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Rank of Kozlu Formation coals in the Zonguldak Basin: implications for coalbed gas

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Abstract: Carboniferous bituminous coals of the Zonguldak Basin have been mined for over a century. Due to underground mining activity, there have been several fatal incidents related to gas explosions. The gas content of the coals varies greatly in the basin mainly based on coal maturity (rank), increasing with increasing coal depth. In this study, we report a map for coal depth and coal rank in the Kozlu-Üzülmez-Karadon districts of Zonguldak Basin with hope the that it would aid coal gas exploration/exploitation and also coal gas degassing efforts for safer underground mining production in the Zonguldak Basin.

Key words: Coal rank, coalbed methane, Carboniferous coals, Zonguldak Basin

1. Introduction

Remnants of terrestrial plants (e.g., various parts of trees), which accumulate in depositional environments with suboxic to anoxic sediment-water interface conditions, can be preserved. Such organic materials undergo chemical and physical changes caused by increasing burial and temperatures; this is defined as thermal maturation also called coalification. As a result, starting from peat, coals such as lignite, hard coal, and anthracite, and at the end of this evolutionary process metaanthracite can be formed. Methods based on the measurement of different parameters are used in order to define the degree of coalification, i.e. type of coals (Stach et al. 1982; Taylor et al., 1998; O'Keefe et al., 2013; Dai et al., 2020). Among these methods, vitrinite reflectance is one of the most effective and reliable methods for determination of the maturity (degree of coalification) (Teichmüller, 1982).

As a byproduct of this maturation (coalification) process, oil and/or gas is generated from organic matter (Tissot and Welte, 1984). Therefore, accurate determination of the level of maturation is important, as coal gas potential depends particularly on the rank of coal. Coal rank is also one of the major factors (in addition to coal maceral composition, volatile matter content) controlling the coking ability of coals (Stach, et al., 1982; Diez et al., 2002). Therefore, accurate determinations and realistic predictions of coal rank enable coal gas resource assessment as well as the coking properties of coal in a basin.

Carboniferous coal-bearing units in the Zonguldak Basin (Figures 1A and 1B) have been studied in the context of the conventional- and coal-gas potential of the basin and maturity measurements have been made for coals in different formations (e.g., Artüz, 1971; Yalçın, 1990, 1994a, 1994b, 1995a, 1995b, 1996; Gürdal and Yalçın, 1992, 2000, 2001, 2008; Yalçın et al., 1994, 2001, 2002, 2003; Mann et al., 1995; Hoşgörmez et al., 1998, 2002; Yalçın and İnan, 2001; Hoşgörmez and Yalçın, 2002; Özgökçe and Yalçın, 2002; Gürdal et al., 2004). Moreover, studies investigating various properties of coals, and in this context, the level of coalification have also been conducted (e.g., Karayiğit, 1989, 1992, 2001, 2003; Karayiğit et al., 1998, 2018a, 2018b, 2022; Yürüm et al., 2001a, 2001b; Seyis et al., 2002). In these studies, the maturity values of the coals were determined either for a selected seam using samples taken from the mines in different districts or for different seams that were encountered in boreholes. In other words, the data on the rank of the coals are in general from a certain point, and studies reflecting coalification changes of certain seams throughout the basin have not been carried out yet.

This paper has been prepared in order to provide coal rank distribution for the Zonguldak area (Kozlu-Üzülmez-Karadon districts) of the Zonguldak Basin and thereby contribute to some exploration work recently

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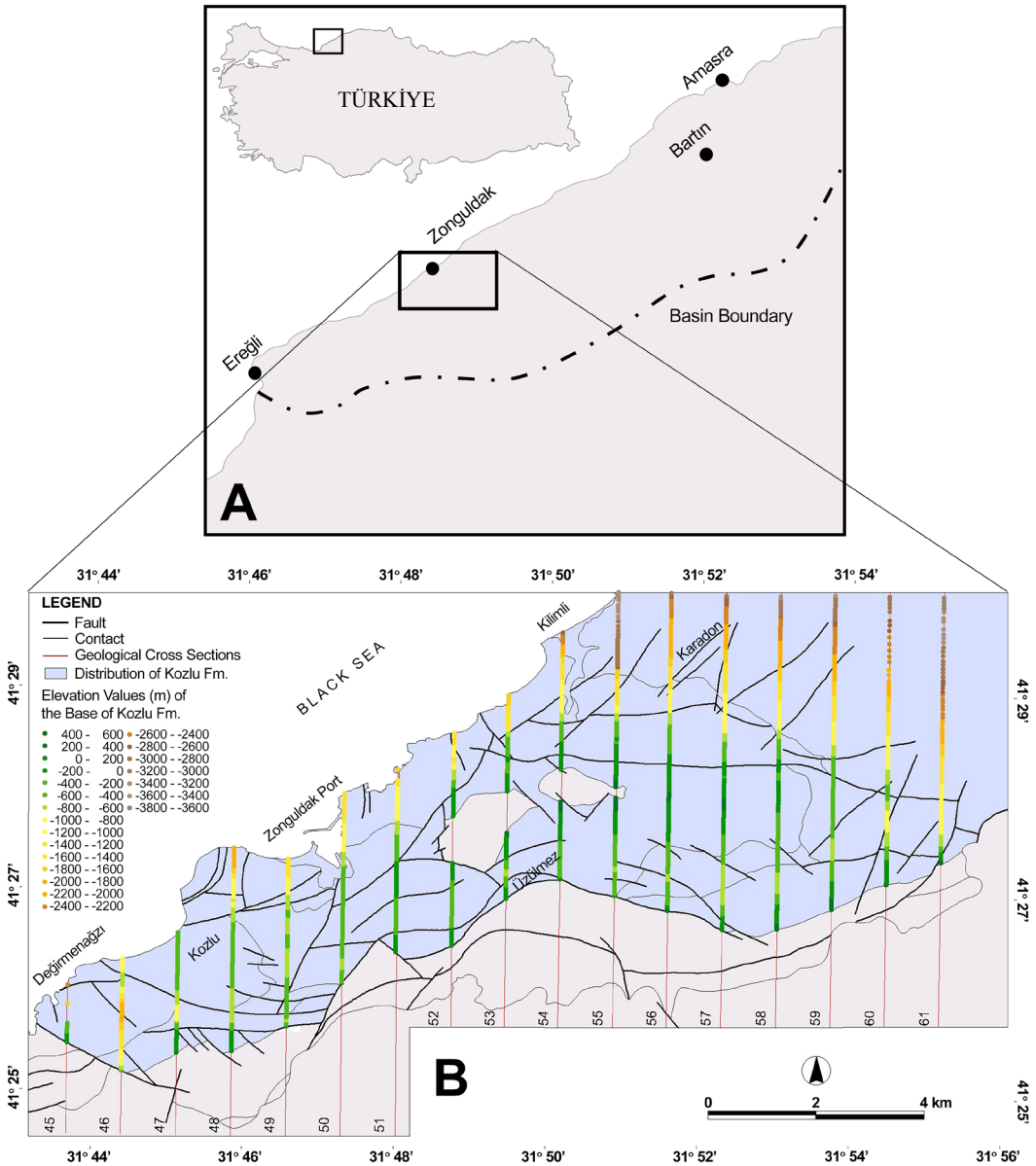

Figure 1. A) Map showing the Zonguldak Basin and the Zonguldak area of the basin focused for this study. **B)** Map showing the geological cross-sections (numbered 45 to 61 from west to east) and digitised points along these sections. The data points have been used for the preparation of the structure map of the base of the Kozlu Formation. Modified from Seyis (2002).

initiated by the relevant institutions regarding the coal gas potential of the basin. In this article, we will present a maturity map for the base of the Langsettian (Westphalian A) Kozlu Formation. A preliminary version of this map was prepared within the frame of a master's thesis (Seyis, 2002). In addition, possible contributions of this map to the coalbed methane (CBM) exploration and degassing efforts for safer coal production in the Zonguldak Basin will also be discussed.

