

# Petroleum Source Rock Assessment of the Middle Oligocene-Lower Miocene Coal Bearing Deltaic Sediments in the NW Turkey\*

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## Abstract

The oil and gas-bearing Thrace Basin (NW Turkey) contains Late Cretaceous to Recent sediments. Middle Oligocene-Lower Miocene deltaic sediments of the Osmancik and Danismert Formations in the NW Turkey comprise organic matter rich shale and coal. Bacteriogenic gases in the Silivri, Hayrabolu, Turgutbey, Umurca, Tekirdag, and Karacali fields in the basin were generated from the Danismert Formation and the upper part of the Osmancik Formation.

This study focuses on petroleum source rock assessment of the coal bearing deltaic sediments based on Rock-Eval - TOC data and organic petrographic analysis of the 51 fresh surface samples taken from Malkara, Kumbag-Tekirdag, Marmara Ereglisi, Akpinar and Sile regions. According to this data, shale and coal have very good source rock potential due to its TOC (total organic carbon) content ranging from 0.02 to 45.53%. T-max (pyrolysis temperature at the maximum rate of kerogen conversion) values have been measured between 351 and 449°C. Thus, the sediments are ranging from immature (only biogenic gas) to middle mature. In addition, organic petrographic investigations in this study suggest that organic matter content of the coals and shales made up amorphous (0-65%), herbaceous (3-20%), woody (20-95%) and coaly (0-15%).

# **PETROLEUM SOURCE ROCK ASSESSMENT OF THE MIDDLE OLIGOCENE-LOWER MIOCENE COAL BEARING DELTAIC SEDIMENTS IN THE NW TURKEY**

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## *Introduction*

The Thrace Basin is the most important productive gas region of Turkey. However, petroleum source rock assessments are very restricted.

Current study focuses on source rock assessment of the coal bearing sediments in the Thrace Basin based on Rock-Eval - TOC and organic petrographical data of the 51 surface samples taken from the rocks.

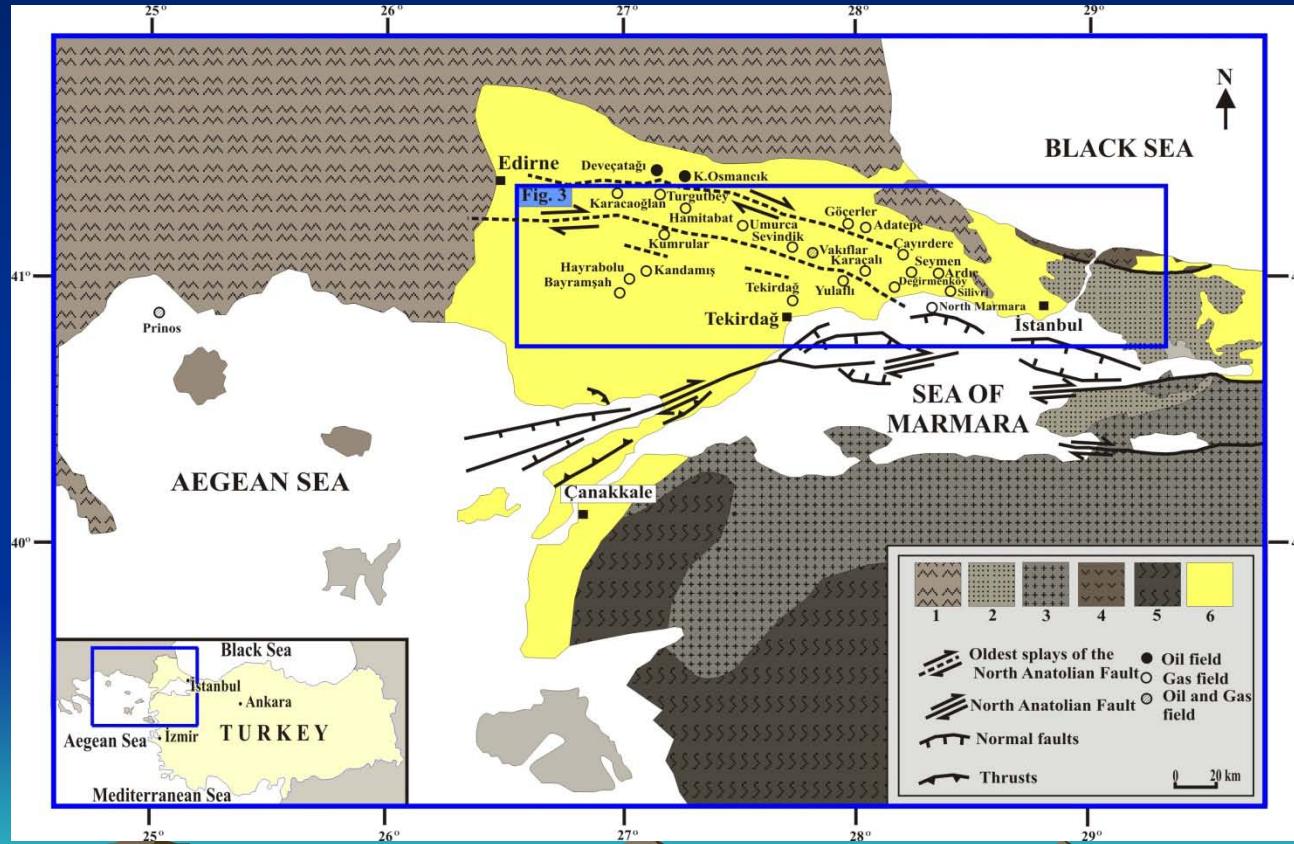
There are nearly 15 meter thick coal in the deltaic sediments as 5 different levels.



