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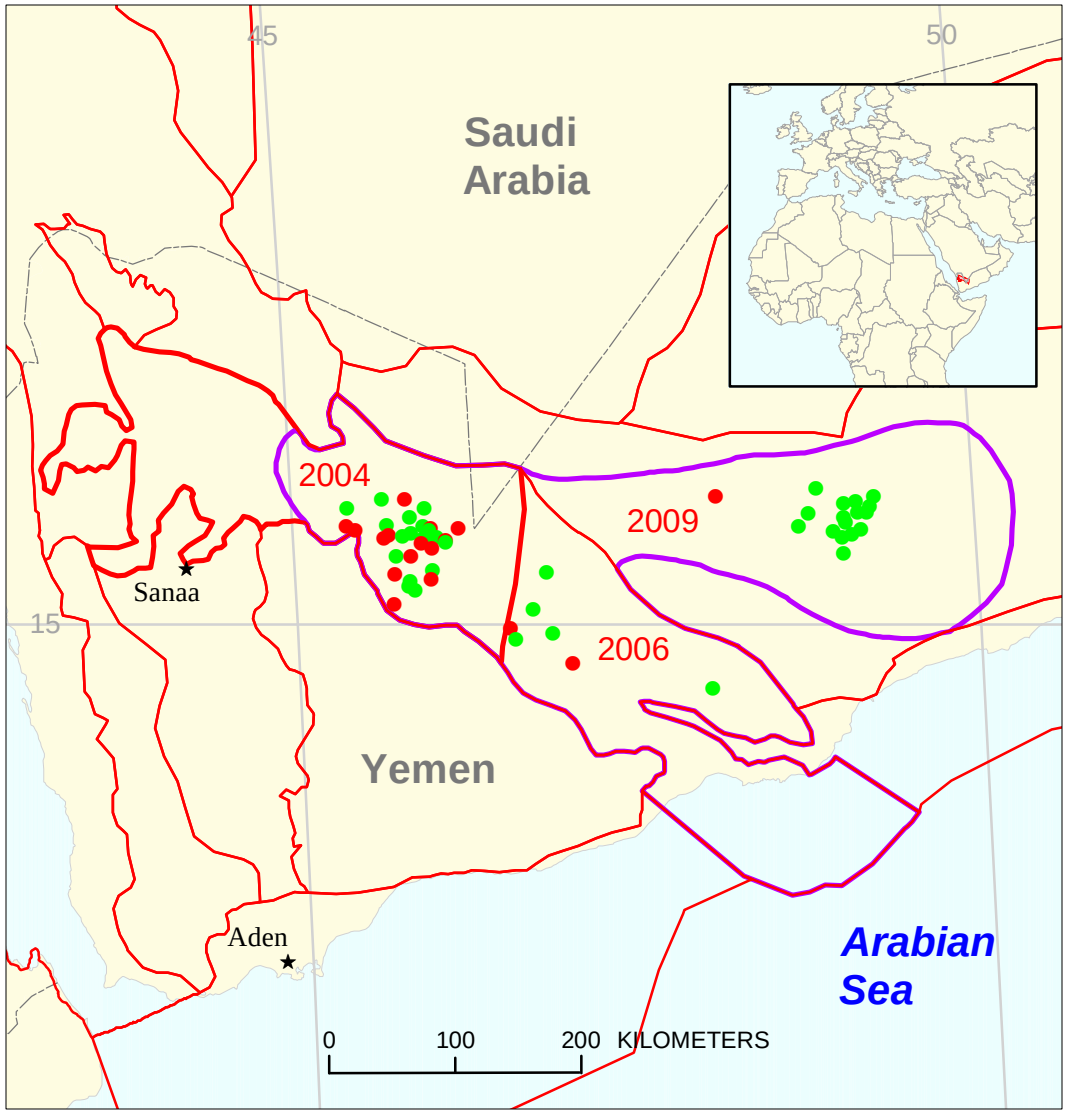
Ma'Rib-Al Jawf/Shabwah/Masila Assessment Unit 20040101



