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Sakarya gas field a new gas discovery by Turkey in the Black Sea deep waters

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Abstract

In August 21-2020, the President of Turkey announced a major gas discovery by TPAO the (Turkiye Petrolleri Anonim Ortakligi), in the Turkish territorial deep waters of the western Black Sea. The gas find is in the block AR/TPO/KD/C26-C27-D26-D27, 7000 square kilometers in size, that totally belongs to TPAO. The new gas accumulation has been named the Sakarya gas field. The exploratory well Tuna-1 (tuna, the Turkish name for Danube River, not the tuna fish) was drilled based on the seismic data, in the water depths of over 2115 meters, some 175 kilometers offshore, to a total depth of 4525 meters, The well encountered more than 100 meters of natural gas bearing reservoirs in the clastic rocks of the Oligo-Miocene age, the Maykop Group. The Maykop Group is the same sequences that has been considered as the source rock for the onshore area surrounding the Black Sea and the source rock for the South Caspian Sea hydrocarbon bearing reservoirs.

Introduction

In August 21-2020, the President of Turkey announced a major gas discovery by TPAO the (Turkiye Petrolleri Anonim Ortakligi), in the Turkish territorial deep waters of the western Black Sea. The gas find is in the block AR/TPO/KD/C26-C27-D26-D27, 7000 square kilometers in size, that totally belongs to TPAO. The new gas accumulation has been named the Sakarya gas field. The exploratory well Tuna-1 (tuna, the Turkish name for Danube River, not the tuna fish) was drilled based on the seismic data, in the water depths of over 2115 meters, some 175 kilometers offshore, to a total depth of 4525 meters, The well encountered more than 100 meters of natural gas bearing reservoirs in the clastic rocks of the Oligo-Miocene age, the Maykop Group. The Maykop Group is the same sequences that has been considered as the source rock for the onshore area surrounding the Black Sea and the source rock for the South Caspian Sea hydrocarbon bearing reservoirs. (Figure-1).

Figure-1, Approximate Location of the Sakarya Gas Accumulation discovered by Turkey Moddified from Blooberg and other Sources

A reserve figure of 320 billion cubic meters of lean gas have been quoted for the accumulation (by different , petroleum, businesses and Economical sources, August , 2020) without any references to the gas pressure, gas compositions, flow rates, production capability and so forth.

In the initial petroleum media reports a figure of 800 billion cubic meters was quoted for the gas discovery, that means, if correct, the 320 billion cubic meters is probably the recoverable gas figure for field, so the field seems to have a 40% recovery factor. This discrepancy between the quoted figures and the general petroleum geology of the Black Sea indicate a possible stratigraphic trap gas accumulation for the discovery. This fact is also evident from the seismic lines near the gas field (Figs. 6-7). Based on the reports the seismic attribute studies (AVO) have played a major role in selecting the location of this discovery. Water depth and distance to the shore makes the development costly and could only fill small part of the Turkish gas requirements.

Materials and Methods

A reserve figure of 320 billion cubic meters of lean gas have been quoted for the accumulation (by different , petroleum, businesses and Economical sources, August , 2020) without any references to the gas pressure, gas compositions, flow rates, production capability and so forth.

Discussion

2-Turkey and its Energy Requirements

Turkish annual gas consumption is close to 45 billion cubic meters of which close to 65% of that is fulfilled through imports (dry gas from Iran, Russia and Azerbaijan and LNG from USA, Qatar, Nigeria, and other sources). The overall costs of the Turkish Government for energy is between 35 to 50 billion USD of which 12-14 billion USD annually is spent for gas.

At present the total hydrocarbon production from the Black Sea is minor, especially when it is compared to the neighboring Caspian Sea, although similarities exist between the two regions in terms of key petroleum geology elements. In respect to possible hydrocarbon reserves for the Black Sea different figures have been quoted such as, in 2000, the USGS World Petroleum Assessment, estimated a figure in excess of 7 BBOE (billion barrels of oil equivalent). In 2017, analysis by Wood Mackenzie have reported an estimated figure of 1.35 BBOE of yet-to-find reserves for the Black Sea.

The Turkish's energy importation costs are responsible for a significant part of the current deficit in the Turkey's economy. Since 1990s, Gazprom has been the dominant supplier of dry gas to the Turkish market, providing half of the gas for local consumption and Turkey since 2005, has turned into the Russia's second-most-significant natural gas customer after Germany. Since 2018, BOTAS, the Turkish state-owned utility company, as well as several other private importers, have been buying larger volumes of liquified natural gas from Algeria, Nigeria, and Qatar, as well as from the United States, which offers lower prices and has reduced the Gazprom share on the Turkish market from 52 percent in 2017 to just 33 percent in 2019 (news from different sources, August, 2020).

