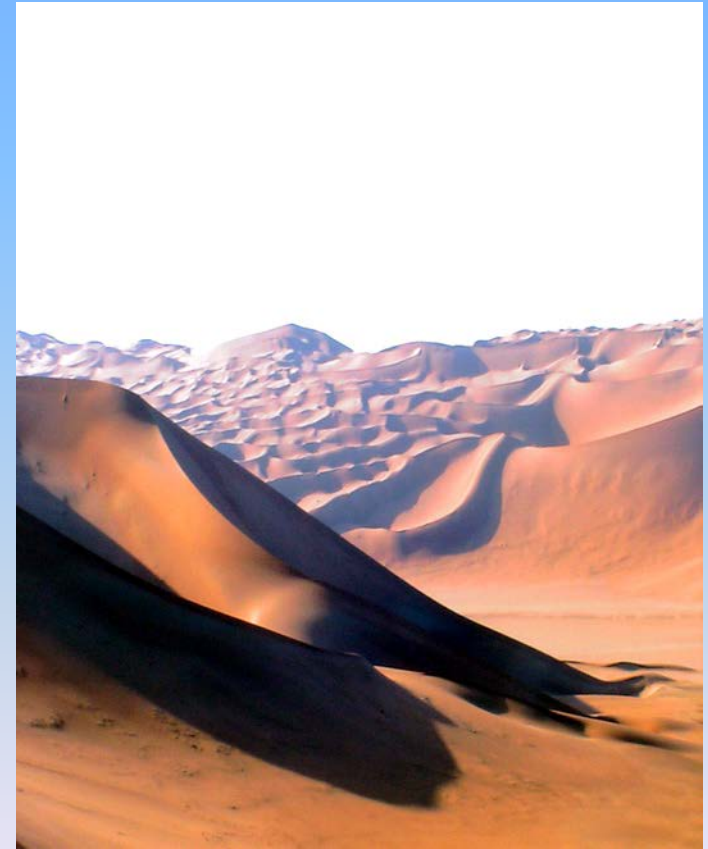


# NAGECO



- North African Geophysical Exploration Company (NAGECO) was formed as a joint venture company between the National Oil Corporation (NOC) of Libya and Western Geophysical of Canada on the 30th of June 1987. In 2009 NOC assumed full ownership of NAGECO Inc.
- Since its formation, NAGECO has continually operated at least two seismic field crews and provide a serves in the Libyan Oil Sector bought 2D &3D with a proven package of services at competitive prices using a combination of leading edge equipment , personnel trained to the highest industry standards and a rigorous Health, Safety and Environment (HSE) programme, NAGECO, with its many years of experience, offers complete data acquisition services as well as data processing.
- NAGECO' s core field equipment includes Sercel Nomad 65 vibrators as well as anew Sercel 428 recording system. Our modern equipment lets NAGECO offer reliable, proven solutions and , linked with our many years of experience , ensuring the absolute minimum of downtime .



*Murzuk Sand Sea*

# NAGECO



- NAGECO currently operates two fully equipped 3D crews capable of working in all types of terrain .
- Using Sercel's modern telemetric recording systems permits NAGECO to address the most demanding of parameters and to meet the ever increasing demand for a higher number of channels .
- Over the years NAGECO has carried out many 3D and 2D surveys for a variety of clients , including waha , Total , Agoco , Zueitina , Wintershall ,Sirte ,Agip Gas , Veba , Ina- Naftaplin OXY , RWE and Alepco .
- Health ,safety and Environmental concerns are fully addressed and complied with through NAGECO's rigorous HSE policy which covers all areas of the company. All crews are equipped with ambulances and its HSE department constantly monitors compliance of every department to the HSE standards that clients (and NAGECO) requires.



*HSE*

# NAGECO

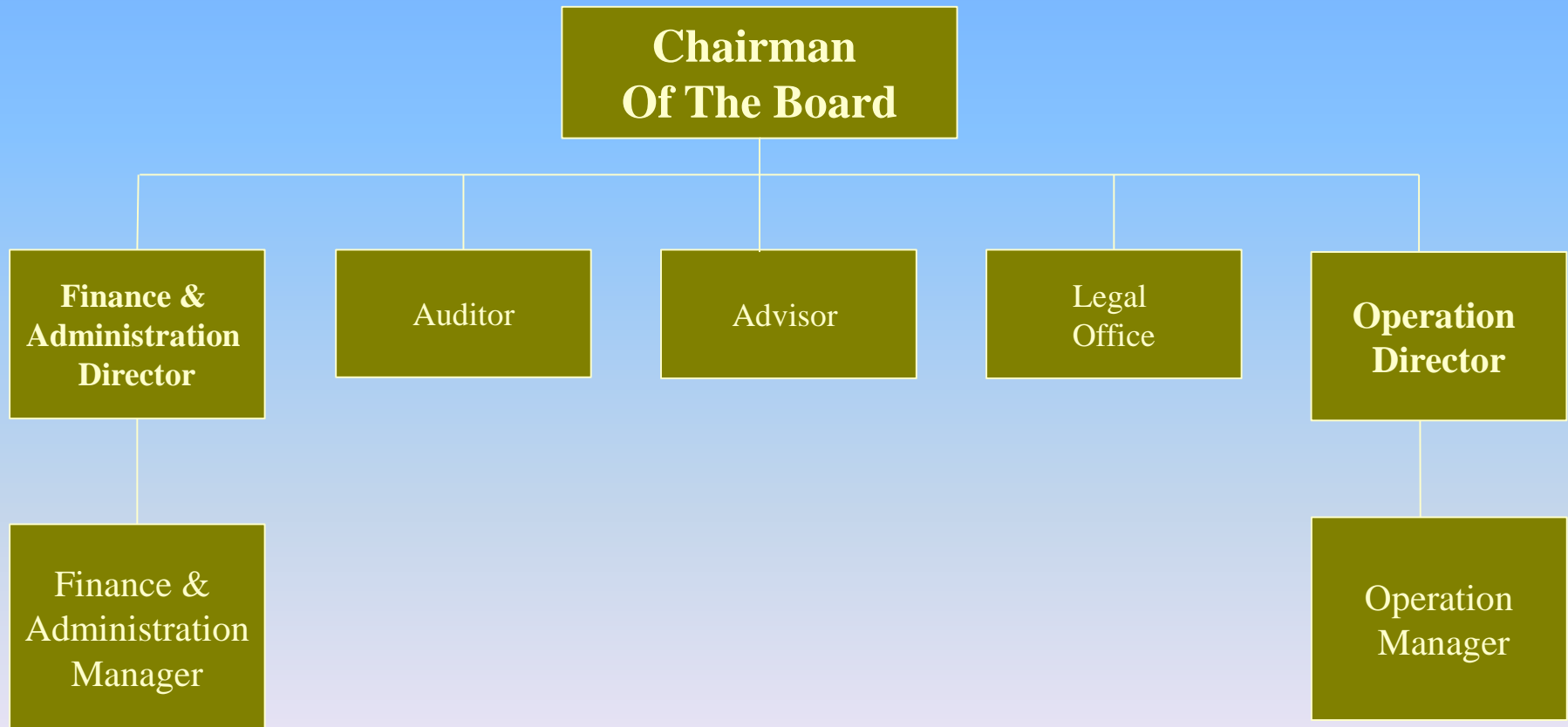


- NAGECO communications network between the field crews and town is maintained using satellite internet and satellite telephones as well as cell phones , where coverage allows . All field vehicles are fitted with modern Motorola FM radios . Garmins are also available .
- Surveying is carried out using modern leica 1200 series GPS field equipment, our fully trained and equipped survey teams carry out the complete survey at field level ,using the most modern processing , mapping and imaging software. From the establishment of control networks through to the final mapping and survey reporting , all the surveying is done on site in the field .
- Data copying and storage are additional services that NAGECO offers .Data storage solutions, such as, Cartridge, CDR and Exabyte are the preferred media of most clients
- NAGECO has Data Processing Centre, enabling NAGECO to offer clients a complete solution from programme design to fully processed data.
- North African Geophysical has, over the last 30 years, gained a prominent position as one of the leading seismic contractors in Libya. We look forward to the next years.



*DATA PROCESSING CENTRE*

# Management Structure



# Libya Opportunities



- Several successful joint and partnership with international service companies
  - NOC-NAGECO-ION
- Libya span offshore multiclients non exclusive seismic acquisition , processing and interpretation

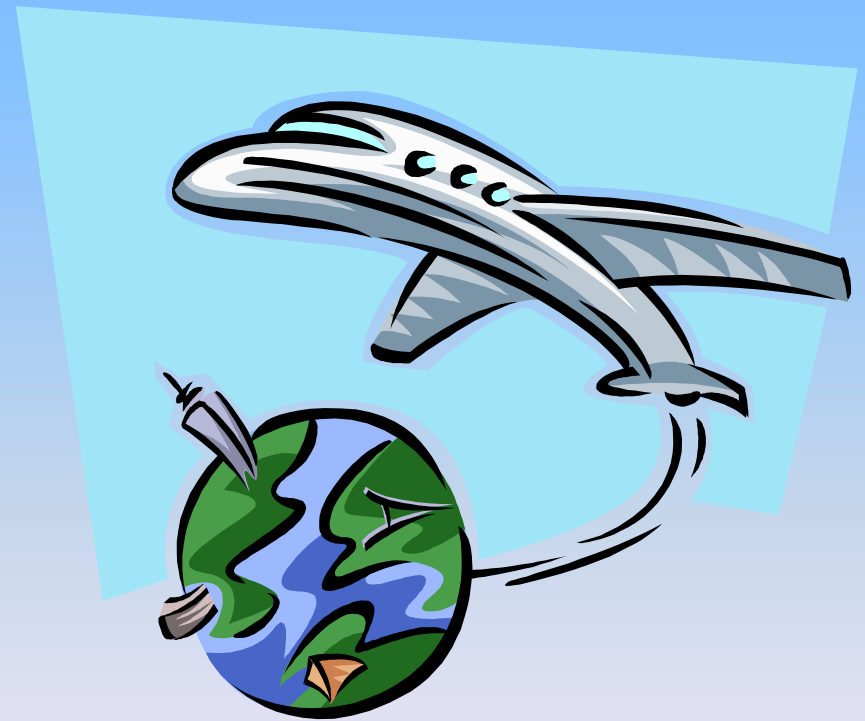


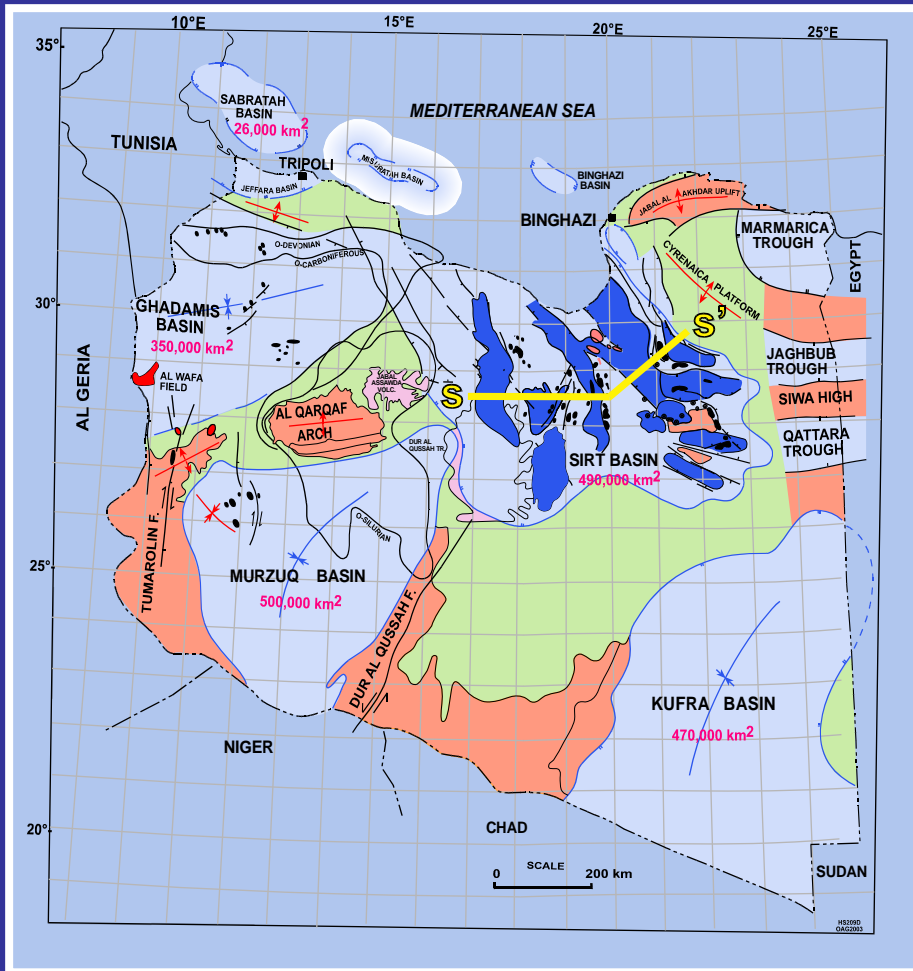


# *Our vision*



- We are open to be apart of any joint venture or project basis share.
- Training partnerships.
- Certification of HSE standards.
- Technology Transfer.