# **Regional Geology and oil -gas fields**

The Thrace basin is bounded by the Istranca Massif, Istanbul Paleozoic sediments and magmatic rocks to the north and the Paleotethys remnants and Neotethys subduction-accretionary complex to the south.

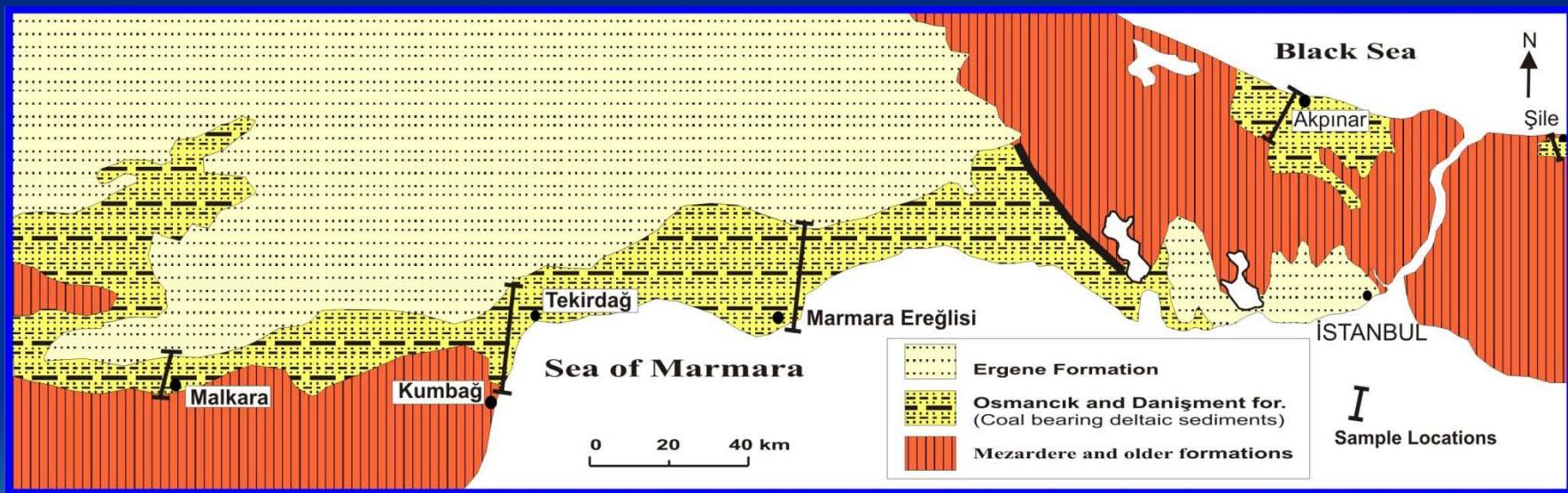
The basin has 2 oil and 20 gas fields.



