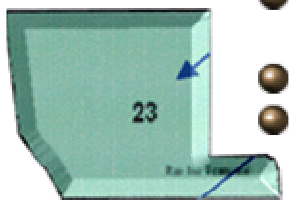
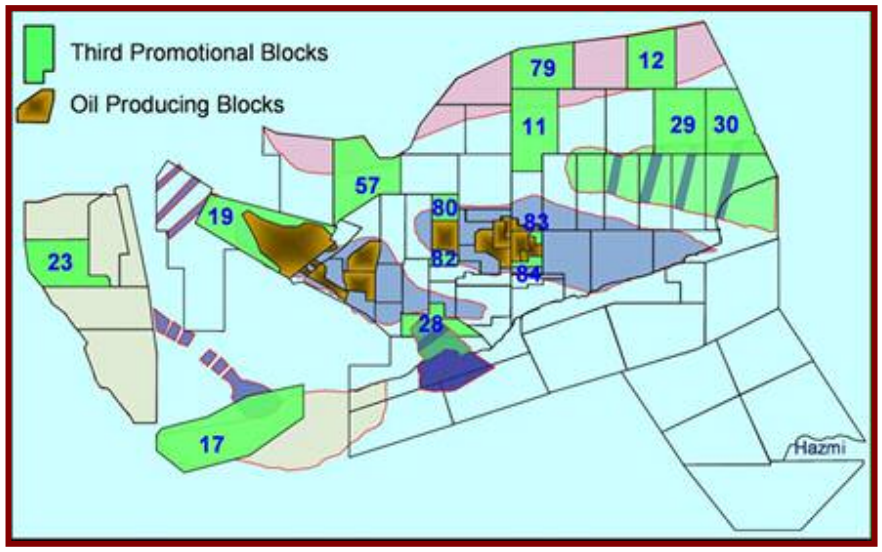
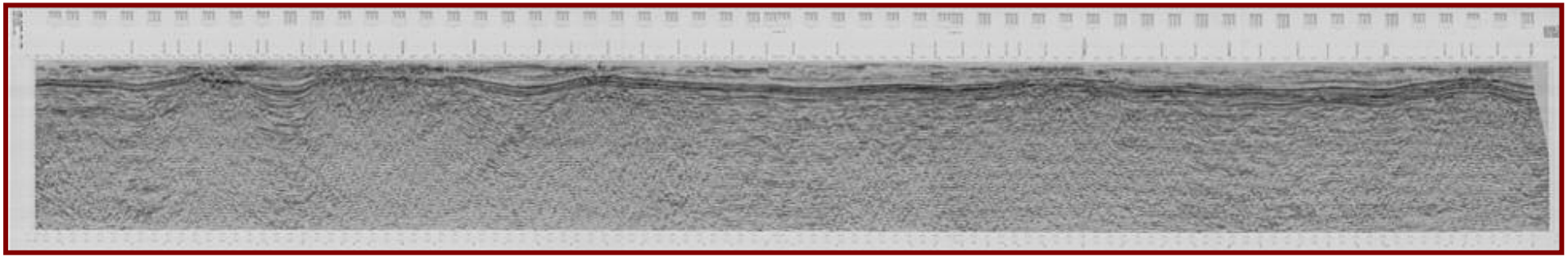
Block 23 (Antufash)



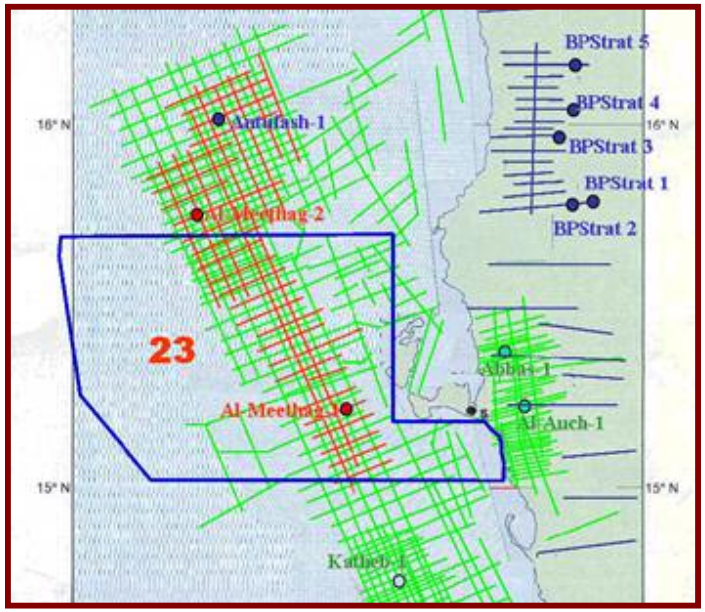
- The Antufash Block (23) occupies an area of 8361 km2 in the Tihama Basin in the Red Sea offshore from the northern part of Yemen.
- To the east, lies the 30-50 km wide Tihama coastal plain which passes eastwards abruptly into the mountain chains occupying the rift shoulders of the southern Red sea.
- The western portion of the Block extends into the central trough of the Red Sea.
- The area is scattered with numerous islands and shoals, which owe their origin to emergent halokinetic structures in the east and to volcanic features in the south and west.



