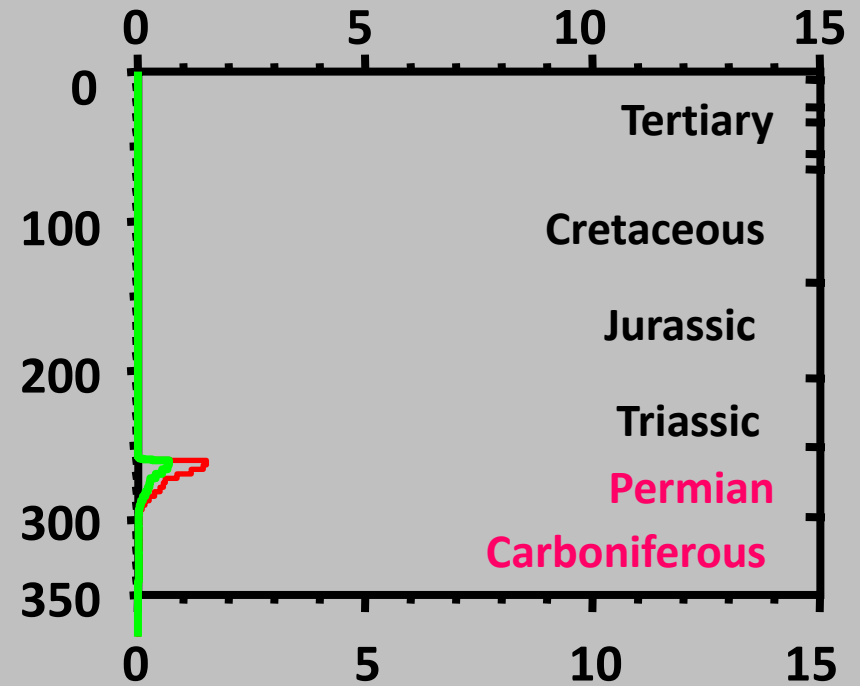
(mg/g TOC/my)



Rate of Oil Generation

Type III

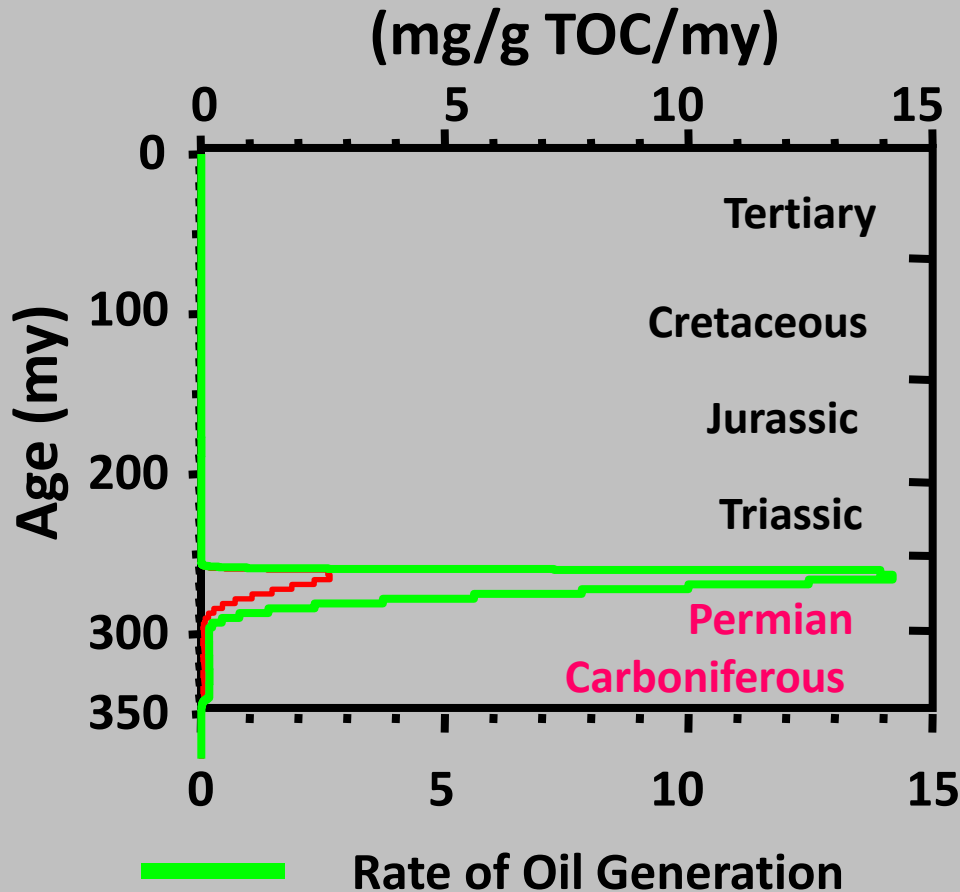
(mg/g TOC/my)



