

The sleeping giant of the gas world

Robert O'Connor Jr, Senior Vice-President, Wavetech Geophysical

Turkmenistan is, by any measure, a sleeping giant in the oil and gas industry. Although oil was discovered in the late 19th century, most serious exploration in the country did not begin until after World War II and, mostly, not until after 1950. The first discovery was the Cheleken oilfield in 1876, stimulated by the developments in Baku, Azerbaijan, across the Caspian Sea.

The first major post-war oil discoveries in the eastern South Caspian Basin were Kum-Dag (1947) and Kotur-Tepe (1948). To the east, just across the border in Uzbekistan, the first major discovery in the Amu-Darya Basin was the giant gasfield, Gazli (1957). Since these discoveries, exploration in central Turkmenistan has focused primarily on gas and in western Turkmenistan primarily on oil, although gas in significant quantities has been found along with the oil in the west.

In this article the geological basins are reviewed from the viewpoint of their hydrocarbon potential, with special emphasis on gas reserves and resources. One of the factors that has constrained the full development of Turkmenistan's gas resources is also discussed.

Geology and gas potential

The principal petroleum resources of Turkmenistan are found in two geological basins: the Amu-Darya and the South Caspian. Parts of two other geological basins, the Middle Caspian and the Mangyshlak, extend into Turkmenistan and these may be significant for future exploration.

For the purposes of this overview, however, we shall concentrate on two producing zones of the Amu-Darya Basin, the Cretaceous and the Jurassic; on the Tertiary pro-

ducing zones of the South Caspian Basin; and on the potentially productive pre-Neogene zones of the Middle Caspian Basin. The regions encompassed by these four production zones are shown in Figure 1. Other potential regions are mentioned, but not discussed in detail.

It is important at the outset to make a distinction between oil and gas reserves and oil and gas resources. As used here, reserves are proven and producible oil and gas deposits. Resources, on the other hand, are geologically inferred deposits of oil and gas which are producible with known technology.

Resource figures represent the statistical expectation of future oil and gas recovery and have not been down-rated to take account of political and economic uncertainties. In other words, resources represent the best guess about extractable oil and gas, taking the known geology and extraction technology into account.

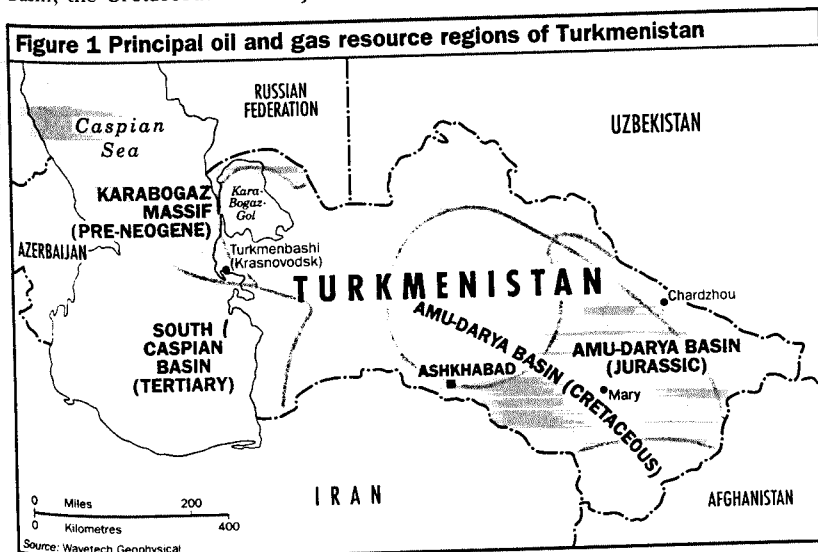
Near the end of the Jurassic period, the region of the Amu-Darya Basin was covered by shallow seas. Organic reef growth was widespread, with oolite and grainstone banks in shallow water, barrier reefs at the margin between shallow and deep water, and pinnacle reefs and atolls in deep water.

This period of carbonate deposition was followed at the very end of the Jurassic period by the deposition of salt and anhydrites, up to 1,200 metres thick in the central part of the basin, effectively sealing off all subsequently generated hydrocarbons in the Jurassic and older formations.