2. Methods and approach

Most of this work was carried out with geographic information systems (GIS). ArcView 3.1 (with Spatial Analyst and 3D Analyst) (ESRI-Redlands, California) was used as the main software. As the geological map of the study area, the 1/10,000 map prepared by Özler et al. (1992), was simplified and digitised. Drilling locations, faults, and contour lines were also obtained from this map. Vitrinite reflectance (% R_o) data from previous studies

(Karayiğit 1989; Mann et al., 1995; Yalçın and Gürdal, 1995; Hoşgörmez, 1996; Yalçın, 1997; Seyis 2002) were first checked for quality and consistency of measurement methods and then used in this study.

In order to define the coal rank (maturity) map of a certain horizon, which represents a defined unit, the base of the Langsettian (Westphalian A) Kozlu Formation was taken as a basis. This unit exists throughout a large part of the study area and contains many coal seams. As the first step of the approach, a structure map has been prepared in order to describe the lateral and depth variations of this horizon. The data points used in the preparation of a structure map were obtained by digitizing the elevation (with respect to sea level) of the base of the Kozlu Formation from geological sections provided by Özler et al. (1992). Figure 1B shows these data points.

There are 4005 points with elevation values varying between a maximum of + 540 m and a minimum of –3740 m. In Figure 1B, the defined points along the sections are grouped and coloured depending on the elevation value they represent. The elevation points belonging to the base of the Kozlu Formation were converted to TIN in ArcView, and a model that represents the structure (geometry) of the unit was created. Later, this model was converted into a grid structure to be used in mapping the degree of coalification. The structure map of the base of the Kozlu Formation obtained in this way is shown in Figure 2. The contour intervals are 200 m. Faults are also superimposed on the map in order to see, where possible, the relationship between the structural configuration of the base of Kozlu Formation and the faults observed on the surface. A north-south geological cross-section shown in Figure 3 suggests that the vertical throws on most of these faults are not so high (less than about 100 m) and thus generated elevation 200-m contours in the structure map do not show major disturbance with respect to faults. It should be noted that in the structure map shown in Figure 2, the values are "elevations" relative to the sea level.

Previous studies have noted that the Zonguldak Basin has a complex structure, divided into compartments by faults due to two major orogenesis, namely the Hercynian and the Alpine (e.g., Özler et al., 1992; Yalçın et al., 2002). However, as shown in Figure 3, the majority of these faults has not led to major displacements. On the other hand, the structural map (Figure 2) suggests that some prominent block boundaries are eminent. In order to minimise the effect of structural differences, the study area is divided into four different regions according to the structure map of the Kozlu Formation and the major faults. These four seemingly fault-controlled regions are shown in Figure 4.

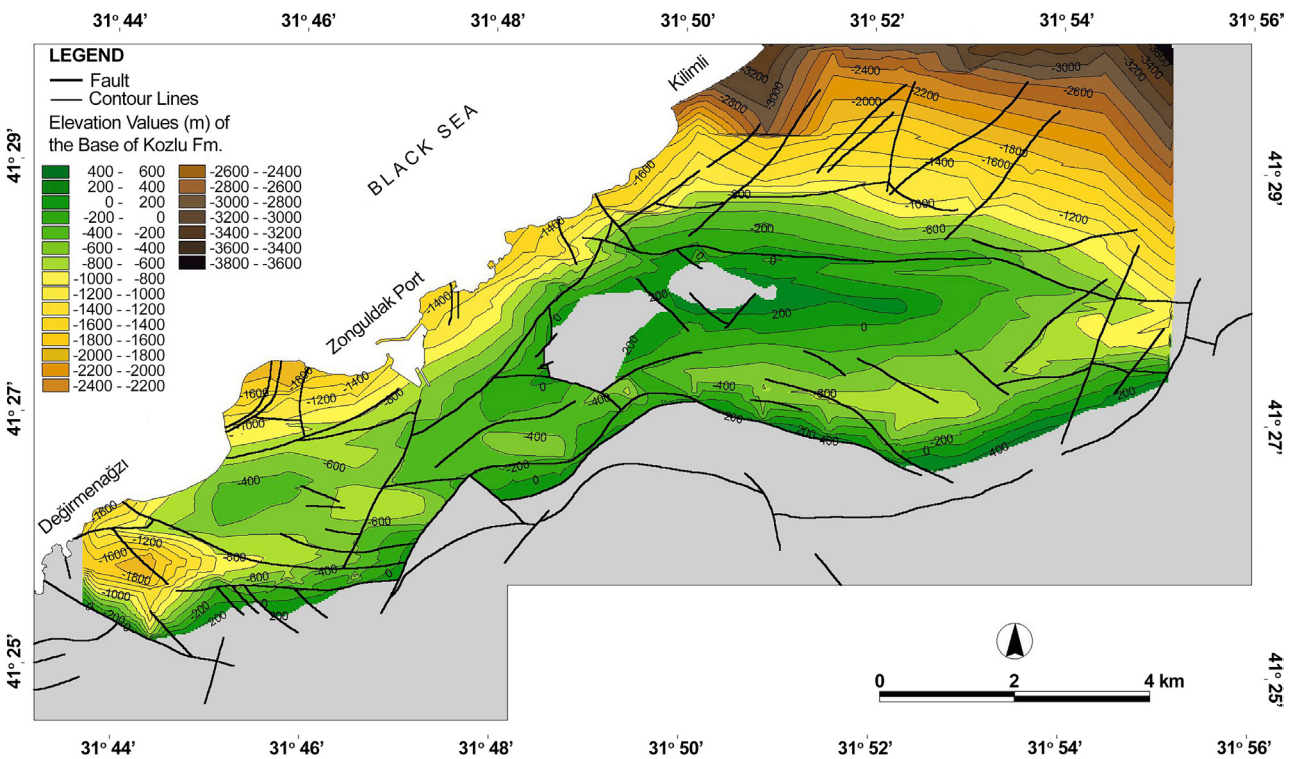

Figure 2. Structure map of the base of Kozlu Formation with superimposed fault traces (contours represent elevation values in meters). Modified from Seyis (2002).

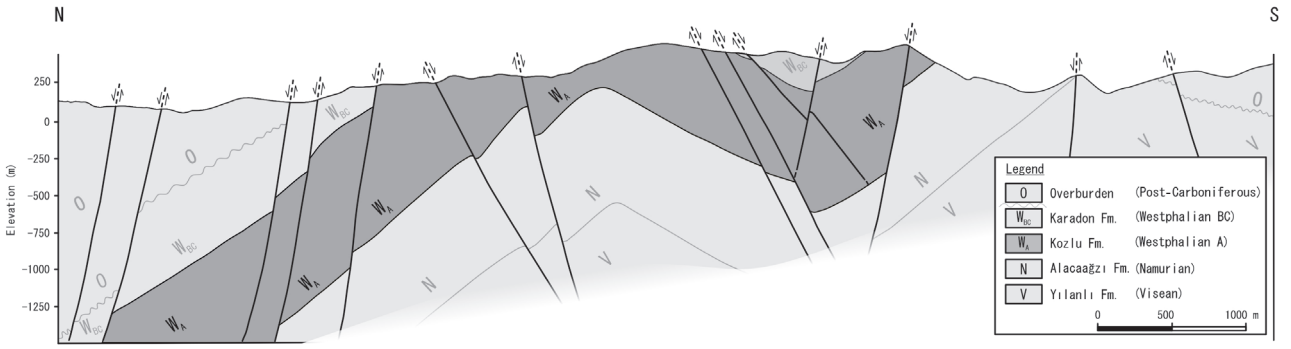

Figure 3. The north-south geological cross-section (Nr. 56 in Figure 1) showing fault-related displacements (modified from Özler et al., 1992). Notice that the displacements along the faults are in general insignificant.