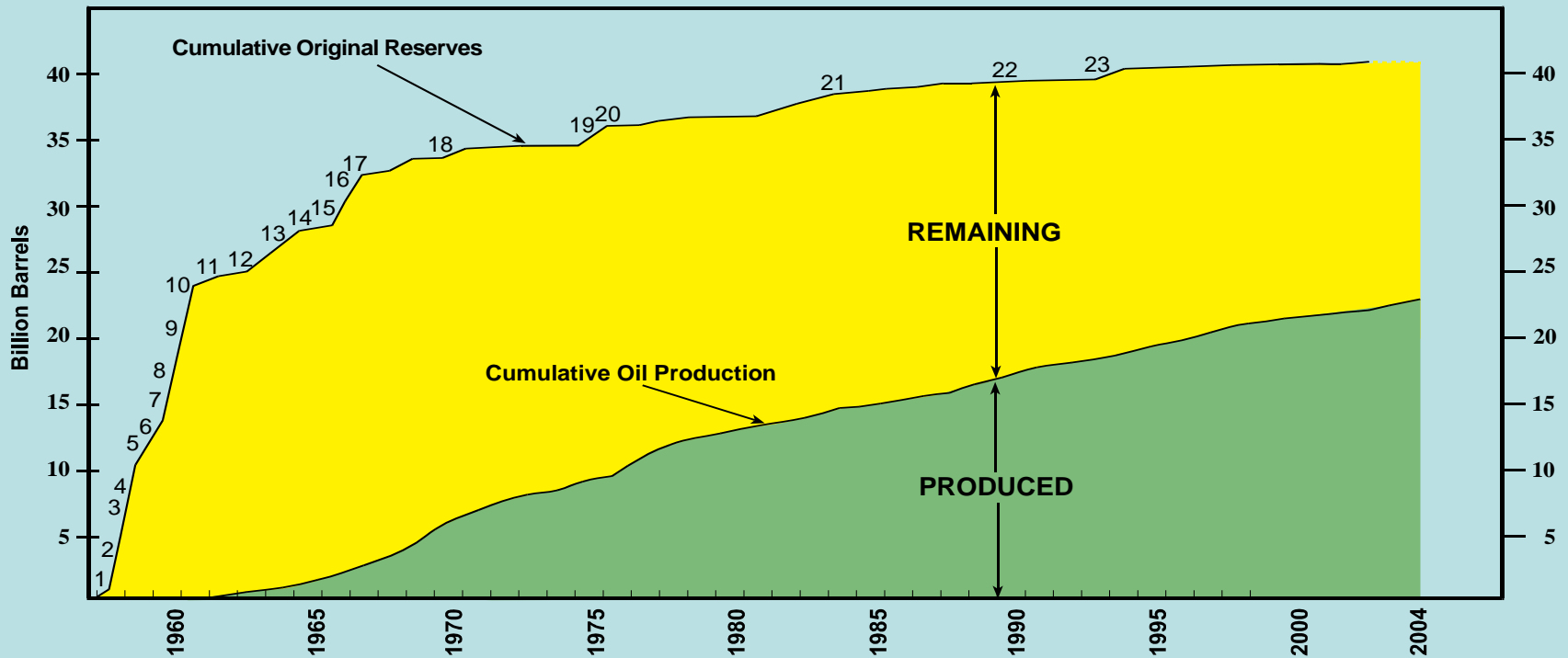
# THE HYDROCARBON POTENTIAL OF LIBYA

# Objectives

- \* To demonstrate that large amounts of hydrocarbons have been generated and expelled in the Libyan sedimentary basins.
- \* A relatively small proportion of the expelled hydrocarbons has been discovered and substantial amount remains undiscovered.



# Cumulative reserves and cumulative oil production

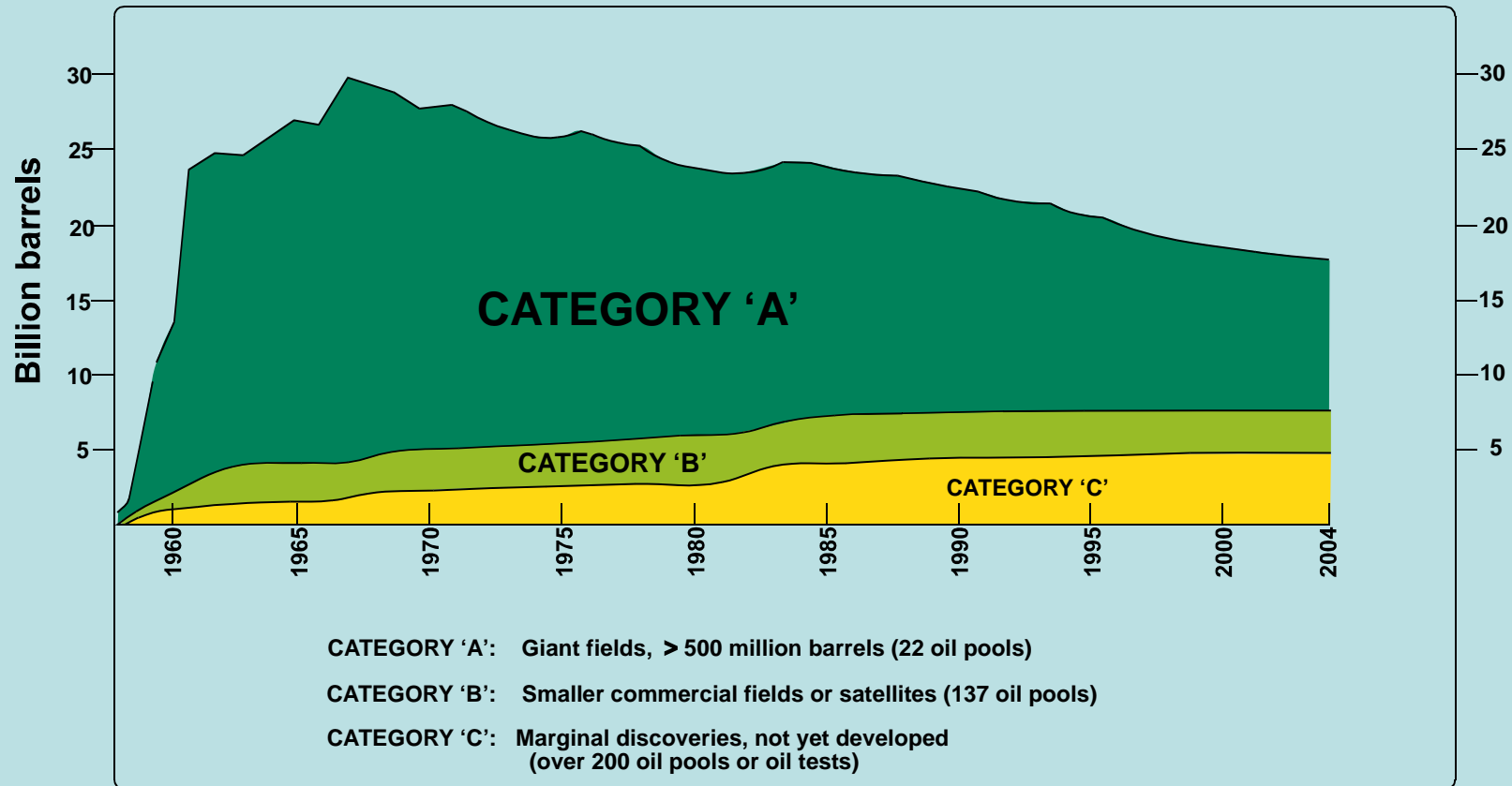


## Principal Discoveries

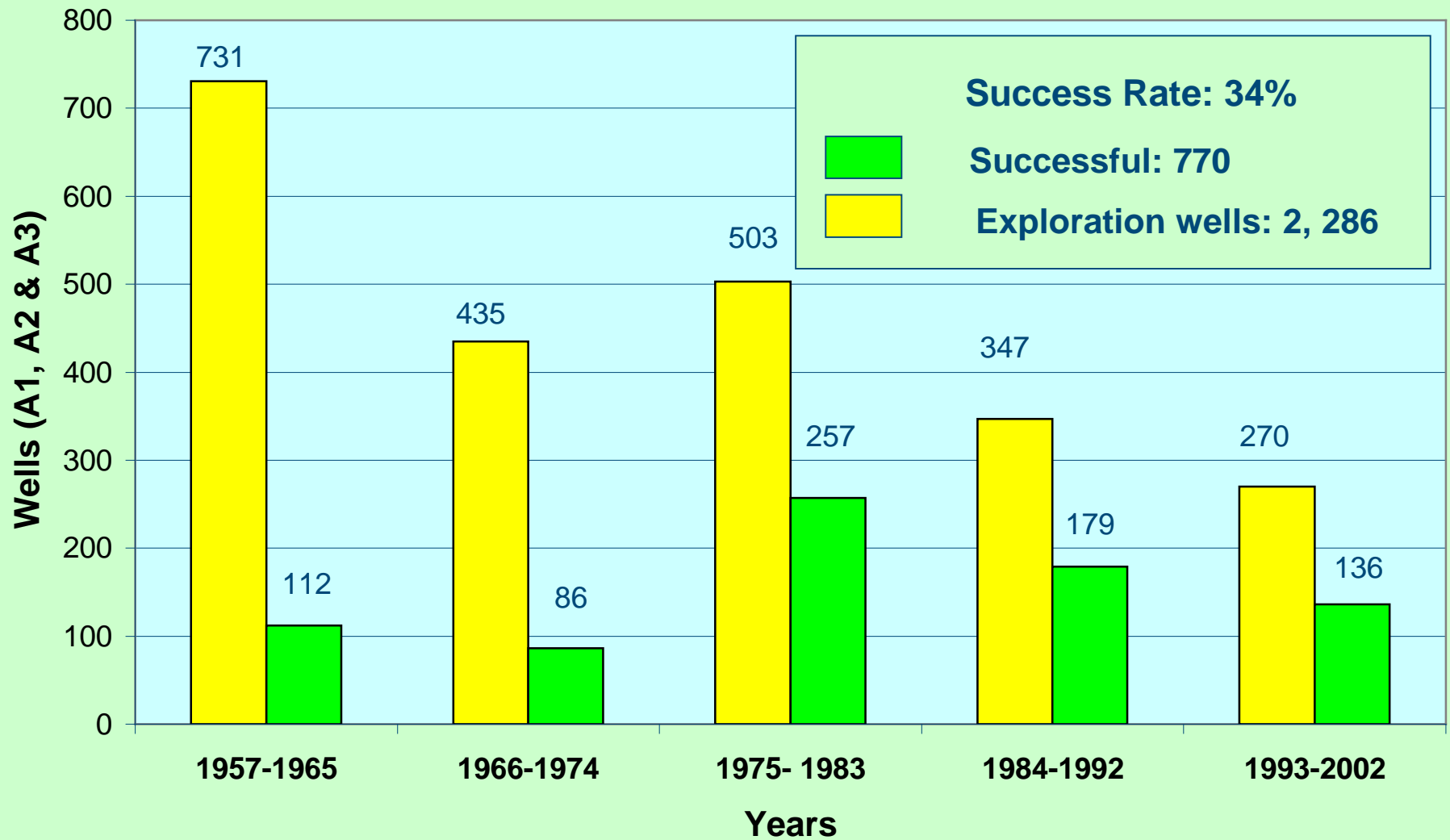
- |                |             |                   |
|----------------|-------------|-------------------|
| 1. Bahi        | 9. Jalu     | 17. Abu Attifel   |
| 2. Dahra-Hafra | 10. Samah   | 18. Messlah South |
| 3. Nasser      | 11. Masrab  | 19. Messlah North |
| 4. Amal        | 12. Jabal   | 20. Bouri         |
| 5. Dayfah      | 13. Sarir L | 21. Al Sharara    |
| 6. Waha        | 14. Nafurah | 22. Al Wafa       |
| 7. Raqubah     | 15. Awjilah | 23. Elephant      |
| 8. Sarir C     | 16. Intisar |                   |



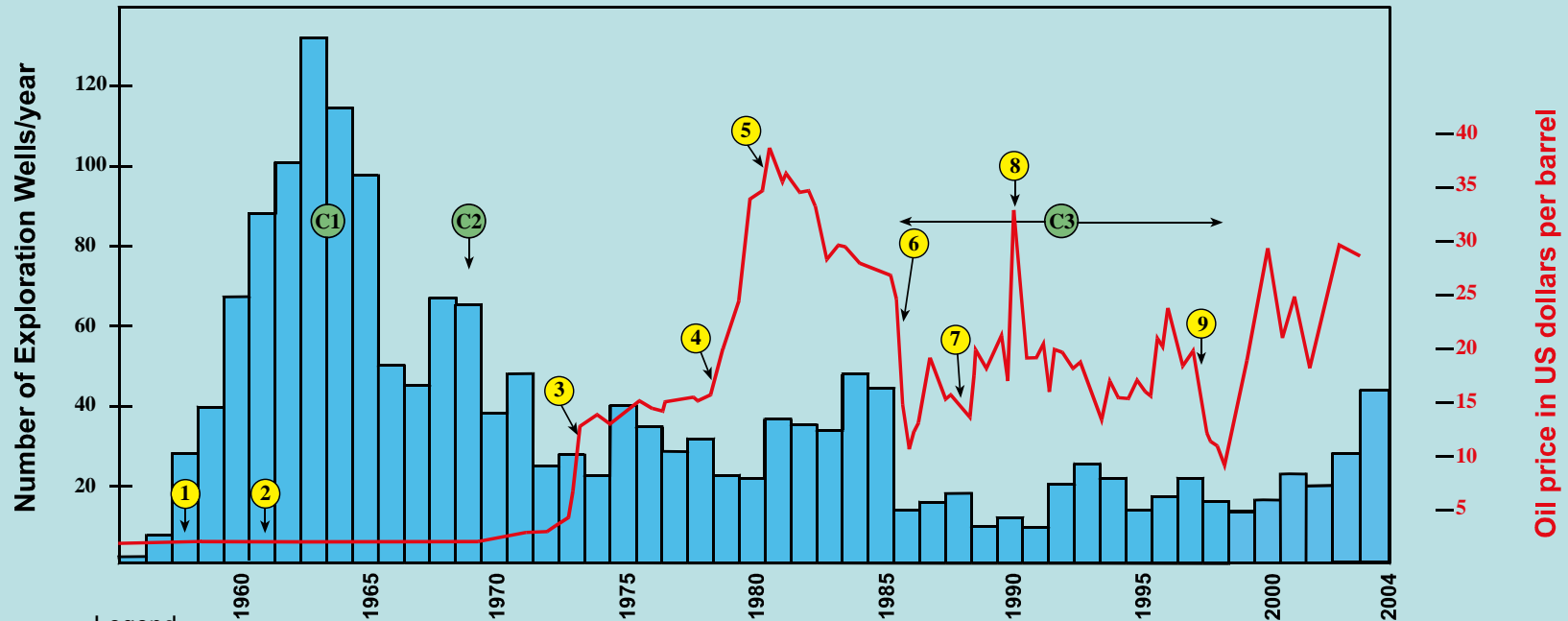
# Remaining recoverable reserves peaked at 29.8 billion barrels in 1967.