With the exception of Uzbekistan, where there has been substantial production from the Jurassic formations, all the Jurassic hydrocarbons ever generated in the basin can be expected to be still in place, most likely trapped in the various reef features that abound in the basin.

Using the proven reserves density from Jurassic fields in Uzbekistan and adjusting for the known and seismically-inferred geology throughout the basin, estimates of potential Jurassic resources in the basin can be made with a reasonable degree of confidence. Such an analysis gives a total of 3bn tonnes (t) of recoverable oil and 13 trillion cubic metres (tcm) of recoverable gas yet to be produced from the Amu-Darya Jurassic formations in Turkmenistan.

Lower Cretaceous rocks of the Amu-Darya Basin have been the traditional source of major accumulations of Turkmenistan gas. The largest field is Dauletabad-Donmez with initial proven reserves in the order of



1.7 tcm, or more. Gas reserves in the Cretaceous fields of the Amu-Darya Basin bring the total remaining reserves to roughly 2 tcm. Potential new gas resources in the same region and zone will most probably be found in by-passed reservoirs and potential stratigraphic traps and are likely to total 1 tcm.

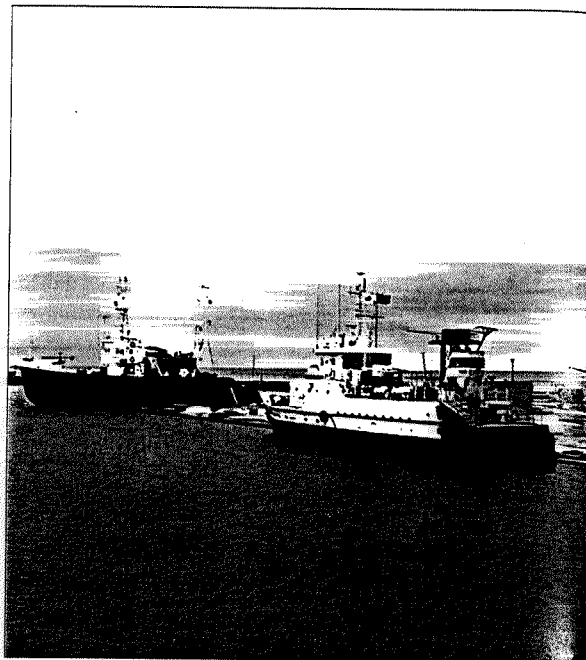
Gas in the tertiary zone

Although the Tertiary zone of the South Caspian Basin is the principal oil-producing province of Turkmenistan, approximately 40% of the total hydrocarbon production there is gas. Proven gas reserves are about 350m cm. Projected gas resources, both onshore and offshore, based on geological reasoning and existing reserves density, are estimated to be 1.6 tcm for the Tertiary section of this region.

Oil reserves and resources for the same region are estimated to be roughly 2bn tonnes. Probable source rocks that supply the hydrocarbons in the region are shales and silts of middle Pliocene age, but, significantly, contributions may also come from rocks of the Oligocene-Miocene section. These latter are believed to be the source rocks in Baku, to the west. Pliocene source rocks, in comparison to many in the world, are lean in organic content, but they occur in thick strata and almost all are still generating oil and gas today.

In addition, there appears to be a very efficient migration system, consisting of alternating sands and shales, for conducting oil and gas from the generation areas into the diapiric structures which form anticlinal traps. These diapiric structures are produced by up-welling and intrusion of high-water-content shales, mostly of Paleogene age, into the younger section above.

The eastern part of the Middle Caspian Basin intersects Turkmenistan territory at its northwestern corner, ending onshore at what is known as the Karabogaz massif. This massif – which is roughly the same size as the Sabin uplift of Texas and Louisiana, in the US, the location of the East Texas field – is likely to have focused hydrocarbon migration from the Mangyshlak Basin to the north, from the Apsheron Depression of the Middle Caspian Basin to the west, and from the eastern South Caspian Basin to the south.