Then locations containing vitrinite reflectance measurements in these four regions were compiled. The next step was an extrapolation of the measured vitrinite reflectance values to the base of the Kozlu Formation. There are 284 vitrinite reflectance measurements for coals obtained from 91 locations in total. All measurements are given in Appendix. A total of 144 measurements were available at five locations in the first region, 33 measurements at five locations in the second region, 75 measurements at 69 locations in the third region, and 32 measurements at 12 locations in the fourth region.

Then, for each region separate plots were created, where the x-axis is the distance between the elevations of samples and the base of the Kozlu Formation at that particular point. The y-axis is the measured vitrinite reflectance value (% R_o) of the respective sample. Thus, a region-specific relation between "the distance of the measured sample to the base of Kozlu Formation and the vitrinite reflectance (% R_o) measurement of the sample" was obtained (Figure 5). The relations are based on semilog plot. The distance (x-axis) is chosen as linear and the vitrinite reflectance (y-axis) is chosen as logarithmic. The extrapolation to the base of the Kozlu Formation for each region is also based on relation obtained from the semilog plots (Figure 5).

In order to define the distances (shown in Figure 5), the elevation values of the samples were subtracted from the elevation values of the base of the Kozlu Formation taken from the structure map. As expected, vitrinite reflectance values increase as the distance to the base decreases; as the distance approaches the value of zero, the % Ro value reaches its maximum; meaning that the actual measurement was made on a coal sample already at or very close to the base of the Kozlu Formation. The regression analysis enabled extrapolation of all the measured vitrinite reflectance values to the base of Kozlu Formation by using distance –R_o relations obtained for each region as shown in Figure 5.

By using the maturity (% R_o) calculated for the base of Kozlu Formation and its elevation for each grid point, new diagrams were created for those four regions. These plots shown in Figure 6 revealed that vitrinite reflectance values increase, as expected, with decreasing elevation (increasing depths) values.

3. Coal rank (maturity) map

Using the approach described above, it was possible to create a coal rank (maturity) map for the base of the Kozlu Formation. To do this, the maturity for each cell of the structure map grid was calculated using the maturity-depth relationship (Figure 6) in that particular region.

As a result of the calculations made for four different regions, a maturity (rank) map of the base of the Kozlu Formation was obtained. This map is shown in Figure 7, where the contouring interval was chosen as 0.05% R_o.

The calculated maturity values in terms of the vitrinite reflectance range between 0.58% R_o and 2.09% R_o with a mean of 1.16% R_o (Figure 8).

In the first region at the southern margin of the basin, the degree of coalification at the base of the Kozlu Formation is around 0.55–0.60% R_o and it increases towards the northwest (Figure 7) where the maturity value rises up to 1.45% R_o. The decreasing values start to increase again in the northwest direction, and the maturity reaches a value of 1.30% R_o again at Değirmenağzı (Figure 7).

In the second region, there is an increasing trend from south to north. The degree of coalification at the base of the Kozlu Formation, which is about 0.80% R_o in the southernmost part of the region, increases gradually towards the northwest and reaches 1.30% R_o at the Black Sea coast (Figure 7).

In the third region, in the areas shown in gray shades (Figure 7), the Kozlu Formation is eroded and the underlying Alacaağzı Formation is exposed. It is bordered

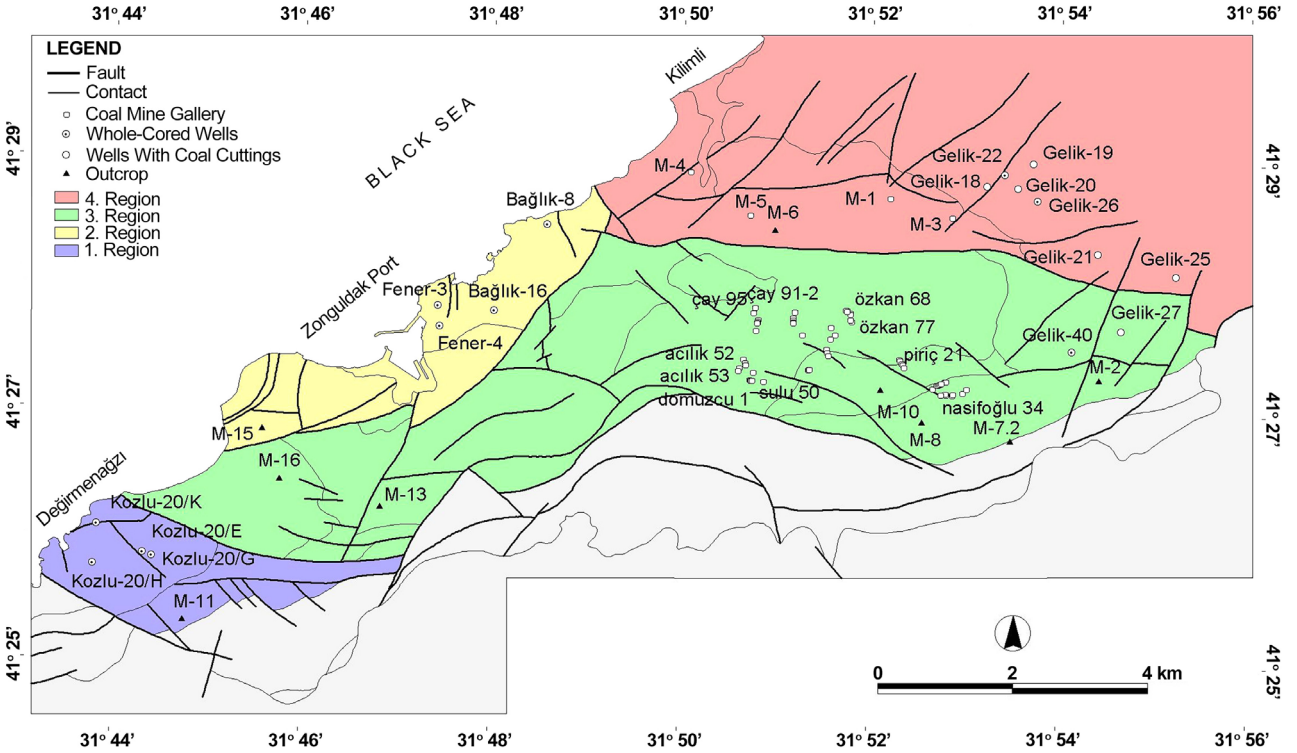

Figure 4. Four regions distinguished based on relatively high throw faults in the central Zonguldak Basin and the locations of the outcrops, mines, and boreholes where coal vitrinite reflectance measurements were available. Modified from Seyis (2002).

