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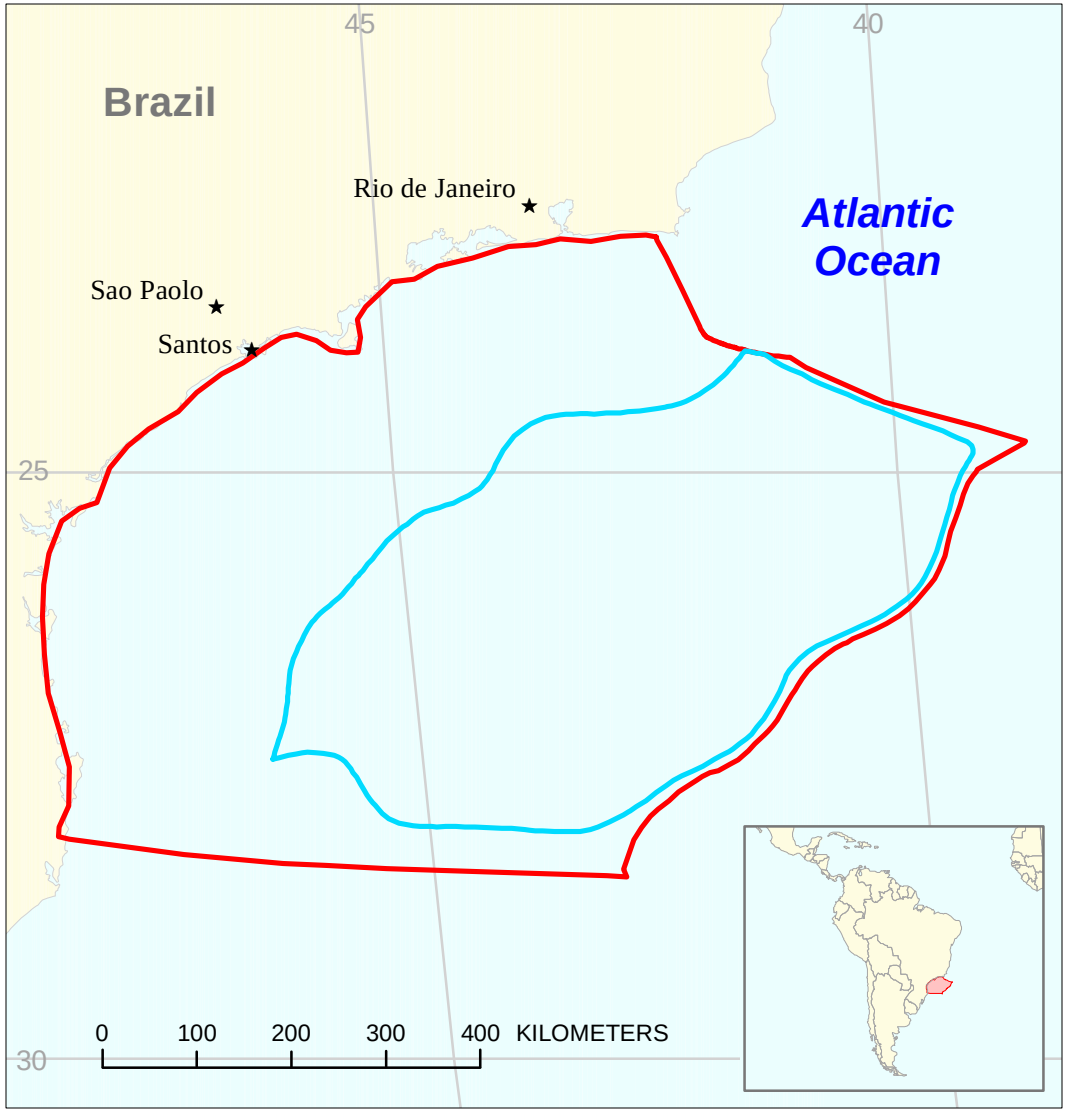
Salt-Structured Deep-Water Sandstones Assessment Unit 60360102



Salt-Structured Deep-Water Sandstones Assessment Unit 60360102
Santos Basin Geologic Province 6036

Geologic Summary

Detailed map of this assessment unit

Assessment Input Data

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

USGS PROVINCE: Santos Basin (6036) **GEOLOGIST:** C.J. Schenk

TOTAL PETROLEUM SYSTEM: Guaratiba-Guaruja (Cretaceous) Composite (603601)

ASSESSMENT UNIT: Salt Structured Deep-Water Sandstones (60360102)

DESCRIPTION: This assessment unit encompasses the deep water area of the Santos Basin, and is bounded by the offshore extension of the Cabo Frio Arch to the north, the Florianopolis Arch to the south, the limit of salt on the Sao Paulo Plateau to the east, and the 400 m water depth to the west.