Picture: Port facilities on the Caspian Sea at Cheleken in Western Turkmenistan

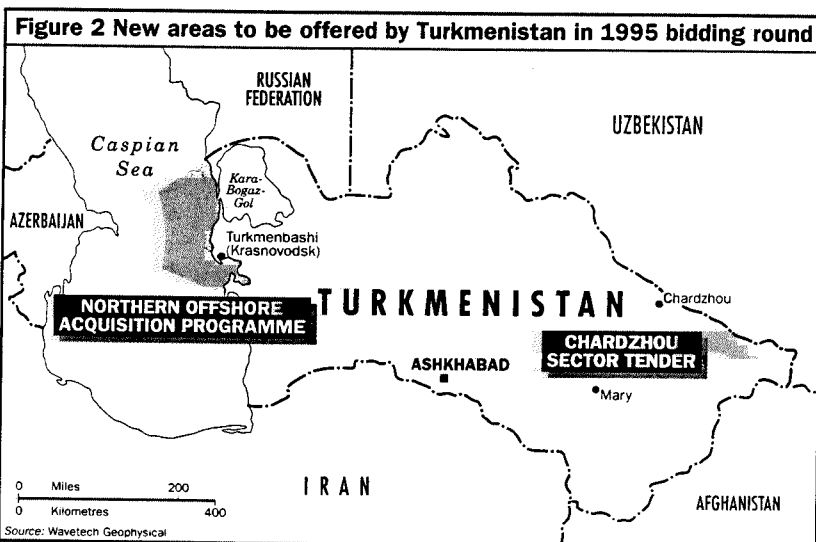
Onshore drilling near the crest of this uplift has been disappointing. Most of the potential reservoir rocks have been eroded. However, offshore, where the section is still intact, major potential exists. Although no drilling has been done there yet, seismic indications suggest the presence of gas that could imply major gas reserves in this structure. Accordingly, a gas resource estimate of 3 tcm has been included in the Turkmenistan resource estimates. Oil is also possible in this structure, but a resource figure cannot be estimated without drilling.

