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GEOLOGICAL AND MINERALOGICAL CHARACTERIZATION OF THE SUNGURLU BENTONITES, CORUM - TURKEY

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Abstract: The geology and mineralogy of the Sungurlu bentonite occurrences have been investigated. In the Sungurlu region, bentonite deposits containing Oligocene - Miocene age sedimentary rocks are composed of alternations of gypsum, mudstone, tuff, and minor amount of fine-grained sandstone. The bentonites have sedimentary origin. Na-montmorillonite was determined by the X-ray powder diffraction analyses of clay size. Detrital quartz, feldspar, gypsum, calcite, metamorphic, and volcanic rock fragments are common impurities.

Key words: bentonite, montmorillonite, sedimentary origin, XRD, DTA, IR.

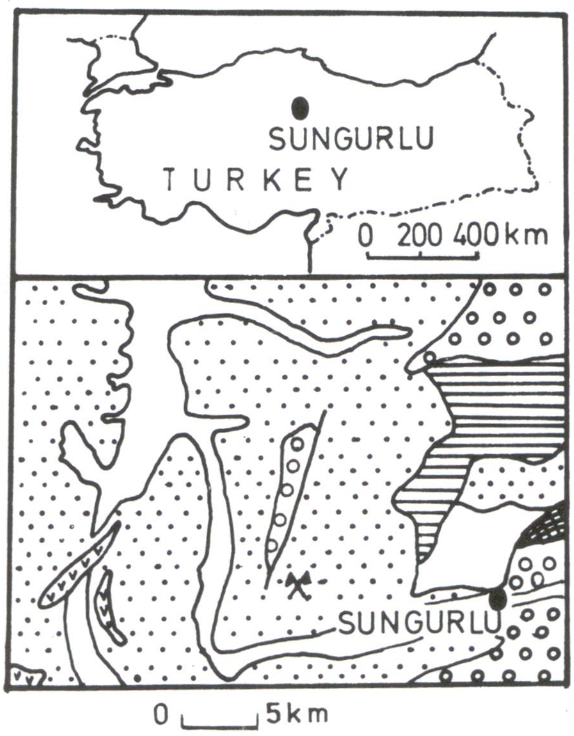
Introduction

Bentonite occurs in the beds of Upper Cretaceous and Tertiary ages at many places in Turkey (MTA 1982; Türkmenoglu et al. 1991; Coban 1992). These deposits have various characteristics and origins. The bentonite deposits in this work around the country of Sungurlu which are situated 130 km south-west of the city of Corum, Central Turkey (Fig. 1). The aim of this study was to investigate the mineralogical features of the Sungurlu bentonites.

Materials and methods

About 50 bentonite samples were collected from the Sungurlu bentonite deposits. The samples were studied by: X-ray powder diffraction (XRD), differential thermal analysis (DTA), infrared spectroscopy (IR) and scanning electron microscopy (SEM).

A Philips 1140 model X-ray powder diffractometer with Ni-filtered, CuKα radiation and a scanning speed of one degree 2Θ/min. was used for obtaining X-ray diffraction patterns. The μm clay fraction was used for the identification of clay minerals.



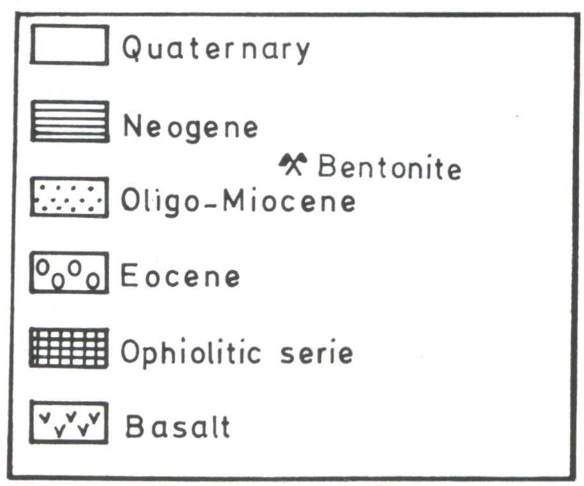


Fig. 1. Simplified geological and location map of the Sungurlu deposit.