SOURCE ROCKS: Source rocks are postulated to be mainly mudstones of the lower Aptian Guaratiba Formation that were deposited prior to the deposition of Aptian salt.

MATURATION: Given the temperatures and thickness of sediment in this assessment unit, the most likely time of generation was in the Eocene-Miocene, but sediment thickness decreases in deeper water where the source may not be mature.

MIGRATION: Migration is postulated to have been mainly vertical along listric faults that cut through the Alagoas (Aptian) salt, with hydrocarbons migrating up and into Late Cretaceous and Tertiary turbidite reservoirs.

RESERVOIR ROCKS: Major reservoirs in this assessment unit are hypothesized to be Late Cretaceous and Tertiary turbidite sandstones that either were deposited between salt structures or were deposited as blanket turbidite sandstones.

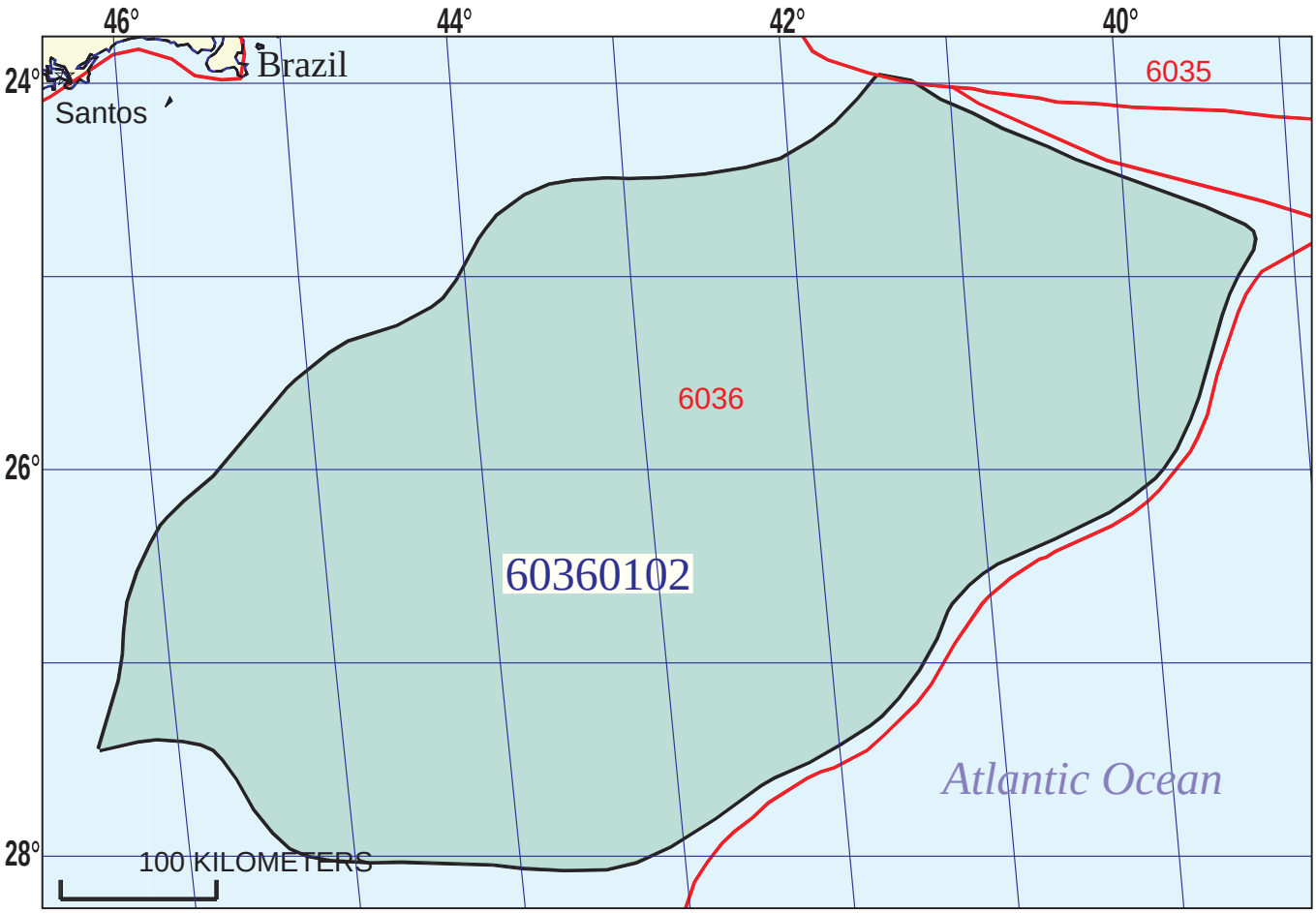
TRAPS AND SEALS: Traps in this assessment are related to structures formed by salt movement. Large salt diapirs are found throughout the assessment unit, and traps are adjacent to the salt, and stratigraphic traps are formed where ponded turbidites are found in the intra-salt basins. Seals are mainly intraformational mudstones in the Tertiary section and salt seals where sands abut the diapirs.