## **Geology of the study area**

Middle Oligocene-Lower Miocene coal bearing sediments are represented by the Osmancık and Danişment Formations.

The formations are underlain and overlain by the Mezardere and Ergene Formations, respectively.



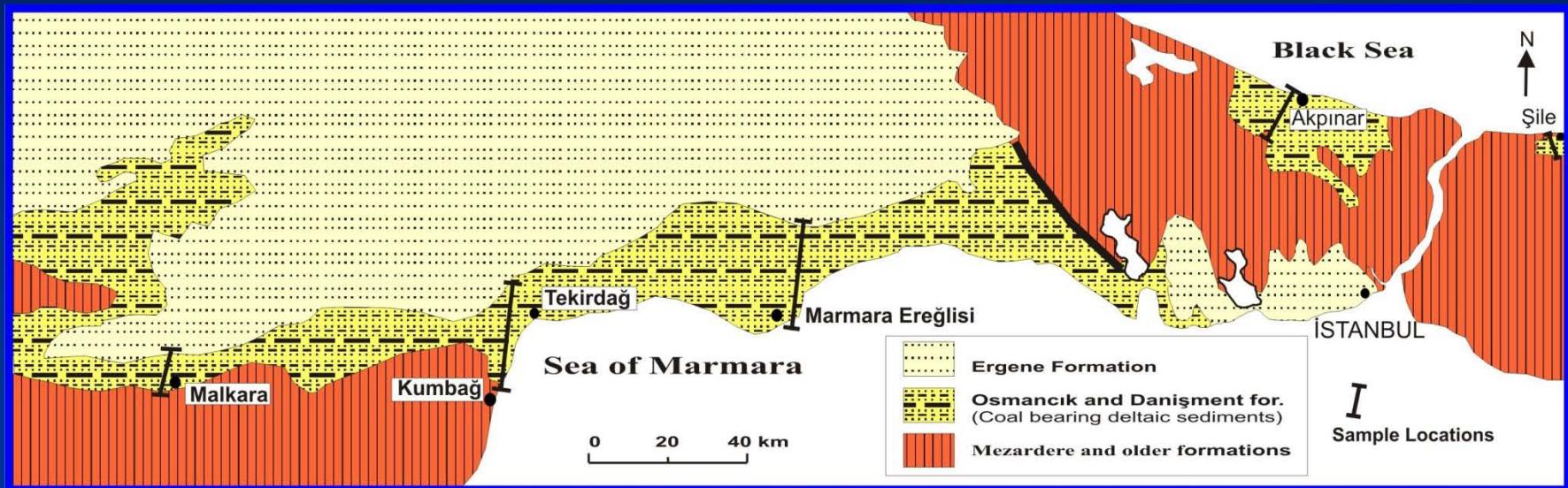
Middle Oligocene-Lower Miocene coal bearing sediments are similar to Maykop Series in the petroleum reach Caspian region.