Ma'Rib-Al Jawf/Shabwah/Masila Assessment Unit 20040101
Ma'Rib-Al Jawf/Masila Basin Geologic Province 2004
Other geologic province boundary

Geologic Summary

Detailed map of this assessment unit

Exploration/Discovery-History Data

- Plots of Known Field Sizes
- Plots of Grown Resources
- Tables

Assessment Input Data

Assessment Results

- Assessment Unit Summary
- Detailed Assessment Results
- Undiscovered Field-Size Distributions

USGS PROVINCE: Ma'Rib-Al Jawf/Masila Basin (2004) **GEOLOGIST:** T.S. Ahlbrandt

TOTAL PETROLEUM SYSTEM: Madbi Amran/Qishn (200401)

ASSESSMENT UNIT: Ma'Rib-Al Jawf/Shabwah/Masila (20040101)

DESCRIPTION: Assessment unit encompasses the entire Total Petroleum System and crosses three provinces in Yemen. The petroleum system is related to an Upper Jurassic source rock sequence essentially deposited as deep marine deposits in a synrift setting (in some areas prerift sag). In the western part of the area, reservoirs are synrift, in the eastern part reservoirs are postrift.

SOURCE ROCKS: The Upper Jurassic (Kimmeridgian) source rocks of the Madbi Formation including both Madbi and Lam Members are organic-rich black shales deposited in the deeper portions of rifts in the Late Jurassic.

MATURATION: Source rocks began generating in the central rift basin in latest Cretaceous to earliest Paleogene time and the process was largely completed by the end of Paleogene time.

MIGRATION: Oil and gas migrated along faults to horst blocks within these various basins. Numerous horst uplifts occur; however migration resulted in hydrocarbon accumulations in those areas where sealed by either a Jurassic salt (Ma'Rib/Al-Jawf/Shabwah or Sab'atayn basin) or by Early Cretaceous carbonate (Masila/Jeza or Say'un basin). Heavy oil is known to occur marginal to the accumulation sites.

RESERVOIR ROCKS: In the western basins (Ma'Rib/Al-Jawf), the reservoirs are dominantly Upper Jurassic (Kimmeridgian, Tithonian) clastics of the Amran Group (Safir Member), or lesser amounts of carbonates in the Amran Group. The Safer/Alif/Yan Member clastics prograded from the northwest of the Ma'Rib Basin and diminish in thickness and content to the southeast; they are largely absent in the southern Shabwah Basin. In the Masila/Jeza Basin, the Early Cretaceous estuarine sandstones of the Qishn Formation (Berremian/Aptian) are the primary reservoir.