# Exploratory drilling results, 1957-2004



# Exploration (wildcat) drilling and World oil price per barrel



## Legend

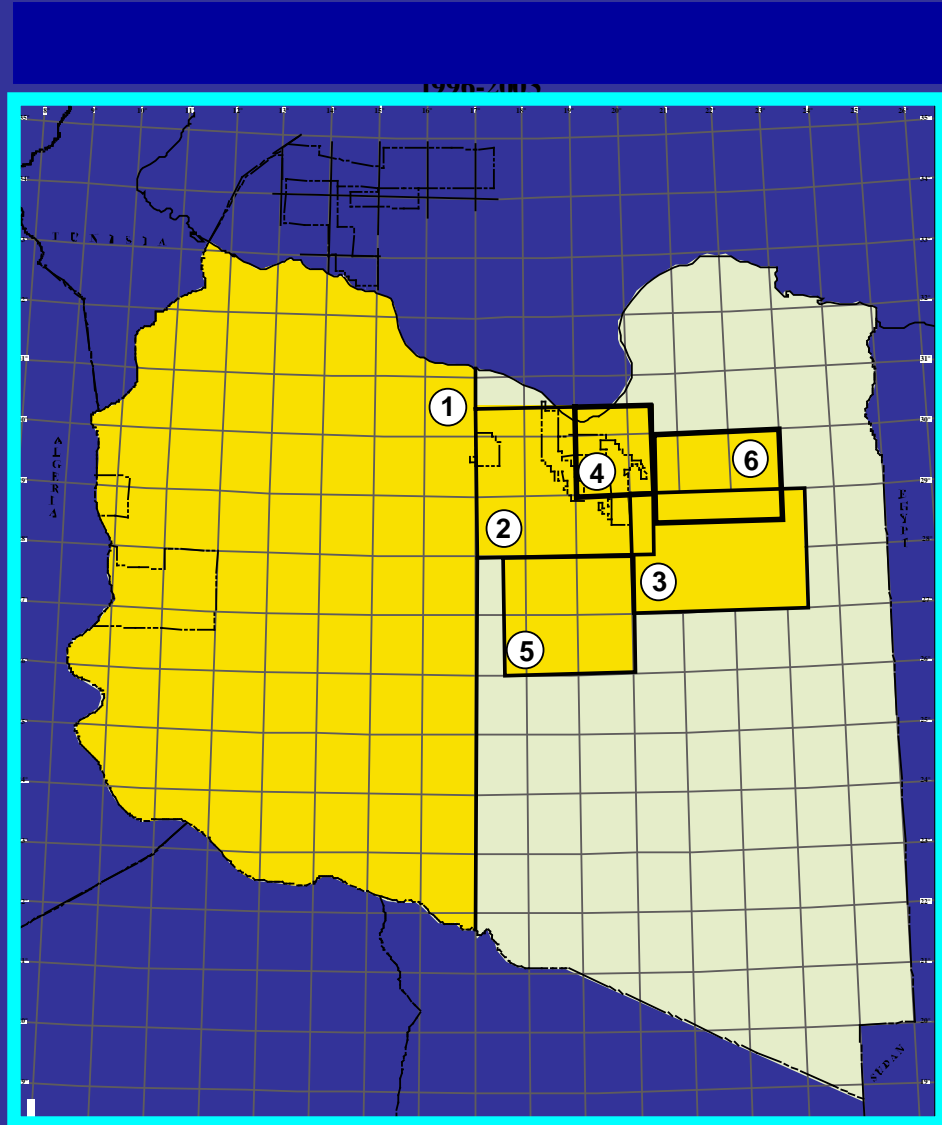
- 1 . First major discoveries in Libya
- 2 . First Libyan oil production
- 3 . October War
- 4 . Iranian Revolution
- 5 . Beginning Iran- Iraq War
- 6 . Saudi government abandoned fixed oil price
- 7 . End of Iran-Iraq War
- 8 . Gulf War
- 9 . OPEC increased production to 27.5MMb per day

## Internal Events:

- C1 Posted price dispute
- C2 Libyan Revolution
- C3 US sanctions imposed on Libya



# Oil Potential Studies



# Methodology for Oil Potential Studies

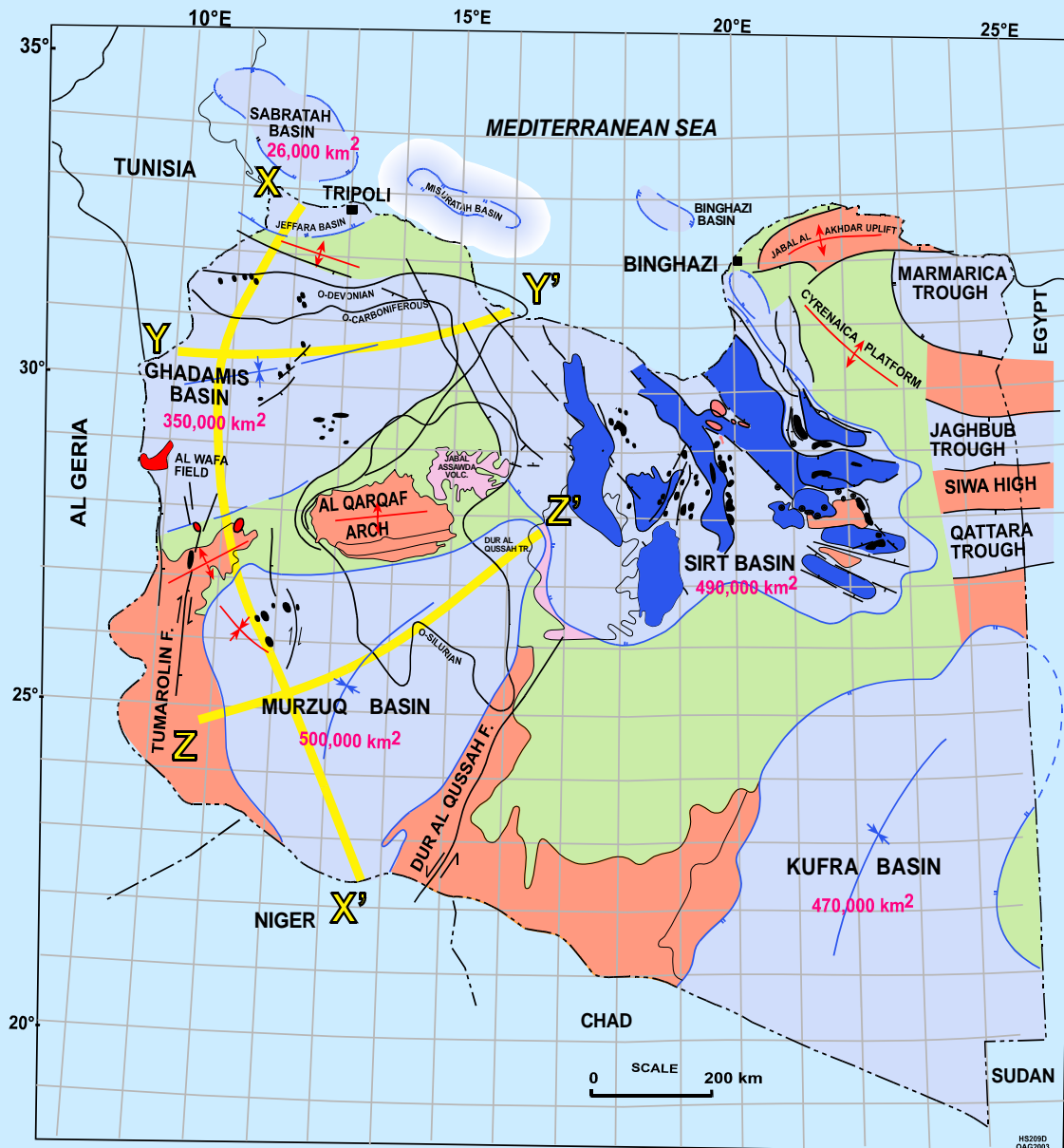
## Used volumetric material balance approach:

- \* Geology, structure and source-maturation geochemistry, spore colouration and BasinMod were used to map potential source rocks.
- \* Organic matter type and richness were based on well control.
- \* Kinetic modeling was used to calculate hydrocarbons generated and expelled from the source-kitchens.
- \* Discovered original oil (or oil equivalent) in-place (OOIP/OOEIP) reserves were compiled.
- \* The undiscovered amount defines the remaining potential.



