




Greater Indus Foreland and Foldbelt Assessment Unit 80420101



-  Greater Indus Foreland and Foldbelt Assessment Unit 80420101
-  Indus Geologic Province 8042
-  Other geologic province boundary

USGS PROVINCE: Indus (8042) Pakistan and India

GEOLOGIST: C.J. Wandrey

TOTAL PETROLEUM SYSTEMS: Sembar-Goru/Ghajiz (804201)

ASSESSMENT UNITS: Greater Indus Basin Foreland and Foldbelt (80420101)

DESCRIPTION: This assessment unit is located in eastern Pakistan and western India. It is a gas prone primarily onshore basin developed parallel to and involving obliquely converging continental plate boundaries. The tightly folded rocks of the Suliman and Kirthar ranges make up the western portion of the assessment unit while the eastern portion is a remnant continental shelf dipping gently to the west. This assessment unit includes Jurassic through Miocene source rocks and reservoirs. These rocks include carbonates and shales of shelf environments, and sandstones, shales, and coals of deltaic and fluvial facies. While the Lower Cretaceous Sembar Formation appears to be the major source of hydrocarbons there are many other potential source rocks that may be contributing in different parts of the basin and foldbelt.

SOURCE ROCKS: Source rocks include the Lower Cretaceous Sembar, Permian Dandot, Triassic Wugali, and Paleocene Patala formations. Total organic carbon content ranges from 0.5 percent to >3.5 percent with an average of 1.4 percent and are Type II and III kerogens.

MATURATION: Maturities range from Ro 0.3 percent to >1.6 percent where sampled. The Lower Cretaceous Sembar may be overmature offshore.

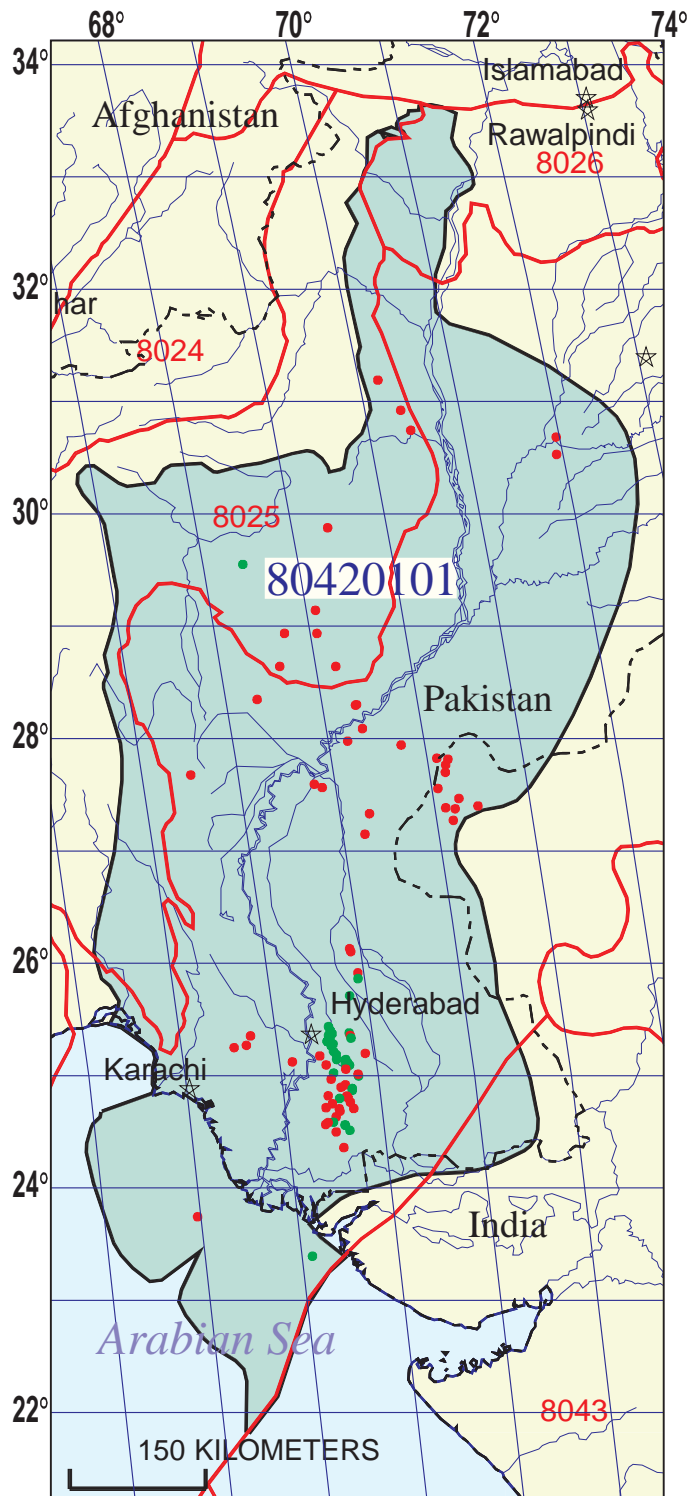
GENERATION AND MIGRATION: Generation occurred at least two different times in the basin, first at the beginning of the Paleocene and then in late Miocene and Pliocene. Generation probably continues today. Migration is primarily vertical and updip into adjacent reservoirs and through extensional faults associated with the plate collision to reservoirs higher in the stratigraphic column.