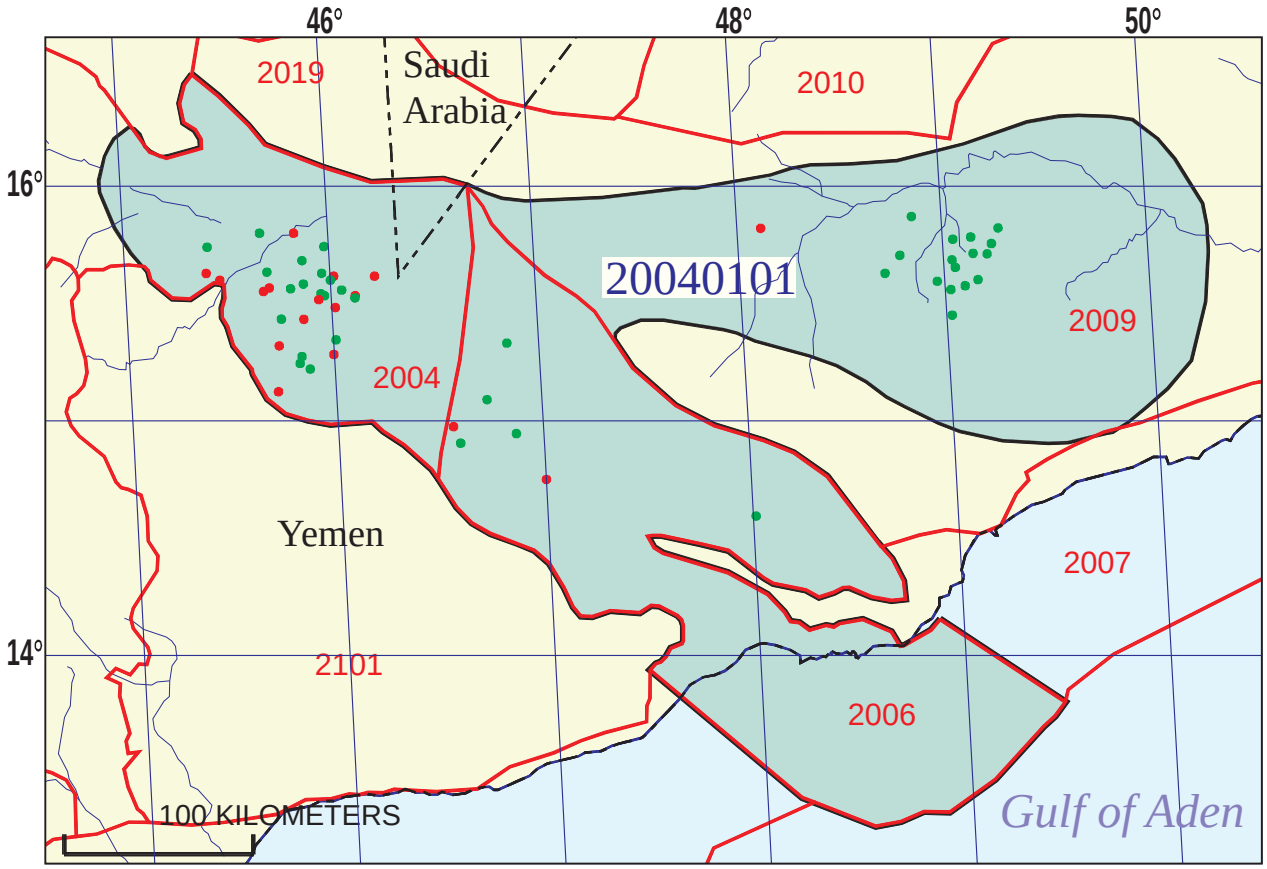
TRAPS AND SEALS: Salt of the Upper Jurassic (Tithonian) Shabwa Member are the critical seal within the Ma'Rib, Al-Jawf, and Shabwah basins, a secondary seal are evaporites of the Avad and Nayfa Formations. The Qishn Carbonate Member (Aptian) provides the seal for the underlying Qishn Clastic Member in the Masila Basin.

REFERENCES:

Bosence, D.W.J., ed., 1997, Special issue on Mesozoic rift basins of Yemen: Marine and Petroleum Geology, v. 14, no. 6, p. 611-730.

Beydoun, Z.R., and others, 1998, International lexicon of stratigraphy, v. III, Republic of Yemen, (2nd ed.): International Union of Geological Sciences and Ministry of Oil and Mineral Resources, Republic of Yemen Publication no. 34, 245 p.

Brannin, Joe, and others, 1999, Geological evolution of the central Marib-Shabwa basin, Yemen: GeoArabia, v. 4, no. 1, p. 9-34.



Ma'Rib-Al Jawf/Shabwah/Masila Assessment Unit - 20040101

EXPLANATION

- Hydrography
- Shoreline
- 2004 — Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 20040101 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

SEVENTH APPROXIMATION
NEW MILLENNIUM WORLD PETROLEUM ASSESSMENT
DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS

Date:……..	5/12/99		
Assessment Geologist:……..	T.S. Ahlbrandt		
Region:……..	Middle East and North Africa	Number:	2
Province:……..	Ma'Rib-Al Jawf/Masila Basin	Number:	2004
Priority or Boutique……	Priority		
Total Petroleum System:……	Madbi Amran/Qishn	Number:	200401
Assessment Unit:……..	Ma'Rib-Al Jawf/Shabwah/Masila	Number:	20040101
* Notes from Assessor			

