

PROPERTIES OF THE ÇANAKKALE-ÇAN LIGNITE DEPOSIT (NORTHWESTERN TURKEY)

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(5 figures, 3 tables)

ABSTRACT. Lignite coals of Miocene age occur in and around the Çan basin, located in Çanakkale county, north-western Turkey. Only one coal seam is mineable with an average thickness of 21.32 m. Weighted averages of chemical analysis for the as received coal indicate 22.52% moisture, 29.69% ash, 3.00% total sulphur, and net calorific value 11836 kJ/kg. The air dried coal has 7.10 % moisture, 35.32% ash, 3.61% total sulphur, and net calorific value 14662 kJ./kg. The total mineable reserve is approximately 73,153,885 tonnes. The Çanakkale-Çan lignite deposit is currently worked by open-pit mining despite its high sulphur content. The construction of the first Turkish fluidised-bed thermal power plant with 210 MW capacity was completed at the end of 2003 in Çan.

Keywords: Miocene, Çan, Turkey, Lignite, coal properties

1. Introduction

The total lignite reserves of Turkey attain 8,4 billion tonnes. Lignite deposits of county of Miocene age are concentrated in western Anatolia. Among these,

the Çan lignite deposit has a quite important place in this reserve. The study area is located in the west of Çan, in the Çanakkale province, and covers 7.5 km² area between Cavus, Kulfa and Durali villages (Figs. 1 & 2).

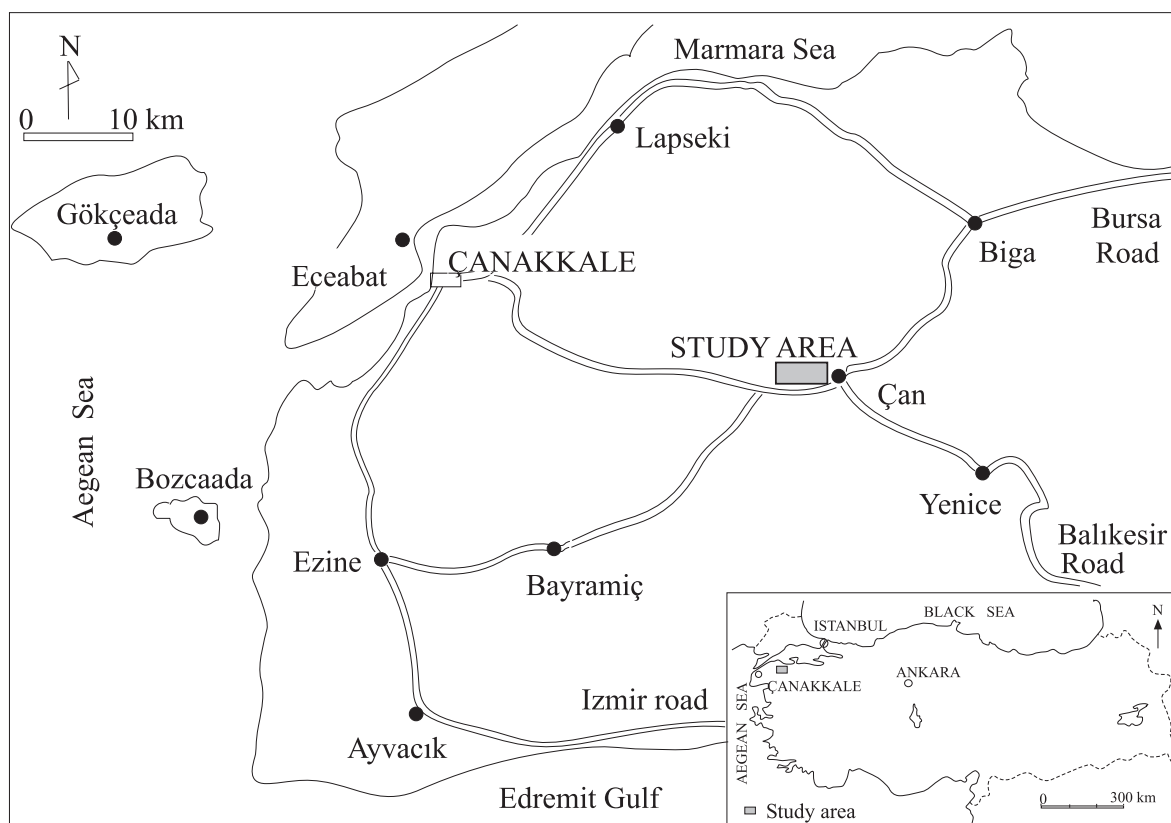


Figure 1. Location map of the Çanakkale Çan lignite deposit.