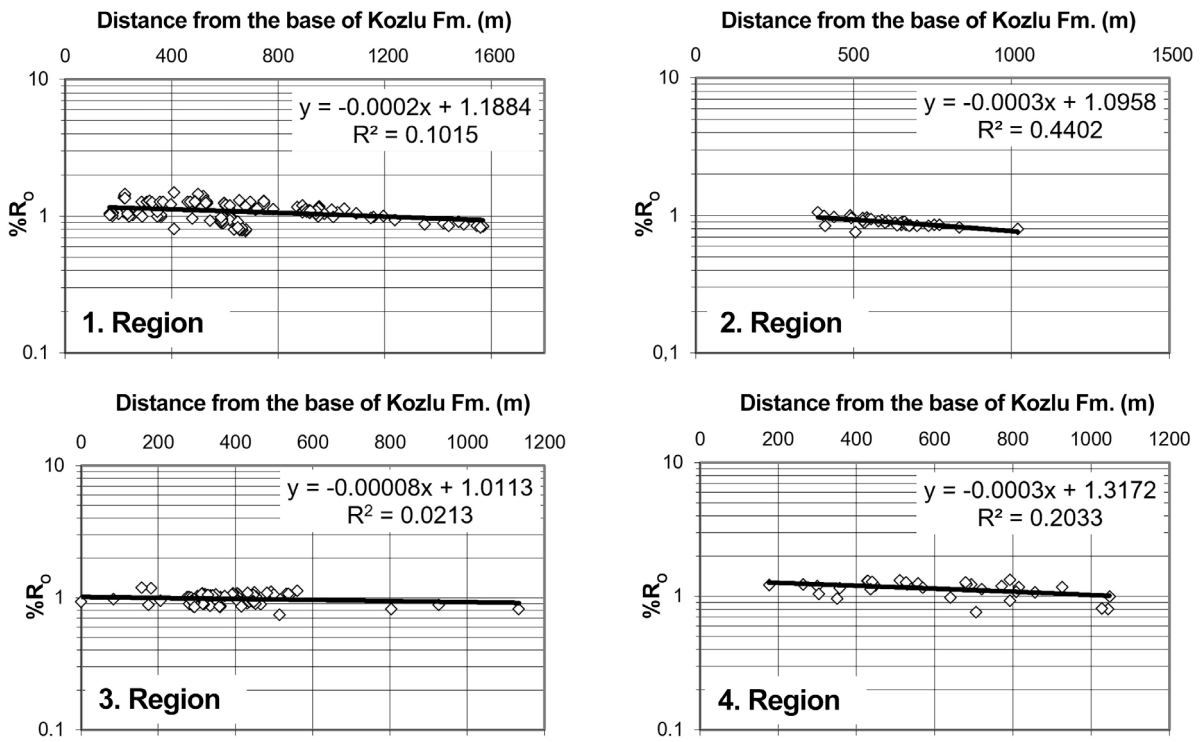

Figure 5. For each region, the plots of vitrinite reflectance measurements against the distance of the respective measurement from the base of Kozlu Formation. Modified from Seyis (2002).

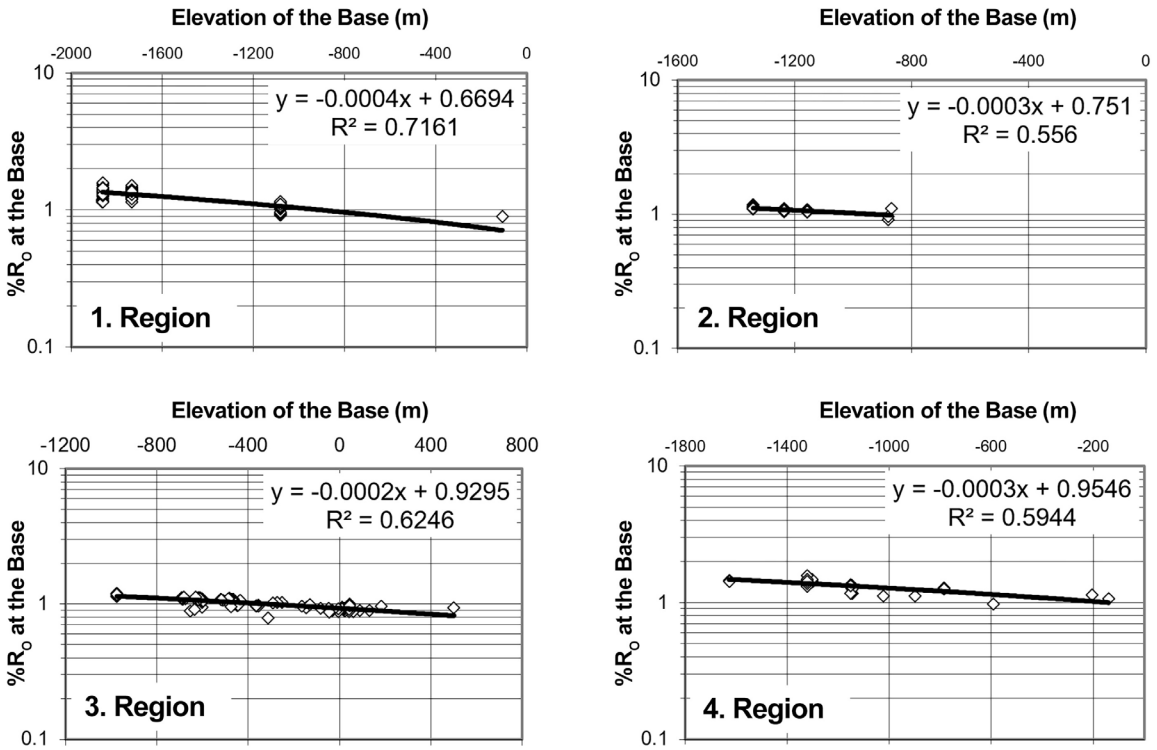

Figure 6. For each region, vitrinite reflectance (%R_o) values for the base of the Kozlu Formation as a function of its elevation. Modified from Seyis (2002).

