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Northwestern Depression/Foldbelt
Assessment Unit 31420102

Northwestern Depression/Foldbelt Assessment Unit 31420102
Sichuan Basin Geologic Province 3142

Geologic Summary

Detailed map of this assessment unit

Assessment Input Data

Assessment Results
- Assessment Unit Summary
- Detailed Assessment Results

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

TOTAL PETROLEUM SYSTEM: Maokou/Longtang-Jialingjiang/Maokou/Huanglong (314201)

ASSESSMENT UNIT: Northwestern Depression/Foldbelt (31420102)

DESCRIPTION: The assessment unit is characterized by structurally controlled gas fields in Permian and Triassic carbonate reservoirs in the northwestern fold belt of the basin and the southern part of the adjoining foreland depression. The gas was derived from a deeply buried pod of mature Permian source rocks that extends across the entire basin. Gas accumulations in the fold belt are normally pressured. Drilling depths to the deeper fields range from 4 to 8 km.

SOURCE ROCKS: The dominant source rocks are oil-prone marine argillaceous limestone with black shale of the Lower Permian Maokou Formation and gas-prone coal beds of the Upper Permian Longtang Formation. The source rock sequence of the Maokou Formation is located in the lower one-third of the formation and is about 50 to 75 m thick. Total organic carbon (TOC) values for the Maokou Formation source rocks range from 0.3 to 1.8 percent and average about 1 percent. The net thickness of coal beds in the Longtang Formation ranges from about 2 to 5 m.

MATURATION: The source rocks have been mature with respect to oil generation since about Late Triassic time and mature with respect to gas generation since about Middle Jurassic to Late Cretaceous time. The absence of oil in the assessment unit suggests that it has been thermally converted to gas. An absence of oil is consistent with the 2 to 2.5 vitrinite reflectance values for Permian coal beds in the northwestern fold belt. Approximately 1 to 3 km of uplift and erosion has occurred in the western Sichuan basin since the early Paleogene. A geothermal gradient of about 20 to 25°C/km probably accompanied oil and gas generation.

MIGRATION: Probably, gas migration in the assessment unit began during the Middle Jurassic to Late Cretaceous stage (Yenshanian) of thin-skin decollement tectonics in the northwestern fold belt. Gas migrated vertically as much as 2,000 m from the pod of mature Permian source rocks into core and crestal regions of faulted detachment anticlines. Oil generated during the Late Triassic stage (Indosinian) of decollement tectonics probably migrated into early detachment anticlines and later was converted to gas.

RESERVOIR ROCK: Primary reservoir rocks consist of limestone and dolomite of Early Permian (Maokou and Qixia Formations), Late Permian (Changxian Formation), Early Triassic (Jialingjiang Formation), and Middle Triassic (Leikoupo Formation) age. Reservoir quality is generally poor (porosity of 4 to 8 percent and permeability of ~0.1 mD) and, thus, usually tectonic fractures are required to improve gas deliverability. Also, reservoir quality is improved by caverns and solution-enhanced fractures formed by circulating ground water during periods of subaerial exposure of the shelf and (or) post-orogenic uplift. The best reservoirs (porosity of 10 to 15 percent and permeability of several tens of millidarcies) are grainstones, patch reefs, and vuggy dolomite.

TRAPS AND SEALS: The major traps are large faulted anticlines of thin-skin decollement origin. The southern part of the foreland depression has several basement-involved anticlinal traps. Combination anticlinal-stratigraphic traps (unconformity and facies-change varieties) may provide additional entrapment. Lower and Middle Triassic evaporite, Lower Triassic marine mudstone, and Middle and Upper Jurassic nonmarine mudstone provide the best regional seals. Seal integrity may have been compromised in many structures by repeated thrust faulting.

REFERENCES:

Chen S.F., and Wilson, C.J.L., 1996, Emplacement of the Longmen Shan thrust-nappe belt along the eastern margin of the Tibetan Plateau: Journal of Structural Geology, v. 18, no. 4, p. 413-430.

Liu S.G., Luo Z.L., Dai S.L., Arne, D., and Wilson, C.J.L., 1995, The uplift of the Longmenshan thrust belt and subsidence of the western Sichuan foreland basin [in Chinese with English abstract]: Acta Geologica Sinica, v. 69, no. 3, p. 205-214.

Liu X.Z., Schneider, W., and Tan W.B., 1988, Lower Permian limestones as source rocks for thermal gas in south Sichuan, China: Erdöl Erdgas Kohle, v. 104, no. 2, p. 60-65.