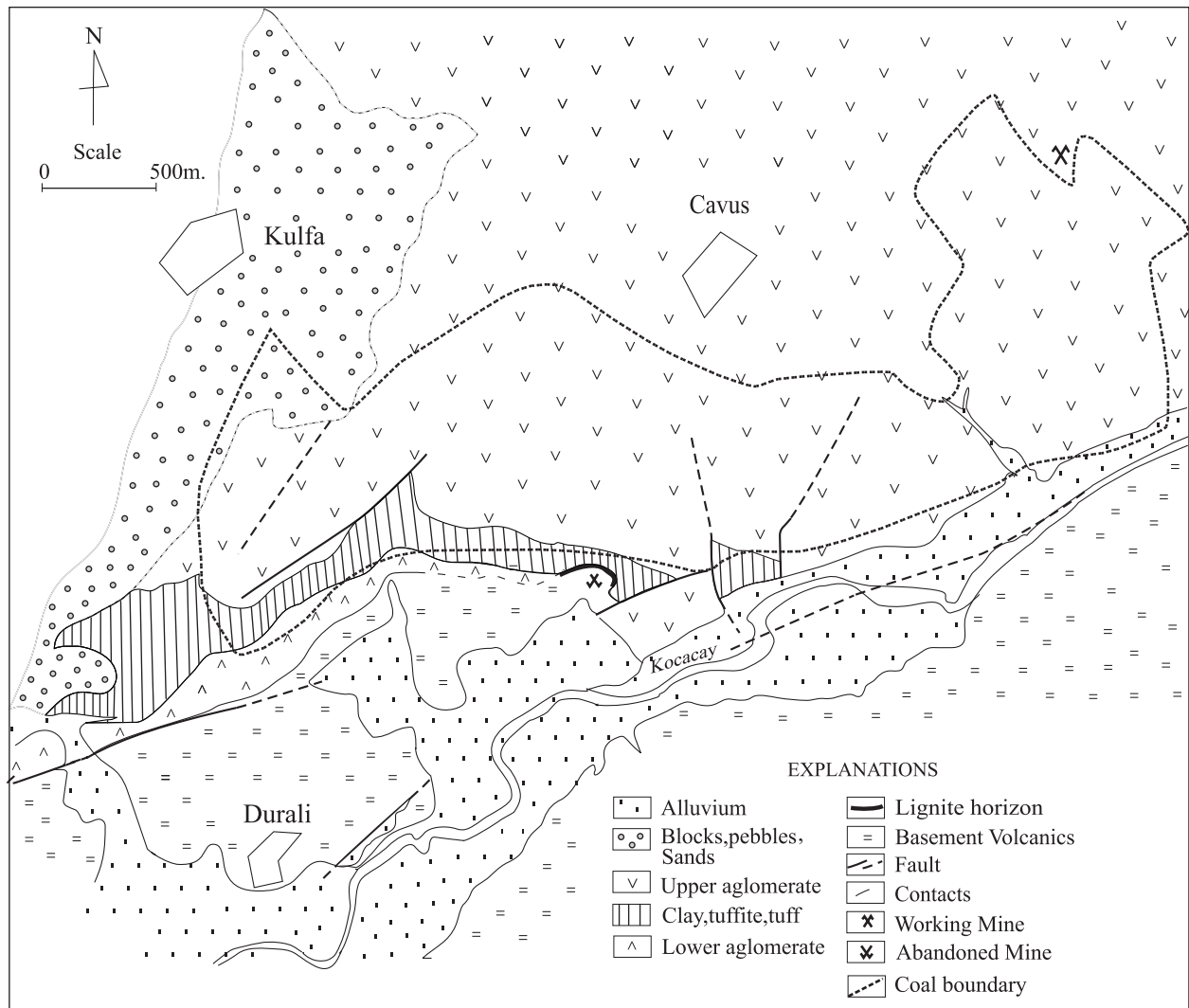


Figure 2. Geological map of the Çanakkale Çan lignite deposit (modified from Hezarfen, 1976).

