Foreland Basins
Assessment Unit 60450102

Bolivia

65

60

Santa Cruz

Sucre

20

Brazil

Argentina

Paraguay

| 0 | 100 | 200 | 300 | 400 | KILOMETERS |

Foreland Basins Assessment Unit 60450102

Santa Cruz-Tarija Geologic Province 6045

USGS PROVINCE: Santa Cruz-Tarija Basin (6045)   **GEOLOGIST:** S.J. Lindquist

TOTAL PETROLEUM SYSTEM: Los Monos-Machareti (604501)

ASSESSMENT UNIT: Foreland Basins (60450102) (frontier)

DESCRIPTION: The Santa Cruz-Tarija Province is a Paleozoic intracratonic rift basin that evolved into a Tertiary thin-skinned thrust belt and foreland basin. This assessment unit includes the Carandaity and Curupaity foreland sub-basins, parallel with the sub-Andean folds and the Brazilian Shield margin, respectively. It is approximately 178,000 sq km in area in Bolivia, Paraguay, and Argentina.

SOURCE ROCKS: Primary Devonian Los Monos and secondary Silurian Kirusillas (El Carmen) oil-and-gas-prone shales attain composite maximum thicknesses of 4 km and are present in the entire area of the assessment unit. The shales were deposited in semi-restricted, marine extensional basins and contain Type II to Type III kerogens and a maximum TOC content of 2 wt. %.

MATURATION: Assessment unit has variable thermal gradients, low in the basin axes and higher at the basin margins. Presently, Silurian rocks are probably at gas maturity stage in the basin axes. Oil generation could have occurred as early as Devonian to Carboniferous time, but more recent generation is possible bordering the persistently high (and hotter) Central Chaco High (assessment unit 60450103).

MIGRATION: Short-distance, updip lateral migration from thermally mature areas into Paleozoic extensional fault blocks. Andean remigration is possible in close proximity to the sub-Andean folds (assessment unit 60450101).

RESERVOIR ROCKS: Reservoirs of all stratigraphic ages (Silurian through Tertiary) are present in this assessment unit, with arithmetic average reservoir properties ranging from 10 to 23 percent for porosity and 10 to 200 mD for permeability. Carboniferous, glacially influenced fluvial-to-submarine siliciclastic channel deposits contain most reserves and exhibit 20 percent porosities and 100 to 150 mD permeabilities.

TRAPS AND SEALS: Traps are Paleozoic extensional fault blocks and stratigraphic truncations, with fabrics parallel to the sub-basin margins. Structural modification from Miocene compression (Andean orogeny) is expected near the sub-Andean folds. Seals are local and regional Paleozoic marine shales ranging from 10 to >1000 m in thickness and glacial diamictites tens to hundreds of meters thick.

REFERENCES:
Lindquist, S.J., 1998, The Santa Cruz-Tarija province of central South America—Los Monos-Machareti(!) petroleum system: U.S. Geological Survey Open-File Report 99-50-C, 16 p., 11 figs., 1 table.
Tankard, A.J., Suarez S., R., and Welsink, H.J., eds., 1995, Petroleum basins of South America: American Association of Petroleum Geologists Memoir 62, 792 p.
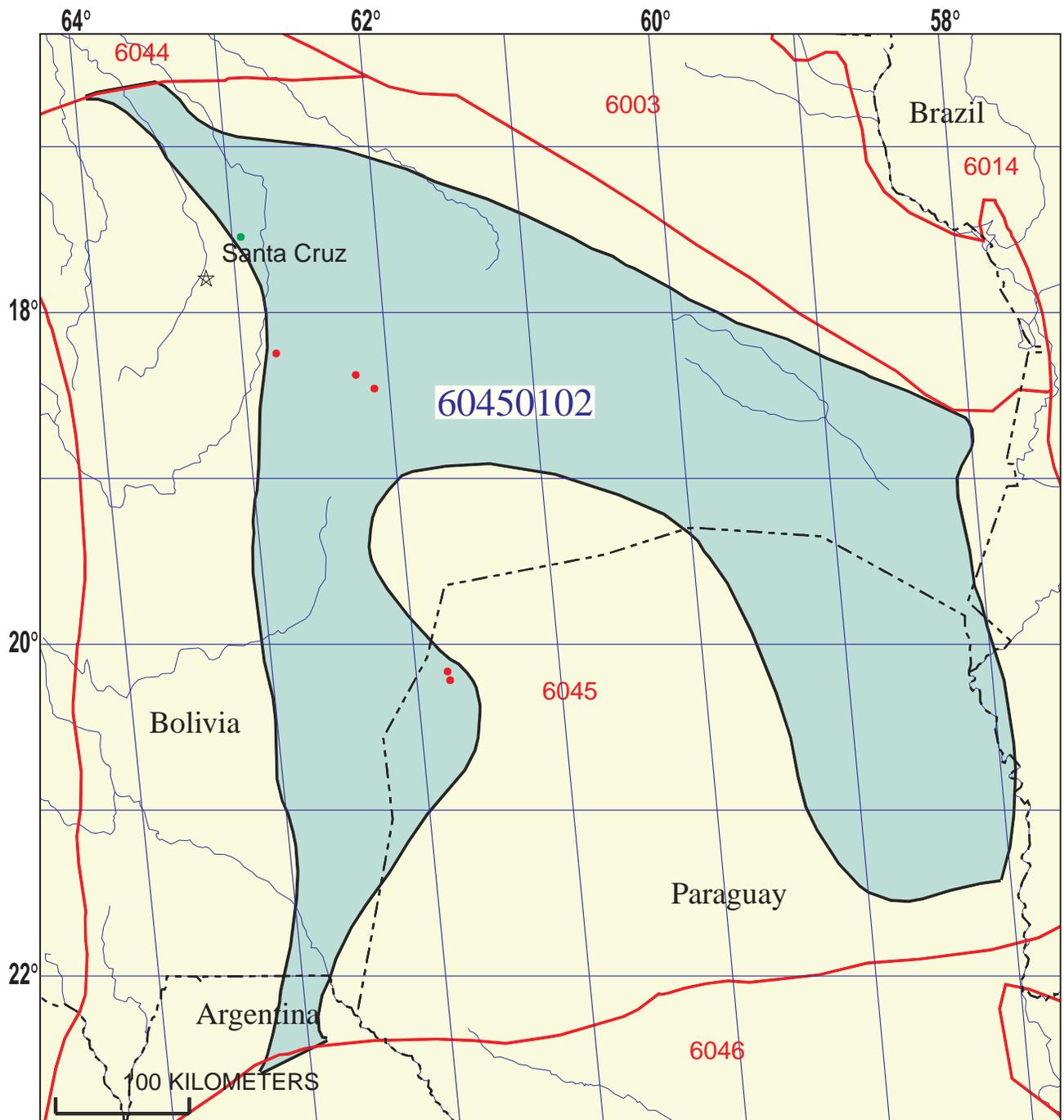
Foreland Basins
Assessment Unit - 60450102

