Permian Reefs/Thrust Folds
Assessment Unit 10150201

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

U.S. GEOLOGICAL SURVEY WORLD PETROLEUM ASSESSMENT 2009—DESCRIPTION AND RESULTS
U.S. Geological Survey World Energy Assessment Team
DESCRIPTION: The assessment unit includes Lower Permian and Upper Carboniferous rocks of the Belsk basin, which is the southern depression of the Ural foredeep. These rocks produce oil in the northern part and gas in the southern part of the basin. Many of the fields have been depleted.

SOURCE ROCKS: Although geochemical data are absent, the geology of the fields indicates that the principal source rock is Lower Permian (Asselian-Artinskian) deep-water, organic-rich black shales developed in the axial zone of the foredeep. Eastward, the black shales pass into thick coarse orogenic clastics; westward, they pass into shallow-shelf carbonates and reefs.

MATURATION: Probably, maximum maturation was achieved after deposition of thick Upper Permian-Triassic orogenic clastics. After that, a large part of the rock column has been removed by erosion, especially in northern areas of the Belsk basin. Geologic data suggest that at peak maturity source rocks were in oil window in the northern part of the basin and in wet gas window in its southern part.

MIGRATION: Only short-distance lateral migration from source rocks into adjacent reef reservoirs is recorded.

RESERVOIR ROCKS: Most of oil and gas accumulations are in carbonate reef reservoirs that have variable, but commonly rather high porosity and permeability. Several fields have been found in Lower Permian self-sourced strongly fractured shale reservoirs.

TRAPS AND SEALS: The great majority of traps are pinnacle reefs that form a chain extending along the entire Belsk basin. Height of the largest reefs reaches several hundred meters. Traps containing fractured shale reservoirs are thrust-related recumbent folds. In both types of traps, hydrocarbon accumulations are sealed by Kungurian (uppermost Lower Permian) evaporites including salt. No fields are present north of the pinch-out line of evaporites.

REFERENCES:
Shamov, D.F., 1957, Facies of Sakmarian-Artinskian rocks of the Ishimbay area near the Urals: Trudy Ufimskogo Neftyanogo Instituta, v. 11, p.3-77.
Permian Reefs/Thrust Folds
Assessment Unit - 10150201

EXPLANATION

- Hydrography
- Shoreline
1015 Geologic province code and boundary
- Country boundary
  - Gas field centerpoint
  - Oil field centerpoint
10150201 Assessment unit code and boundary

Date:………………….. 6/3/99
Assessment Geologist:…….. G.F. Ulmishek
Region:…………………… Former Soviet Union
Province:………………… Volga-Ural Region
Priority or Boutique………. Priority
Total Petroleum System:….. Belsk Basin
Assessment Unit:………… Permian Reefs/Thrust Folds

* Notes from Assessor
Reserve data are lacking from the Petroconsultants’ file. Fields not grown.
Inert gas is nitrogen.

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: 3 Gas: 5
Established (>13 fields) Frontier (1-13 fields) Hypothetical (no fields)

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

Median size (grown) of discovered gas fields (bcfg):
1st 3rd 270 2nd 3rd 920 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) 1 median no. 5 max no. 10
Gas fields:…………………………...min. no. (>0) 5 median no. 20 max no. 35

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 6 max. size 80
Gas in gas fields (bcfg)……………………min. size 18 median size 50 max. size 1000
**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>500</td>
<td>800</td>
<td>1200</td>
</tr>
<tr>
<td>NGL/gas ratio (bngl/mmcf)</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/mmcf)</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Oil/gas ratio (bo/mmcf)</td>
<td></td>
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</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>35</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Sulfur content of oil (%)</td>
<td>0.2</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Drilling Depth (m)</td>
<td>2000</td>
<td>2700</td>
<td>3500</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>3</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>CO₂ content (%)</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Hydrogen-sulfide content (%)</td>
<td>0.1</td>
<td>0.2</td>
<td>1</td>
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<tr>
<td>Drilling Depth (m)</td>
<td>2500</td>
<td>4000</td>
<td>5500</td>
</tr>
<tr>
<td>Depth (m) of water (if applicable)</td>
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<td></td>
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</tbody>
</table>
### ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT

TO COUNTRIES OR OTHER LAND PARCELS (uncertainty of fixed but unknown values)

1. **Russia** 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></td>
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<tr>
<td>Portion of volume % that is offshore (0-100%)</td>
<td></td>
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Permian Reefs/Thrust Folds, AU 10150201
Undiscovered Field-Size Distribution

Minimum field size: 3 MMBO
Mean number of undiscovered fields: 5.1

OIL-FIELD SIZE (MMBO)
Permian Reefs/Thrust Folds, AU 10150201
Undiscovered Field-Size Distribution

Minimum field size: 18 BCFG
Mean number of undiscovered fields: 20