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Leshan-Longnusi Paleohigh
Assessment Unit 31420401

Leshan-Longnusi Paleohigh Assessment Unit 31420401
Sichuan Basin Geologic Province 3142

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: Sichuan Basin (3142) **GEOLOGIST:** R.T. Ryder

TOTAL PETROLEUM SYSTEM: Cambrian/Silurian Marine Shale-Dengying/Lower Paleozoic (314204)

ASSESSMENT UNIT: Leshan-Longnusi Paleohigh (31420401)

DESCRIPTION: The assessment unit is characterized by structurally controlled gas fields in Sinian, Cambrian, and Ordovician carbonate reservoirs situated on the Leshan-Longnusi paleohigh (LLPH), a Late Silurian to Early Devonian regional uplift that occupies much of the central uplift. In the vicinity of the LLPH, Lower Permian rocks rest unconformably on lower Paleozoic rocks as old as Late Cambrian and as young as Middle Silurian. The gas was derived from a deeply buried pod of mature Cambrian and Silurian source rocks. The gas accumulations are normally pressured and most of them reside at drilling depths of 4 to 7 km.

SOURCE ROCKS: The dominant source rocks are marine shelf black shale of Early Cambrian and Early Silurian age. The 100-to 400-m-thick Lower Cambrian source rock sequence rests disconformably on Upper Sinian dolomite reservoirs and extends across most of the LLPH. Total organic carbon (TOC) values range from 0.1 to 2.0 percent and average about 0.7 percent. Lower Silurian graptolitic black shale source rocks thicken from an erosional zero edge around the center of the LLPH to as much as 650 m on the flanks of the LLPH. The TOC values for the Silurian black shale range from 0.5 to 2.0 percent and average about 0.8 percent. Type I and II varieties of kerogen characterize both source rocks. Many Chinese investigators suggest that dolomite in the Upper Sinian Dengying Formation is a major source rock but this seems unlikely judging from the very low TOC values (average~0.1) of the strata.

MATURATION: The Cambrian and Silurian source rocks have been mature with respect to gas generation since about the Middle Jurassic. Based on bitumen-filled vugs in reservoirs and reflectance (% R_o max) values of 2.5 to 5 for dispersed organic matter, oil generated from the source rocks has been converted to bitumen and gas. A geothermal gradient of about 20 to 25°C/km probably accompanied oil and gas generation.

MIGRATION: Because of an absence of carrier beds, most gas that was generated in the Middle Jurassic to Early Cretaceous remained in or near the source rock until widespread folding and tectonic fracturing occurred during Late Cretaceous (Yenshanian) to early Cenozoic (Himalayan) compression. After this fracturing event, gas either remained in place and filled existing fractures or was involved in limited lateral migration toward the LLPH. Oil had converted to gas before significant migration occurred.

RESERVOIR ROCK: The dominant reservoir rock is tidal-flat algal dolomite in the Upper Sinian Dengying Formation. The upper 400 to 500 m of the Dongying Formation has reservoir potential. Reservoir quality of the algal dolomite is generally poor (average porosity of 3.2 percent and average permeability <1 mD). Secondary porosity controlled by intracrystalline pores, dissolution pores and vugs, and open tectonic fractures along crestal zones of anticlines provide the better reservoirs. Dissolution pores and vugs, as well as other reservoir enhancing features such as local karst-related fractures and caverns, are most commonly found where tidal-

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AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……			
NGL/gas ratio (bngl/mmcfg)……			