EXPLANATION

	Hydrography
	Shoreline
6045	Geologic province code and boundary
- - -	Country boundary
•	Gas field centerpoint
•	Oil field centerpoint

60450102 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

Map labels: 64°, 62°, 60°, 58°, 18°, 20°, 22°, 6044, 6003, Brazil, 6014, Santa Cruz, 60450102, Bolivia, 6045, Paraguay, Argentina, 100 KILOMETERS, 6046

Date:………………………….. 3/5/99
Assessment Geologist:…….. C.J. Schenk
Region:……………………….. Central and South America   Number: 6
Province:……………………. Santa Cruz-Tarija Basin   Number: 6045
Priority or Boutique………… Priority
Total Petroleum System:…… Los Monos-Machareti   Number: 604501
Assessment Unit:………….. Foreland Basins   Number: 60450102
* Notes from Assessor   Rocky Mountain (US Region 4) growth factor.
                           Analogs (US Plays)-3704, 3705, 3707, 2806, 2808, 2908.

CHARACTERISTICS OF ASSESSMENT UNIT

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

What is the minimum field size?……….   3   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: 3
      Established (>13 fields) _____ Frontier (1-13 fields)   X   Hypothetical (no fields) _____

Median size (grown) of discovered oil fields (mmboe):
                              1st 3rd _____   2nd 3rd _____   3rd 3rd _____
Median size (grown) of discovered gas fields (bcfg):
                              1st 3rd   94.1   2nd 3rd   39.4   3rd 3rd _____

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)   2   median no.   35   max no.   100
Gas fields:……………………….…..min. no. (>0)   1   median no.   25   max no.   75

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   3   median size   12   max. size   1200
Gas in gas fields (bcfg):………………….... min. size   18   median size   72   max. size   3600

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS
(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)…………………….…..………	1300	2600	3900
NGL/gas ratio (bngl/mmcfg)………………....…..	30	60	90

Gas fields:	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg)……………..……..	19	37	55
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)……………………….……….	30	42	52
Sulfur content of oil (%)………………….....…...	0.01	0.08	0.16
Drilling Depth (m) ……………....……….….…….	500	2500	5000
Depth (m) of water (if applicable)……………..……			

Gas Fields:	minimum	median	maximum
Inert gas content (%)……………………......……			
CO_2 content (%)…………………………….....…			
Hydrogen-sulfide content(%)………………..……			
Drilling Depth (m)……………………….…………	500	3000	6000
Depth (m) of water (if applicable)………………….			