# GHADAMIS AND MURZUQ BASINS

# Location of structural cross sections

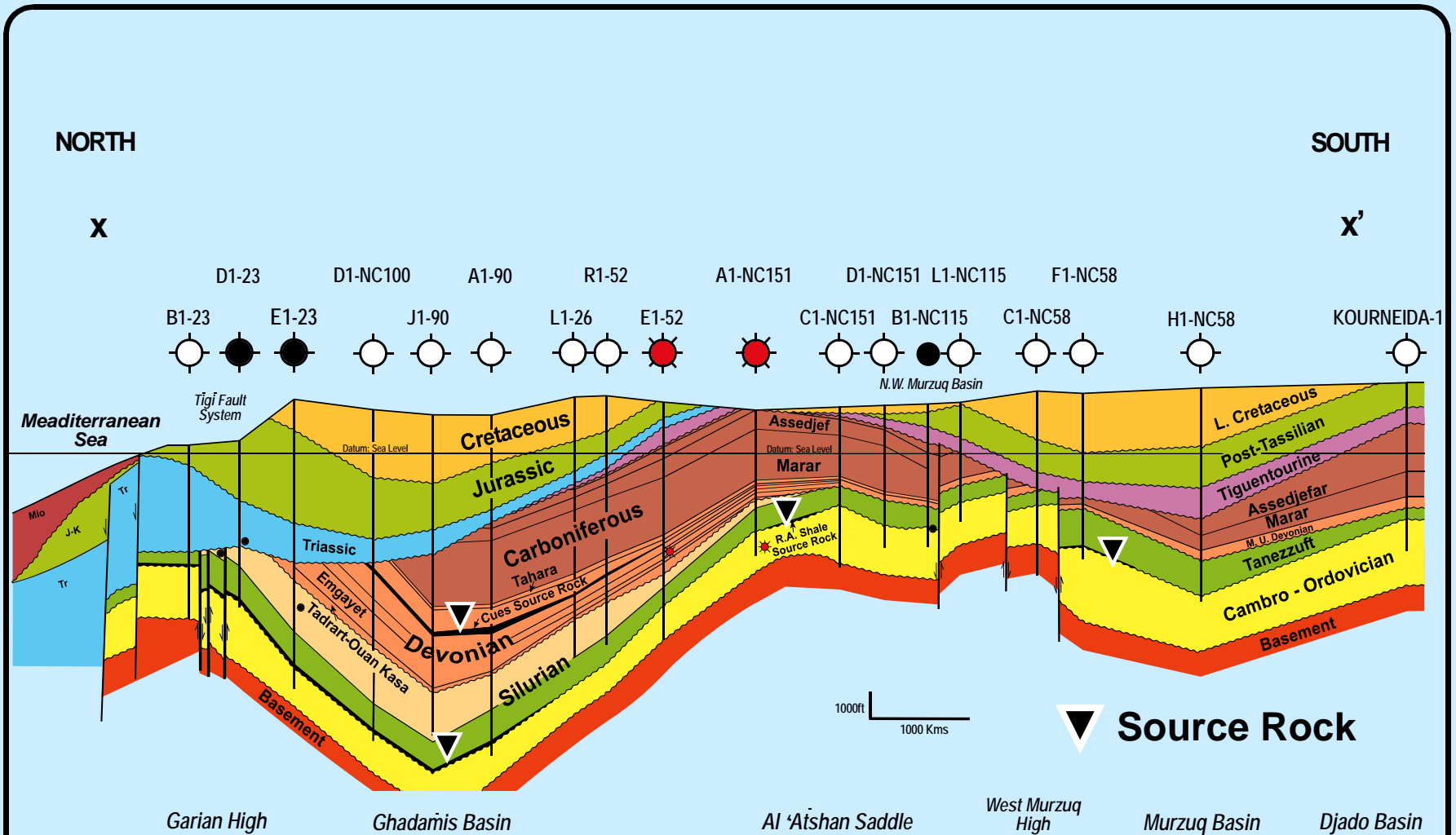


## TECTONIC MAP OF LIBYAN BASINS

### LEGEND

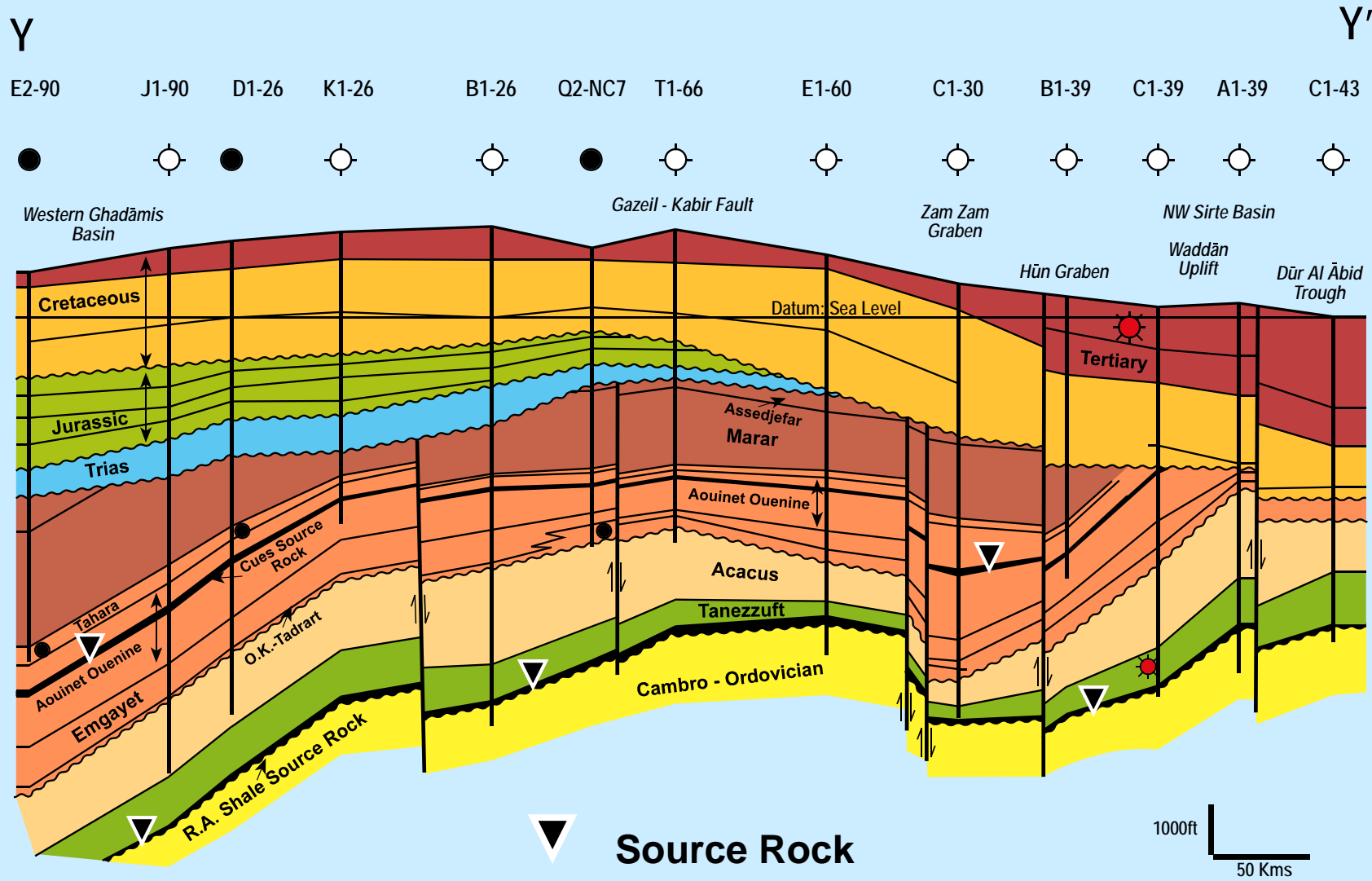
- CRETACEOUS TROUGH
- PLATFORM/ BASIN
- BASEMENT HIGH OR BASEMENT/PALAEOZOIC EXPOSURE
- SHALLOW BASEMENT

# Structural cross-section X – X'



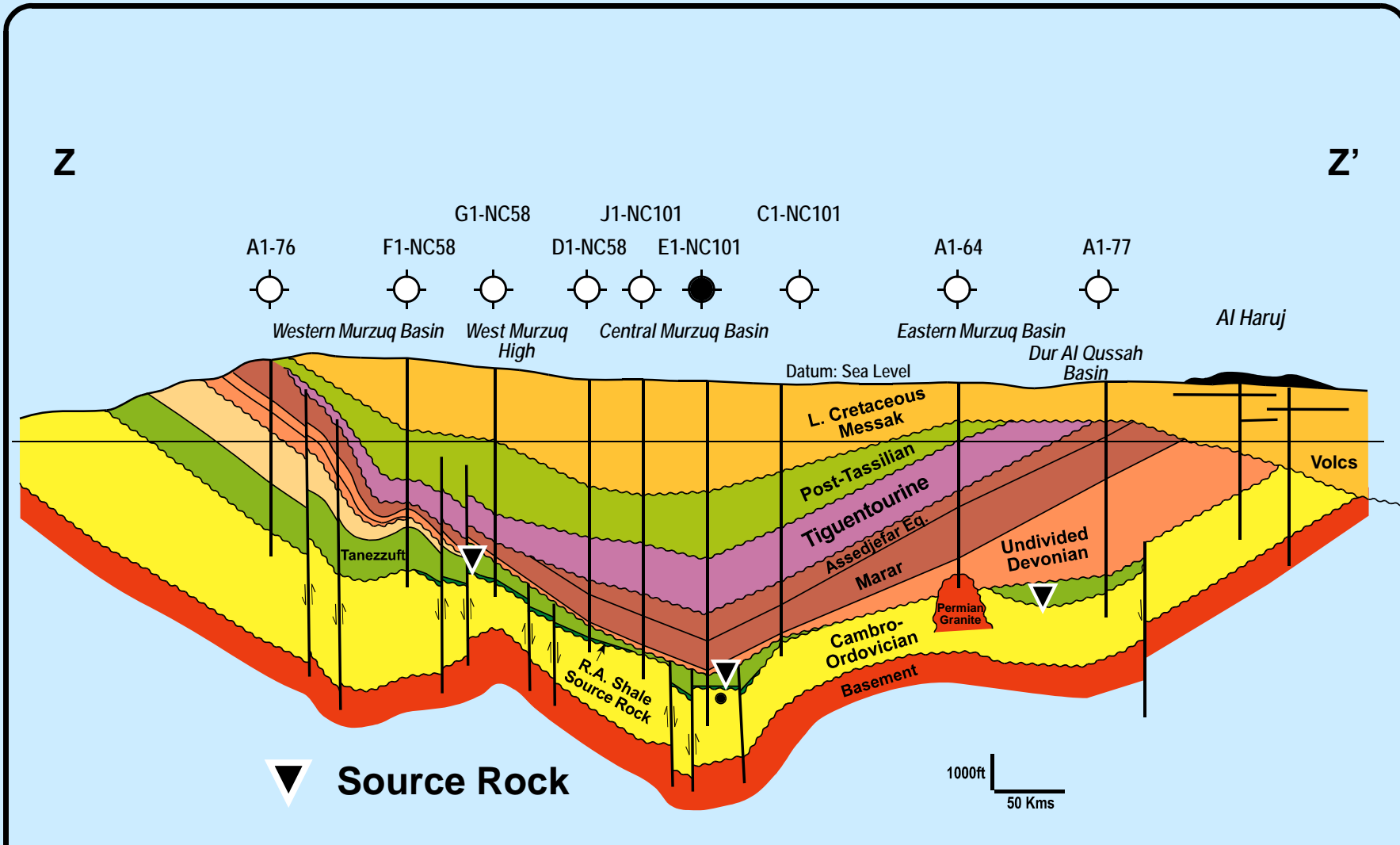
**North - South structural cross-section across Ghadamis and Murzuq Basins**

# Structural cross-section Y – Y', Ghadamis Basin



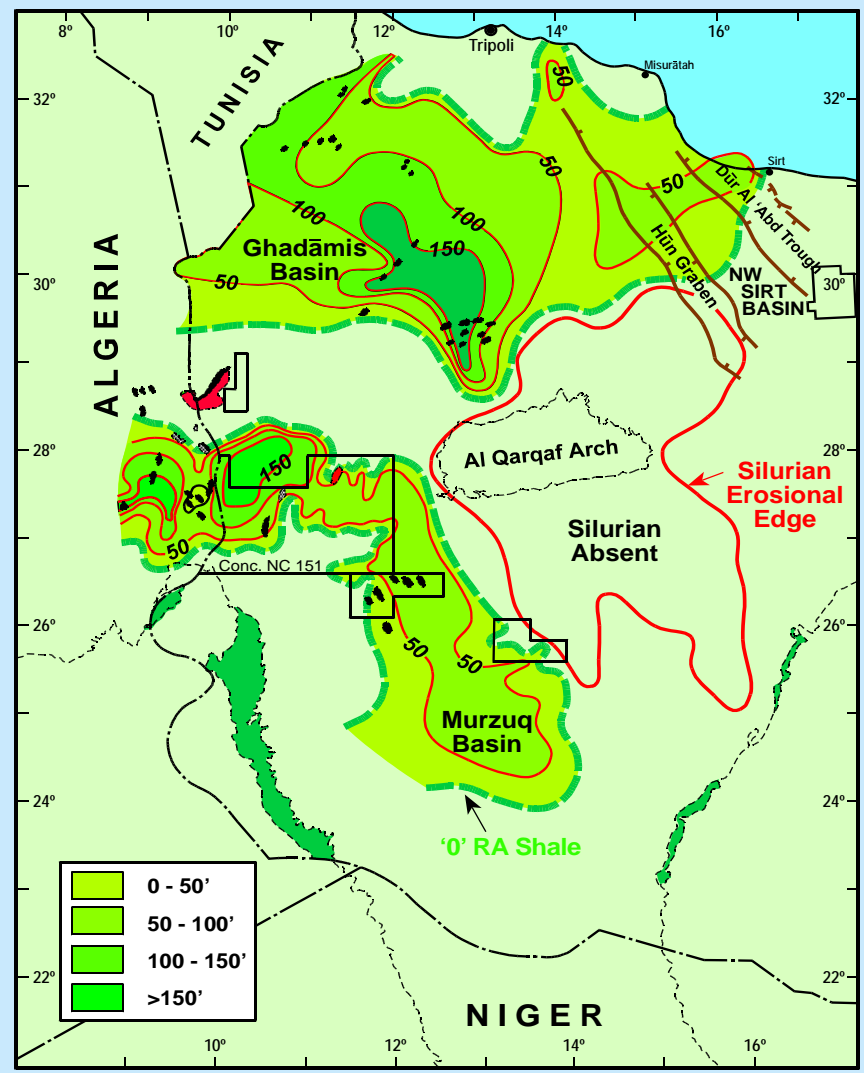
**East - West structural cross-section  
across Ghadamis Basin**

# Structural cross-section Z – Z', Murzuq Basin



**East - West structural cross-section across Murzuq Basin**

# Net thickness of highly radioactive Lower Tanezzuft shales



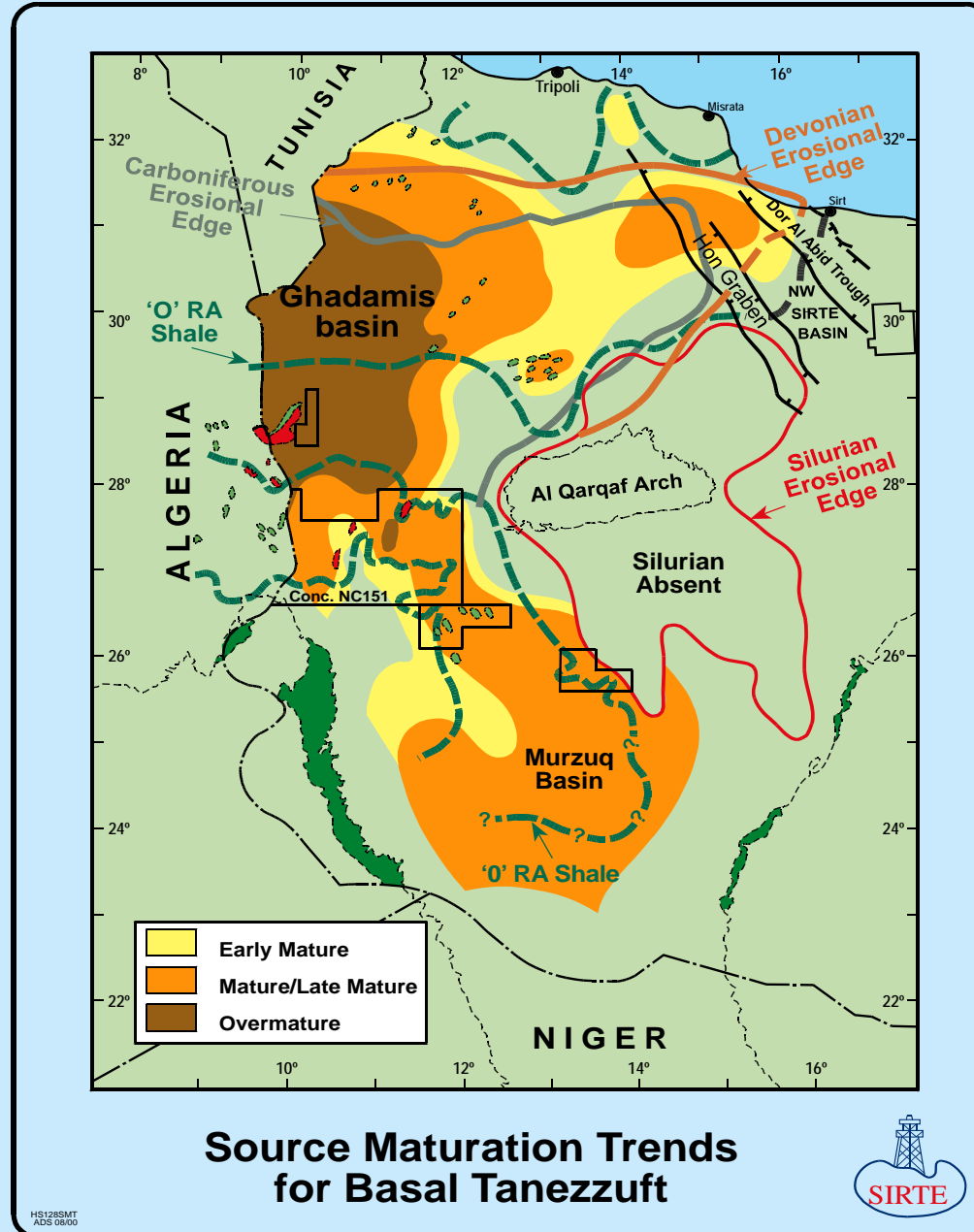
Net Cumulative Thickness Map  
Highly Radioactive Zone,  
Basal Tanezzuft