RESERVOIR ROCKS: Included reservoir rocks are carbonates and sandstones of the Permian Torba and Wargal, Lower Cretaceous Sembar, Goru, and Lumshiwai, Upper Cretaceous Pab, Paleocene Namal, and Eocene Ghazij formations. Porosities range from 9 percent to 30 percent and average 12 percent to 16 percent.

TRAPS AND SEALS: While almost all fields discovered to date are structural features such as anticlines and tilted fault blocks, the Sui gas field appears to be a reef like stratigraphic trap. Stratigraphic traps are also likely to be found in the deltaic and alluvial sequences of the basin. Seals include interbedded shales and the thick shales and clays of the Miocene-Pliocene Siwaliks Group and fault truncations.

REFERENCES:

- Ahmad, S., Alam, Z., and Khan, A. R., 1996, Petroleum exploration and production activities in Pakistan: Pakistan Petroleum Information Service, 72 p.
- Kingston, J., 1986, Undiscovered petroleum resources of South Asia: U.S. Geological Survey Open-File Report 86-80, 131 p.
- Quadri, V.N., Chughtai, S.A., Farani, Z., Quadri, G.J., Here are recommendations in search of giants in Pakistan, Oil and Gas Development Corporation, Islamabad, 2000: Oil and Gas Journal, v. 98, no. 2, p. 57-60.



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EXPLANATION

- Hydrography
- Shoreline
- 8042 — Geologic province code and boundary
- - - Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 80420101 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

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

Date:..... 10/12/99
 Assessment Geologist:..... C.J. Wandrey
 Region:..... South Asia Number: 8
 Province:..... Indus Number: 8042
 Priority or Boutique..... Priority
 Total Petroleum System:..... Sembar-Goru/Ghazij Number: 804201
 Assessment Unit:..... Greater Indus Foreland and Foldbelt Number: 80420101
 * Notes from Assessor Lower 48-all growth function. Inert gas is N₂.

CHARACTERISTICS OF ASSESSMENT UNIT

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

What is the minimum field size?..... 1 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: 22 Gas: 52
 Established (>13 fields) X Frontier (1-13 fields) Hypothetical (no fields)

Median size (grown) of discovered oil fields (mmboe):
 1st 3rd 18.4 2nd 3rd 6.4 3rd 3rd 15.6
 Median size (grown) of discovered gas fields (bcfg):
 1st 3rd 124 2nd 3rd 89 3rd 3rd 168

Assessment-Unit Probabilities:

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

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) 5 median no. 20 max no. 50
 Gas fields:.....min. no. (>0) 20 median no. 100 max no. 250

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 1 median size 4 max. size 50
 Gas in gas fields (bcfg):.....min. size 6 median size 70 max. size 10000

Assessment Unit (name, no.)
 Greater Indus Foreland and Foldbelt, 80420101

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

<u>Oil Fields:</u>	minimum	median	maximum
Gas/oil ratio (cfg/bo).....	1100	2200	3300
NGL/gas ratio (bngl/mmcfg).....	30	60	90
<u>Gas fields:</u>	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg).....	20	35	50
Oil/gas ratio (bo/mmcfg).....			

SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS

(variations in the properties of undiscovered fields)

<u>Oil Fields:</u>	minimum	median	maximum
API gravity (degrees).....	17	34	51
Sulfur content of oil (%).....	0.01	0.5	2
Drilling Depth (m)	400	2200	4500
Depth (m) of water (if applicable).....	0	100	200
<u>Gas Fields:</u>	minimum	median	maximum
Inert gas content (%).....	2	12	40
CO ₂ content (%).....	0.3	15	70
Hydrogen-sulfide content (%).....			
Drilling Depth (m).....	400	2000	6000
Depth (m) of water (if applicable).....	0	100	200

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

1. Pakistan represents 95 areal % of the total assessment unit

<u>Oil in Oil Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	95	_____
Portion of volume % that is offshore (0-100%):.....	_____	9	_____
<u>Gas in Gas Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	95	_____
Portion of volume % that is offshore (0-100%):.....	_____	5	_____

2. India represents 5 areal % of the total assessment unit

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

3. Province 8042 represents 72 areal % of the total assessment unit

<u>Oil in Oil Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	87	_____
Portion of volume % that is offshore (0-100%):.....	_____	10	_____
<u>Gas in Gas Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	47	_____
Portion of volume % that is offshore (0-100%):.....	_____	10	_____