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

1.   Bolivia   represents   73.2   areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……….……			
Volume % in parcel (areal % x richness factor):…		73.2	
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):…		73.2	
Portion of volume % that is offshore (0-100%)……		0	

2.   Paraguay   represents   25.1   areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……….……			
Volume % in parcel (areal % x richness factor):…		25.1	
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):…		25.1	
Portion of volume % that is offshore (0-100%)……		0	

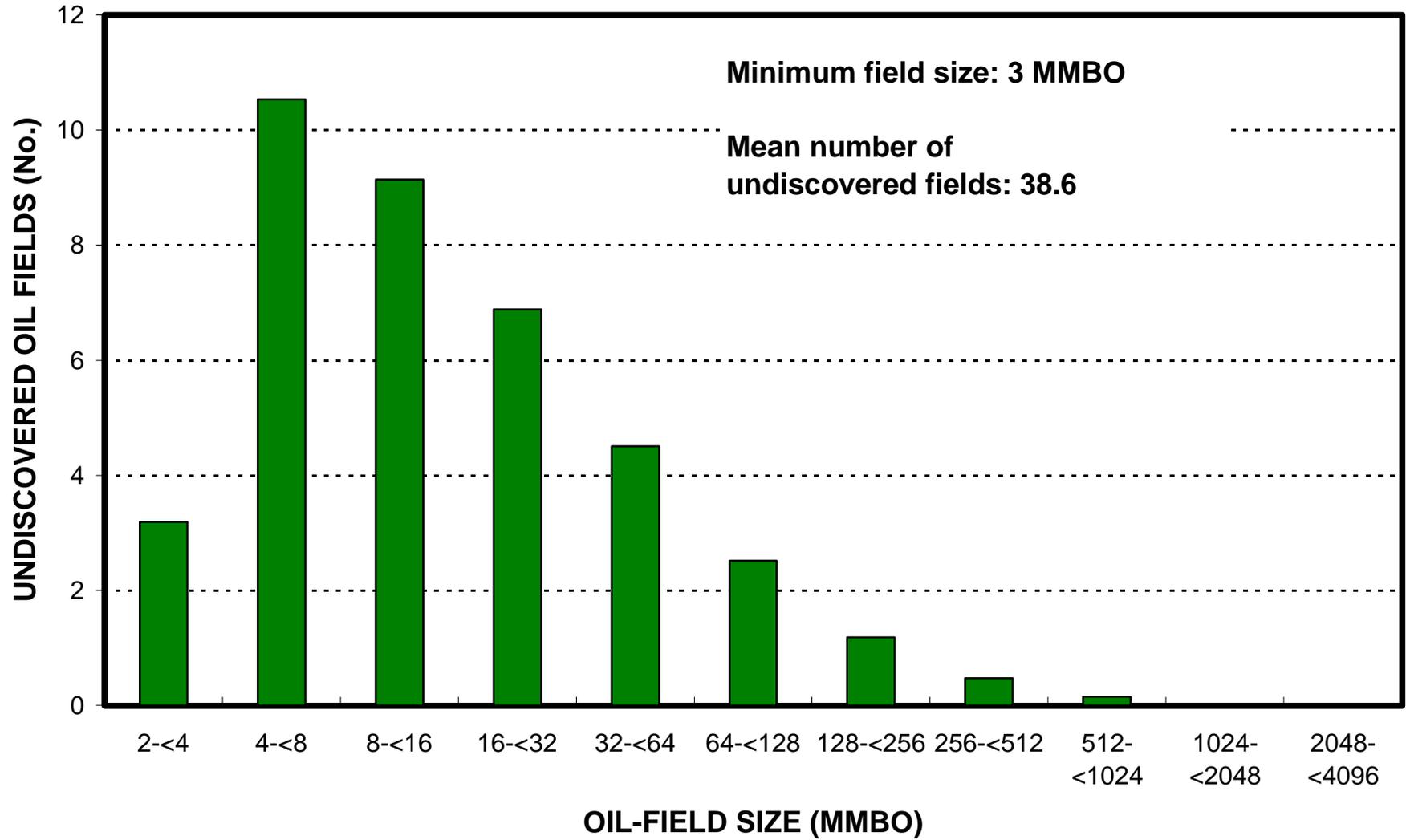3.   Argentina   represents   1.1   areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……….……			
Volume % in parcel (areal % x richness factor):…		1.1	
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):…		1.1	
Portion of volume % that is offshore (0-100%)……		0	

4.   Brazil   represents   0.6   areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):……….……			
Volume % in parcel (areal % x richness factor):…		0.6	
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):…		0.6	
Portion of volume % that is offshore (0-100%)……		0	

Foreland Basins, AU 60450102
Undiscovered Field-Size Distribution

Minimum field size: 3 MMBO

Mean number of
undiscovered fields: 38.6

UNDISCOVERED OIL FIELDS (No.)

OIL-FIELD SIZE (MMBO)

2-<4 4-<8 8-<16 16-<32 32-<64 64-<128 128-<256 256-<512 512-<1024 1024-<2048 2048-<4096

Foreland Basins, AU 60450102
Undiscovered Field-Size Distribution