REFERENCES:

Cainelli, C., and Mohriak, W.U., 1998, Geology of the Atlantic eastern Brazilian basins; Brazilian Geology, Part II: American Association of Petroleum Geologists International Conference and Exhibition Short Course Notes, Rio de Janeiro, Brazil, chapter paginated.

Demercian, S., Szatmari, P., and Cobbold, P.R., 1993, Style and pattern of salt diapirs due to thin-skinned gravitational gliding, Campos and Santos basins, offshore Brazil: Tectonophysics, v. 228, p. 393-433.

Ramos, R., Duraes, E., Fochesatto, L., and Gamboa, L., 1998, Deep reservoirs in the Santos Basin, Brazil, *in* Mello, M.R., and Yilmaz, P.O., eds., 1998 American Association of Petroleum Geologists International Conference and Exhibition, Rio de Janeiro: Extended Abstracts Volume, p. 702-703.



Salt-Structured Deep-Water Sandstones Assessment Unit - 60360102

EXPLANATION

- Hydrography
- Shoreline
- 6036 — Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 60360102 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

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

Date:……..	11/5/99		
Assessment Geologist:……..	C.J. Schenk		
Region:……..	Central and South America	Number:	6
Province:……..	Santos Basin	Number:	6036
Priority or Boutique……	Boutique		
Total Petroleum System:……	Guaratiba-Guaruja (Cretaceous) Composite	Number:	603601
Assessment Unit:……..	Salt-Structured Deep-Water Sandstones	Number:	60360102
* Notes from Assessor	MMS offshore data set. Campos Basin partial analog, Salt Dome Province Tertiary Sandstones (60350103)		

CHARACTERISTICS OF ASSESSMENT UNIT

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

What is the minimum field size?……. 8 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: 0 Gas: 0
Established (>13 fields) _____ Frontier (1-13 fields) _____ Hypothetical (no fields) X

Median size (grown) of discovered oil fields (mmboe):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____
Median size (grown) of discovered gas fields (bcfg):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered field ≥ minimum size……	0.9
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):…….. 0.9

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)	1	median no.	60	max no.	150
Gas fields:……min. no. (>0)	1	median no.	10	max no.	25

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	8	median size	70	max. size	4600
Gas in gas fields (bcfg):……min. size	48	median size	210	max. size	12000

Assessment Unit (name, no.)
Salt-Structured Deep-Water Sandstones, 60360102

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……	700	1400	2100
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)……	20	35	50
Sulfur content of oil (%)……	0.2	0.5	1.8
Drilling Depth (m) ……	2000	3500	5200
Depth (m) of water (if applicable)……	400	1500	3400

Gas Fields:	minimum	median	maximum
Inert gas content (%)……			
CO_2 content (%)……			
Hydrogen-sulfide content (%)……			
Drilling Depth (m)……	2000	4000	6500
Depth (m) of water (if applicable)……	400	1500	3400