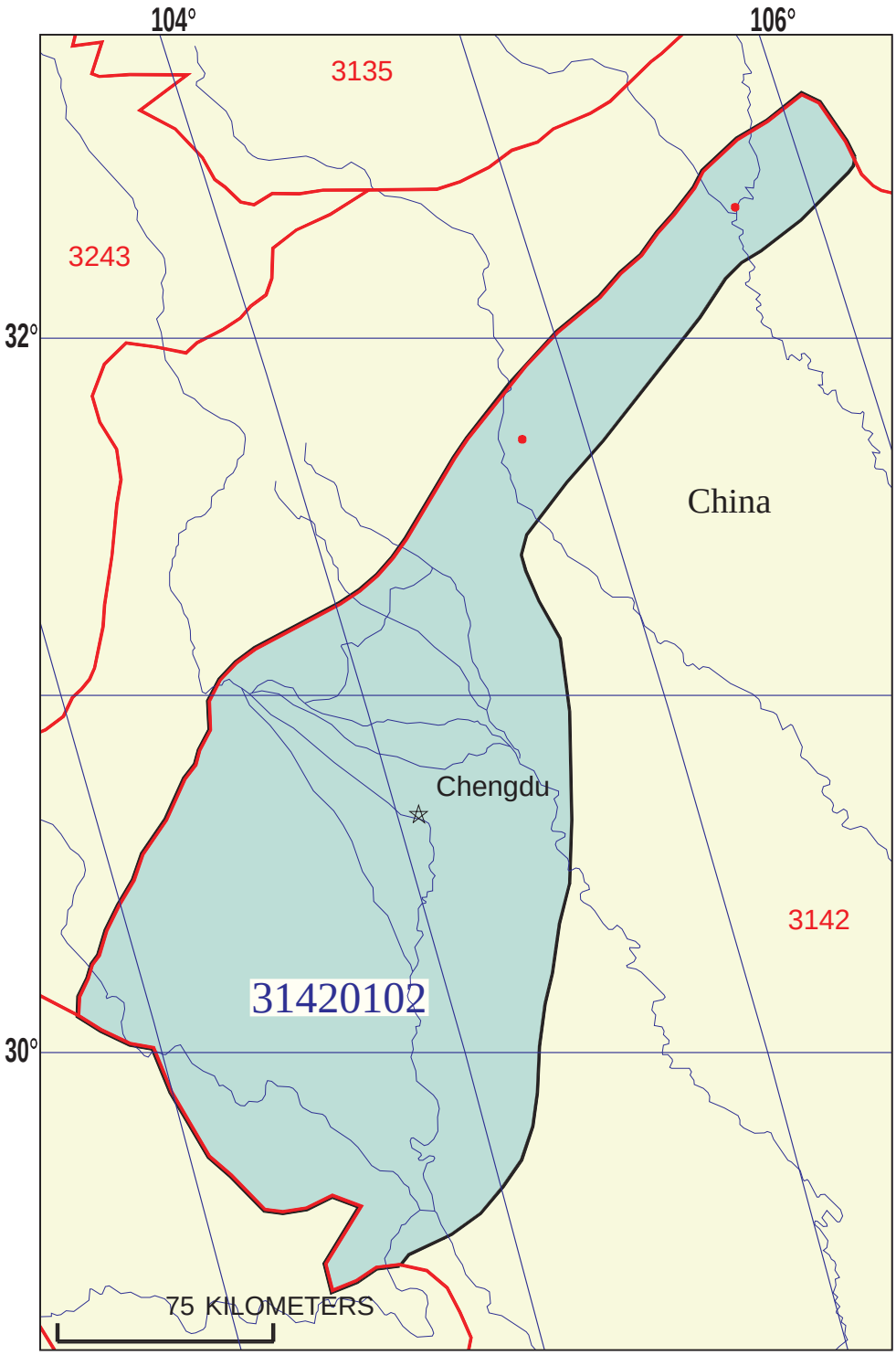
Ryder, R.T., Rice, D.D., Sun Z.C., Zhang Y.G., Qiu Y.Y., and Guo Z.W., 1994, Petroleum geology of the Sichuan basin, China–Report on U.S. Geological Survey and Chinese Ministry of Geology and Mineral Resources field investigations and meetings, October 1991: U.S. Geological Survey Open-File Report 94-426, 67 p.

Tang Z., 1989, Chapter 6–Carbonate reservoirs, *in* Zhang J.M., ed., Sichuan oil and gas field: Beijing, Petroleum Industry Press, p. 151-205.

Wang J.Q., 1996, Relationship between tectonic evolution and hydrocarbon in the foreland of the Longmen mountains: Journal of Southeast Asian Earth Sciences, v. 13, nos. 3-5, p. 327-336.

Wang J.Q., Bao C., Lou Z.L. and Guo Z.W., 1989, Formation and development of the Sichuan basin, *in* Zhu X., ed., Chinese sedimentary basins: Amsterdam, Elsevier, p. 147-163.

Zhang J. M., 1989, Chapter 5–Generation and evolution of oil and gas, *in* Zhang J.M., ed., Sichuan oil and gas field: Beijing, Petroleum Industry Press, p. 111-150.



Northwestern Depression/Foldbelt Assessment Unit - 31420102

EXPLANATION

- Hydrography
- Shoreline
- 3142 Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 31420102 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:……	Maokou/Longtang-Jialingjiang/Maokou/Huanglong	Number:	314201
Assessment Unit:……	Northwestern Depression/Foldbelt	Number:	31420102
* Notes from Assessor	No growth function applied.		

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: 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)	2	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	6	median size	35	max. size	2000

Assessment Unit (name, no.)
Northwestern Depression/Foldbelt, 31420102

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 (%)……	0.01	1	4.5
CO_2 content (%)……	0.01	0.6	10
Hydrogen-sulfide content (%)……	0.01	0.5	5
Drilling Depth (m)……	2000	4000	8000
Depth (m) of water (if applicable)……			

Assessment Unit (name, no.)
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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	

Northwestern Depression/Fold Belt, AU 31420102
Undiscovered Field-Size Distribution