HS150col  
ADS04/99



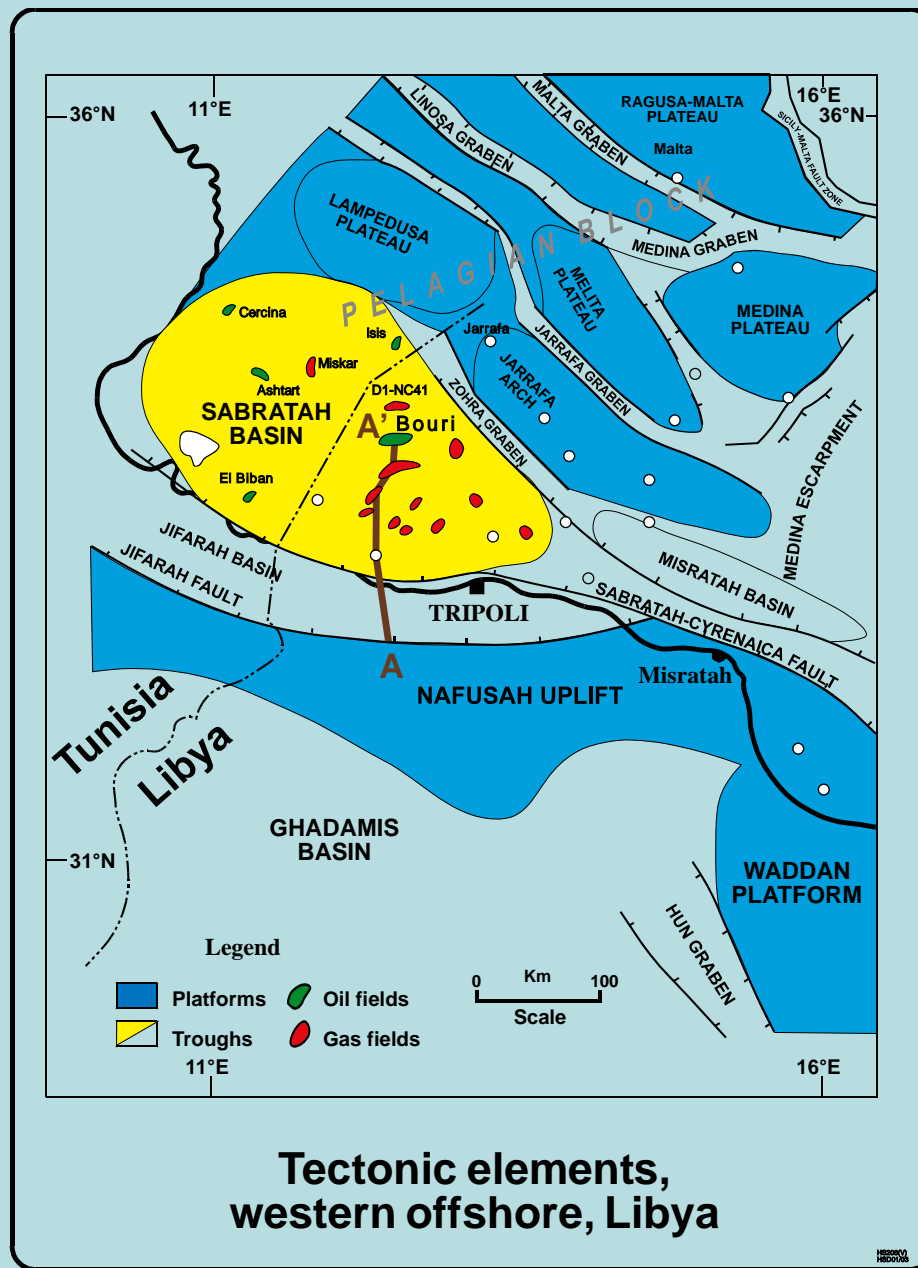
# Organic maturity at the base of Tanezzuft Shale



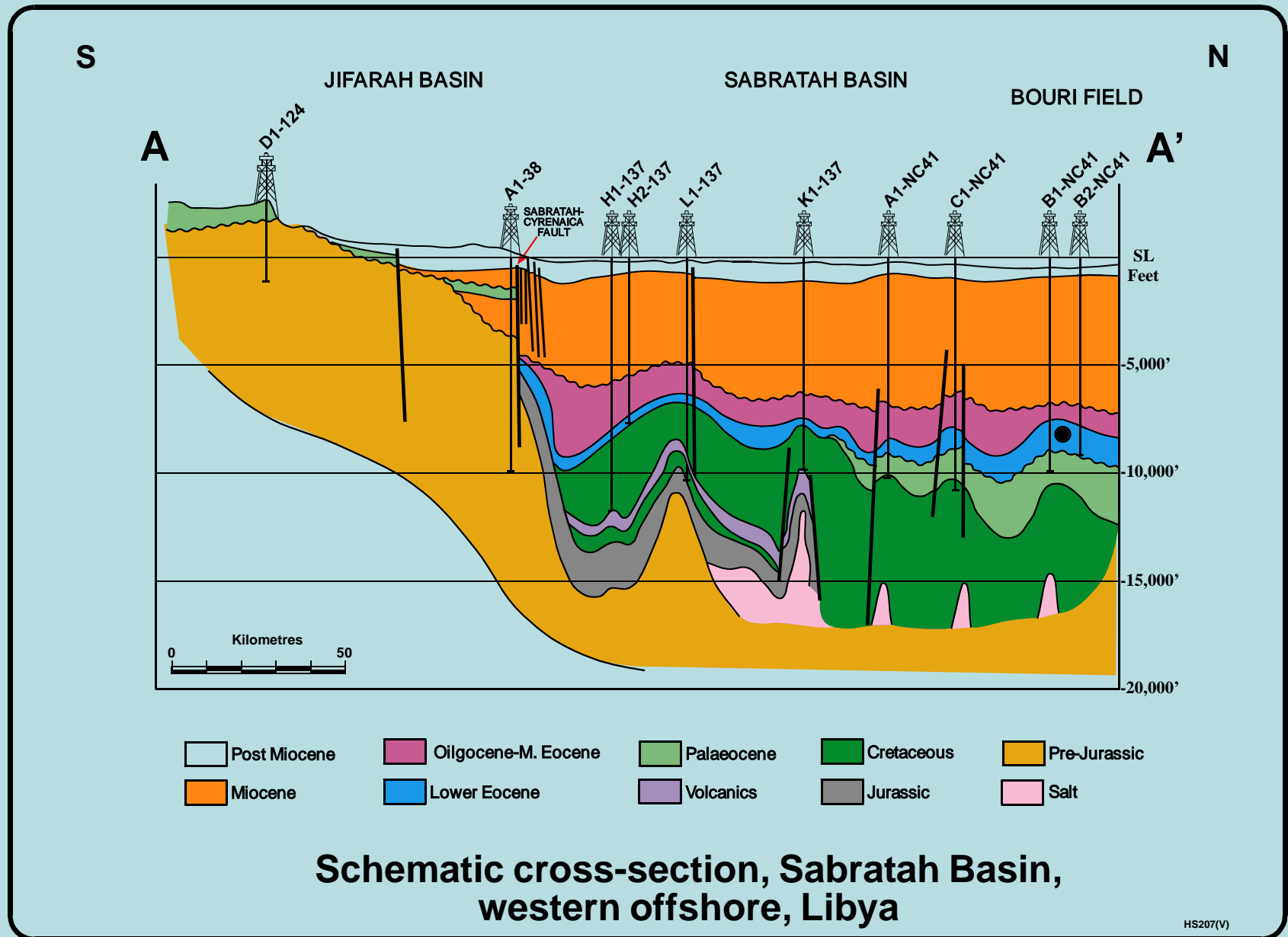
Source Maturation Trends  
for Basal Tanezzuft