3-General Geology of the Black Sea

The Black Sea, located between Russia, Georgia, Turkey, Bulgaria, Romania, and Ukraine, covers an area of approximately 423,000 square kilometers with a maximum water depth of 2245 meters. (Figure-2). It has a very thick young sedimentary column, more than 14-15 kilometers in thickness, composed almost entirely of the Tertiary clastics, occasionally with thin Upper Cretaceous carbonates, and volcanic intercalation. The Black Sea water has a unique, two-layer hydrographic structure. The surface layer of low salinity water is about 100 meters in thickness, overlying an 1800 to 2,000 meters layer of brackish water which is black and almost lifeless. Below 200 meters, there is a switch from dissolved oxygen to hydrogen sulphids in the water composition.

Inflow and outflow of water from the Mediterranean Sea into the Black Sea through Bosporus and the Dardanelles Straits is generally in both directions. While the denser, more saline waters from the Mediterranean flows into the Black Sea underneath the less dense, and fresher outflowing water from the Black Sea. This creates a significant and permanent layer of deep water which does not drain or mix and is therefore create an anoxic bottom water. The Black Sea have been considered by many petroleum geologists as the sea where hydrocarbon source rock is depositing.

Figure-2, Geographic Location of the Black Sea and its Surrounding Countries

Geologically the Black Sea has been divided into the Western and Eastern basins separated by the Andrusov Ridge, (Nikishin et al, 2015, and M.D. Simmons et al, 2018) (Figure-3). Both sub basins are mostly filled with the young Tertiary sediments that constitutes the hydrocarbon sources and the reservoir rocks in the Black Sea Basins.

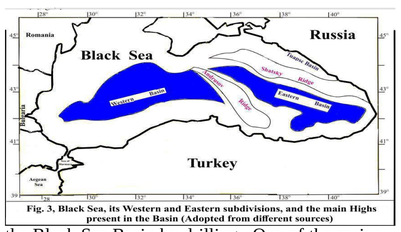

Fig. 3, Black Sea, its Western and Eastern subdivisions, and the main Highs present in the Basin (Adopted from different sources)

The Black Sea, and the South Caspian Sea, both are the partial remains of the Paleo-Tethys Ocean after the collision between the African and Eurasian continents (M. D. Simmons et al 2018). The hinterlands surrounding both seas have been the main supply of sediments, mostly clastics to the seas. Both seas have been filled by young sediments, with excessive thicknesses, mostly of Tertiary clastics supplied from the surrounding outcrop. Deposition of carbonate rocks have also been reported on the highs in the Black Sea Basin by drilling. One of the major questions in the Black Sea history is the geodynamic elements and the geological timing for the formation of the two subdivisions (the western and eastern sub basins, (Fig.3). Based on the geological investigations, these subbasins may have different (continental and oceanic) basements.

Figure -4 depicts a generalized stratigraphic column for the Black Sea general sedimentary sequence, modified from M.D. Simmons and Gabor Tari (2018) and Nikishin et al, (2015) Chronostratigraphic charts. The clastics rocks reservoir quality is quite dependent to the surface outcrops where the sediments to the sea have been sourced from. Therefore, the surrounding areas with igneous rocks (mostly on the northern sides) have contributed to better sandstone reservoirs, while the areas with volcanic and/or sedimentary rocks (generally in the southern parts) have provided lower quality sandstones.

Sedimentary rocks older than the Cretaceous, are present in the outcrops of the Turkish Coastal area of the Black Sea. Their presence in the Black Sea deep waters, . as being shown on Figure-4, has to be proved by drill.

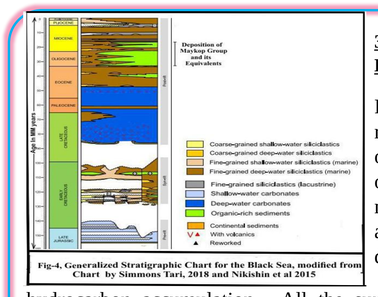

Fig-4, Generalized Stratigraphic Chart for the Black Sea, modified from Chart by Simmons Tari, 2018 and Nikishin et al 2015

3-1 PETROLEUM GEOLOGY OF THE BLACK SEA:

Presence of potential source rocks and reservoirs in Black Sea marginal outcrops, and abundant active seepages of oil and gas in these rocks, have been the main reasons for looking into the mainland and shallow waters in shelf areas (water depths of 100—200 meters) for hydrocarbon accumulation. All the surrounding countries have found small to medium size hydrocarbon accumulations in their territories. Almost all these discoveries, have been on structural traps and/or traps formed by major faults. In the Western Black Sea, the Danube drainage area, where the sea borders of Bulgaria and Romania intersect with the Turkish maritime borders, have been more proliferous for hydrocarbon resources, both onshore and shallow waters offshore. In these areas both the Romanian and Bulgarian companies have been producing oil and natural gas for decades.