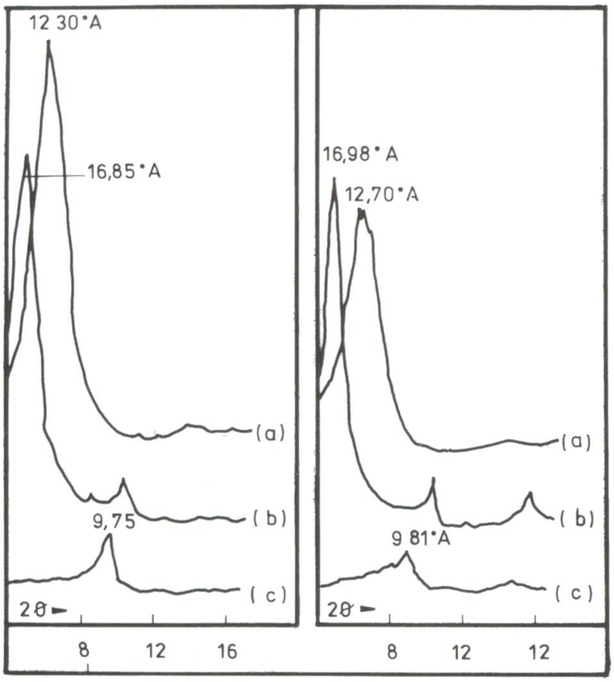


Fig. 2. X-ray powder diffraction patterns of the Sungurlu bentonites. a - air dried; b - ethylene glycoled; c - heated at 550 °C.

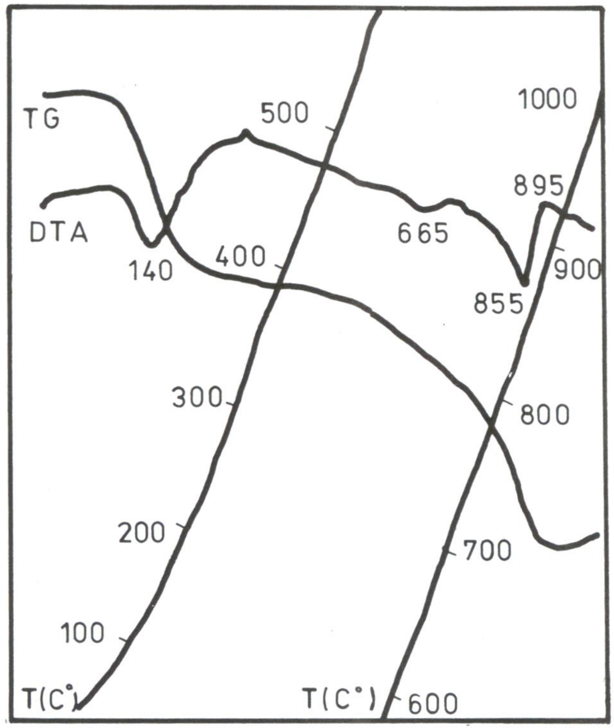


Fig. 3. Thermal analysis curves for the Sungurlu bentonite sample.

The DTA and TG curves were obtained simultaneously using a Netzsch STA Model 429 apparatus, with a speed of heating 10 °C/min. The IR spectra were obtained with a Perkin-Elmer Model 983 spectrophotometer. The KBr pressed pellet technique was used. The morphological features and crystal structure of smectite particles wre examined by Scanning Electron Miscroscope (SEM). The SEM studies were made on Au coated samples with JEOL-JSM-T330 model apparatus.

Results and discussion

Clay minerals: the XRD data for the Sungurlu bentonites show the abundance of dioctahedral smectite (montmorillonite). Montmorillonite was determined from the XRD patterns, according to Brown & Brindley (1984). Fig. 2 shows the X-ray diffraction patterns of two samples. The montmorillonite d_{001} spacings were 12.30 to 12.70 Å, for air-dried samples, and 16. 85 - 16. 98 Å, for ethylene glycol saturated samples. The basal spacings of (001) reflection decreases to 9.75 - 9.81 Å after heating to 50 °C (Fig. 2).

Na-montmorillonite is the dominant clay mineral component of the Sungurlu bentonite. Feldspar, detrital quartz, calcite, gypsum, volcanic and metamorphic rock fragments are the non-clay components in these samples.

Differential thermal analysis

The DTA curves show two large endothermic peaks at 140 °C, at 855 ° C and a small endothermic peak at 665 °C (Fig. 3). The first peak at 140 °C shows interlayer water loss. The other endothermic peaks at 665 °C and at 855 °C are characteristic of montmorillonite, and these peaks show the loss of hydroxyl water (Grim & Kulbicki 1961).

The temperature of the decomposition peak of montmorillonites is lower than that of trioctahedral types, and Al^{+++} is the predominant octahedral cation. The loss of hydroxyl for the dioctahedral form of smectite, is in the range of 450 ° C to 650 °C (Grim 1962).

In the Sungurlu bentonite, the exothermic peak at 895 °C is sharp, and this peak reflects the crystallization of a new structure.