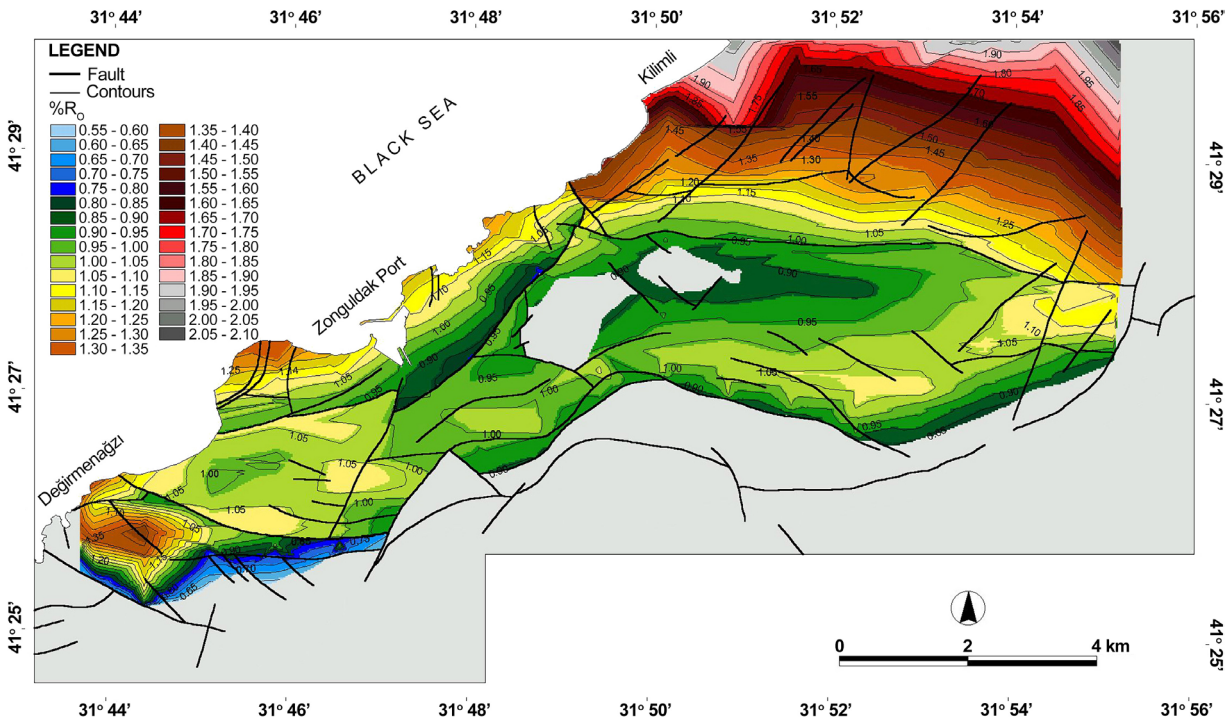

Figure 7. Coal rank map for the base of the Kozlu Formation. The minimum vitrinite reflectance value is 0.58 % R_o and the maximum is 2.09% R_o. Modified from Seyis (2002).

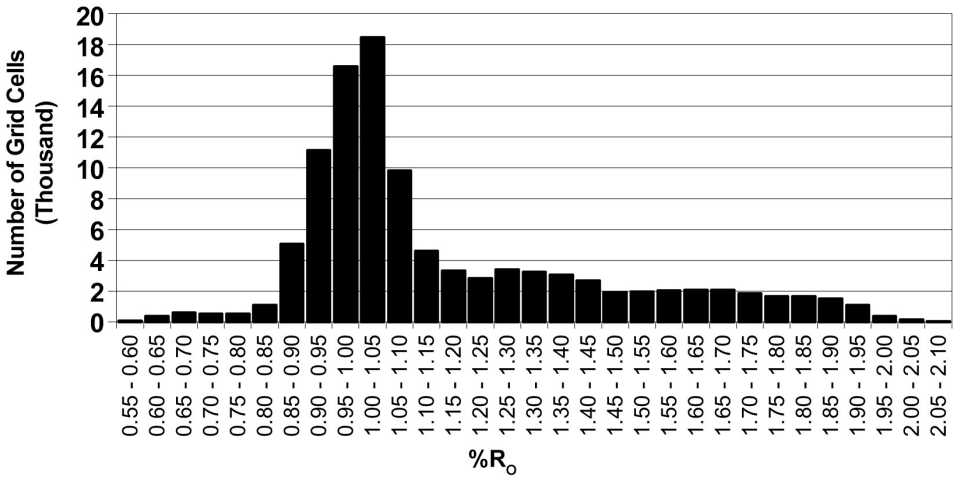

Figure 8. Calculated vitrinite reflectance (% R_o) for the base of Kozlu Formation displayed for each grid point (grid cell dimensions are 25 × 25 m). Modified from Seyis (2002).

by the fourth region on its eastern side and by the basin edge in the south (Figures 4 and 7). At the peripheries of these uplifted localities, the degree of coalification at the base of the Kozlu Formation is about 0.85–0.90% R_o. Although the maturity level increases in all directions from the eroded areas, some differences are noticed. Whereas an increase up to 1.05% R_o is observed in the west-southwest direction, in the southeast direction, after reaching 1.10–1.15% R_o, the maturity decreases again, and a value of 0.90% R_o is reached at the basin edge. The rank of coals increases in the E-NE direction up to 1.0% R_o in the narrow part located between the uplifts and the fourth region (Figure 7).

In the fourth region, starting from the fault bordering this region in the south, coalification increases regularly and rapidly towards the north-northeast (Figure 7). Starting from maturity of 1.0% R_o, the value of 2.09% R_o is reached within a few kilometres of distance to the north-northeast. The main reason for this is, as shown in the structural map in Figure 2, the greater thickness of the overburdened rocks deposited on top of the Kozlu Formation.

Although the coalification map of the base of Kozlu Formation was created with a limited number of measured maturity data points and some generalizations, it reflects coalification changes sufficiently as summarised above. For this reason, in the following section, a brief assessment of the coal gas potential of the study area will be conducted considering this map.

4. Implications for coalbed gas

Coal is a very good gas source rock for gas generation because of the high total organic carbon (TOC) and the terrestrial origin of the organic matter it contains. When sufficient maturity is reached, the amount of methane that can be formed exceeds 100 cm^3 per gram of coal (Jüntgen and Klein, 1975). When other hydrocarbon gases are added to this, the gas potential reaches up to 120 cm^3 per gram of coal (or m^3 of gas per ton of coal). The actual dimensions of this potential are controlled by the composition of the coals and respective kinetic properties of hydrocarbon generation (Ungerer and Pelet, 1987; Ungerer, 1990; Behar et al., 1997; Burnham and Braun, 1999; Yalçın et al., 2007).

The vitrinite-rich humic coals of the Zonguldak Basin have a high gas generation potential (Yalçın et al., 1994, 2002). Although the maturity values corresponding to the beginning and end of gas generation differ depending on the kinetic properties of the organic matter and the rate of the temperature increase (Jüntgen and Heek, 1968; Yalçın and Welte, 1988), the maturity range between 0.90 and 1.10% Ro can be considered the beginning of gas generation. Gas generation continues until a maturity value of 2.3–2.5% Ro is reached (Tissot and Welte, 1984). The calculated maturity for the coals of the Kozlu Formation in the study area as discussed above ranges between 0.59 and 2.09% Ro. Therefore, in quite a big area of the basin (Figure 7), the coal seams at the base of the Kozlu Formation have reached a gas generation maturity. This aspect will be discussed below in more detail.

In light of these facts about gas generation, the created coalification map was used to determine the areas to be considered for coal gas exploration in the study area. Since this map is prepared for the base of the Kozlu Formation, it can be inferred that the maturity for the top of the Kozlu Formation will be about 0.1% R_o less than the maturity at a given point, as the average thickness of this formation is 500 m and the vertical maturity gradient is 0.2% R_o/km across the basin. Considering the 1.0% Ro value as

the required rank for the onset of gas generation, it could be concluded that the coal seams in the Kozlu Formation generated gas in areas where the maturity is >1.1% R_o on the current map. Therefore, primarily these areas should be considered in planned coal gas exploration studies (Figure 9).

On the other hand, Yalçın (1994b) and Yalçın et al. (2002) noted that the amount of gas generated in the underlying coal seams of both the Namurian aged Alacaağzı Formation and the lower parts of the Kozlu Formation is higher than the gas storage capacity of the respective seams. Therefore, it is very likely that the excess gas might have migrated upwards and accumulated in the coals in the upper parts. Therefore, the target depths for gas exploration can be expanded a little more.