The Çan lignite deposit was investigated by the Mineral Research and Exploration General Directorate (M.T.A.). Prospecting began in 1957. Geological and economical investigations were carried out by Hezarfen (1976), Has et al. (1976), and Gökmen et al. (1993). Some graduation projects were made at University South Wales, under direction of Whateley (Bray, 1996; Hughes, 1996; Seddon, 1995).

The Çan lignite has been exploited by Turkish Coal Enterprises (T.K.I.) since 1979. After M.T.A. finished exploration and reserve drilling studies, T.K.I. (1987) prepared an open-pit mining project for producing 1,500,000 tonnes/year of coal to be used in the national economy. To solve some mining problems, additional development drillings were made for T.K.I. in the following years by Sun et al. (1987) and Gürsoy & Gürsoy (1989). In 2001, Nakoman & Inaner carried out a university project about the reserve and quality of Çan deposit and in 2002 T.K.I. prepared an open-pit mining project to produce 2,300,000 tonnes/year of coal to be used in the thermal power plant from 2004 onwards.

In total, 144 reserve calculation boreholes were drilled by M.T.A. Of these, 53 boreholes intersected mineable coal sequences, and these boreholes form the basis for this study. The aim of this study is to determine the economic value of the Çan deposit, which has acquired particular importance because of the fluidised-bed thermal power plant being built in the area. Proven and mineable reserves were calculated by polygon and isopach methods (Nakoman & Inaner, 2001). At this point it was not deemed necessary to detail the reserve calculations and quality estimates. Weighed average content of moisture, ash, total sulphur, and lower calorific values were determined for the as-received and air-dried coals for every borehole, and then for the whole deposit. Overburden ratios were calculated for every borehole, and then for the whole deposit (Nakoman & Inaner, 2001).

The Çan deposit has been exploited by T.K.I. in open-pit mine with an excavator and truck system for the purpose of supplying coal for domestic heating and industry. Because of their higher calorific value, lignites