Infrared spectroscopy

The IR spectroscopy technique was used for identification of montmorillonite and some impurities in the

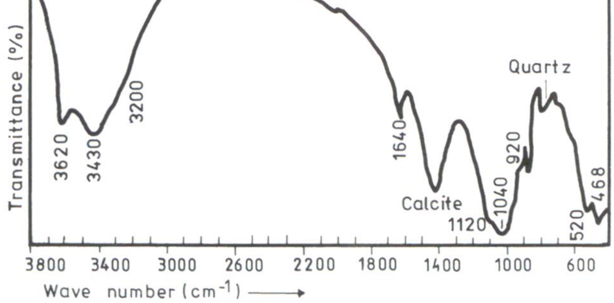


Fig. 4. Infrared spectra of montmorillonte (< 2 μm) from the Sungurlu bentonite.

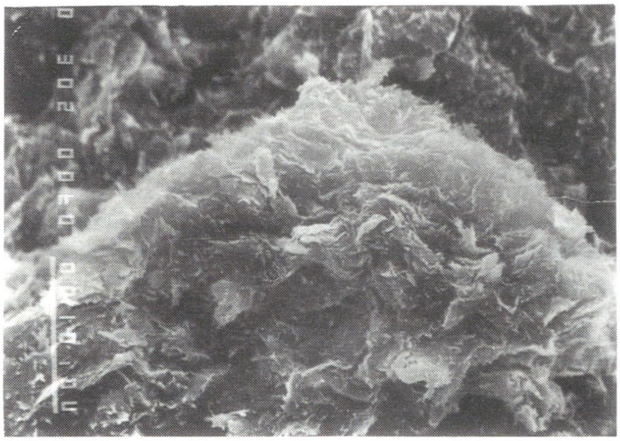


Fig. 5. Scanning electron micrograph of montmorillonite from the Sungurlu bentonite.

<2 μm fractions of the Sungurlu bentonites. The characteristic bands are at 845 - 835, 796 - 790, 623, 522, 462 cm^{-1} (Van Dee Marel & Beutelspacher 1976). On the other hand, the AlAlOH, FeAlOH and AlMgOH absorption bands for dioctahedral smectites are 920, 880 cm^{-1} and 840 cm^{-1} (Farmer 1974).

Montmorillonite from the Sungurlu bentonite shows absorption bands in the 3620 cm^{-1} and 3618 cm^{-1}. These bands are OH stretching vibrations of montmorillonite (Fig. 4). The AlAlOH and AlMgOH bending vibrations were observed at 920 cm^{-1} and 880 cm^{-1}. Some of the samples show a band at 3430, 3200 cm^{-1} and 1640 cm^{-1} typical of the adsorbed water. The sample in Fig. 4 has a similar spectra to Upton (Wyoming U.S.A.) montmorillonite (Van Der Marel & Beutelspacher 1976).

Scanning electron miscoscopy

Scanning electron microsopy of the Sungurlu bentonite showed that montmorillonite particles occur mostly in the form of "Rosette-shaped aggregates"(Henning & Störr 1986) - Fig. 5. These aggregates are often associated with volcanic glassy material.

Conclusion

The Sungurlu bentonite samples are mainly composed of Na-montmorillonite, according to the X-ray, DTA and IR data. Quartz, feldspar, calcite, gypsum and rock fragments (metamorphic to volcanic) are the other components in the samples.

The bentonites were produced by the alteration of andesitic to dacitic tuffs, deposited in an arid climate with later transportation and deposition in the Oligo - Miocene basin.

References

Brown G. & Brindley G. W., 1984: X-ray diffraction procedures for clay mineral identification. In: Brindley G. W. & Brown G. (Eds.): *Crystal structures and clay minerals and their identification. Mineral. Soc.*, London, 305 - 356.

Coban F., 1992: Geology, petrography and clay mineralogy studies of some Turkish bentonites. *Mediterranean Clay Meet. Lipari-Italy, Abstr.*, 37 - 38.

Grim E. R. & Kulbicki G., 1961: Montmorillonite high temperature reactions and classification. *Amer. Mineral.*, 40, 1330 - 1369.

Grim E. R., 1962: Applied clay mineralogy. *Mc Graw-Hill Book Comp.*

Henning K. H. & Störr H., 1986: Electron micrographs (TEM, SEM) of clays and clay minerals. *Akademia Verl.*, Berlin, 350.

Farmer V. C., 1974: Layer silicates. In: Farmer V. C. (Ed.).: *Infrared spectra of minerals. Mineral. Soc.*, London, 331 - 363.

MTA 1982: *Bentonite inventory of Turkey.* Publ. No. 184, Ankara.

Türkmenoglu A. G., Göktürk E. H., Güngör P. & Özalp T., 1991: Chemical characterization of Hancili bentonites, Kalecik - Turkey. *7th Euroclay Conf. Dresden, Abstr.*, 3, 1107 - 1111.

Van Der Marel & Beutelspacher H., 1976: Atlas of infrared spectroscopy of clay minerals and their admixtures. *Elsevier Sci. Publ.*