



Source Rock Characteristic of The Kızıldere Clays (ARSUZ-HATAY)

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Abstract: Iskenderun Bay is the extension of the Adana Basin and is a convenient place for hydrocarbon exploration in terms of its formation mechanism. It is necessary to find rocks that can display lithological properties of source, reservoir and cover rocks in the mechanism of oil formation. There are formations in reservoir and cover rock lithology in İskenderun basin.

Kızıldere formation, which is the main rock, has gray-colored sandstone claystone sequences. Sandstones are 10-50 cm thick and claystones 2-30 cm thick. Stratified gypsum levels are observed at the top of the succession of sandstone and claystone and the thickness of the layers is between 5 and 15 cm. The hydrocarbon production of Kızıldere Formation clay was found by calculating the amount of TOC (Total Organic Carbon) and the average value was 0.56%. In addition, TOC values in the region are higher in the north and north east of the region and decrease in the south.

The sandstones in the region where the tectonic fractures are abundant due to MisisAndırın systems are reservoir rocks, and the evaporitic units known as Haymaseki formation are cover rocks.

Keywords: Total Organic Carbon, TOC, Kızıldere Formation.

Kızıldere Killerinin (ARSUZ-HATAY) Ana Kaya Karakteristikleri

Özet: İskenderun körfezi, Adana Havzasının devamı niteliğindedir ve oluşum mekanizması bakımından hidrokarbon aramaları için uygun yerdir. Petrol oluşum mekanizmasında ana kaya, rezervuar ve örtü kaya litolojik özelliklerini gösterebilecek kayaların bulunması gerekmektedir. İskenderun havzasında rezervuar ve örtü kaya litolojisinde formasyonlar mevcuttur.

Ana kaya olan Kızıldere formasyonu gri renkli kumtaşı kıltaşı ardışımından meydana gelmektedir. Kumtaşları katmanları 10-50 cm kalınlığındadır ve kıltaşı katmanlarının kalınlıkları ise 2-30 cm arasında değişmektedir. Kumtaşı ve kıltaşı ardışımının üstünde yer yer tabakalı jibs seviyeleri gözlemlenmektedir ve katman kalınlıkları 5-15 cm arasındadır.

Kızıldere Formasyonu killerinin hidrokarbon üretimi TOK (Toplam Organik Karbon) miktarının hesaplanmasıyla bulunmuştur ve bu değer ortalama %0.56 olarak belirlenmiştir. Ayrıca bölgede TOC değerlerinin bölgenin Kuzey ve Kuzey doğusunda yüksektir ve güneye gidildikçe azalma görülmüştür.

Misis yükselimine bağlı olarak tektonik çatlakların bol görüldüğü bölgece kıltaşı kumtaşı ardışımlı formasyonda kumtaşlarının rezervuar kaya, üzerine gelen Haymaseki formasyonu olarak bilinen evaporitik birimler ise örtü kaya niteliğindedir.

Anahtar Kelimeler: Toplam Organik Karbon, TOK, Kızıldere Formasyonu

1. INTRODUCTION

The potential for hydrocarbons formation of a sedimentary basin can be approximately determined using organic geochemical data. Hydrocarbon production occurs in the source rocks, accumulation in the reservoir rocks. The rocks, called the source rocks, are a general name given to rocks producing oil and / or natural gas. The thermal age and the amount of organic matters (OM) of source rock are higher than other rocks. The most common analyzes made at source rocks are total organic material (TOC) and total organic material (TOM).

TOC (%) analysis is an analytical technique that measures the total amount of organic carbon in the rocks. Total organic carbon, the result of the sum of the amounts of carbon derived of kerogen and hydrocarbons derived from kerogen in the rock [1].

TOC analyzes are usually made by pyrolytic methods, but organic materials can also be measured by laser based spectrometric methods recently [2,3]. TOC can be measured directly and quickly during logging when the well is opened [4].

TOC ratio in the source rock can be correlated with the sedimentation environment. This type

of issue was studied by Baumgardner and Hamlin [5] in Texas mudstones with high organic matter concentration and revealed facies-TOC relationship.