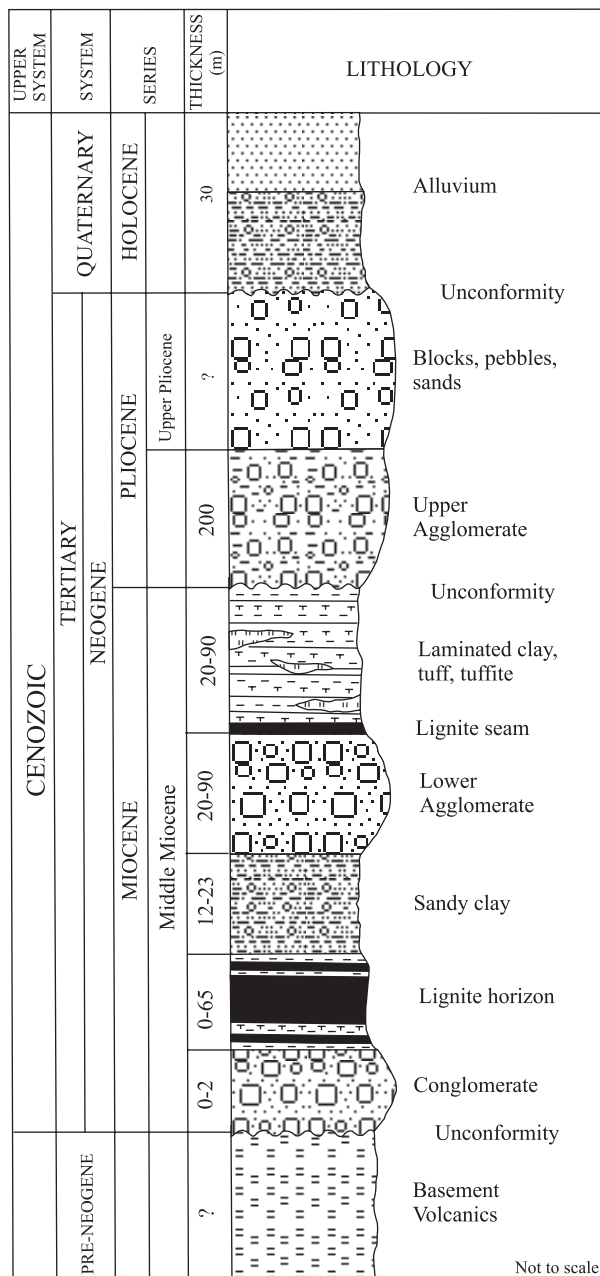


Figure 3. Schematic generalised stratigraphic column of the Çanakkale Çan lignite deposit (modified from Hezarfen, 1976).

excavated from the upper layers are used both in the industry and for domestic heating. Lignites from the lower layers will in the future be used in the thermal power plant, because of their lower calorific value. The amount of exploited coal will be increased in the coming years according to the requirements of the thermal power plant under construction. Different mining projects for lignite producing were made by T.K.I for determining the annual production when the thermal power plant will begin to generate energy. Approximately 18,000,000 tonnes of coal has been mined by T.K.I. up to present. T.K.I. have planned to produce 2,300,000 ton/year lignite for the next twenty years for the Çan thermal power plant,

industry and domestic consumption. This lignite source will be integrated into the local economy in an efficient and clean manner.

2. Geology

Neogene-aged coal-bearing limnic sediments unconformably overly the crystalline metamorphic substratum in western Anatolia. Formations are classified as pre-Neogene, Neogene, and post-Neogene by Hezarfen (1976) and Gökmen et al. (1993) (Figs. 2 & 3). The basement of the Çan basin is made up of Paleozoic phyllites, Mesozoic arkoses, limestones, spilite and diopsidic diabases. They are classified as “basement volcanics”. Neogene formations overlie discordantly the basement rocks and consist of detrital rocks at the base, and volcanic rocks at the top. Reaching up to 400 m, the Miocene is represented by basal conglomerate, lignite horizon, sandy clay, lower agglomerates, and alternations of laminated clay, tuff and tuffite layers are with a 0.80 m thick lignite vein at the bottom. The overlying Pliocene is made up of upper agglomerates and blocks, pebbles and sands about 300 m thick in total. The Plio-Pleistocene is made up of young andesitic volcanic rocks. Post-Neogene formations are represented by gravel terraces and alluvium (Fig. 3).

The age of the coal was determined by Akyol (in Hazerfen (1976) and Can (1984)) as Middle Miocene, using palynological methods.

Çan coals are generally hard, bright, black coloured and light. Depending on external appearances Duparque (1926) classified these lignites as “Ksiloit lignites”. According to the Francis Classification (1961), they are “Black lignites”.

3. Economical evaluation

Out of the 144 reserve boreholes drilled in the Çan deposit by M.T.A., results of the economical evaluation of 53 boreholes are enumerated below (Fig. 4).

Total coal-bearing area covers 2,947,173 m², excluding the area still being mined (Fig. 2). The proven lignite reserves were determined as 94,878,750 tonnes, mineable reserve as 73,153,885 tonnes, by the polygon method (Table 1). But the proven coal reserve was found to be 95,771,521 tonnes by the isopach method suggested by the Turkish Standards (TSE, 1980).

There is only one mineable Miocene-aged coal seam with an average thickness of 21.32 m in the area. The calorific value is highest in the upper layers. The weighed averages of chemical analysis show that the as-received coal has 22.52% moisture, 29.69% ash, and 3.00% total sulphur, and calorific value 2827 kcal/kg (11836 kJ/kg). The air dried coal is composed of 7.10 % moisture, 35.32% ash, 3.61% total sulphur, and calorific value 3502 kcal/kg (14662 kJ/kg) - (Table 3).