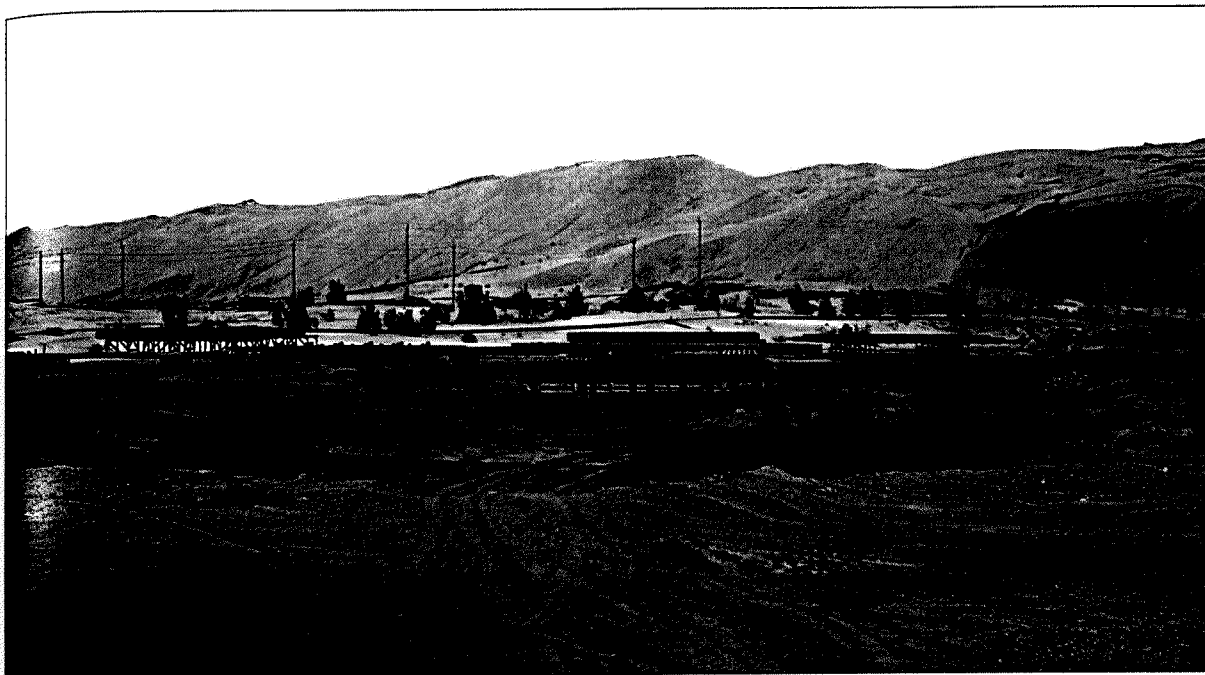
Other areas warrant attention

The provinces discussed above represent the principal known or inferred gas reserves and resources potential of Turkmenistan, but they do not cover the whole of the country's ultimate potential gas resources. Two other provinces, in particular, warrant attention.

The first is the region of western Turkmenistan where the Tertiary zone of the eastern South Caspian Basin thins in an easterly direction and the underlying Mesozoic section becomes sufficiently shallow for Cretaceous and Jurassic drilling to become economic. Significant gas shows have been reported from these latter levels at the Kizel-Tepe field, in Iran, along the same geological trend.

The second province is the Paleozoic section of the northwestern Amu-Darya region (and southeastern Mangyshlak Basin). Here, several penetrations into carbonate rocks of Carboniferous age have resulted in very high gas flows, suggesting that





Picture: Sand dunes behind Kotur-Tepe field in western Turkmenistan

the floor of gas potential in central Turkmenistan has not yet been determined.

Not enough is known yet about these two provinces to assign any resource estimates. However, they must be kept in mind as representing possible important future exploration objectives.

Collecting the foregoing reserves and resources numbers, we obtain the information given in the accompanying table. It is interesting to compare Turkmenistan oil and gas resource equivalents with those of other major basins of the world. As given in the table, reserves and resources in Turkmenistan are, in order-of-magnitude terms, roughly 20bn tonnes of oil equivalent (toe).

With similar calculation methods, this compares with 100bn toe for Saudi Arabia, 10bn toe for the North Sea and 5bn toe for the US Gulf of Mexico. Of the Turkmenistan potential, approximately 80% is expected to be gas.

The basic strategy for the further development of oil and gas reserves and resources by Turkmenistan has been to hold open competitive bidding rounds for the international oil and gas industry. So far, there has been one exploration licensing round and two production licensing rounds.

Table 1

Summary of Turkmenistan oil and gas reserves and resources

Geological province	Gas reserves and resources (trillion cubic metres)	Oil reserves and resources (billion tonnes)
Amu-Darya Jurassic	13	3
Amu-Darya Cretaceous	3	-
South Caspian Tertiary	2	2
Middle Caspian Pre-Neogene	3	-
Totals	21	5

The Chardzhou Sector of the Amu-Darya Basin was up for an exploration licensing round in mid-November 1994 and the offshore tracts west of the Karabogaz uplift are up for participation in a seismic acquisition programme prior to a bidding round scheduled for 1995 (Figure 2). There has been interest in these rounds and all previous ones have drawn bidders, but the level of interest has been much lower than would ordinarily be expected, given the large oil and/or gas resources that have been offered.

Lack of pipelines

Probably the most significant factor affecting the investment climate for oil and gas ventures in Turkmenistan has been the obvious lack of available pipeline transportation. All pipelines in Turkmenistan, both oil and gas, were built during the period of Soviet sovereignty and connect to the Russian system in the north.

Functioning pipelines to the south and west do not exist, although some were started prior to the revolution in Iran. Feasibility studies are under way to resurrect the southern routes (as well as consider new ones), and serious discussions are also under way to explore the feasibility of reactivating the links to the north. In time, these issues will be resolved, but, for the moment, transportation is a problem.

Immense reserves

It is very clear that the gas resources of Turkmenistan are immense. It is also clear that these resources must eventually make their way into the world markets, but precisely when and how is not clear. Lack of available transportation for gas is the primary factor limiting foreign investment in gas in the country at the present time. When this situation, or its perception, changes, the ability to acquire huge gas resources for minimal investment will cease, and the opportunity to hit it really big, in the tradition of the old oil industry, will have passed into history. □