Analyzes of organic matter-rich claystones are made in the source rock exploration. However, a rock rich in organic carbon may not be enough to become the source rock. Maturity of organic matter has an important role in hydrocarbon production. The source rocks are darker in color due to the oxidation of the organic material that they contain. Depending on the increase in the total amount of organic carbon in the shales, the color of the rock is changed from red to green, green and gray [6]. Black shales, clayey limestones and marls have the potential to be the source rock [7]. The source rocks of the shales contain at least 1% organic matter and 0.50% total organic carbon [8].

The study area consists of Konacık, Tülek, Işıklı in Arsuz-HATAY (Figure 1), which have been deposited in the Neogene period and known as the Iskenderun basin. The Iskenderun basin was first named by the Aksu and Demirkol [9] as the "Iskenderun Neogene As Basin".



Figure 1. Study area and sample locations.

2. MATERIAL METHOD

TOC analysis basically relies on the principle of determining the percentage of total carbon (TC) and inorganic carbon (IC) in the sample and subtracting the percentage of inorganic carbon from the total carbon percentage to find the total organic carbon (TOC) percentage.

$$TC - IC = TOC (\%)$$

TC percentage is first determined in the TOC device. This process determines the percentage of the total carbon content by using dry air as a carrier gas at 200°C on the TC arm of the sample in the high temperature porcelain boots. Then, the samples are taken from the same specimen and the amount of inorganic carbon is determined in percentage by using 5% to 1% phosphoric acid (H₃PO₄) in the porcelain container at 200°C on the IC line of the device. Geology of the Region

The Iskenderun basin is surrounded by the Taurus Mountains in the north, the Yumurtalık fault associated with Misis-Andırın systems in the west and the Amanos Mountains in the east. Kızıldağ ophiolite is formed in Paleozoic and Mesozoic era, and this unit is overlain by Neogene, which is composed of Kalecik formation, Horu formation, Kızıldere formation, Menzelet formation, Haymaseki formation and Aktepe formation. Neogene sedimentation begins with the Middle Miocene transgression [10, 11].

The Miocene deposits, unconformably located on the ophiolites started with coarse clastics (Kalecik formation). The reefal limestones (Horu formation) are located on the lacustrine formation of Kalecik and Kızıldere formation where sandstone-shale succession is observed [11, 12, 13]. Evaporitic units (Haymaseki formation) deposited on the Kızıldere formation due to sea regression during the Messianic period after the marine units (Aktepe formation) began to deposit into the sea by transgression. Transgression continued in the Lower Pliocene,

and the basin was closed with sediments where the river facies dominated the Upper Pliocene-Quaternary.

The source rock Kızıldere formation was first named by [12]. The measured thickness of the formation consisting of gray colored thick-medium sandstone-claystone sequences is 800-2500 m. The Menzelet formation consisting of light gray sandy marls with transition lithology between Kızıldere formation and Haymaseki formation is in conformity with Kızıldere formation. Aktepe formation is unconformity unit top the Kızıldere formation. The presence of planktonic foraminifera such as *Globigerinoides bulloideus*, *G. bolli*, *G. trilobus*, *G. quadrilobatus*, *G. ruber*, *G. sacculifer*, *G. subquadratus*, *Orbulina universa*, *O. suturalis*, *O. bilobata*, *Praeorbulina glomerata glomerata*, *P. glomerata curva*, *Globoquadrina venezuelana*, *Globigerinella obesa*, *Paragloborotalia mayeri* indicates the Middle-Late Miocene age [14].

The Haymaseki formation, which consists of laminated sandy shales and contains different sizes of evaporitic units, was included in the Kızıldere formation by some researchers [14,15]. The unit is composed of succession claystone and sandstone in very thin bands at intermediate levels with limestone and gypsum stratification.

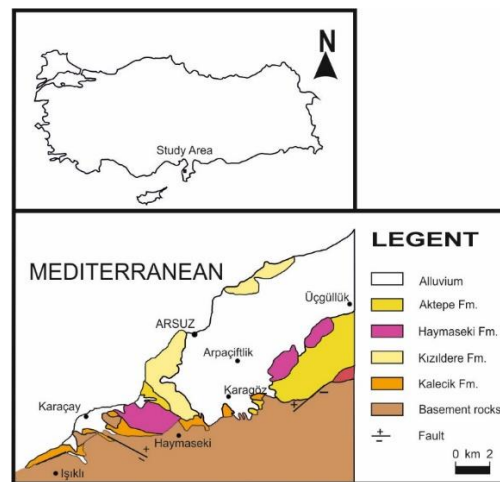


Figure 2. Geological map of the study area [16.]