CHARACTERISTICS OF ASSESSMENT UNIT

Oil (<20,000 cfg/bo overall) **or** Gas (≥20,000 cfg/bo overall):… Oil

What is the minimum field size?……. 5 mmboe grown (≥1mmboe)
(the smallest field that has potential to be added to reserves in the next 30 years)

Number of discovered fields exceeding minimum size:…… Oil: 36 Gas: 15
Established (>13 fields) X Frontier (1-13 fields) _____ Hypothetical (no fields) _____

Median size (grown) of discovered oil fields (mmboe):
1st 3rd 85.8 2nd 3rd 67.9 3rd 3rd 31.9
Median size (grown) of discovered gas fields (bcfg):
1st 3rd 976.7 2nd 3rd 1135 3rd 3rd 77.8

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered field ≥ minimum size……	1.0
2. **ROCKS:** Adequate reservoirs, traps, and seals for an undiscovered field ≥ minimum size……	1.0
3. **TIMING OF GEOLOGIC EVENTS:** Favorable timing for an undiscovered field ≥ minimum size	1.0

Assessment-Unit GEOLOGIC Probability (Product of 1, 2, and 3):…….. 1.0

4. **ACCESSIBILITY:** Adequate location to allow exploration for an undiscovered field ≥ minimum size…… 1.0

UNDISCOVERED FIELDS

Number of Undiscovered Fields: How many undiscovered fields exist that are ≥ minimum size?:
(uncertainty of fixed but unknown values)

Oil fields:……min. no. (>0)	10	median no.	70	max no.	140
Gas fields:……min. no. (>0)	10	median no.	35	max no.	60

Size of Undiscovered Fields: What are the anticipated sizes (**grown**) of the above fields?:
(variations in the sizes of undiscovered fields)

Oil in oil fields (mmbo)…… min. size	5	median size	23	max. size	600
Gas in gas fields (bcfg):…… min. size	30	median size	100	max. size	3000

Assessment Unit (name, no.)
Ma'Rib-Al Jawf/Shabwah/Masila, 20040101

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……	2000	4000	6000
NGL/gas ratio (bngl/mmcfg)……	30	60	90

Gas fields:	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg)……	22	44	66
Oil/gas ratio (bo/mmcfg)……			

SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS

(variations in the properties of undiscovered fields)

Oil Fields:	minimum	median	maximum
API gravity (degrees)……	19	36	45
Sulfur content of oil (%)……	0.1	0.25	0.54
Drilling Depth (m) ……	750	2500	4000
Depth (m) of water (if applicable)……	0	0	100

* V-12, 19, 2.3, 25, 26 V-2-26ppm
* Ni-6, 7, 1.3, 5.0, 11 Ni-6-11ppm

Gas Fields:	minimum	median	maximum
Inert gas content (%)……			
CO_2 content (%)……			
Hydrogen-sulfide content (%)……			
Drilling Depth (m)……	750	3000	5000
Depth (m) of water (if applicable)……	0	0	100

Assessment Unit (name, no.)
Ma'Rib-Al Jawf/Shabwah/Masila, 20040101

ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT TO COUNTRIES OR OTHER LAND PARCELS (uncertainty of fixed but unknown values)

1. Yemen represents 100 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		100	
Portion of volume % that is offshore (0-100%).....		1	

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		100	
Portion of volume % that is offshore (0-100%).....		1	

2. Province 2004 represents 21.2 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		35	
Portion of volume % that is offshore (0-100%).....		0	

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		35	
Portion of volume % that is offshore (0-100%).....		0	

3. Province 2006 represents 39.4 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		25	
Portion of volume % that is offshore (0-100%).....		5	