Assessment Unit (name, no.)
Salt-Structured Deep-Water Sandstones, 60360102

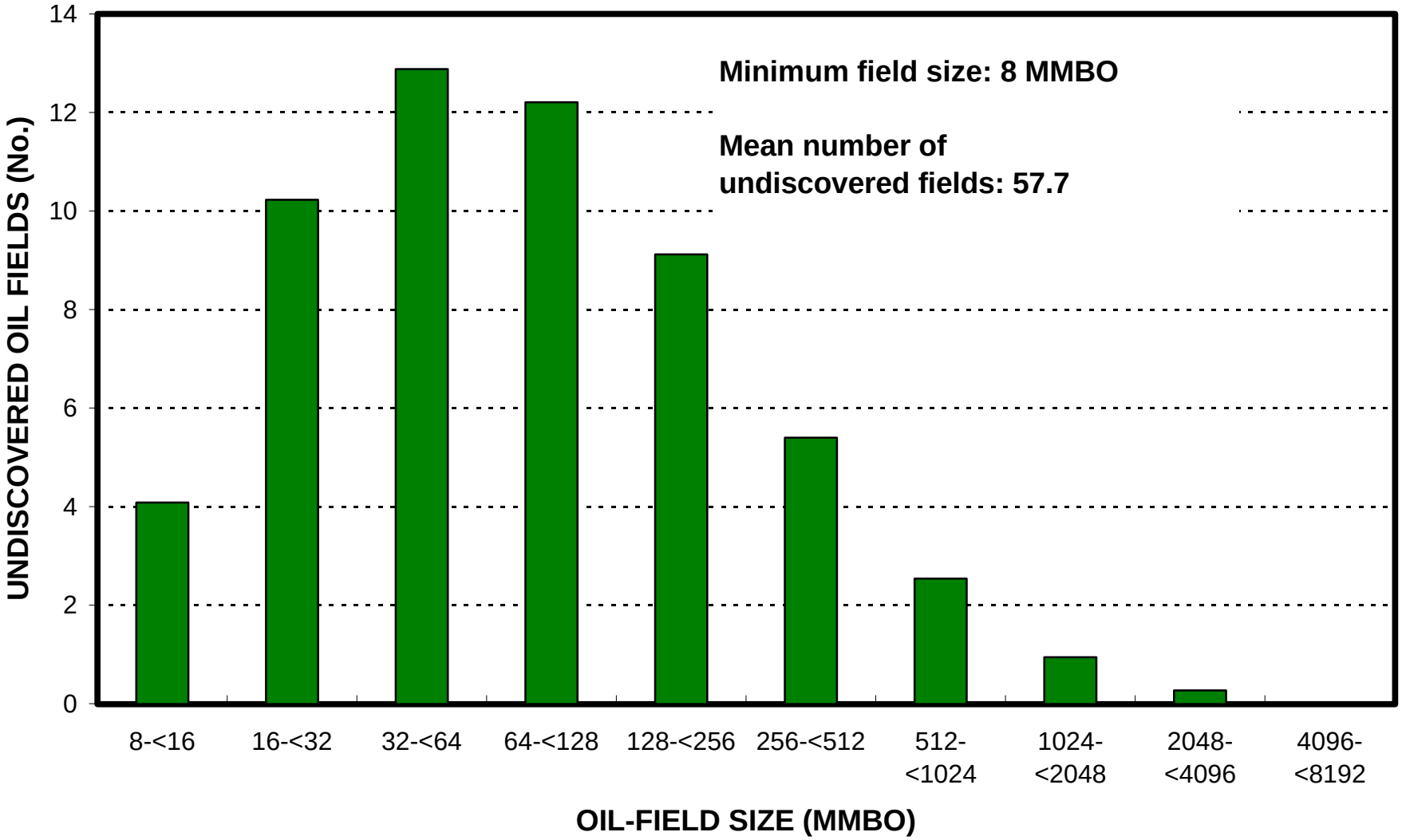
ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT TO COUNTRIES OR OTHER LAND PARCELS (uncertainty of fixed but unknown values)

1. Brazil 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%)……		100	

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%)……		100	

Salt-Structured Deepwater Sandstones, AU 60360102
Undiscovered Field-Size Distribution



Salt-Structured Deepwater Sandstones, AU 60360102
Undiscovered Field-Size Distribution