Area (Km^2)	:	8,361
Province	:	Al Hudaydah
Basin	:	Tihamah Basin
Wells	:	1
Seismic	:	More than 1000



Seismic Line 74-545



Previous Work Map

PREVIOUS EXPLORATION ACTIVITIES

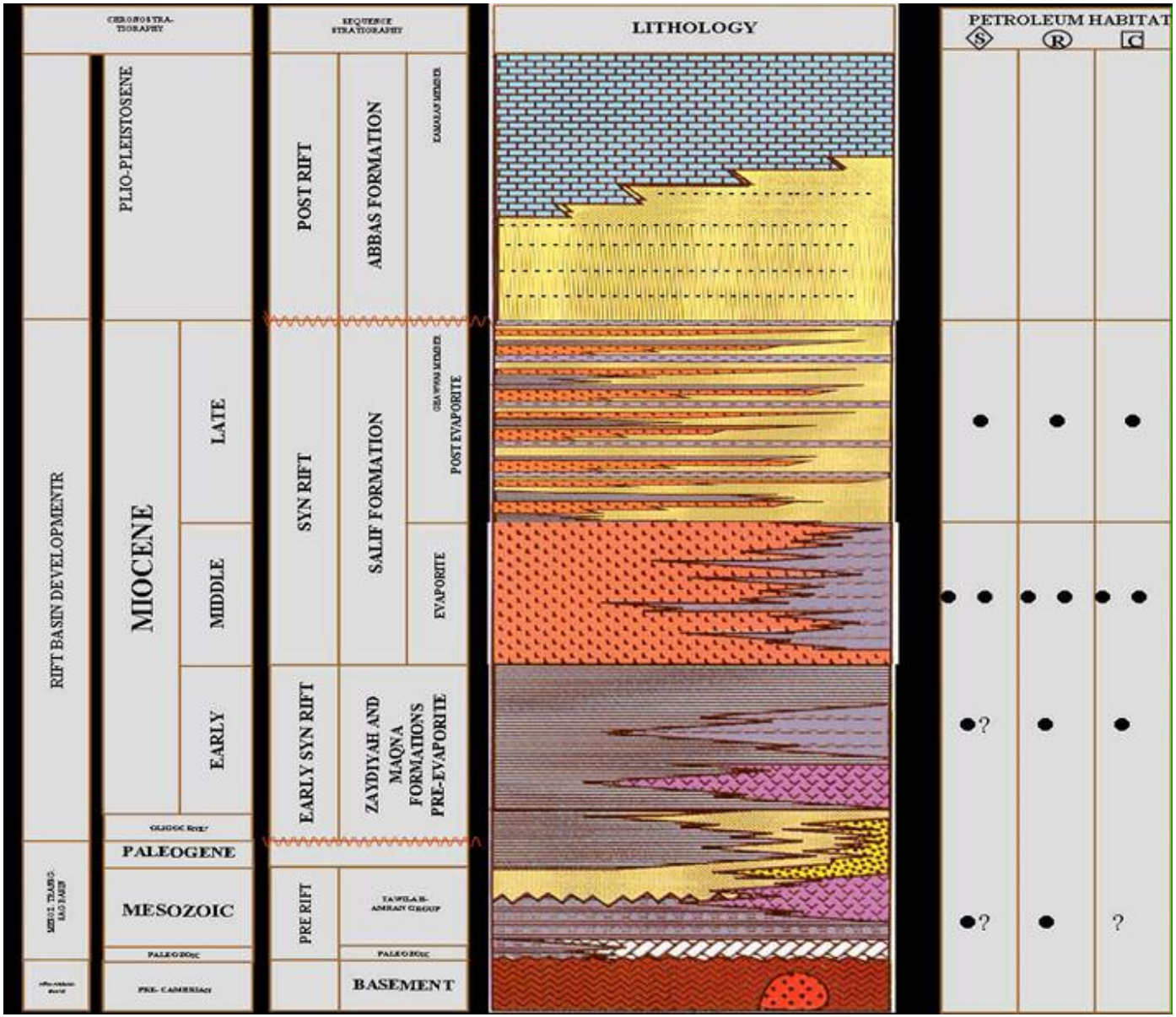
Company	Period	Activities
Shell	1974-1977	Geological Geophysical (2D seismic)
Hunt	1985-1988	Geological Geophysical (2D seismic) Drilling 1 well
BP	1990-1993	Geological Geophysical (2D seismic)