OLIGOCENE-LOWER MIocene -	AGE	FORMATION	MEMBER	THICKNESS (m)	LITHOLOGY	EXPLANATION
Quaternary	Alluvium			300-40		Pebbles, sand and mud Unconformity
Middle Miocene	Ergene			300		Blocks, pebbles, sand and mud Unconformity
	Danişment			500		Coal bearing deltaic conglomerate, sandstone, mudstone and shale
	Osmancık			700		Coal bearing deltaic sandstone, siltstone and shale
	Mezardere					Deltaic shale
Upper Eocene	Keşan			650		Turbiditic pebbly sandstone and mudstone

Paleogene	Neogene	Period	Epoch	Age	Formation	Ma
					M	
Eocene	Oligocene	Miocene		Kotsakurian		15
		E		Sakaraulian		20
		L		Caucasian		25
		E		Chattian		30
		L		Rupelian		35
		E		Priabonian	Koun Formation	40
		M		Bartonian		



## Sample Locations





*10 samples taken from a coal  
mine in Malkara (MK1-10 in the  
Table 1)*





*11 samples taken from Kumbağ-Tekirdağ road (KT1-11 in the Table 1)*





*11 samples taken from Marmara Ereğlisi cliffs (ME1-11 in the Table 1)*





*10 samples taken from a coal mine in Akpınar (AK1-10 in the Table 1)*



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*9 samples taken from coal a  
mine in Şile (SL1-9 in the Table  
1)*



# *Rock Eval-TOC data of the samples*

Sample No	TOC* (wt %)	S <sub>1</sub> * (mg HC /g sample)	S <sub>2</sub> * (mg HC/g sample)	S <sub>3</sub> * (mg HC/g sample)	Tma x* (°C)	HI* (mg HC/g org C)	OI* (mg CO <sub>2</sub> /g org C)
MK1	28,82	0,64	58,75	30,82	413	204	107
MK2	33,89	0,85	46,10	24,31	418	136	72
MK3	0,90	0,01	0,38	1,07	426	42	119
MK4	32,31	0,70	74,06	29,93	419	229	93
MK5	3,56	0,36	1,35	2,57	430	38	72
MK6	31,63	0,42	44,60	25,00	418	141	79
MK7	0,29	0,01	0,10	0,62	430	34	214
MK8	0,38	0,01	0,10	0,76	431	26	200
MK9	0,76	0,01	0,24	1,46	424	32	192
MK10	0,17	0,00	0,03	0,36	438	18	212
KT1	6,28	0,08	6,67	3,56	433	106	57
KT2	5,38	0,07	5,59	3,81	431	96	35
KT3	19,59	0,59	20,67	22,30	429	106	114
KT4	4,97	0,09	1,69	8,21	438	34	165
KT5	0,09	0,01	0,02	0,90	431	22	100
KT6	32,52	1,29	70,07	24,95	411	215	77
KT7	8,09	0,18	3,83	8,56	427	47	106
KT8	0,30	0,00	0,08	0,23	441	27	77
KT9	0,62	0,01	0,22	0,42	421	35	68
KT10	0,10	0,00	0,01	0,19	446	10	190
KT11	0,48	0,00	0,13	0,31	449	27	65
ME1	0,56	0,01	0,24	0,20	423	43	3 6
ME2	0,79	0,02	0,47	0,28	432	59	35
ME3	0,61	0,01	0,32	0,31	422	52	51



ME4	0,59	0,01	0,21	0,40	423	36	68
ME5	0,62	0,01	0,36	0,51	439	58	82
ME6	0,49	0,00	0,23	0,26	435	47	53
ME7	1,17	0,03	2,11	0,37	428	180	32
ME8	16,22	0,27	9,53	13,44	423	59	83
ME9	0,32	0,00	0,09	0,20	437	28	62
ME10	0,19	0,01	0,06	0,11	436	32	58
ME11	37,48	3,65	65,67	30,61	384	175	82
AK1	35,72	2,62	78,36	30,17	392	219	84
AK2	32,26	2,63	69,83	11,03	425	216	34
AK3	30,93	2,89	80,05	33,17	392	259	107
AK4	0,68	0,04	0,49	0,82	427	72	121
AK5	0,02	0,01	0,05	0,17	N/A	250	850
AK6	38,76	2,36	90,31	19,70	362	233	51
AK7	32,63	2,05	48,54	37,54	391	149	115
AK8	39,45	2,92	98,34	18,88	358	249	48
AK9	0,24	0,03	0,11	0,47	356	46	196
AK10	1,97	0,04	1,10	1,70	425	56	86
SL1	0,04	0,00	0,03	0,16	355	75	400
SL2	0,02	0,00	0,03	0,18	N/A	150	900
SL3	1,21	0,40	3,11	0,46	381	257	38
SL4	0,06	0,00	0,02	0,30	422	33	500
SL5	45,53	11,34	132,95	27,66	367	292	61
SL6	34,08	2,03	41,89	40,57	381	123	119
SL7	35,14	2,36	54,38	39,22	405	155	112
SL8	35,07	3,20	90,19	42,11	400	257	120
SL9	14,80	1,22	6,26	13,91	351	42	94



