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NOTES

VEIN-LIKE SEPIOLITE OCCURRENCE AS A REPLACEMENT OF MAGNESITE IN KONYA, TURKEY

Key Words—Magnesite, Sepiolite, Serpentinite, Thermal analysis.

A vein-like occurrence of sepiolite has recently been discovered in the Çayırbağı magnesite deposit, 20 km southwest of Konya, Central Anatolia, Turkey (Figure 1). The Çayırbağı magnesite deposit is in a serpentinite which extends over several square kilometers. The magnesite is a microcrystalline type and occurs as veins ranging from a few millimeters to 30 cm in thickness. Sepiolite was observed only at the opening and the neighboring cuts of an adit and occurs in some of the magnesite veins with the magnesite mineral. Magnesite is present in the center and at the bottom of these veins. In contrast, nearly pure sepiolite occurs close to the topographic surface, and there is a gradual transition from magnesite to sepiolite in these veins. The magnesite-sepiolite transition is both megascopically and microscopically apparent. The replacement of fine (<40 μm) magnesite crystals by typical fibrous sepiolite can be seen in thin sections. Sepiolite is also present close to the surface in intersecting monomineralic veins that vary in thickness from a few to 150 mm and that crosscut the magnesite. All veins sharply contact the host serpentinite; however, no alteration of the serpentinite was noted.

EXPERIMENTAL

The <2-μm fractions of several samples collected from sepiolite-rich zones and veins were used in the experiments. Chemical analyses were carried out on samples previously ignited at 950°C. Above 950°C, the Çayirbağı sepiolite lost 19.26% water, in good agreement with the amount of water in the structure proposed by Brauner and Preisinger (1956). Chemical composition adjusted for total water loss is shown in Table 1. X-ray powder diffraction (XRD) patterns were recorded using a Philips X-ray diffractometer and Fe-filtered CoKα radiation at 40 kV and 20 mA and a scanning speed of 1°2θ/min. The XRD data, including relative peak intensities, measurable d-spacings, and hk*l* indices are given in Table 2.

Differential thermal (DTA) and thermal gravimetric (TGA) analyses were made simultaneously on air-dried samples under atmospheric pressure at a heating rate of 10°C/min using a Linseis L-81 Thermowage instrument. The effect of heating on the structure of the Çayırbağı sepiolite was examined by XRD using oriented slides heated under atmospheric pressure at 200°, 400°, and 600° C for 2 hr. These XRD patterns are shown in Figure 2. The infrared (IR) absorption spectra were recorded by the KBr method with a Perkin-Elmer 599 infrared (IR) spectrophotometer.

RESULTS AND DISCUSSION

X-ray powder diffraction

XRD patterns of randomly oriented specimens revealed that the samples were composed of sepiolite; however, some of the reflections were broad and diffuse, and some were not well resolved. From a visual comparison of XRD data with those reported by Brind-

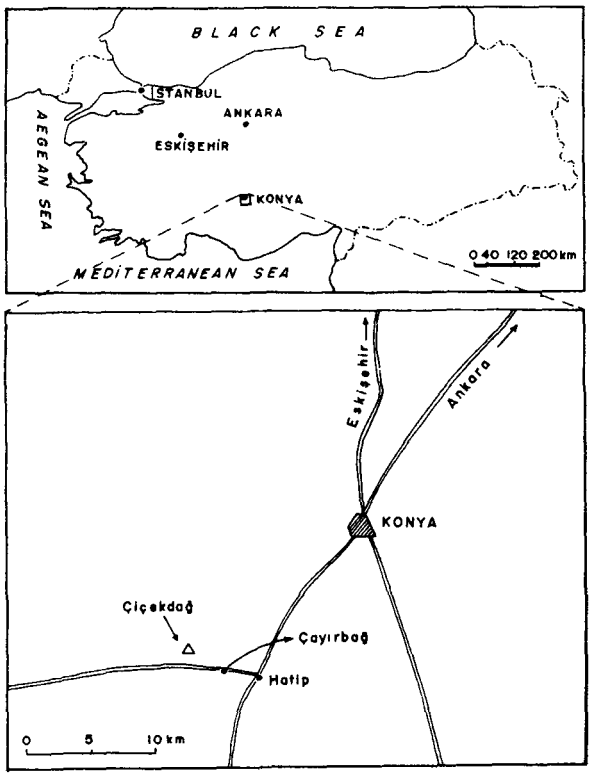

Figure 1. Map showing the location of the Çayırbağı sepiolite occurrence (triangle).

Table 1. Chemical composition of the Çayırbağı sepiolite.

	Wt. %
SiO_2	55.95
Al_2O_3	0.17
Fe_2O_3 (total iron)	0.03
MgO	24.04
CaO	0.10
Na_2O	—
K_2O	—
H_2O	19.26
Total	99.55

ley (1980), Post (1978), and Bailey (1980), the Çayırbağı sepiolite appears to be poorly crystalline.