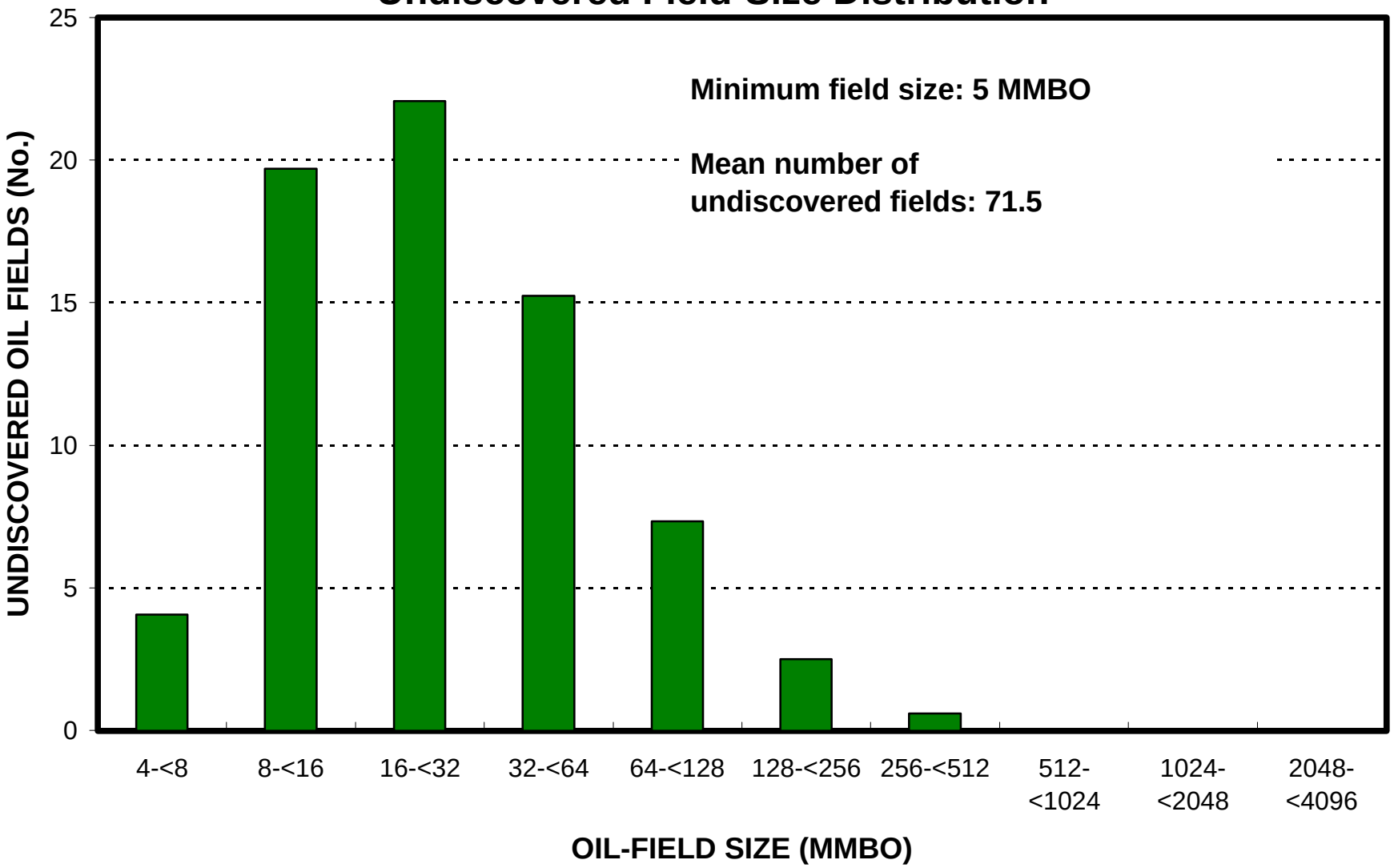
Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		25	
Portion of volume % that is offshore (0-100%).....		5	

4. Province 2009 represents 39.4 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		40	
Portion of volume % that is offshore (0-100%).....		0	

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		40	
Portion of volume % that is offshore (0-100%).....		0	

Ma'Rib-Al Jawf/Shabwah/ Masila, AU 20040101
Undiscovered Field-Size Distribution



Ma'Rib-Al Jawf/Shabwah/ Masila, AU 20040101
Undiscovered Field-Size Distribution