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## ***Assessment of the Source Rock Analysis***

Assessment of the analysis in the Table indicates that the deltaic sediments have very good source rock potential due to its TOC content ranging from 0.02% to 45.53 %.

T-max values have been measured between 351 and 449 °C. Thus, the deltaic sediments is ranging from immature (only biogenic gas) to middle mature.

Coaly sediments of the Malkara, Kumbağ-Tekirdağ Marmara Ereğlisi regions where located in the south of the basin are early and middle mature.

Coaly sediments of the Akpınar and Şile regions where located north of the basin are immature.



# Petrographical analysis of the selected samples

Sample No	Vitrinit reflectance (Ro)	Kerogene type
MK1	0,28	Amorphous 0%; herbaceous 5%; woody 90%; coaly 5%
MK2	0,27	Amorphous 5%; herbaceous 15%; woody 80%; coaly 0%
MK4	0,29	Amorphous 0%; herbaceous 5%; woody 95%; coaly 0%
MK6	0,29	Amorphous 0%; herbaceous 10%; woody 85%; coaly 5%
KT1	0,32	Amorphous 5%; herbaceous 5%; woody 85%; coaly 5%
KT3	0,37	Amorphous 5%; herbaceous 5%; woody 80%; coaly 10%
KT4	0,30	Amorphous 2%; herbaceous 3%; woody 90%; coaly 5%
KT6	0,29	Amorphous 5%; herbaceous 10%; woody 85%; coaly 0%
KT7	0,35	Amorphous 5%; herbaceous 5%; woody 75%; coaly 15%
ME2	0,32	Amorphous 2%; herbaceous 3%; woody 85%; coaly 10%
ME8	0,32	Amorphous 0%; herbaceous 15%; woody 80%; coaly 5%
AK1	0,29	Amorphous 0%; herbaceous 5%; woody 95%; coaly 0%
AK2	0,28	Amorphous 0%; herbaceous 5%; woody 95%; coaly 0%
AK3	0,29	Amorphous 2%; herbaceous 3%; woody 95%; coaly 0%
AK4	0,27	Amorphous 0%; herbaceous 10%; woody 80%; coaly 10%
AK6	0,28	Amorphous 5%; herbaceous 5%; woody 85%; coaly 5%
AK7	0,29	Amorphous 2%; herbaceous 3%; woody 85%; coaly 10%
SL5	0,27	Amorphous 10%; herbaceous 15%; woody 75%; coaly 0%
SL6	0,24	Amorphous 0%, herbaceous 5%; woody 90%, coaly 5%
SL8	0,26	Amorphous 0%; herbaceous 10%; woody 90%; coaly 0%
SL9	0,24	Amorphous 5%; herbaceous 10%; woody 85%; coaly 0%



## **Assessment of the Organic Petrographical Analysis**

*Assessment of the analysis in the Table suggests that organic matter content of the coals and shales made up*

*amorphous (0-5%),  
herbaceous (3-15%),  
woody (75-95%) and  
coaly (0-15%).*

*Thus, the sediments are represented by type III and II kerogens (Table, 2).*



## **Conclusions**

*Current study show that the deltaic sediments of the Osmancık and Danişment Formations have very good source rock potential*

*The deltaic sediments are ranging from immature (only biogenic gas) to middle mature.*

*Coaly sediments are early-middle mature in the south of the basin and the sediments are immature in the north of the basin.*

*The sediments are represented by type III and II kerogens.*