The XRD patterns of oriented slides prepared from air-dried samples show the characteristic 110 reflection of sepiolite at 12.4 Å. This value is slightly greater than those reported in the literature (e.g., Grim, 1953; Bailey, 1980). When the samples were saturated with Mg^{2+} and solvated with ethylene glycol, the 110 reflection increased slightly to ~13 Å (Figure 2), which suggests a small amount of mixed layering of an unknown nature. Some of the other reflections were also modified as shown in Figure 2.

Table 2. X-ray powder diffraction data for sepiolite from Çayırbağı, Konya, Turkey.

hkl	d(obs) (Å)	I
110	12.4	100 +
130	7.7	10 b
200, 040	6.4	5 b
150	5.0	5 b
060, 131	4.51, 4.30	25 nr, b
260	3.74	15 b
400, 080, 420, 331, 261	3.37, 3.05	20 nr, b
441, 281, 530, 022, 112, 371, 191, 2,10,0, 390	2.61, 2.49	30 nr, b
202, 042	2.45	15 b
062, 312, 2,10,1	2.26	15 b
402, 082	2.08	
	1.70	5 b
	1.54, 1.52	10 nr, b

b = broad; nr = not resolved.

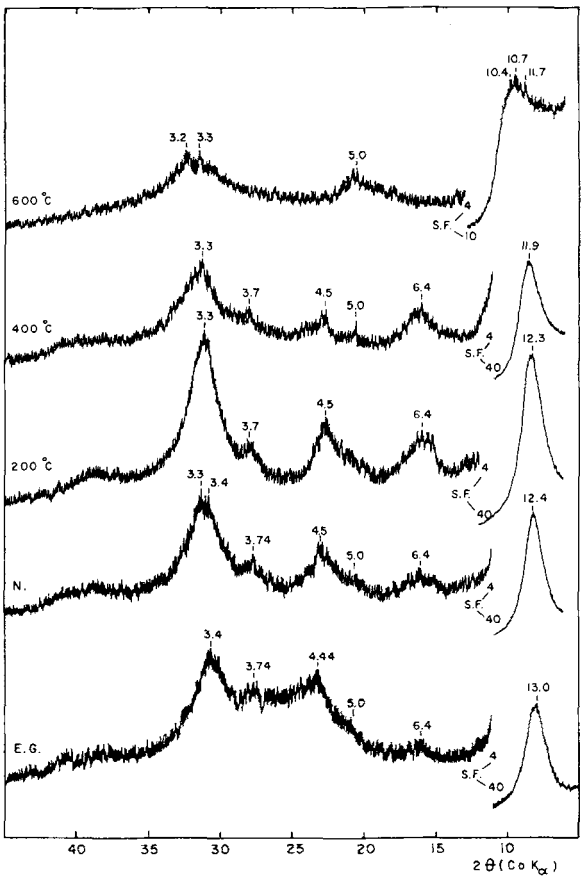

Figure 2. X-ray powder diffraction patterns of oriented samples of the Çayırbağı sepiolite; untreated and preheated (N.); ethylene glycol solvated (E.G.); and heated (200°C, 400°C, 600°C). Numbers on the patterns represent d-spacing (Å). S.F. = scale factor.

Thermal analyses

The DTA curve for the Çayırbağı sepiolite (Figure 3) was comparable with that given by Caillère and Hénin (1957) for Eski-shehir sepiolite. The first endothermic peak appeared at about 105°C. In addition, two endotherms occurred at about 250° and 500°C and were less pronounced because of an exothermic peak at about 355°C. A final endothermic-exothermic inversion was noted at about 800°C.

The dehydration behavior of the present sepiolite is in good agreement with those of the sepiolites described by Nagata *et al.* (1974), Serna *et al.* (1975), and Rautureau and Mifsud (1977). The TGA curve (Figure 3) indicates that weight losses due to dehydration occurred in four steps. The initial weight loss below 175°C is attributed to the loss of "zeolitic" water. The weight losses at 200°–375°C and 400°–600°C correspond to

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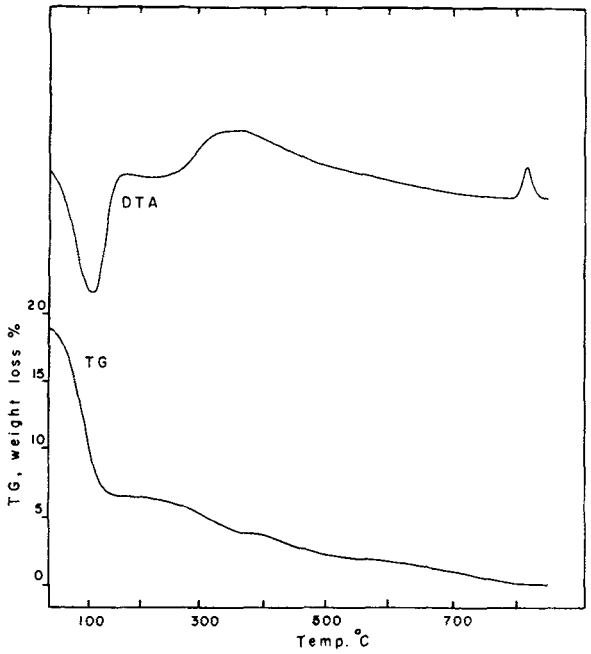

Figure 3. Differential thermal (DTA) and thermal gravimetric (TG) curves of the Çayırbağı sepiolite.

