Two highly prolific oil and gas basins known to exist - all underexplored

- Four proven basins with oil and gas (Amu Darya, Afghan-Tajik, Tirpul (Herat), and Kushka).
- North Afghanistan basins cover >515,000 km² and >500 structures identified.
- Only 67 structures explored, led to commercial discovery of six oil and eight gas fields.
- Oil confirmed in Tirpul basin.
- Negligible exploration in Katawaz and Helmand basins.

Significantly unexploited resource
Northern Afghan Basins

- 3.4 billion barrels of potential unexploited petroleum liquids.
- 16 trillion cubic feet of probable natural gas resource.
- 0.50 billion barrels of probable natural liquid gas.

Petroleum Resources

The United States Geological Survey (USGS) and the Afghanistan Geological Survey (AGS) jointly assessed the oil and gas resources in northern, Western and Southern Afghanistan. The estimated mean volumes of unexploited petroleum in the Northern assessment area were 1.6 billion barrels of crude oil, 16 trillion cubic feet of natural gas, and 0.50 billion of natural gas liquids, (USGS FS-3031, 2006). Most of the unexploited crude oil occurs in the Afghan-Tajik basin and most of the unexploited natural gas is located in the Amu Darya basin. These two basins within Afghanistan encompass an area of approximately 515,000 square kilometers.
Basins in Afghanistan

Afghanistan has five (5) major and 1 minor sedimentary basin (figure1), all of which are underexplored.

Almost all of the petroleum exploration and development activities were confined to northern Afghanistan within the Amu Darya and Afghan-Tajik basins. During the Soviet era (1957-1989), a total of seven (6) oil and eight (8) gas fields were discovered.

Limited exploration in the Tirpul basin (Herat Province) confirmed the presence of oil whilst Katawaz and Helmand basins have no reported shows, owing to negligible or no work at all.

Northern Afghanistan Basins

The Afghan-Tajik, Amu Darya, and Kushka basins represent a total petroleum system, their location is shown in figure 2. The Kushka Basin is an extension of the highly prolific Amu Darya Basin. This basin has giant and supergiant fields in Turkmenistan and Uzbekistan including the South Yolotan field in Turkmenistan, which is one of the largest gas fields in the world.

The Afghan-Tajik basin offers similar geology and reservoirs making it a prized prospect for development. Lack of investment in post-Soviet times has precluded any active exploration programs to date within Afghanistan.

- Source rocks - The Lower to Middle Jurassic continental to marine clastics and coals and Upper Jurassic (primarily Oxfordian) anoxic basinal black mudstone, contain up to 2.5 weight % of total organic carbon with Type III kerogen and thin coal layers.
- Two identified Reservoirs were:
  (i) Hauterivian Kyziltash Formation sandstone several tens of meters thick, with high porosity and permeability and contains most of the oil and gas reserves.
  (ii) The second important reservoir is Upper Jurassic (Callovian to Oxfordian) shallow-shelf carbonates that contain sour gas.
- Geothermal gradient of producing wells of the North Afghan high is about 34.6 degrees C/km. The Jurassic beds are in the thermal gas window in all the basin areas. Cretaceous beds are partly in the thermal gas window (deeper parts) and in the oil window (basin perimeter and in part of the Turanian platform area). Paleogene and some Neogene beds are in the oil window on the basin perimeter.
- Traps - All known fields are in structural traps, most of the discovered productive traps are in anticlinal uplifts. Undiscovered fields are expected in structural traps, in reefs, or combination of the two.
- The principal regional seal is the Kimmeridgian to Tithonian Gaurdak Formation composed of salt and anhydrite with local carbonate beds.
- Plays - over 500 structures were discovered in the Amu Darya Basin. Five important plays are recognized in the North Afghanistan basins that together are assumed to contain more than 95% of the hydrocarbons.
During the Soviet era, exploration and development were confined to Amu Darya and Afghan-Tajik basin, and to a lesser extent, Tirpul basin. Only 7,700 km of seismic profile had been shot and out of the 370 wells that were drilled only 59 were exploration wells. The level of exploration coverage with respect to the total basin size is considered very low. The success rate was 23%

No further petroleum exploration and development were ever undertaken since 1989, after the exit of the Soviet Union.

Limited volume of oil was produced unlike exploitation of significant gas volumes to the Soviet Union. Angot was the only oil field developed and used for local consumption.

The Angot oilfield, located 11 km east of Sari-e-Pul city, was the only one that sustained production until 2006. Fifteen (15) wells were drilled of which 4 wells are classified as producers. Well #8 was the first production well in Afghanistan. Highlight Oil was produced from Hauterivian reservoir between 1083—1125m depths and consumed locally as heating fuel.

The Kashkari oilfield, located approximately 12 km south of Sari-e-Pul city had 10 wells drilled, 4 of which were ascribed as production wells with extended flow tests occurring for up to 3 weeks per interval. The Hauterivian sandstone reservoir exists at depths between 1800 and 1950m.
Petroleum Reserves and Resources

Soviet Resource Estimate

Between 1957 and 1984, a total of 14 petroleum fields comprising 6 oil and 8 gas fields were discovered and developed. About 370 wells have been drilled in northern Afghanistan, 59 of which are classified as exploration wells; and 211 are development wells. By 1989, eighty eight (88) MMBO of recoverable reserves and a geological resource of 233 MMBO were estimated from the 6 identified oilfields in the Amu Darya-Tajik basins. Only five (5) oilfields (Angot, Kashkari, Bazarkami, Zamarudsay and Aqdarya) contain significant accumulations, totaling 74 MMBO recoverable reserves and 219 MMBO geological reserves within the Hauterivian, Albian, and Aptian Formations (Cretaceous). Estimated reserves as at end of 1989 are shown below.

<table>
<thead>
<tr>
<th>Description</th>
<th>88 MMBO</th>
<th>5TCFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Recoverable Reserves</td>
<td>88 MMBO</td>
<td>5TCFG</td>
</tr>
<tr>
<td>Estimated Produced Volumes</td>
<td>0.17 MMBO</td>
<td>2TCFG</td>
</tr>
<tr>
<td>Remaining Reserves</td>
<td>87 MMBO</td>
<td>3TCFG</td>
</tr>
</tbody>
</table>

USGS-AGS Petroleum Resource Assessment

However, recent re-assessment by USGS-AGS revealed significant undiscovered petroleum potential. USGS-AGS estimated 1.6 billion barrels (0.2 billion metric tons) of crude oil, 16 trillion cubic feet (0.4 trillion cubic meters) of natural gas, and 0.5 billion barrels (0.8 billion metric tons) of natural gas liquids. Most of the probable crude oil resource is in the Afghan-Tajik Basin (Figure 4) and most of the probable natural gas resource is in the Amu Darya Basin, (USGS, 2006).

<table>
<thead>
<tr>
<th>Basin/Subsalt carbonates</th>
<th>Greatest Gas potential</th>
<th>Greatest Oil potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurassic Evaporite Basin Subsalt</td>
<td>5,474 BCFG</td>
<td>886 MMBO</td>
</tr>
<tr>
<td>Eastern Suprasalt Thrust and Folds – Afghan-Tajik</td>
<td>627 MMBO</td>
<td>886 MMBO</td>
</tr>
</tbody>
</table>

Figure 4  Oil Potential in the Suprasalt Assessment Units  (After USGS, 2006)