WESTERN OFFSHORE

# Tectonic elements, Western Offshore, Libya

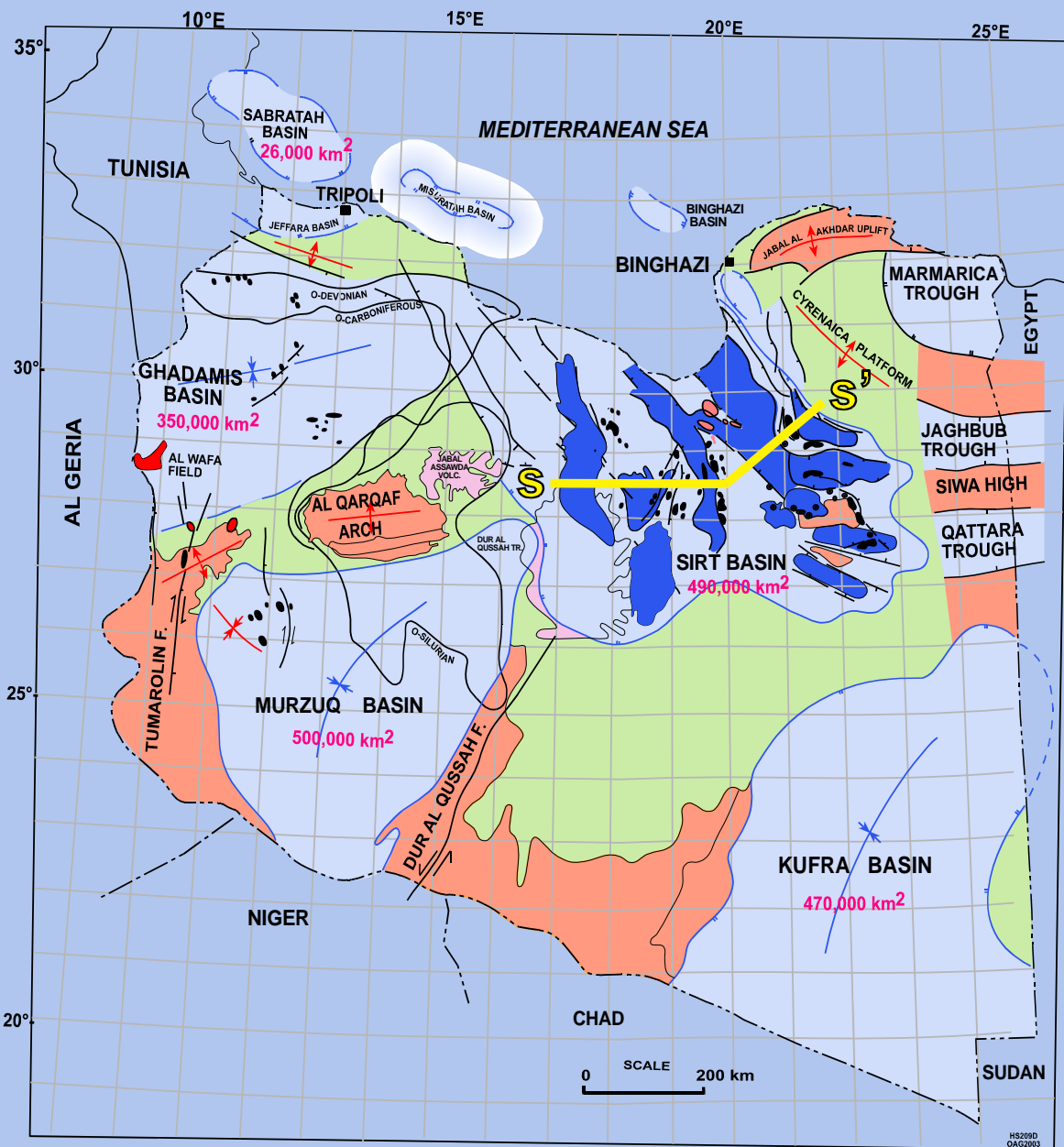


# Schematic N – S cross-section, Western Offshore, Libya





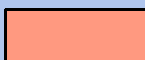

# THE SIRT BASIN

# Location of generalized structural cross-section S – S'



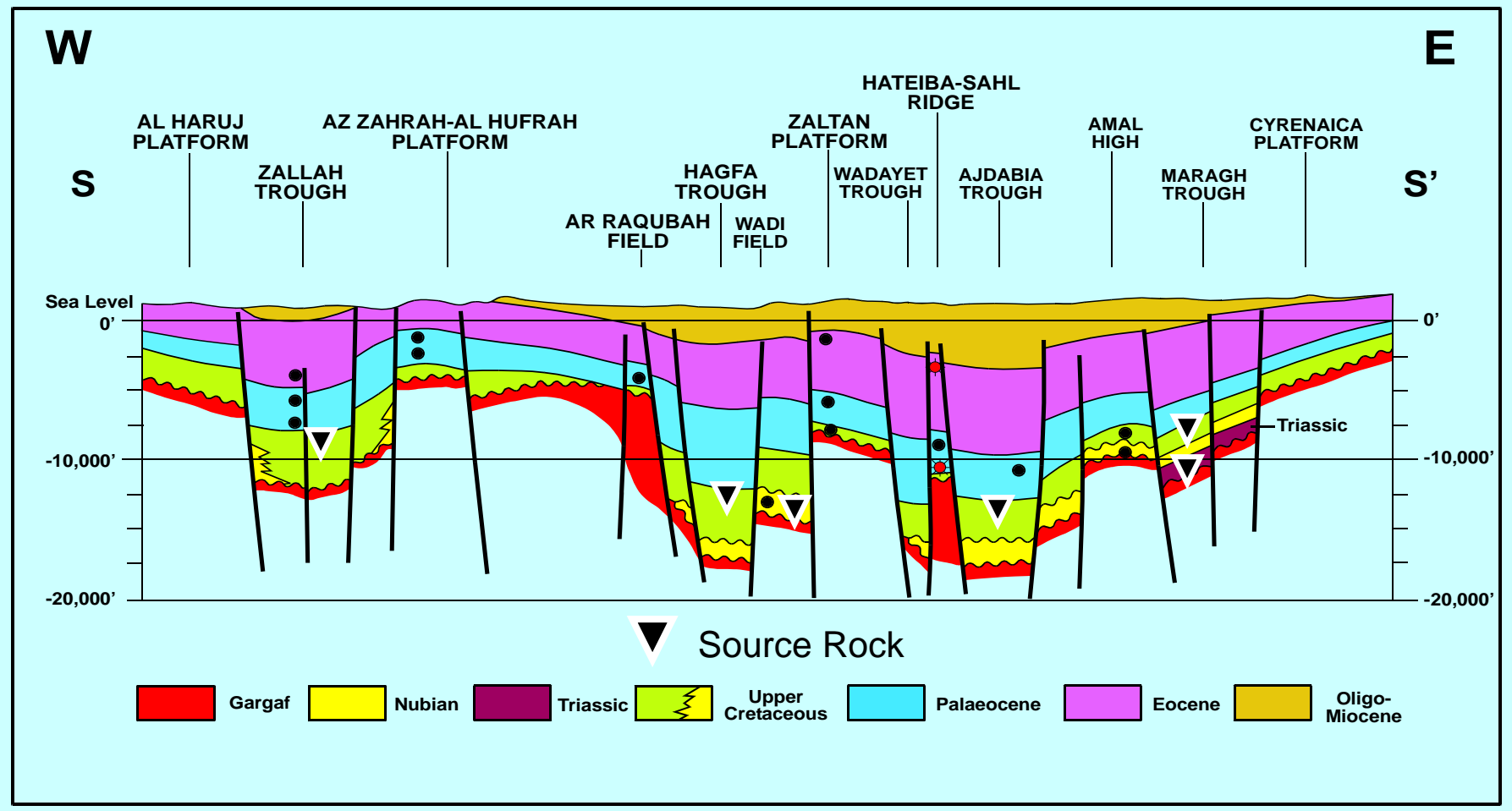
## TECTONIC MAP OF LIBYAN BASINS

### LEGEND

-  CRETACEOUS TROUGH
-  PLATFORM/ BASIN
-  BASEMENT HIGH OR BASEMENT/PALAEOZOIC EXPOSURE
-  SHALLOW BASEMENT

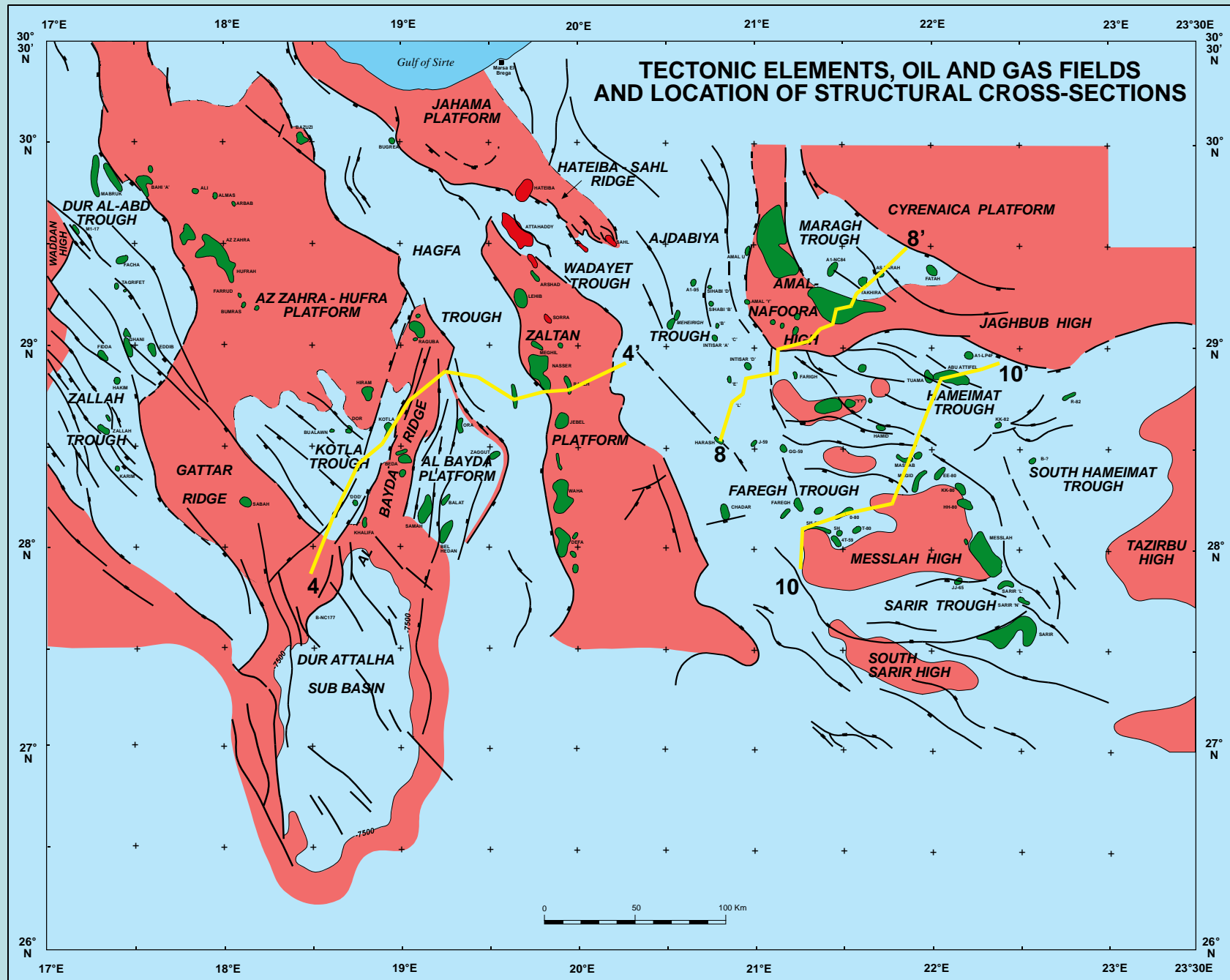


# Generalized East-West cross-section S – S', Sirt Basin



East-West schematic structural cross-section across Sirt Basin

# Location of structural cross-sections, Sirt Basin



# Structural cross-section 4 – 4', Sirt Basin

WEST  
C

EAST  
C'

D1-85  
K.B.778'  
T.D. 11,559'

Y1-59  
K.B.827'  
T.D. 11,790'

H1-47  
K.B.789'  
T.D. 9608'

J1-47  
K.B.479'  
T.D. 9984'

K1A-47  
K.B.311'  
T.D. 5994'

L1-13  
K.B.488'  
T.D.6799'

F1-13  
K.B.487'  
T.D.13,020'

D2-104A  
K.B.617'  
T.D.13,149'

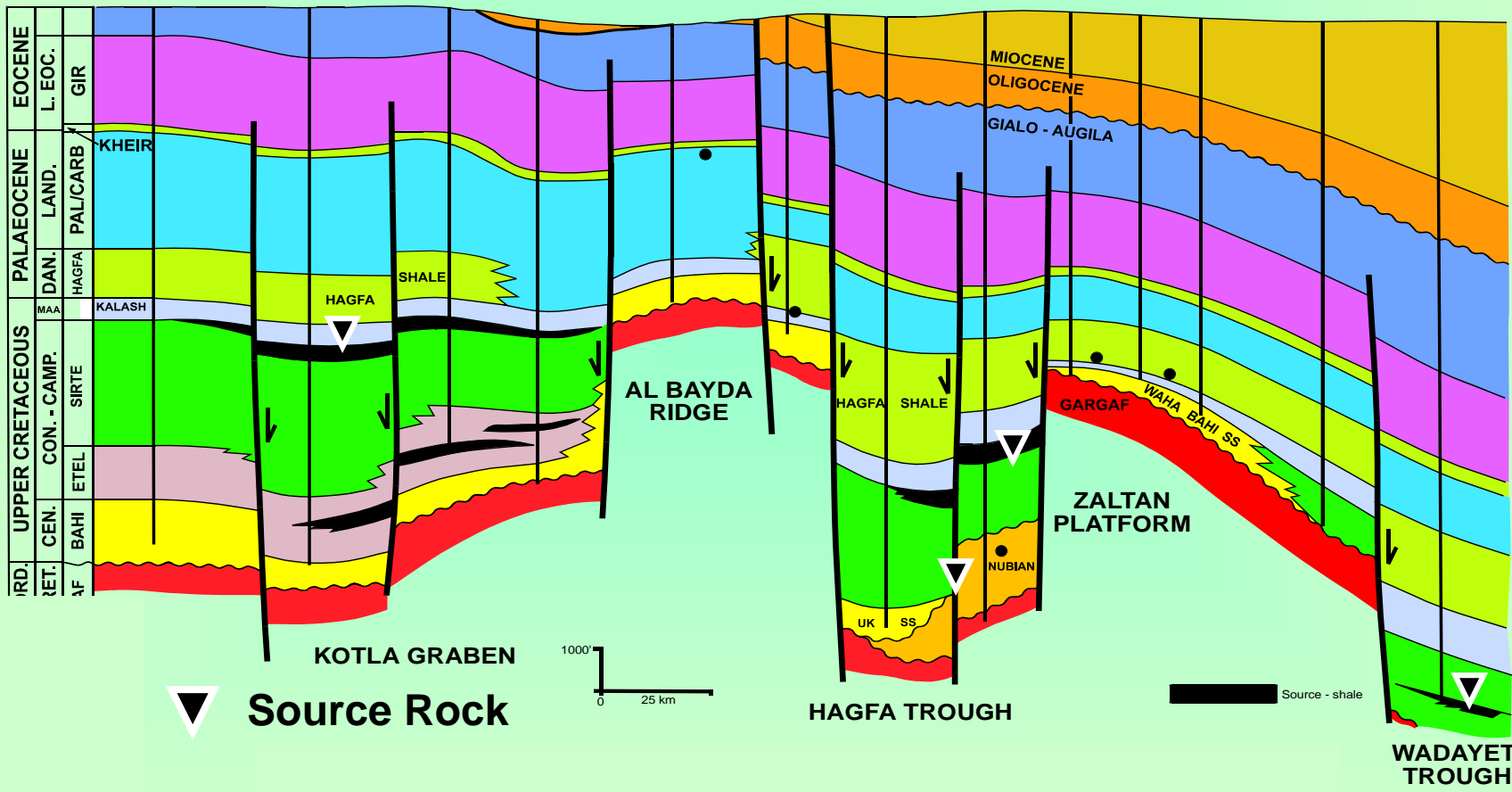
C240-6  
K.B.639'  
T.D.7911'

DD2-6  
K.B.533'  
T.D.7911'

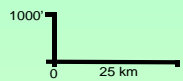
LLL1-6  
K.B.433'  
T.D.8675'

LL1-6  
K.B.395'  
T.D.10,810'

EE1-6  
K.B.362'  
T.D.16,238'

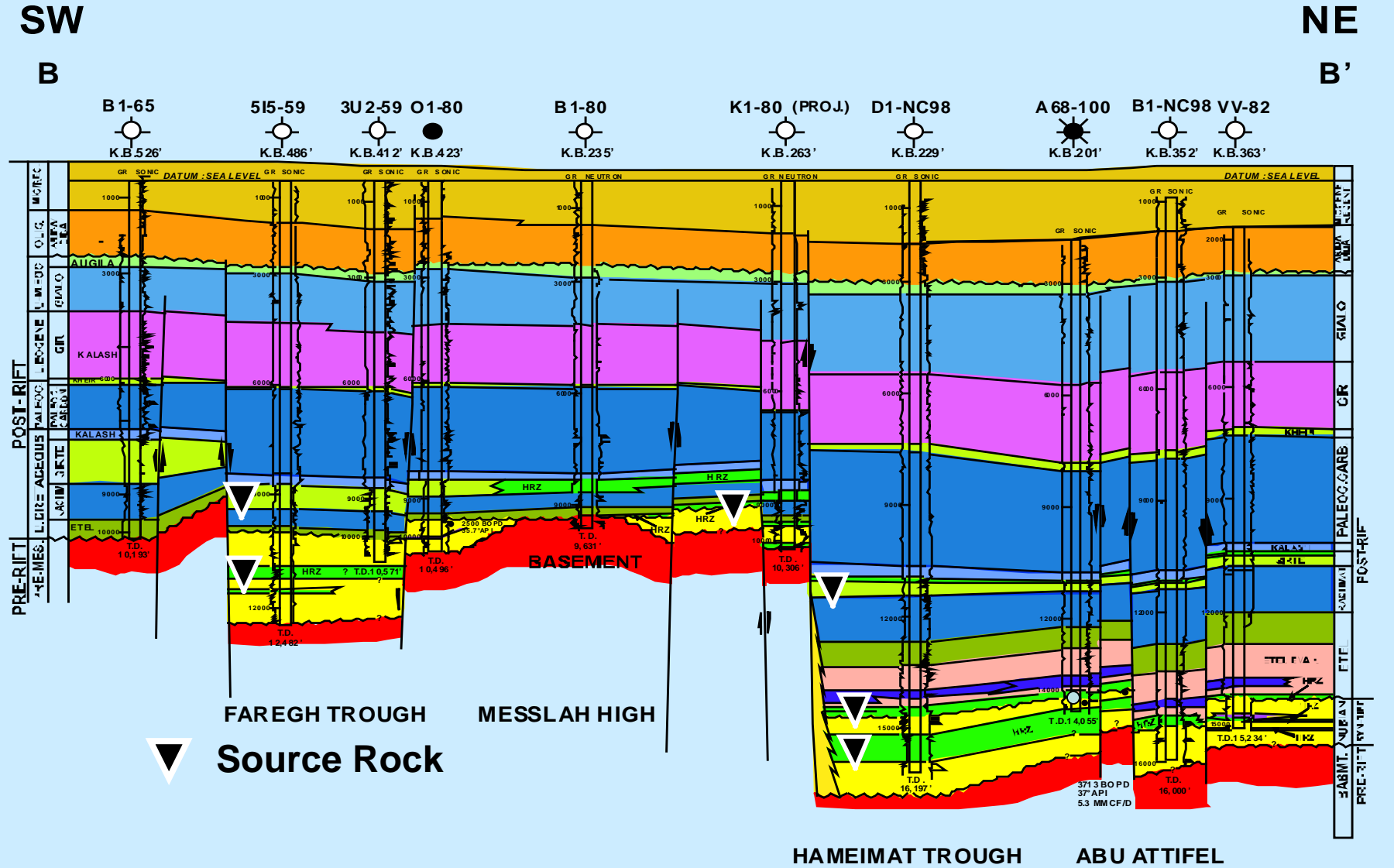


▼ Source Rock



Source - shale

# Structural cross-section 10 – 10', Sirt Basin



0 20km

# Structural cross-section 8 – 8', Sirt Basin

SOUTHWEST

NORTHEAST

AM4

AM4'