DRILLED WELLS

WELL NAME	COMPANY	DATE	TD TD FM	SHOWS STATUS
AL Meethag#1	Hunt	1985	1841 m Miocene	Oil/Gas shows P & A

The Tihamah basin on- and offshore is developed in the south-eastern part, Yemeni Red Sea as a result of rifting process, which started in Upper Oligocene and continue to the recent. The sedimentary successions include a thick syn- and post-rift strata and are represented by the Tihamah Group (marine, transitional and continental depositional environments). The syn-rift sequence comprises predominately clastic sediments of the Zaydiyah Formation (Early Miocene), the marine sediments with sand interbedding of the Maqna Formation (Lower/Middle Miocene), the evaporites with subordinate shales and clastic input of the Salif Formation (Upper Miocene) and including the Ghawwas Member (Upper Miocene), which represent the upper part of the Salif Formation. The post-rift sequence is represent by the Abbas Formation (Pliocene/Pleistocene), consist predominately of clay and mudstone in Abbas-1 well with vertical variations of thickness and lateral facies changes in other subsurface sections. The reef limestone of the Abbas Formation which developed in the upper part of the subsurface sections and along the shore of the Yemeni Red Sea is of Pleistocene age and belong to the Kamaran Member and is similar to the organic reef of the Farasan Islands off the Southern Red Sea coast of Saudi Arabia. Oil seeps were found in the As-Salif peninsula, migrated crude was present in the onshore region of the Tihamah plain (Alpha-1 and Abbas-1 wells) and oil and gas shows in several on- and offshore wells indicate presence of a proven source rocks in several stratigraphic levels and appears to be oil and gas-prone. Exploration results of the petroleum system of the Tihamah basin indicate good source rocks mainly the shale and mudstone layers of the Zaydiyah and Maqna Formations and the shale within the Ghawwas Member of the Salif Formation. The sandstone horizons of the Zaydiyah, Maqna, Salif and Abbas Formations provide a good reservoir potential with good porosity and permeability. The evaporites sediments (anhydrite and halite) of the Salif Formation and the Ghawwas Member offer a very good seal. The geothermal gradient in the Red Sea is not constant and change in different direction related to the distance from the rift center. The strong halokinesis, the different thickness of the salt, the lateral and vertical variation of sediment depositions in the basin, the volcanic activities, intertonguing of volcanic flows and intrusions of dykes and sills of Yemen Volcanic Group and the NNW/SSE structural features between the rift margin and rift center formed the Tihamah rift basin into margin-parallel structural zones, salt walls and pillows, which

divided the basin in several sectrors with different character. The shape and limits of the Tihamah basin are
determined by the distribution and the thickness of the syn-rift which reachs a several thousand of meters and dominated by the salt, sandstones and shales. The thickness of the salt is decreasing and thinning towards the margins and by facies changes to other evaporites, mainly to anhydrite, gypsum and often further carbonates. The post-rift sediments represented by a thick clastic sediments reach several thousands of meters. This thick sediment succession indicate that a great denudation was produceed by fluvial erosion with an rapid transport of sediment from the great



scarpment along the eastern mountains. Accordingly, the rollover anticline and the diapir fairways offer the most attractive combination of source, reservoir and seal, whereas the diapir and salt-cored anticline zones are likely to have good source but limited reservoir potential. The massive salt fairway offers limited trapping possibilities and limited source and reservoir rocks.

PETROLEUM SYSTEM

TRAPS AND PLAY FAIRWAYS

- The area can be divided into four sub-parallel structural zones:
  - The Outer Shelf zone - potential traps exist in *roller anticlines* and *turtleback* structures.
  - The Coastal zone - contains *roller anticlines* ،*fault block traps* and *stratigraphic traps in fluviatile channel sands*.
  - The Salt-cored Anticline zone - which contains *numerous, simple, large anticlines with multiple closure over several sequences.*
  - The Diapir zone.

SOURCE ROCKS

- In the Meethag#1 and Antufash#1 wells, cuttings samples have yielded good quality oil source rocks with up to one third of shales exhibiting some source rock quality and with one high graded unit having over 20% TOC, a P2 yield of 85 kg/tone and a hydrogen index of >450
- Typically source rocks occupy 5-15% of each sequence, with average P2 yields of10 kg/t and HI of 275

RESERVOIR ROCKS

- Potential reservoir quality rock could be expected in sandstones of fluvial and alluvial origin throughout the block.
- Potential reservoir facies are restricted to two facies:
  - shallowing upward mixed evaporite/clastics
  - prograding lake margin/alluvial fans
- The 10 md cutoff (oil net/gross boundary) for the sandstone is about 30% effective porosity in Al Meethag-1.
- The effective porosities are about 70% of the total porosity in the sandstone of Al Meethag-1.

SEALS

- Abundant interbedded evaporites