The major petroleum source rock in the Black Sea region, , the Maykop Group, has been deposited during the Oligocene–Lower Miocene within a region that covers the Black Sea , many parts of its margins, and the Greater Caucasus and the South Caspian Sea areas. Deposition of the Maykop Shale and sandstone group relates to the initial isolation of northern parts of the Pale-Tethys at the end of the Eocene and beginning of the Oligocene. During the Oligocene–Miocene periods several eustatic and regional changes in sea level had happened, which are recorded within the Maykop Group by the cyclic deposition of fine grained organic-rich sediments (hydrocarbon source rocks) and fine to coarse grained sandstone packages (hydrocarbon reservoirs).

Oligocene and Miocene source rocks are immature at several locations in the shelf area where marginal hydrocarbon (mainly biogenic gas) discoveries have been made and samples being collected. Charge for the thermogenic hydrocarbon accumulations is interpreted to have been provided by long-distance lateral migration from the source kitchens in the more central parts of the Black Sea basin, where Oligocene and (some) Miocene source rocks are within the oil and gas windows). Generally, until this last discovery by TPAO in deeper waters, not too large, low success rates in the main land and shelf areas, lack of favorable petroleum geology, and high costs has been the main discouragement reasons for looking into the deeper waters aggressively.

Conclusion

The Black Sea because of its geographic position in land and between several major European countries who all need sources of energy for their consumptions have been the subject of extensive geoscience studies, since before the world war one. The petroleum geology of the sea to be considered as a hydrocarbon bearing sedimentary basin, similar to the Southern Caspian Sea and/or East Mediterranean Se, basins, have been the subject of many discussions and printed papers in the geological literature. Considering the fundamental requirements for such a position have been a major controversy among these geoscientists. A brief review of these arguments and theirs pros and cons are the followings:

-Pros : Presence of a very thick sedimentary column (exceeding 14-15 kilometers), presence of oil and gas shows in these sediments in the surrounding areas and discoveries of several commercial hydrocarbon accumulations in these rocks

-Cons: Presence of almost one single source rock, the Maykop group, not a high quality source rock and not always being matured , improper reservoir rocks, and general absence of proper structures for trapping oil and gas.

- The Maykop Suite and its equivalents, assumed to be the source rock for hydrocarbon in the region, has not been considered to be a high-quality source rock. Other minor and older possible source rocks deeper in the Eocene, have been considered but, given the likely depth of burial for those units, gas is a more likely hydrocarbon to be present.

- Considering the total volume of hydrocarbon accumulations discovered with the numbers of exploration wells drilled show a very low success rate.

-Few hydrocarbon discoveries on the shelf and shallow waters show that these discoveries are generally in traps developed by faults. Based on the interpreted regional seismic sections,(figures 6 and 7) deep water parts of the basin lack such types of traps for hydrocarbon accumulations.

-Considering the above indications, it could be assumed that the Sakarya gas, being the first commercial gas accumulation discovered in the deep waters of the basin is a stratigraphic trap discovery (Figures 6 and 7. This is also obvious from the quoted figures for the reserves (800 and 320 billion cubic meters), therefore locating additional accumulations in this basin requires extensive 3D seismic, more exploration wells, and difficulties for on developments.

-No details on gas composition, reservoir gas pressure, flow rates and other necessary data for possible development of the field being reported. Generally in the oil business it is not technically possible to confirm a reserve figure only through a single exploratory well results.

-The unit production costs of the Sakarya Gas Field compared to the other gas fields on production in the nearby (onshore and shallow offshores) countries (Romania, Bulgaria and …….) will be high due to the elements such as water depth and 175 kilometers distance to the shore.

-In ranking the new discovery to the other gas field in the nearby waters (i.e. in the Southern Caspian Sea and/or in the Eastern Mediterranean Sea) the discovery can not be considered as a large discovery, as it is about a third of Egypt Zohr field, one of the largest discovered gas accumulation in the East Mediterranean Sea which is estimated to hold 850 billion cubic meters of natural gas.

-Turkey plans to produce and make this gas available by 2023 that seems to be too optimistic as the Black Sea has tough geological and climate conditions for exploration and production. Generally, the average period from discovery to the market is around 7-8 years. Even by considering the quoted the 320 million cubic meters reserve, if confirmed, its full development (not considering its costs) will only covers a fraction of Turkey's gas requirements. Turkey in 2019 has used some 45 billion cubic meters of gas of which only 0.3 billion cubic meter have been from its internal sources. Full development of Sakariya gas field, if happened, adds at best 12-13 billion cubic meters to this internal figure. So still a large deficit exists between the consumption and the internal production.

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