Q1-59

L1-103

K1-103

N1-103

C1-12

BB1-12

F1-102

J1-102

H1-59

G56-51

G30-51

G50-51

A2-96

L1-51

D1-51

K.B. 472'

K.B. 418'

K.B. 388'

K.B. 374'

K.B. 363'

K.B. 341'

K.B. 222'

K.B. 220'

K.B. 137'

K.B. 167'

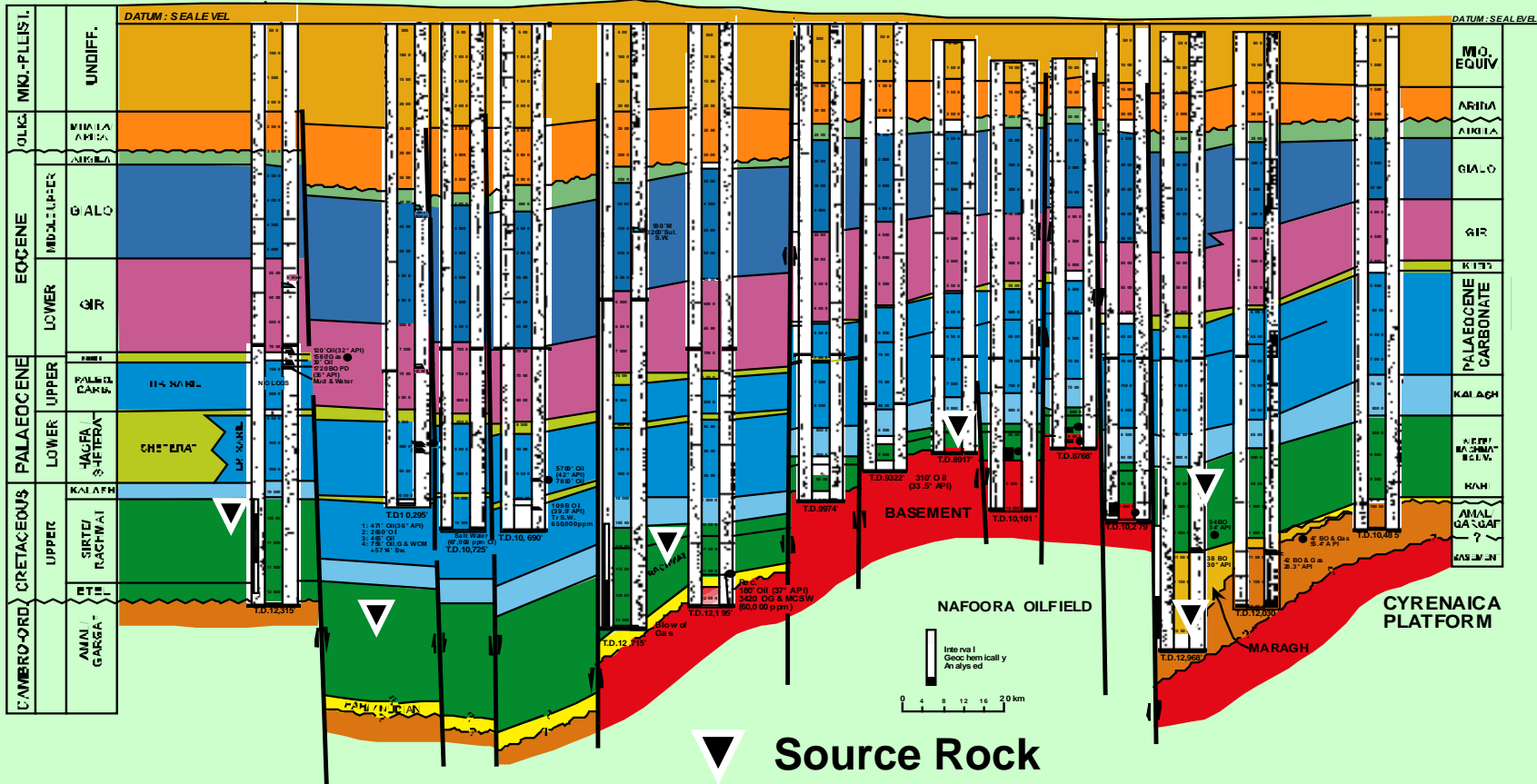
K.B. 105'

K.B. 125'

K.B. 100'

K.B. 105'

K.B. 135'