4. Province 8025 represents 22 areal % of the total assessment unit

<u>Oil in Oil Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	10	_____
Portion of volume % that is offshore (0-100%):.....	_____	0	_____
<u>Gas in Gas Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	50	_____
Portion of volume % that is offshore (0-100%):.....	_____	0	_____

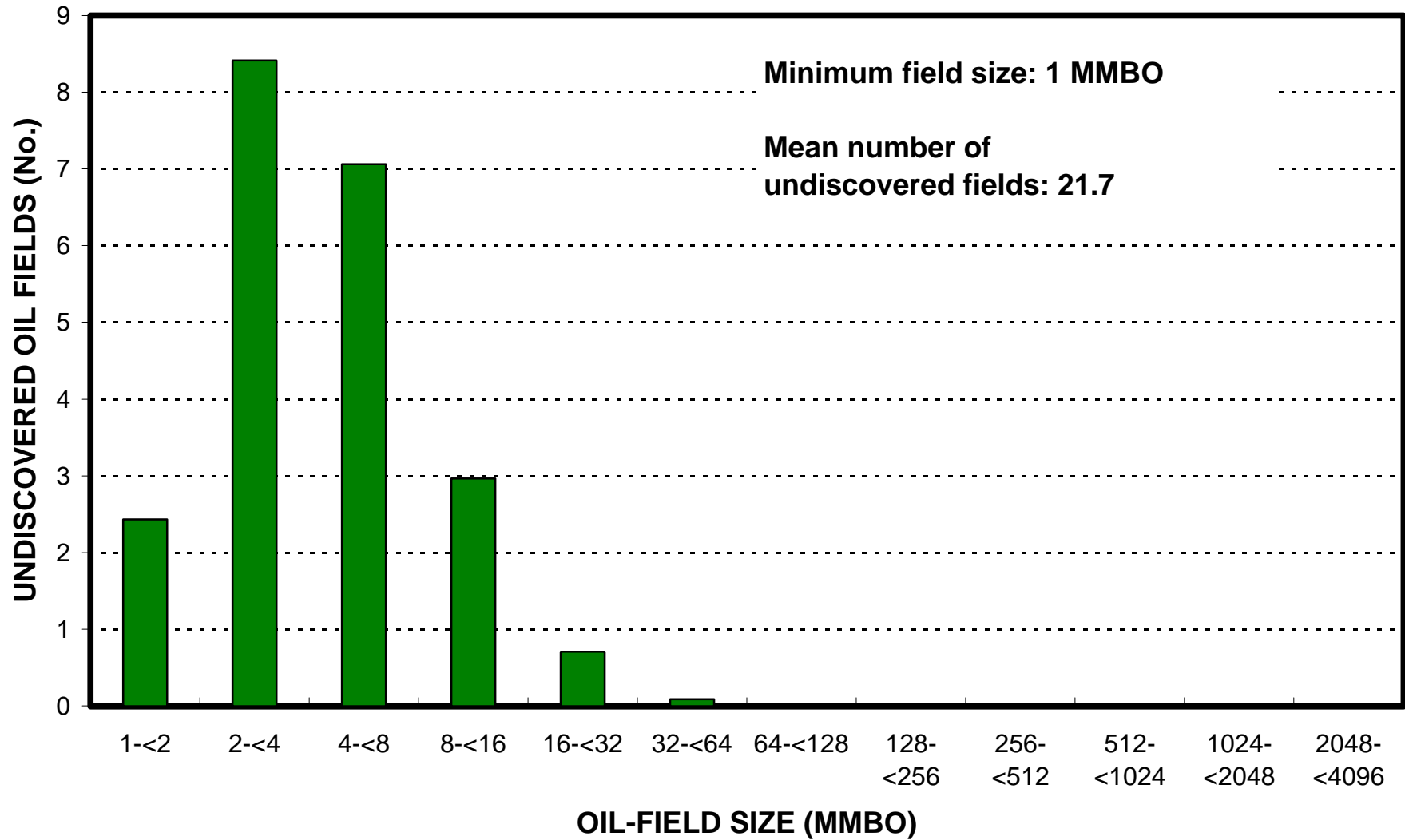
5. Province 8026 represents 6 areal % of the total assessment unit

<u>Oil in Oil Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	<u>3</u>	_____
Portion of volume % that is offshore (0-100%).....	_____	<u>0</u>	_____

<u>Gas in Gas Fields:</u>	minimum	median	maximum
Richness factor (unitless multiplier):.....	_____	_____	_____
Volume % in parcel (areal % x richness factor):...	_____	<u>3</u>	_____
Portion of volume % that is offshore (0-100%).....	_____	<u>0</u>	_____

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Undiscovered Field-Size Distribution



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Undiscovered Field-Size Distribution