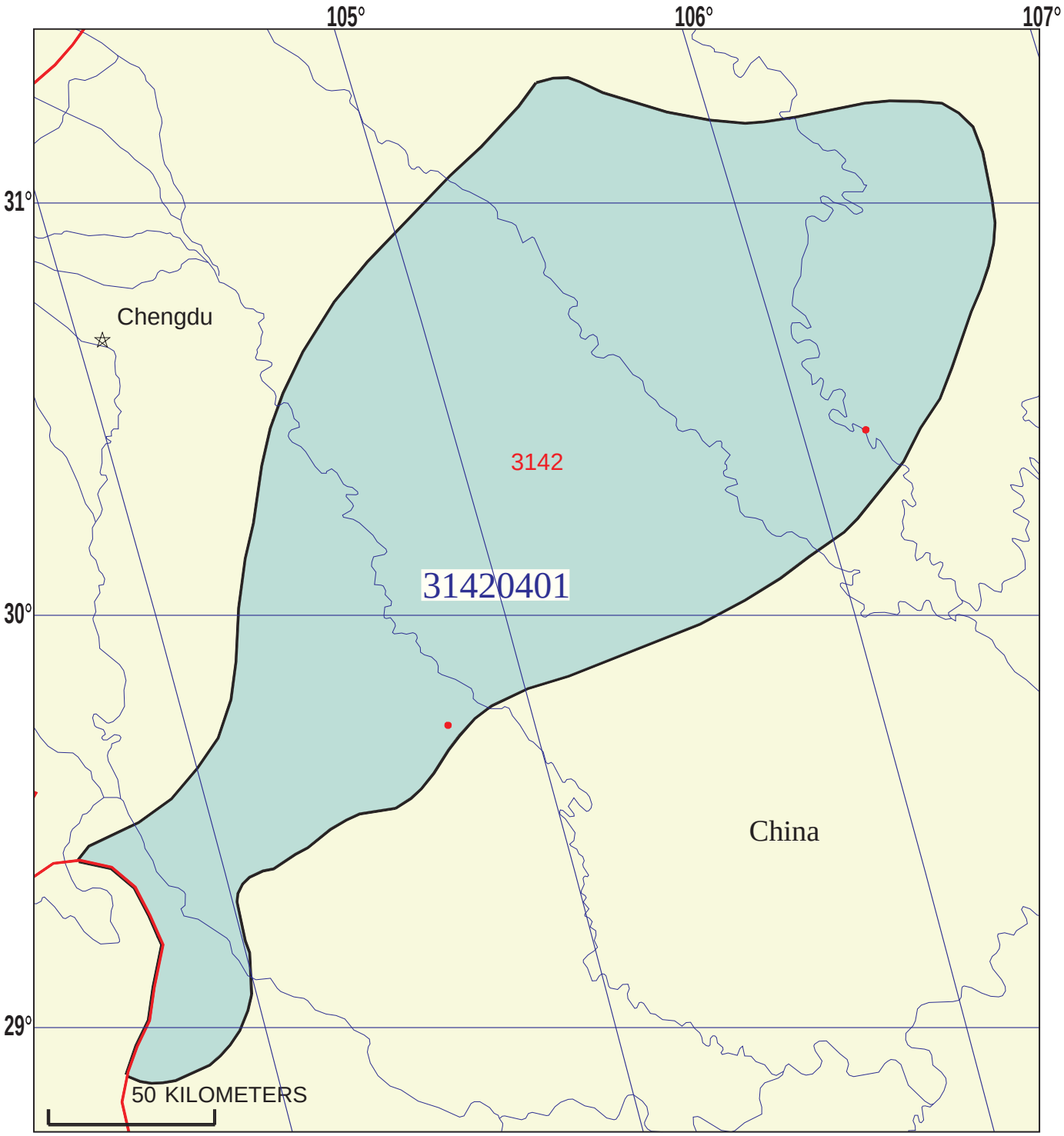
Gas fields:	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg)……	22	44	66
Oil/gas ratio (bo/mmcfg)……			

SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS

(variations in the properties of undiscovered fields)

Oil Fields:	minimum	median	maximum
API gravity (degrees)……			
Sulfur content of oil (%)……			
Drilling Depth (m) ……			
Depth (m) of water (if applicable)……			

Gas Fields:	minimum	median	maximum
Inert gas content (%)……	4	6.5	10
CO_2 content (%)……	2	5	10
Hydrogen-sulfide content (%)……	0.5	1.3	2
Drilling Depth (m)……	4000	5500	7000
Depth (m) of water (if applicable)……			



Leshan-Longnusi Paleohigh
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EXPLANATION

- Hydrography
- Shoreline
- 3142 Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 31420401 Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

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

Date:……..	12/16/99		
Assessment Geologist:……..	R.T. Ryder		
Region:……..	Asia Pacific	Number:	3
Province:……..	Sichuan Basin	Number:	3142
Priority or Boutique……	Boutique		
Total Petroleum System:……	Cambrian/Silurian Marine Shale-Dengying/Lower Paleozoic	Number:	314204
Assessment Unit:……..	Leshan-Longnusi Paleohigh	Number:	31420401
* Notes from Assessor	Commercial concentration of helium (0.28%).		

CHARACTERISTICS OF ASSESSMENT UNIT

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

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: 2
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 _____ 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……	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)	_____	median no.	_____	max no.	_____
Gas fields:……min. no. (>0)	1	median no.	20	max no.	50

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	_____	median size	_____	max. size	_____
Gas in gas fields (bcfg):……min. size	18	median size	60	max. size	3500

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AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……			
NGL/gas ratio (bngl/mmcfg)……			

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)……			
Sulfur content of oil (%)……			
Drilling Depth (m) ……			
Depth (m) of water (if applicable)……			

Gas Fields:	minimum	median	maximum
Inert gas content (%)……	4	6.5	10
CO_2 content (%)……	2	5	10
Hydrogen-sulfide content (%)……	0.5	1.3	2
Drilling Depth (m)……	4000	5500	7000
Depth (m) of water (if applicable)……			

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

1. China 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):…			
Portion of volume % that is offshore (0-100%)……			

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%)……		0	

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Undiscovered Field-Size Distribution