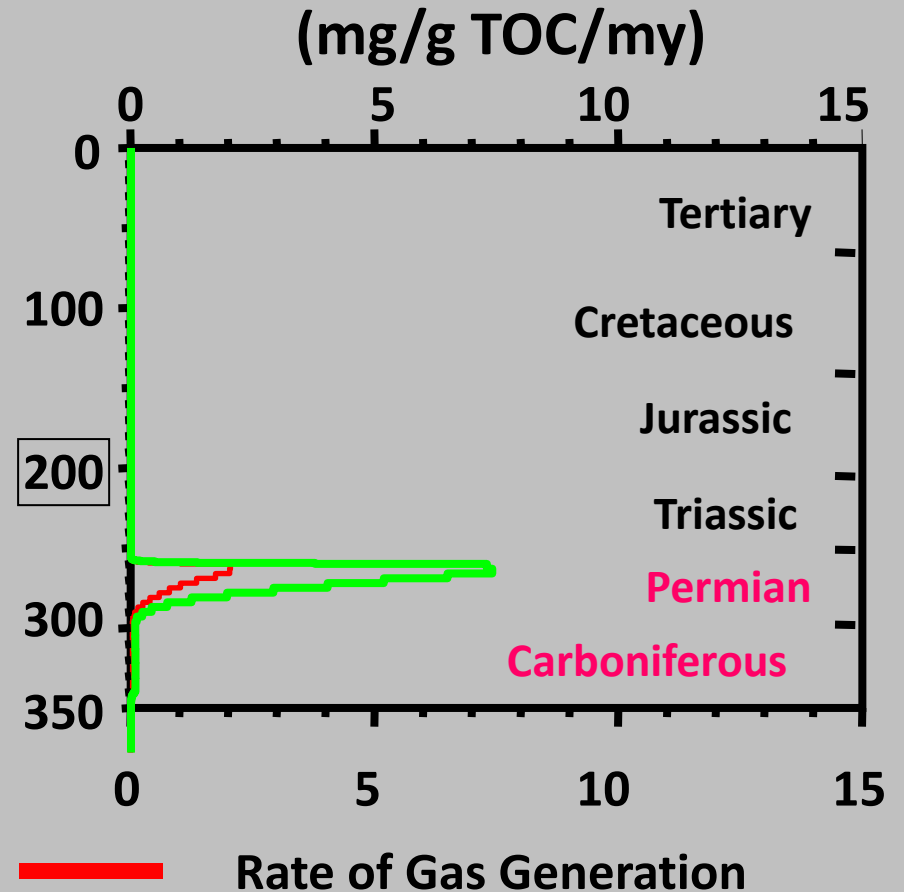
Rate of Gas Generation

Generation Timing

Type II



Type II/III





Conclusions



- The best Upper Devonian — but thin, excellent oil & gas source rocks are present in the Gneudna Formation of the Gascoyne Platform:
Barrabiddy 1A
- The thickness of these source-beds ranges from 20 to 70 cm and their cumulative thickness is 6 m. They are located between 655 and 727 m



Conclusions



Source Beds

- TOC values = 5.2 to 13.6%
- S_1+S_2 = 10.9 to 40.1 mg/g rock
- Extract = 2698 to 4836 ppm
- Vitrinite Reflectance = 0.77 to 0.94%
- T_{max} values = 443 to 448°C
- Peak Generation = Late Palaeozoic
- Prospective Targets = Palaeozoic