

## Potential unconventional reservoirs in different basins of Turkey

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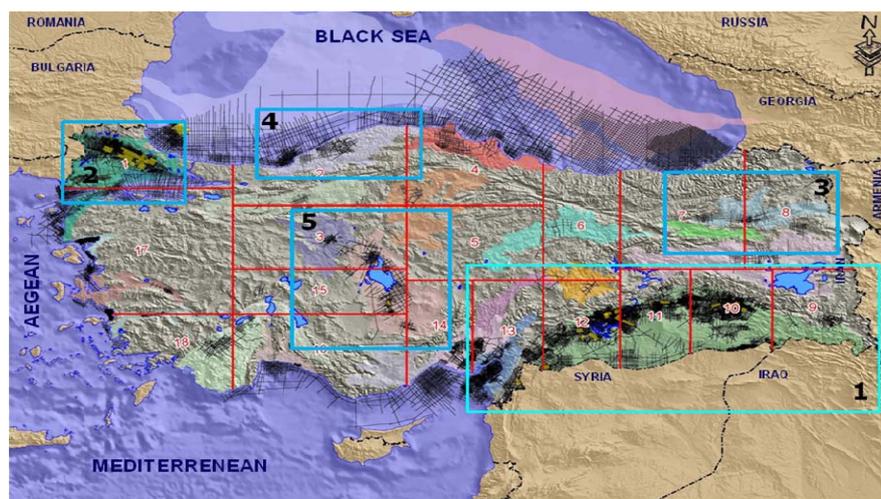
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There are numerous potential unconventional reservoirs in different basins located in different geographical regions of Turkey. In this study, most important and geochemically well investigated 10 formations will be introduced. Domestic oil production is obtained from the SE Anatolia, the Asian part of Turkey and the gas production is from the Thrace Basin, European part of the country (Fig. 1). All other internal basins are still unexplored basins. Although source rocks in those basins have very high hydrocarbon generation potential, more than 90% of the oil and gas demands are provided from the neighbouring countries. Unconventional production techniques may be the future supply of the demand in Turkey, a great market by itself and the rapidly developing country.

### Potential Areas and Basins for Unconventional Resources in Turkey



**Fig. 1** All basins are illustrated with different colors. 1: SE Anatolia, 2: Thrace Basin, 3: Eastern Anatolian Basins, 4: Onshore Black Sea Basins, 5: Central Anatolian Basins

There are four different potential formations in the oil-prone (SE) South East Anatolia (Fig. 2). These formations (older to younger) and their geochemical properties are given below according to their maximum values obtained from the core&cuttings;

Mid - U. Ordovician Bedinan Formation: (Thickness: 500 - 1500 m, Type-III Kerogene)

TOC: 0.5 - 6.5%                       $S_1+S_2$ : 2000 - 25000                       $T_{max}$ : 440 - 477 °C                       $R_0$ : 0.7 - 1.1

The U. Silurian - L. Devonian Dadas Formation: (Thickness: 100 - 400 m, Type-II Kerogene)

TOC: 0.5 - 16%                       $S_1+S_2$ : 2000 - 50000                       $T_{max}$ : 435 - 465 °C                       $R_0$ : 0.5 - 1.2

L. Permian Kas Formation:                      (Thickness: 30 - 80 m, Type-III Kerogene)

TOC: 2.89 - 22%                       $S_1+S_2$ : 120 - 4240                       $T_{max}$ : 436 - 446 °C

L. Maastrichtian Kiradag Formation:                      (Thickness: 50 m, Type-III Kerogene)

TOC: 1 - 10.13%                       $S_1+S_2$ : 130 - 2925                       $T_{max}$ : 427 - 442 °C



**Fig. 2 Potential unconventional formations in different basins of Turkey**

There are two different potential formations in the gas-prone Thrace Basin (Fig. 2). These formations (older to younger) and their geochemical properties are given below according to their maximum values obtained from the core&cuttings;

Mid - L. Eocene Hamitabat Formation:                      (Thickness: 1500 m)

TOC: 1.54 - 6.37%                       $S_1+S_2$ : 230 - 39860                       $T_{max}$ : 412 - 438 °C

L. Oligocene Mezardere Formation:                      (Thickness: 2000 - 2500 m)

TOC: 1.00 - 4.06%                       $S_1+S_2$ : 30 - 12490                       $T_{max}$ : 437 - 445 °C

Komurlu Formation is the Turkish equivalent of world-class source rock Maykop Formation which is the main source rock in the Black Sea and Caspian Region. It was deposited in almost all Eastern Anatolian Basins and outcrops in different parts of those basins. Its thickness is about 180 m in the Komurlu Section. Unfortunately, there is no well penetrated this formation, we only have analysis

results from the outcrop samples. Because the samples were collected from the outcrops around the basin margins,  $T_{\max}$  values are slightly low varying between 406 - 447 °C. However, TOC values indicate very high values (1.10 - 28.95%) and  $S_2$  values are in a broad range between 4.39 - 106.61

Lower Cretaceous Caglayan Formation is a potential unconventional reservoir in the onshore Black Sea Basins. Its thickness was measured more than 2000 m in some sections. Organic matter is generally Type-III kerogene. TOC values are slightly lower (1.02 - 1.87%) than other formations given above. Meanwhile,  $T_{\max}$  values are in the range of 413 - 532°C.

Salt Lake (Tuz Golu) Basin which is the largest basin in the Central Anatolia (Fig. 1) has different source rocks. However, Paleo-Eocene Karapinaryaylasi Formation indicates highest source rock parameters and unconventional potential. Its thickness is about 1000 - 1500 m. All geochemical parameters are observed in a broad variety. TOC: 0.01 - 12.61%;  $S_1+S_2$ : 10 - 15890;  $T_{\max}$ : 239 - 544 °C

Although there are 3 different formations bearing unconventional potential in the Taurus Basins, only two of them will be given in this study. U. Jurassic - L. Cretaceous Akkuyu Formation is measured about 300 m thick in different parts of Taurus Mountains. TOC values are in the range of 0.12 - 11.37%;  $T_{\max}$  varies between 426 - 443 °C. L. Carboniferous Ziyarettepe Formation includes Type-II kerogene organic matter with 1.63 - 6.46% TOC. Its maturity degree is indicated by the  $T_{\max}$ : 428 - 457 °C.

All these formations and their geochemical properties indicate that Turkey has a great unconventional resources potential. Most of the internal basins are still unexplored having a few wells and insufficient amount of seismic lines. In addition, non of the formations in oil and gas producing basins have not been tested with the unconventional production techniques.