Total Borehole	RESERVES					
	Area for Reserve (m ²)	Area for Overburden (m ²)	Mineable Thickness (m)	Bulk Density (tonnes/m ³)	Proven Reserve (tonnes)	Mineable Reserve (tonnes)
53	2,947,173	3,025,156	21.32	1.510	94,878,750	73,153,885

Table 1. Results of lignite reserve values of the Çanakkale Çan lignite deposit.

Total Borehole	OVERBURDEN					
	Overburden Thickness (m)	Overburden (m ³)	Intercalation Overburden (m ³)	Slope Overburden (m ³)	Total Overburden (m ³)	Overburden Ratio (m ³ /tonnes)
53	149.50	452,301,649	2,158,435	314,154,379	768,614,571	10.51

Table 2. Results of overburden values of the Çanakkale Çan lignite deposit.

Total Borehole	QUALITY							
	As received basis				Air dried basis			
	Moisture (%)	Ash (%)	Total Sulphur (%)	Calorific Value (kcal/kg)	Moisture (%)	Ash (%)	Total Sulphur (%)	Calorific Value (kcal/kg)
53	22.52	29.69	3.00	2827	7.10	35.32	3.61	3502

Table 3. Results of lignite quality values of the Çanakkale Çan lignite deposit.



Figure 4. General view of the Çanakkale Çan lignite deposit.

Overburden, intercalation of barren rock and slope overburden (batters) were calculated by polygon method for each individual polygon and then for the whole area. Average overburden thickness is 149.50 m and average intercalation thickness is 0.73 m. An overburden of 452,301,649 m³, an intercalation of 2,158,543 m³ and a slope overburden of 314,154,379 m³ were calculated in the Çan deposit. Total overburden is 768,614,571 m³. Although different average ratios have been calculated for individual polygons in the coalfield, an average overburden ratio was found to be 10.51:1, expressed as m³ of overburden to one tonne of lignite for the whole sector (Table 2). Overburden ratio limit was set as 20:1 m³/tonnes for determining open-pit and underground mining boundaries in our calculations. All mineable re-

serves will be excavated by the open-pit mining method in this coalfield.

4. Conclusions

The total mineable reserve is estimated at over 73 million tonnes. Çanakkale-Çan lignite deposit is currently being mined by open-pit mining, despite its high sulphur content. Lignites possessing higher calorific values are mainly exploited for household and industrial use in the country. Lignites possessing lower calorific values and higher total sulphur contents can be used in the fluidised-bed thermal power plants. The flue gases are minimised using the fluidised bed boiler technology. The stack gases that can



Figure 5. General view of the Çanakkale Çan thermal power plant.

be harmful to the environment are directly eliminated during the combustion process as a result of circulating fluidised bed boiler technology and therefore a separate flue gas cleaning system is not required.

Although Çan lignites have an important place in the energy policy of Turkey, because of the environmental pollution its higher sulphur content would create, these lignites are used neither by the numerous ceramic plants in the area nor at any other industrial plant. It was impossible to remove the sulphur from these lignites.

The construction of the first fluidised-bed thermal power plant in Turkey with 210 MW capacity begun in Çan in 2000. It was completed at the end of 2003 and test production has started immediately (Fig. 5). Fluidised-bed technology is a modern incineration technology in power plants that is suited for high-sulphur low-calorific value lignites, allowing an increase in the production from the Çan lignite. This will provide an important contribution to Turkey's energy production. Annual energy production will be 2,000,000,000 kWh/year. Thermal power plant will use 1,800,000 tonnes/year lignite. Total energy production of Turkey is 130.000.000 kWh/year. Çan thermal power plant will contribute to Turkish electricity production of approximately % 2 in near future.

5. Acknowledgements

This study was financially supported by Research Project 0908-98-06-05 of Dokuz Eylül University. We would like to thank philologist N.U. Tanyer and also the reviewers for their constructive criticism.

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Manuscript received 26.3.2003 and accepted for publication 26.4.2004.