It is clear that the maturity discussed above is a strong indication for coal gas generation and its presence in the coal seams. However, for the assessment of coal gas production; besides coal maturity, many other features like coal thickness, continuity and dip of the seams, adsorption

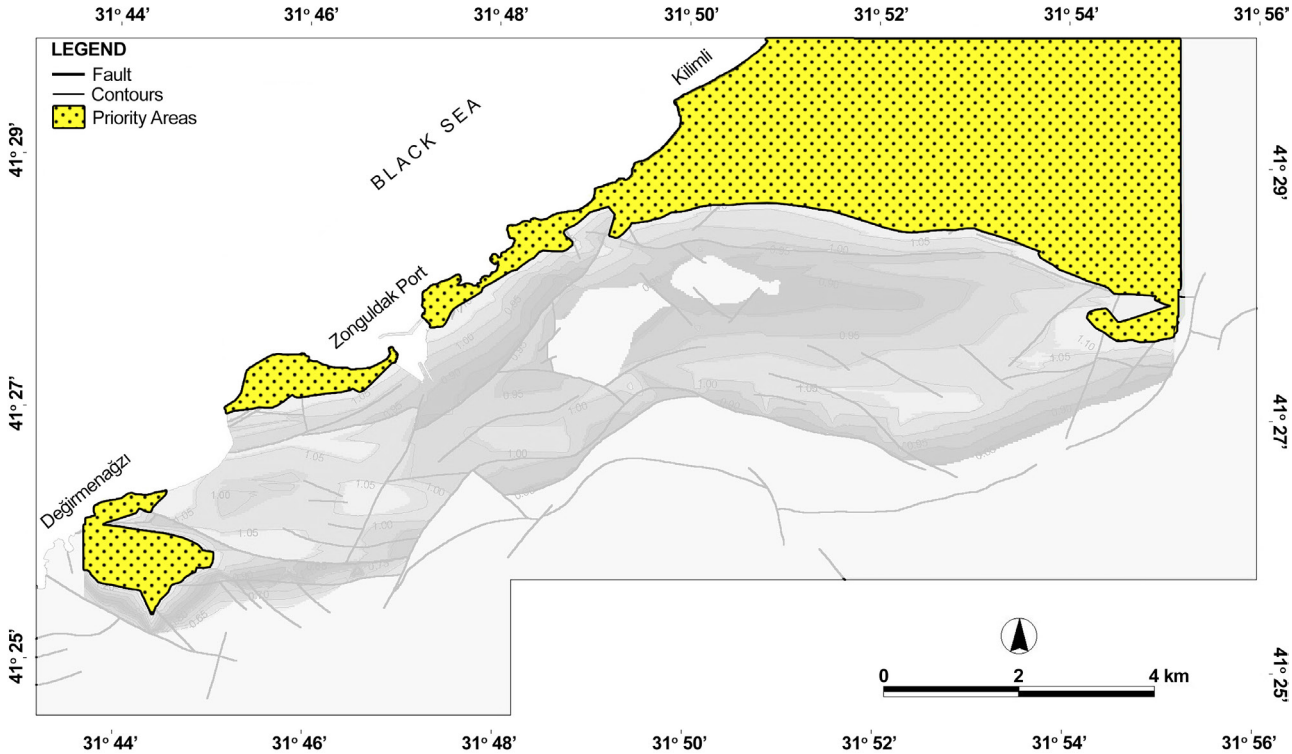

Figure 9. Priority areas to be considered for coal gas exploration in the central part (Kozlu-Üzülmez and Karadon districts) of the Zonguldak Basin.

capacity, mineralogical composition, and frackability should also be considered.

5. Conclusion

The Langsettian (Westphalian A) Kozlu Formation in the central part of the Zonguldak Basin contains vitrinite-rich humic coals. From coal maturity (vitrinite reflectance) data available from outcrops, mines, and boreholes, we have predicted with the help of a specific approach coal rank for the base of the Kozlu Formation. From the calculated maturity for the Kozlu Formation, a maturity map has been produced. The maturity for the base of the Kozlu Formation varies between 0.59 and 2.09% Ro. Accordingly, we have mapped the area where the coals at the base of the Kozlu Formation exceed 1.1% Ro, which is accepted as the beginning of major gas generation. We finally suggest that coal gas exploration activities should primarily focus on these areas where coal maturity exceeds 1.1% Ro.

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APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Acılık 52	Gallery	31,8438	41,4559	-170.00	1.06	0.02	Karayiğit (1989)
Acılık 53	Gallery	31,8436	41,4554	-170.00	1.04	0.05	Karayiğit (1989)
Acılık 72	Gallery	31,8626	41,4637	336.00	0.98	0.03	Karayiğit (1989)
Acılık 73	Gallery	31,8625	41,4636	332.00	0.95	0.02	Karayiğit (1989)
Acılık 74	Gallery	31,8626	41,4635	330.00	0.95	0.01	Karayiğit (1989)
Acun 62-1	Gallery	31,8633	41,4624	384.00	0.86	0.02	Karayiğit (1989)
Acun 63-2	Gallery	31,8599	41,4613	382.00	0.89	0.03	Karayiğit (1989)
Acun 64-2	Gallery	31,8606	41,4603	286.00	0.91	0.02	Karayiğit (1989)
Bağlık-16	WC Well	31,8005	41,4632	-470.30	0.84	0.03	Karayiğit (1989)
Bağlık-16	WC Well	31,8005	41,4632	-375.45	0.76	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-848.87	0.96	0.01	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-954.87	1.06	0.02	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-936.37	0.99	0.02	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-813.82	0.96	0.02	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-795.57	0.94	0.02	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-688.27	0.90	0.02	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-904.37	0.98	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-852.37	1.00	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-799.57	0.97	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-751.87	0.93	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-680.37	0.90	0.03	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-797.07	0.94	0.04	Karayiğit (1989)
Bağlık-8	WC Well	31,8097	41,4747	-732.37	0.92	0.04	Karayiğit (1989)
Binkılıç 126-1	Gallery	31,8465	41,4471	138.00	0.89	0.03	Karayiğit (1989)
Binkılıç 127-1	Gallery	31,8463	41,4472	123.00	0.88	0.03	Karayiğit (1989)
Binkılıç 128	Gallery	31,8461	41,4475	70.00	0.88	0.02	Karayiğit (1989)
Çay 15	Gallery	31,8549	41,4603	-45.00	0.98	0.05	Karayiğit (1989)
Çay 91-2	Gallery	31,8465	41,4639	387.00	0.95	0.02	Karayiğit (1989)
Çay 95	Gallery	31,8462	41,4631	305.00	0.88	0.03	Karayiğit (1989)
Domuzcu 1	Gallery	31,8456	41,4542	80.00	0.95	0.01	Karayiğit (1989)
Domuzcu 2	Gallery	31,8458	41,4542	80.00	0.93	0.04	Karayiğit (1989)
Domuzcu 3	Gallery	31,8459	41,4542	80.00	0.93	0.04	Karayiğit (1989)
Domuzcu 4	Gallery	31,8460	41,4542	80.00	0.94	0.04	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-464.85	0.86	0.02	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-536.55	0.84	0.02	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-588.65	0.88	0.02	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-586.10	0.86	0.02	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-702.90	0.89	0.03	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-499.85	0.84	0.03	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-481.35	0.86	0.03	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-605.35	0.89	0.03	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-402.75	0.82	0.04	Karayiğit (1989)
Fener-3	WC Well	31,7906	41,4637	-682.30	0.94	0.04	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-491.41	0.86	0.02	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-629.72	0.92	0.02	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-482.21	0.84	0.03	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-557.27	0.89	0.03	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-519.86	0.85	0.03	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-579.77	0.91	0.04	Karayiğit (1989)
Fener-4	WC Well	31,7909	41,4610	-478.57	0.85	0.04	Karayiğit (1989)
Gelik-18	Well WCC	31,8872	41,4804	-488.17	1.17	0.04	Karayiğit (1989)
Gelik-18	Well WCC	31,8872	41,4804	-745.62	1.25	0.04	Karayiğit (1989)
Gelik-18	Well WCC	31,8872	41,4804	-792.62	1.32	0.05	Karayiğit (1989)
Gelik-18	Well WCC	31,8872	41,4804	-874.17	1.30	0.05	Karayiğit (1989)
Gelik-18	Well WCC	31,8872	41,4804	-875.17	1.31	0,05	Karayiğit (1989)

APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Gelik-19	Well WCC	31,8953	41,4834	-700.08	1.17	0.02	Karayiğit (1989)
Gelik-19	Well WCC	31,8953	41,4834	-855.08	1.19	0.05	Karayiğit (1989)
Gelik-20	Well WCC	31,8927	41,4801	-578.28	1.16	0.04	Karayiğit (1989)
Gelik-20	Well WCC	31,8927	41,4801	-699.78	1.20	0.04	Karayiğit (1989)
Gelik-20	Well WCC	31,8927	41,4801	-970.38	1.21	0.06	Karayiğit (1989)
Gelik-21	Well WCC	31,9069	41,4715	-483.88	1.19	0.02	Karayiğit (1989)
Gelik-21	Well WCC	31,9069	41,4715	-426.34	1.15	0.04	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-880.88	1.28	0.02	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-791.28	1.22	0.03	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-273.98	1.00	0.04	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-464.73	1.07	0.04	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-793.93	1.27	0.05	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-641.23	1.27	0.05	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-626.68	1.23	0.06	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-639.68	1.22	0.06	Karayiğit (1989)
Gelik-22	WC Well	31,8903	41,4820	-528.38	1.33	0.09	Karayiğit (1989)
Gelik-25	Well WCC	31,9206	41,4686	-504.70	0.98	0.04	Karayiğit (1989)
Gelik-25	Well WCC	31,9206	41,4686	-709.50	1.13	0.05	Karayiğit (1989)
Gelik-26	WC Well	31,8961	41,4785	-358.09	0.93	0.03	Karayiğit (1989)
Gelik-26	WC Well	31,8961	41,4785	-341.24	1.08	0.03	Karayiğit (1989)
Gelik-26	WC Well	31,8961	41,4785	-429.59	1.13	0.05	Karayiğit (1989)
Gelik-26	WC Well	31,8961	41,4785	-886.89	1.23	0.06	Karayiğit (1989)
Gelik-27	Well WCC	31,9111	41,4613	-524.77	1.10	0.03	Karayiğit (1989)
Gelik-27	Well WCC	31,9111	41,4613	-414.27	1.13	0.04	Karayiğit (1989)
Gelik-27	Well WCC	31,9111	41,4613	-792.62	1.18	0.04	Karayiğit (1989)
Gelik-27	Well WCC	31,9111	41,4613	-817.37	1.19	0.05	Karayiğit (1989)
Gelik-27	Well WCC	31,9111	41,4613	-481.22	1.11	0.06	Karayiğit (1989)
Hacımemiş 25-1	Gallery	31,8800	41,4543	-200.00	1.06	0.03	Karayiğit (1989)
Hacımemiş 26-1	Gallery	31,8802	41,4543	-200.00	1.01	0.05	Karayiğit (1989)
Kozlu-20/E	WC Well	31,7390	41,4305	-367.10	0.87	0.02	Karayiğit (1989)
Kozlu-20/E	WC Well	31,7390	41,4305	-423.10	0.85	0.02	Karayiğit (1989)
Kozlu-20/E	WC Well	31,7390	41,4305	-626.15	0.94	0.02	Karayiğit (1989)
Kozlu-20/E	WC Well	31,7390	41,4305	-443.55	0.89	0.03	Karayiğit (1989)
Kurul 12	Gallery	31,8559	41,4557	-39.00	0.94	0.04	Karayiğit (1989)
Kurul 13	Gallery	31,8560	41,4557	-39.00	0.96	0.03	Karayiğit (1989)
Kurul 14	Gallery	31,8561	41,4558	-39.00	0.95	0.02	Karayiğit (1989)
Kurul 65-1	Gallery	31,8598	41,4598	282.00	0.93	0.03	Karayiğit (1989)
Nasifoğlu 34	Gallery	31,8832	41,4528	-147.00	1.04	0.03	Karayiğit (1989)
Nasifoğlu 36	Gallery	31,8814	41,4525	-150.00	1.05	0.04	Karayiğit (1989)
Nasifoğlu 37	Gallery	31,8815	41,4526	-154.00	1.07	0.02	Karayiğit (1989)
Nasifoğlu 40-1	Gallery	31,8794	41,4525	-200.00	1.09	0.02	Karayiğit (1989)
Nasifoğlu 41-1	Gallery	31,8839	41,4533	-200.00	1.09	0.03	Karayiğit (1989)
Nasifoğlu 44	Gallery	31,8445	41,4570	-100.00	1.04	0.04	Karayiğit (1989)
Nasifoğlu 45	Gallery	31,8448	41,4565	-120.00	1.01	0.03	Karayiğit (1989)
Nasifoğlu 46-2	Gallery	31,8449	41,4563	-122.00	1.03	0.04	Karayiğit (1989)
Nasifoğlu 48-2	Gallery	31,8463	41,4552	-155.00	1.03	0.03	Karayiğit (1989)
Özkan 100-1	Gallery	31,8469	41,4619	384.00	0.87	0.02	Karayiğit (1989)
Özkan 101-2	Gallery	31,8469	41,4618	381.00	0.86	0.02	Karayiğit (1989)
Özkan 103-2	Gallery	31,8466	41,4608	305.00	0.90	0.04	Karayiğit (1989)
Özkan 68	Gallery	31,8633	41,4633	338.00	0.89	0.02	Karayiğit (1989)
Özkan 69	Gallery	31,8633	41,4631	335.00	0.90	0.01	Karayiğit (1989)
Özkan 77	Gallery	31,8635	41,4621	245.00	0.91	0.03	Karayiğit (1989)
Özkan 82	Gallery	31,8532	41,4625	325.00	0.89	0.03	Karayiğit (1989)
Özkan 84	Gallery	31,8532	41,4622	305.00	0.92	0.02	Karayiğit (1989)
Özkan 85	Gallery	31,8532	41,4621	298.00	0.90	0,01	Karayiğit (1989)

APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Özkan 86	Gallery	31,8532	41,4620	285.00	0.86	0.03	Karayiğit (1989)
Özkan 87	Gallery	31,8532	41,4618	275.00	0.90	0.02	Karayiğit (1989)
Özkan 98-2	Gallery	31,8471	41,4622	420.00	0.85	0.01	Karayiğit (1989)
Özkan 99-2	Gallery	31,8470	41,4620	401.00	0.85	0.02	Karayiğit (1989)
Piriç 20	Gallery	31,8720	41,4572	-145.00	1.06	0.04	Karayiğit (1989)
Piriç 21	Gallery	31,8721	41,4570	-150.00	1.06	0.03	Karayiğit (1989)
Piriç 22	Gallery	31,8724	41,4567	-167.00	1.08	0.03	Karayiğit (1989)
Piriç 23	Gallery	31,8726	41,4565	-174.00	1.07	0.03	Karayiğit (1989)
Piriç 24	Gallery	31,8729	41,4561	-190.00	1.05	0.03	Karayiğit (1989)
Sulu 10	Gallery	31,8595	41,4576	-7.00	1.00	0.05	Karayiğit (1989)
Sulu 27-1	Gallery	31,8795	41,4541	-220.00	1.06	0.04	Karayiğit (1989)
Sulu 28-2	Gallery	31,8793	41,4540	-218.00	1.08	0.04	Karayiğit (1989)
Sulu 29-2	Gallery	31,8790	41,4539	-215.00	1.04	0.06	Karayiğit (1989)
Sulu 30-1	Gallery	31,8789	41,4539	-213.00	1.08	0.03	Karayiğit (1989)
Sulu 31-2	Gallery	31,8786	41,4538	-210.00	1.06	0.01	Karayiğit (1989)
Sulu 33-2	Gallery	31,8779	41,4534	-184.00	1.05	0.06	Karayiğit (1989)
Sulu 38-1	Gallery	31,8802	41,4525	-153.00	1.07	0.04	Karayiğit (1989)
Sulu 39-2	Gallery	31,8802	41,4527	-175.00	1.06	0.01	Karayiğit (1989)
Sulu 50	Gallery	31,8481	41,4540	-144.00	1.02	0.04	Karayiğit (1989)
Sulu 8	Gallery	31,8591	41,4584	23.00	1.01	0.02	Karayiğit (1989)
Sulu 81-4	Gallery	31,8534	41,4633	423.00	0.87	0.03	Karayiğit (1989)
Sulu 9	Gallery	31,8593	41,4580	7.00	1.01	0.05	Karayiğit (1989)
Kozlu-20/H	WC Well	31,7302	41,4290	-784.05	1.00	0.01	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-827.35	1.09	0.02	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1018.55	1.12	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-843.20	1.07	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-831.85	1.13	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-813.60	1.10	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-791.40	1.04	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-383.85	0.87	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-575.30	0.99	0.04	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-952.45	1.13	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1013.20	1.14	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-844.00	1.08	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-828.05	1.08	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1204.10	1.28	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-815.45	1.06	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-814.10	1.10	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-828.95	1.11	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1417.70	1.30	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1274.00	1.28	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-726.90	0.99	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-586.80	0.97	0.05	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1055.70	1.18	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1118.70	1.14	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1119.10	1.15	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1131.30	1.19	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1115.75	1.20	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-815.10	1.06	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-792.20	1.10	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1202.60	1.27	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1264.95	1.28	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1246.40	1.25	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1206.60	1.25	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1205.10	1.30	0,06	Yalçın (1997)

APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Kozlu-20/H	WC Well	31,7302	41,4290	-1203.10	1.24	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1246.00	1.29	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1202.10	1.24	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1379.00	1.28	0.06	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1131.85	1.21	0.07	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-814.60	1.06	0.07	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1337.20	1.22	0.07	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1407.05	1.26	0.07	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1366.80	1.28	0.07	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1136.30	1.24	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-760.90	1.04	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1512.00	1.42	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1427.30	1.28	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1136.75	1.25	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1247.40	1.27	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1201.10	1.26	0.08	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1509.65	1.46	0.09	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1508.60	1.36	0.09	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1511.00	1.40	0.10	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1447.50	1.27	0.10	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1766.05	1.52	0.10	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1514.10	1.37	0.11	Yalçın (1997)
Kozlu-20/H	WC Well	31,7302	41,4290	-1753.15	1.48	0.12	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-448.45	0.80	0.02	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-538.35	0.93	0.03	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-404.50	0.80	0.03	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-418.62	0.79	0.03	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-489.30	0.94	0.03	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-805.15	1.05	0.03	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-736.60	1.00	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-724.40	1.02	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-723.80	0.99	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1117.09	1.19	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-737.10	1.08	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-406.75	0.78	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-417.90	0.79	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-420.40	0.82	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1080.45	1.20	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-429.15	0.81	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-435.05	0.91	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-462.20	0.97	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-462.60	0.97	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-462.75	0.96	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-463.75	0.94	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-487.20	0.99	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-499.20	0.94	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-497.95	0.91	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-497.15	0.90	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-495.20	0.97	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-494.70	0.95	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-494.50	0.93	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-488.00	0.98	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-821.85	1.06	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-801.95	1.03	0.04	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-427.73	0.79	0,05	Yalçın (1997)

APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Kozlu-20/K	WC Well	31,7309	41,4342	-1095.45	1.19	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-435.70	0.83	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-463.55	0.98	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-487.50	0.93	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-496.70	0.92	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-604.90	0.96	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-496.20	0.95	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-495.70	0.95	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-489.75	0.93	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1070.10	1.18	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-497.60	0.98	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-853.40	1.08	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-916.25	1.05	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-905.50	1.05	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-842.00	1.03	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-802.45	1.04	0.05	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1118.50	1.20	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-490.10	0.89	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1072.10	1.19	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-794.40	1.00	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-916.60	1.02	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-904.20	1.06	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-864.70	1.08	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-843.00	1.00	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-830.25	1.02	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-829.40	1.06	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-882.55	1.04	0.06	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1130.50	1.18	0.07	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1142.05	1.25	0.07	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-1104.70	1.24	0.07	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-904.90	1.01	0.07	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-463.35	1.01	0.08	Yalçın (1997)
Kozlu-20/K	WC Well	31,7309	41,4342	-848.50	1.04	0.08	Yalçın (1997)
M-1	Gallery	31,8701	41,4786	145.00	0.80	0.01	Seyis (2002)
M-10	Outcrop	31,8688	41,4533	500.00	0.82	0.10	Seyis (2002)
M-11	Outcrop	31,7461	41,4217	300.00	0.81	0.07	Seyis (2002)
M-13	Outcrop	31,7808	41,4370	150.00	0.82	0.07	Seyis (2002)
M-14	Outcrop	31,8068	41,4367	50.00	0.82	0.05	Seyis (2002)
M-15	Outcrop	31,7598	41,4472	150.00	0.80	0.09	Seyis (2002)
M-16	Outcrop	31,7630	41,4406	200.00	0.75	0.08	Seyis (2002)
M-2	Outcrop	31,9073	41,4548	250.00	0.85	0.07	Seyis (2002)
M-3	Gallery	31,8811	41,4761	115.00	0.76	0.02	Seyis (2002)
M-4	Gallery	31,8349	41,4818	5.00	0.81	0.02	Seyis (2002)
M-5	Gallery	31,8454	41,4761	100.00	1.04	0.05	Seyis (2002)
M-6	Outcrop	31,8499	41,4743	210.00	0.96	0.07	Seyis (2002)
M-7.2	Outcrop	31,8918	41,4466	500.00	0.94	0.08	Seyis (2002)
M-8	Outcrop	31,8762	41,4490	450.00	0.89	0.06	Seyis (2002)
Kozlu-20/G	WC Well	31,7406	41,4301	-383.30	0.91	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-316.50	0.85	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-301.70	0.83	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-292.25	0.84	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1207.00	1.31	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.85	1.30	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.87	1.29	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.89	1.23	-	Mann et al. (1995)

APPENDIX

SAMPLE NAME	SAMPLE TYPE	LONGITUDE	LATITUDE	ELEVATION (m)	VITRINITE REFLECTANCE (%R_o)	STANDART DEVIATION	REFFERENCE
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.91	1.23	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.93	1.26	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1166.10	1.28	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1342.60	1.41	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1362.90	1.45	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1453.40	1.50	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-767.60	1.05	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-1115.95	1.26	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-666.10	1.01	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-812.85	1.14	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-840.05	1.07	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-860.03	1.12	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.25	1.18	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.40	1.17	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.50	1.15	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.65	1.18	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.80	1.17	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-944.35	1.11	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-969.90	1.20	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-989.65	1.17	-	Mann et al. (1995)
Kozlu-20/G	WC Well	31,7406	41,4301	-908.95	1.15	-	Mann et al. (1995)
Gelik-40	WC Well	31,9024	41,4585	-301.10	1.03	-	Hoşgörmez (1996)
Gelik-40	WC Well	31,9024	41,4585	-315.70	0.93	-	Hoşgörmez (1996)
Gelik-40	WC Well	31,9024	41,4585	-323.30	1.02	-	Hoşgörmez (1996)