3. FIELD OBSERVATIONS

The petroleum-bearing regions formed during the Miocene period and formations; Kalecik Formation (Middle Miocene) composed of conglomerates, Horu Formation (Middle Miocene) composed of reefal limestones and Kızıldere Formation. Among these units, Kızıldere formation, which provides the characteristics of reservoir rock with Horu formation and oil reservoir rock source rock and cover rock, is important. The Middle-Late Miocene aged formation is typically observed in the Konacık (Arsuz) region. Sand and clay

thickness of the formation is common of successive gray-yellow sandstones medium-thick layer between 10 to 50 cm (Fig 3A-B), the gray claystone between 2-30 cm are fine to medium layer (Figure 3-C). Stratified gypsum levels are observed at the top of the succession of sandstone and claystone and the thickness of the layers is between 5 and 15 cm. Tectonic fractures are widely found in the formation due to the effect of tectonism after the Middle Miocene (Figure 3-D). Plant residues can be seen in the sequenced marls with gypsum.

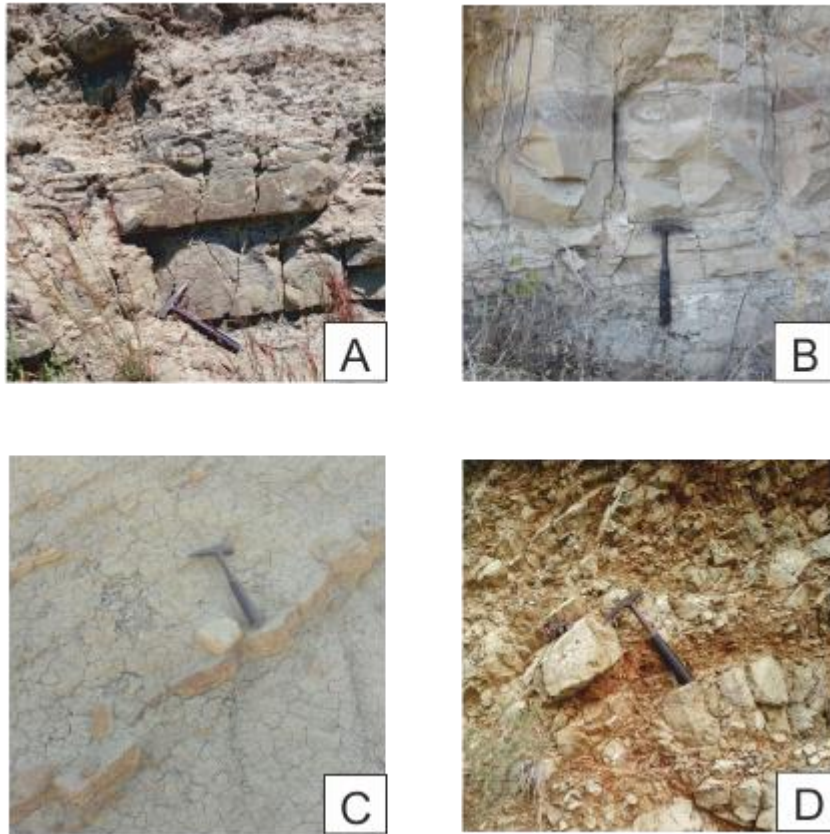


Figure 3. Field observations of Kızıldere formation, (A) Cracked sandstone strata, (B) Gray-colored claystone-sandstone succession, (C) claystone with fine sandstone layers, (D) claystone-sandstone layers formed by the effect of tectonics.

4. AMOUNT of TOTAL ORGANIC CARBON

The total Organic Carbon averages of the claystones, which are found in succession with the sandstones and marls taken from the region, are 0.56 % (Table 2). This value is determined by Ruble et al. [17] indicate that claystones can