ZALTAN PLATFORM

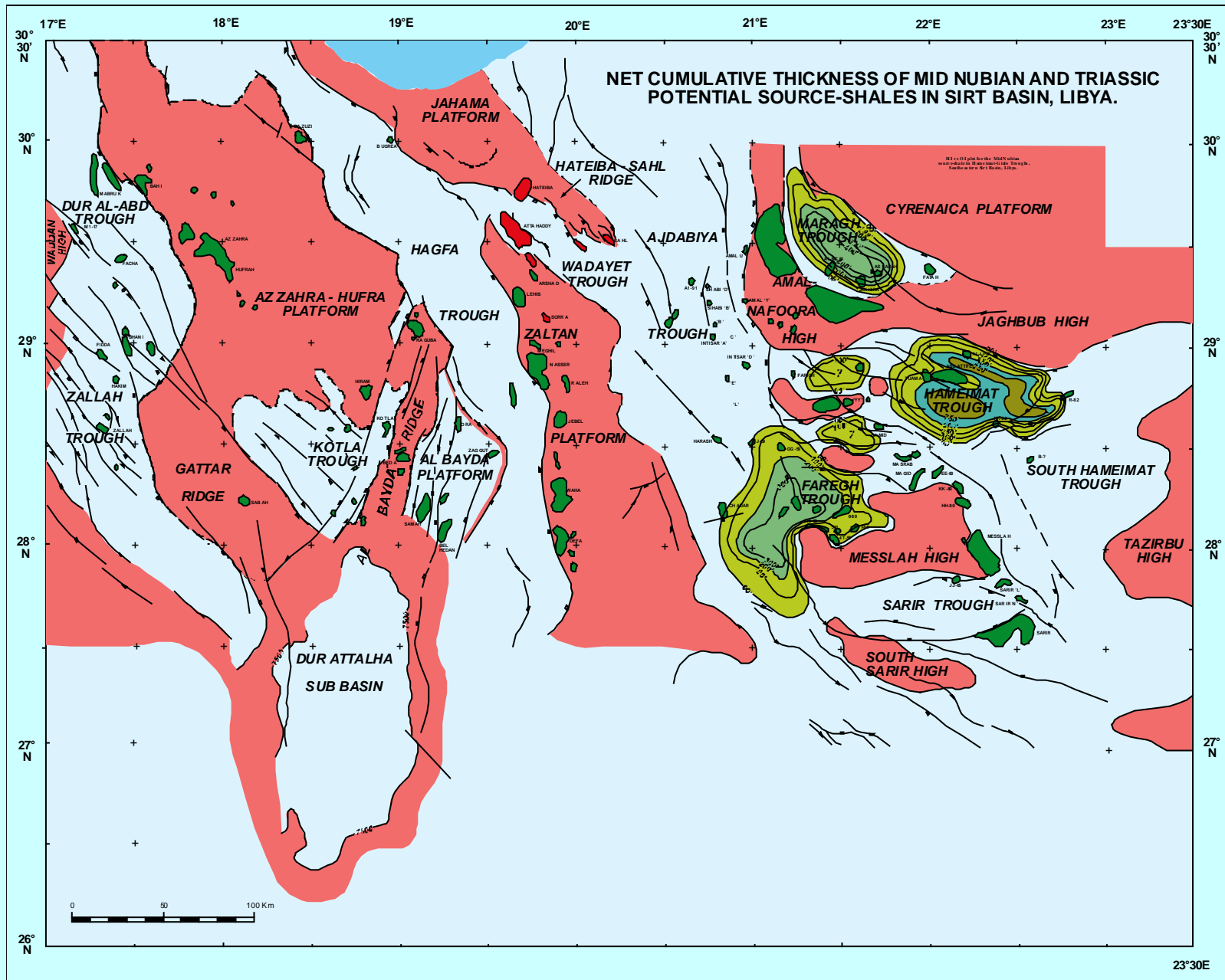
AJDABIYA TROUGH

NAFOORA HIGH

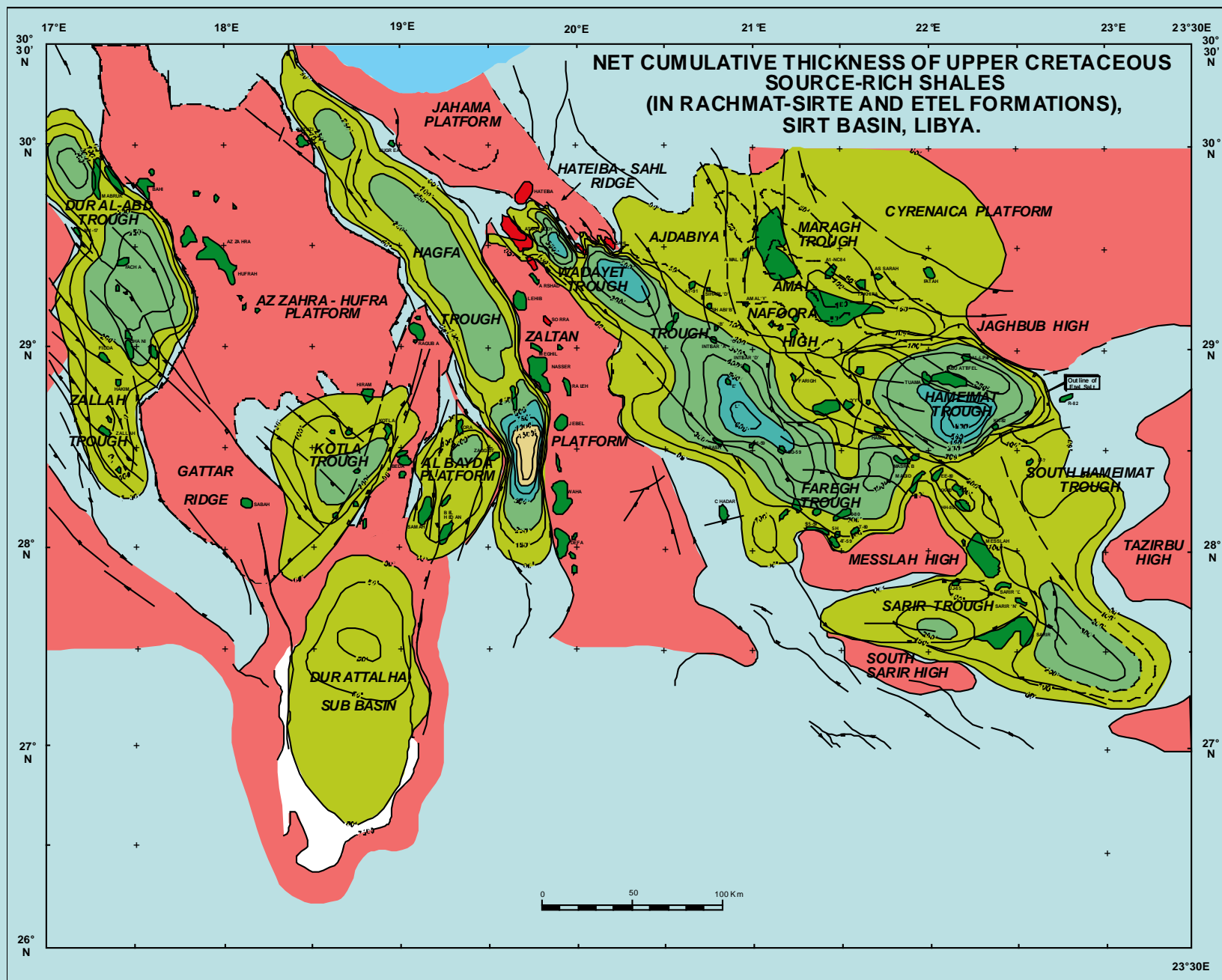
MARAGH TROUGH



# Net cumulative thickness, Nubian and Triassic source-shales

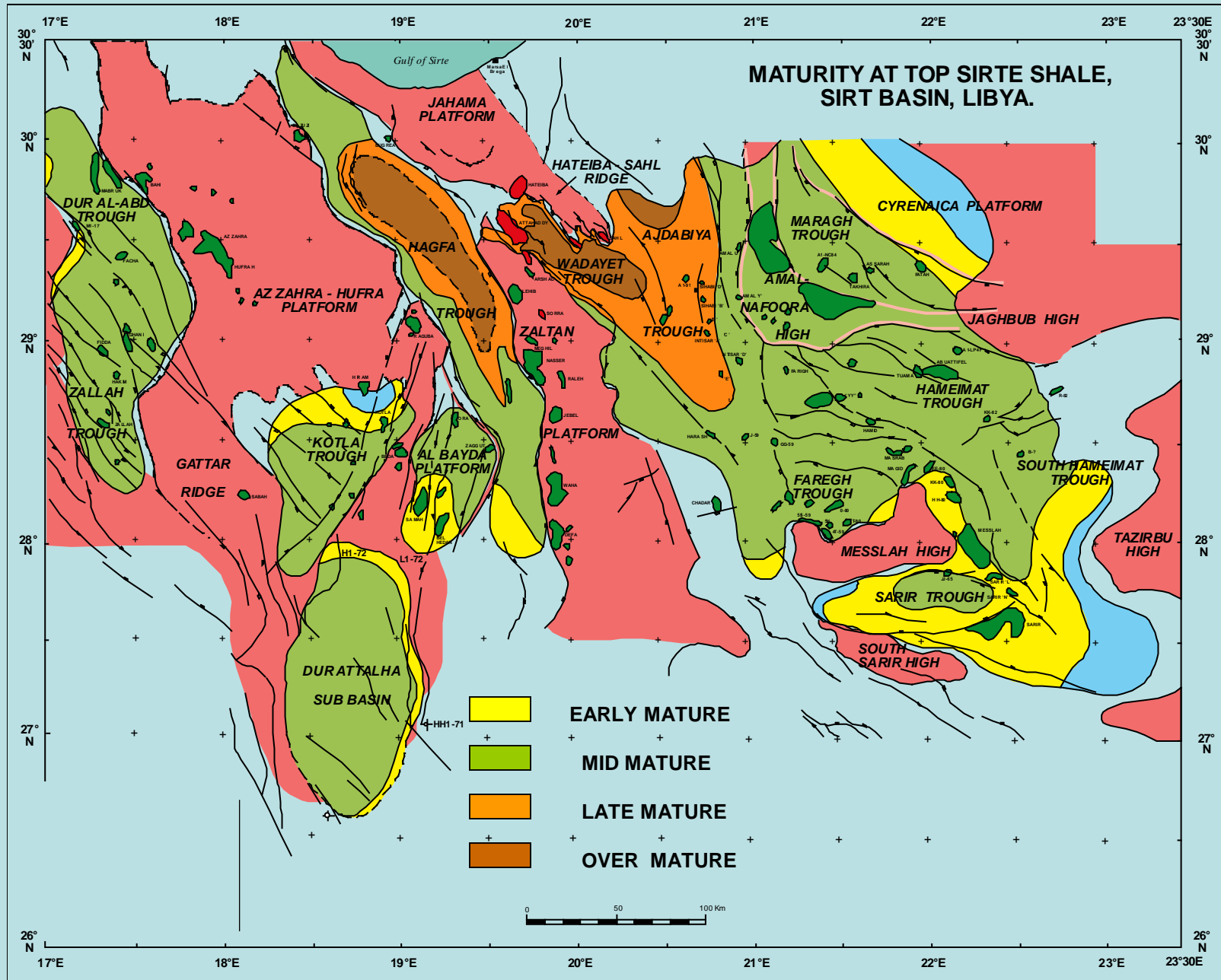


# Net cumulative thickness, Rachmat-Sirte source-shales





# Maturity at the top of Sirte Shale, Sirt Basin

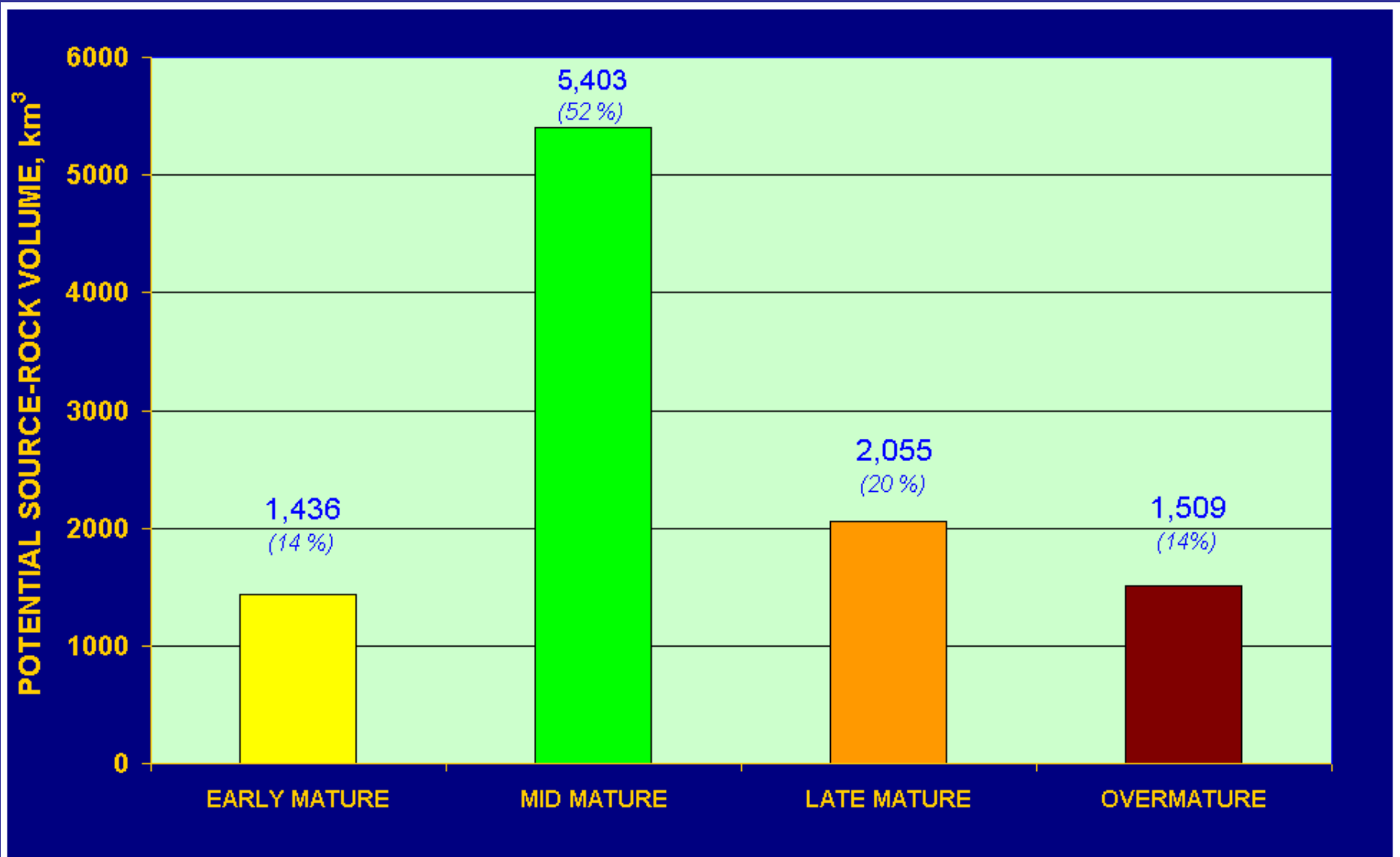




# Inventory of potential source-rocks in Libyan sedimentary basins, (Total volume = 10,402 km<sup>3</sup>)

	Early Mature	Mid Mature	Late Mature	Over Mature	<b>TOTAL</b> (km <sup>3</sup> )	
<b><u>BASINS:</u></b>						
<b>WESTERN OFFSHORE*</b> (W. OF 15° EAST)						
<b>GHADAMIS BASIN:</b>						
<i>Cues, incl. Atshan Saddle</i>	99.5	935.8	336.5	-	1,371.8	
<i>Tanezzuft</i>	738.3	1,046.9	277.4	720.6	2,783.2	
<i>Tanezzuft, Atshan Saddle</i>	114.5	230.3	206.6	107.3	658.7	
<b>SUBTOTAL, GHADAMIS BASIN:</b>	<b>952.3</b>	<b>2,213.0</b>	<b>820.5</b>	<b>827.9</b>	<b>4,813.7</b>	<b>(46%)</b>
<b>MURZUQ BASIN</b> ( <i>Tanezzuft</i> )	<b>49.3</b>	<b>524.5</b>	<b>219.0</b>	<b>-</b>	<b>792.8</b>	<b>(8%)</b>
<b>SIRT BASIN</b> ( <i>Upper and Lr. Cret. &amp; Triassic</i> )	<b>434.3</b>	<b>2,665.2</b>	<b>1,015.2</b>	<b>680.7</b>	<b>4,795.4</b>	<b>(46%)</b>
<b>TOTAL* (km<sup>3</sup>):</b>	<b>1,435.9</b>	<b>5,402.7</b>	<b>2,054.7</b>	<b>1,508.6</b>	<b>10,401.9</b>	<b>(100%)</b>
* Source rock mapping tentative.	(14%)	(52%)	(20%)	(14%)	(100%)	

# Distribution of maturity in potential source-rocks in Libyan sedimentary basins, (Total volume = 10,402 km<sup>3</sup>)



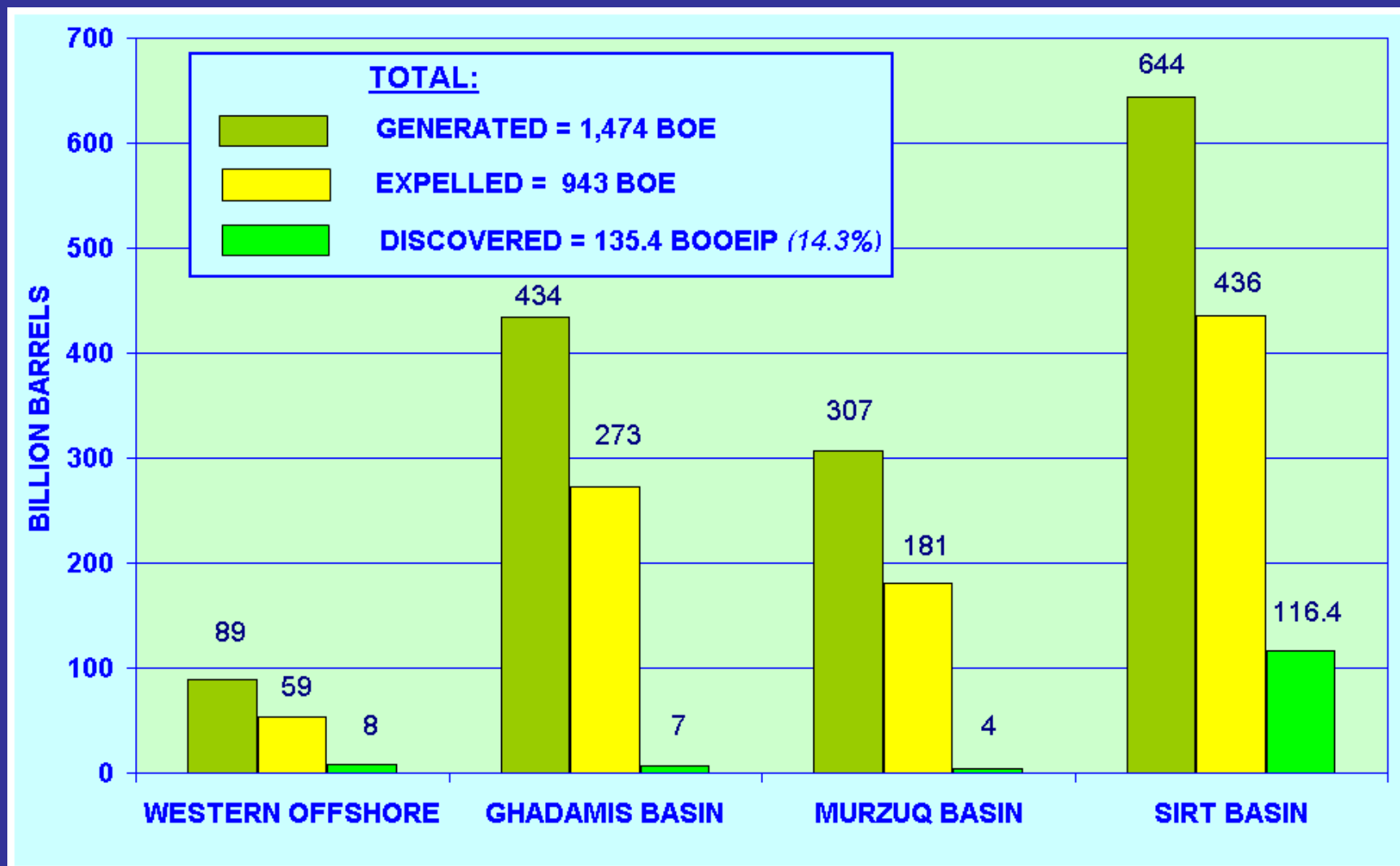
# Volumes of hydrocarbons generated, expelled and discovered in Libyan sedimentary basins

<b><u>BASINS:</u></b>	<b>VOLUME OF HC GENERATED</b>	<b>VOLUME OF HC EXPELLED</b>	<b>VOLUME OF HC DISCOVERED</b>	<b>% HC DISCOVERED</b>
	<b><u>BBOE</u><sup>*</sup></b>	<b><u>BBOE</u><sup>*</sup></b>	<b><u>BBOOEIP</u><sup>**</sup></b>	
<b>Sabratah Basin<sup>@</sup></b>	<b>89</b>	<b>53</b>	<b>8</b>	<b>15</b>
<b>Ghadamis Basin</b>	<b>434</b>	<b>273</b>	<b>7</b>	<b>3</b>
<b>Murzuq Basin</b>	<b>307</b>	<b>181</b>	<b>4</b>	<b>2</b>
<b>Sirt Basin</b>	<b>644</b>	<b>436</b>	<b>116</b>	<b>27</b>
<b>TOTAL</b>	<b>1,474</b>	<b>943</b>	<b>135</b>	<b>14.3</b>

**NOTE:** \* Billion Barrels of Oil Equivalent, \*\* Billion Barrels of Original Oil Equivalent In-Place,

@ West of Longitude 15° E

# Discoveries amount to 14.3% of hydrocarbons expelled in Libyan sedimentary basins



# Conclusions

- \* Large amount of hydrocarbons remains undiscovered, particularly in areas of low “Discovery / Expelled Ratio”
- \* The undiscovered hydrocarbons will be found in areas not yet intensively explored
- \* New exploration concepts need to be applied using modern technology.
- \* Stratigraphic trap mapping and deep exploration hold the greatest promise for large discoveries.

## Future Exploration Plays

- \* **Deep Structural Plays:** Trough areas in Sirt Basin.
- \* **Porosity Pinchout Plays:** Platform areas of Sirt Basin, and Silurian and Devonian of Ghadamis and Murzuq Basins.
- \* **Conventional Structural Plays:** Least explored areas of Murzuq, Kufra and East Libyan Basins.
- \* **Unexplored Sedimentary Basins:** Largely unexplored Kufra Basin, Eastern Offshore and Eastern Onshore.

*The End*

*THANK YOU*