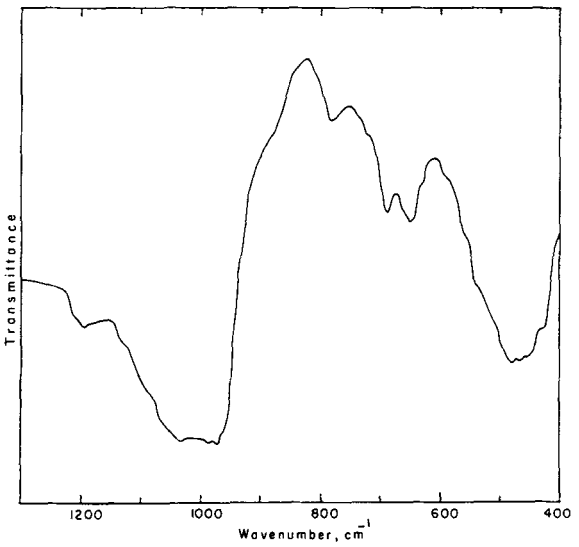

Figure 4. Infrared spectrum of the Çayırbağı sepiolite in the region 1300 to 400 cm^{-1}.

the loss of bound water. The final weight loss at 630°–830°C is attributed to dehydroxylation.

Samples of sepiolite heated to 200°C gave rise to 110 reflections that were slightly shifted to about 12.3 Å. The other XRD reflections remained unchanged. After the samples were heated at 400°C, the 110 reflection shifted to about 11.9 Å, indicating the partial removal of the bound water which produces the folding of the structure (Nagata *et al.*, 1974). The remaining reflections persisted to 600°C with only slight modifications. The XRD patterns of the samples heated to 600°C were modified as is shown in Figure 2, corresponding to the forming of sepiolite anhydrite.

Infrared spectra

The IR spectrum of the Çayırbağı sepiolite (Figure 4) is comparable to those described by Nagata *et al.* (1974) and Post (1978). The absorption band given by Nagata *et al.* (1974) at 1017 cm^{-1} appears as two bands at 1035 and 990 cm^{-1}. Additional bands occur at about 468 cm^{-1} and 457 cm^{-1} along with bands at 1620 cm^{-1} and 3000–3700 cm^{-1}.

GENESIS

Based on the field data and textural relations detected in the sepiolite-magnesite veins, the Çayırbağı sepiolite appears to have formed mainly by the *in situ* replacement of pre-existing magnesite. Magnesite was apparently replaced volume by volume. The pure sepiolite veins represent either completely replaced magnesite veins or veins formed by precipitation of sepiolite directly from silica and magnesia-rich solutions. Field data also suggests that the sepiolitization took place by descending and percolating meteoric solutions through the serpentinite bodies. The actual composition of the solutions, however, is not known, but they were probably alkaline and silica-rich (Siffert and Wey, 1962).

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REFERENCES

Bailey, S. W. (1980) Structures of layer silicates: in *Clay Minerals and Their X-ray Identification,* G. W. Brindley and G. Brown, eds., Mineralogical Society, London, 1–123.

Brauner, K. and Preisinger, A. (1956) Struktur und Entstehung des Sepioliths: *Tschermaks Min. Petr. Mitt.* **6,** 120–140.

Brindley, G. W. (1980) Order-disorder in clay mineral structures: in *Clay Minerals and Their X-ray Identification,* G. W. Brindley and G. Brown, eds., Mineralogical Society, London, 125–195.

Caillère, S. and Hénin, S. (1957) The sepiolite and palygorskite minerals: in *The Differential Thermal Investigation of Clays,* R. C. Mackenzie, ed., Mineralogical Society, London, 456 pp.

Grim, R. E. (1953) *Clay Mineralogy:* McGraw-Hill, New York, 384 pp.

Nagata, H., Shimoda, S., and Sudo, T. (1974) On dehydra-

tion of bound water of sepiolite: *Clays & Clay Minerals* **22,** 285–293.
Post, J. L. (1978) Sepiolite deposits of the Las Vegas, Nevada area: *Clays & Clay Minerals* **26,** 58–64.
Rautureau, M. and Mifsud, A. (1977) Etude par microscope électronique des différents états d'hydration de la sépiolite: *Clay Miner.* **12,** 309–318.
Serna, C., Ahlrichs, J. L., and Serratosa, J. M. (1975) Folding in sepiolite crystals: *Clays & Clay Minerals* **23,** 452–457.
Siffert, B. and Wey, R. (1962) Synthèse d'une sépiolite à température ordinaire: *C.R. Acad. Sci. Paris* **254,** 1460–1462.

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The symposium will consist of two half-day sessions focusing on the geology, mineralogy, production, specifications, and uses of kaolin, montmorillonite, and attapulgite clays on Tuesday, September 9, at the Clarion Hotel in St. Louis.

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