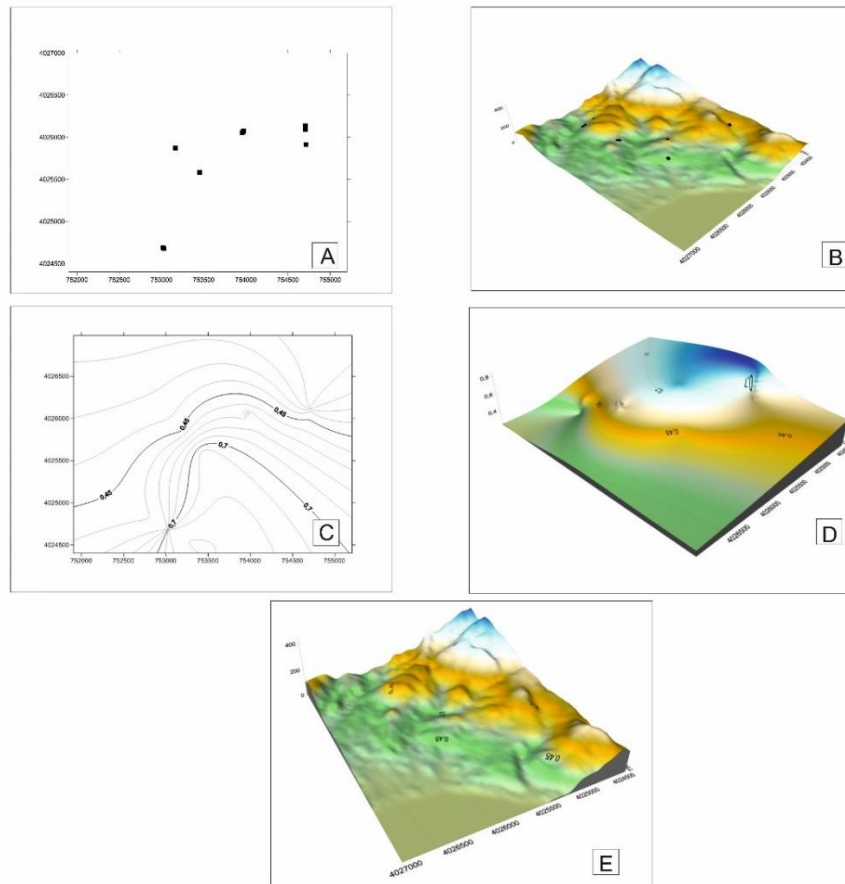
product oil and natural gas (Table 3). Total organic carbon values are 6-23% (mean 13%) of the total carbon content in claystones, and the inorganic carbon content is high in the rocks, which generally have a high total organic carbon content. Figure 4 shows contour and 3D diagram maps plotted according to TOC values.

Table 2. Sample location and total, inorganic, organic carbon ratio of Kızıldere claystones.

Sample	GPS Coordinates		Total Carbon (%)	IR Carbon (%)	TOC (%)
	Latitude	Longitude			
KD-1	754711.40	4025913.47	0,1184	0,01303	0,1054
KD-6	753015.84	4024689.96	3,2725	2,7615	0,5110
KD-7	753030.08	4024679.75	4,5155	3,681	0,8345
KD-8	754704.88	4026135.61	3,7525	3,514	0,2385
KD-9	753958.00	4026051.00	5,2425	4,7165	0,5260
KD-11	753967.00	4026062.00	5,250	4,4885	0,7615
KD-13	753976.00	4026075.00	5,380	4,8385	0,5415
KD-14	754706.19	4026091.01	3,045	2,6345	0,4105
KD-15	753451.88	4025581.70	3,4045	2,620	0,7845
KD-16	753166.41	4025871.88	3,490	3,0565	0,4335

Table 3. Rock classification by total organic carbon ratio [17].

Quality	TOC (wt %)
Poor	<0.5
Fair	0.5 - 1
Good	1 - 2
Very Good	2 - 4
Excellent	>4

**Figure 4.** (A) Map showing sample locations, (B) Representation of sample locations in 3D block diagram, (C) Local contour map of TOC values in claystones, (D) 3D block diagram with TOC values in claystones, (E) Topographic distribution of TOC values.

RESULTS

Field observations of Kızıldere sandstones and claystones that form in the lagoonal environment and layer evaporitic units, total organic carbon (TOC) contents and determination of plant residues are important in determining the oil potential. TOC values of claystones indicate that they can produce hydrocarbons.

Total Organic Carbon averages are 0.56 in the claystone samples. This value is determined by [17] shows that claystones can produce oil. The TOC values in the region are decreasing from north to southwest. This change suggests that claystones in the north east of the region are more likely to produce petroleum. The amount of organic matter to the southeast is expected to decrease. Gypsiferous units on the Kızıldere formation are covered rock in petroleum, therefore oil and gas exploration have reached positive results.

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