Jurassic Lacustrine Assessment Unit 31420201

Geologic Summary
Detailed map of this assessment unit
Exploration/Discovery-History Data
Plots of Known Field Sizes
Plots of Grown Resources
Tables
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: Daanzhai-Daanzhai/Lianggaoshan (314202)

ASSESSMENT UNIT: Jurassic Lacustrine (31420201)

DESCRIPTION: The assessment unit is characterized by structurally and stratigraphically controlled oil fields with Lower Jurassic nonmarine limestone and sandstone reservoirs. The oil was derived from a pod of Lower Jurassic lacustrine source rock that approximately coincides with the central uplift of the basin. Commonly, oil accumulations in the assessment unit are overpressured.

SOURCE ROCKS: Lacustrine shale and mudstone in the Lower Jurassic Daanzhai Formation is the source rock. The net thickness of the source rock sequence is about 50 to 100 m. Total organic carbon (TOC) values range from about 0.6 to 2.2 percent and average about 1 percent. Type II kerogen is the dominant kerogen.

MATURATION: The source rocks have been mature with respect to oil generation since Late Cretaceous time. Higher than average gas to oil ratios in the oils and vitrinite reflectance (% Ro max) values ~1 to 1.35 indicate that some gas was generated. A geothermal gradient of about 20 to 25°C/km probably accompanied oil and gas generation.

MIGRATION: Most oil was trapped in the pod of mature source rocks. Several fields located as much as 100 km from the pod suggest either lateral migration of that magnitude or additional pods of mature lacustrine source rock. Little vertical migration of oil is suggested.

RESERVOIR ROCK: Reservoir rocks consist of 10-to-20 m-thick, pelecypod-bearing bioclastic limestone (Lower Jurassic Daanzhai Formation) of lacustrine origin and 20- to 30-m-thick quartzose sandstone and siltstone (Lower Jurassic Lianggaoshan Formation) of fluvial-lacustrine origin. Both reservoir units are closely associated with lacustrine source rocks. Generally, their quality is poor and they depend on secondary porosity provided by dissolution pores and vugs and open tectonic fractures for commercial production. Porosity in the better reservoirs ranges from 4 to 11 percent and averages about 8 percent and permeability ranges from 0.1 to several hundred millidarcies and averages about 10 mD.

TRAPS AND SEALS: Major traps are broad, basement-involved anticlines, structural terraces, stratigraphic pinchouts, and combination structural-stratigraphic traps. Middle Jurassic, Upper Jurassic, and Lower Cretaceous nonmarine red mudstone units provide regional seals.

REFERENCES:
Jurassic Lacustrine Assessment Unit - 31420201

EXPLANATION

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

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
Province: Sichuan Basin
Priority or Boutique: Boutique
Total Petroleum System: Daanzhai-Daanzhai/Lianggaoshan
Assessment Unit: Jurassic Lacustrine

*Notes from Assessor MMS growth function.

### CHARACTERISTICS OF ASSESSMENT UNIT

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

- **Oil**

What is the minimum field size? 1 mmboe grown (>1mmboe)

<table>
<thead>
<tr>
<th>Established (&gt;13 fields)</th>
<th>Frontier (1-13 fields)</th>
<th>Oil</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 3rd</td>
<td>6</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>2nd 3rd</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd 3rd</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

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

**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

**UNDISCOVERED FIELDS**

**Number of Undiscovered Fields:** How many undiscovered fields exist that are ≥ minimum size?

- **Oil fields:** min. no. (>0) 1 median no. 10 max no. 25
- **Gas fields:** min. no. (>0) median no. max no.

**Size of Undiscovered Fields:** What are the anticipated sizes (grown) of the above fields?

- **Oil in oil fields (mmbo):** min. size 1 median size 2 max. size 20
- **Gas in gas fields (bcfg):** min. size median size max. size
### AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS
(uncertainty of fixed but unknown values)

<table>
<thead>
<tr>
<th></th>
<th>minimum</th>
<th>median</th>
<th>maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oil Fields:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas/oil ratio (cfg/bo)</td>
<td>2500</td>
<td>5000</td>
<td>7500</td>
</tr>
<tr>
<td>NGL/gas ratio (bngl/mmcfg)</td>
<td>30</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td><strong>Gas fields:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquids/gas ratio (bngl/mmcfg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil/gas ratio (bo/mmcfg)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS
(variations in the properties of undiscovered fields)

<table>
<thead>
<tr>
<th></th>
<th>minimum</th>
<th>median</th>
<th>maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oil Fields:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>API gravity (degrees)</td>
<td>30</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>Sulfur content of oil (%)</td>
<td>0.04</td>
<td>0.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Drilling Depth (m)</td>
<td>1500</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Depth (m) of water (if applicable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gas Fields:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inert gas content (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ content (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen-sulfide content (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling Depth (m)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth (m) of water (if applicable)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>Oil in Oil Fields:</th>
<th>Gas in Gas Fields:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>minimum</td>
<td>median</td>
</tr>
<tr>
<td>Richness factor (unitless multiplier):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume % in parcel (areal % x richness factor):</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Portion of volume % that is offshore (0-100%):</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
Jurassic Lacustrine, AU 31420201
Undiscovered Field-Size Distribution

Minimum field size: 1 MMBO
Mean number of undiscovered fields: 10.8

OIL-FIELD SIZE (MMBO)

UNDISCOVERED OIL FIELDS (No.)

0 1 2 3 4 5 6

1-<2 2-<4 4-<8 8-<16 16-<32 32-<64 64-<128 128-<256 256-<512 512-<1024