Appraisal of the Usability of Sepiolite Material with Respect to Radiometric and Elementary Properties in Eskişehir, Turkey*

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ABSTRACT

Sepiolite is a naturally occurring clay mineral of sedimentary origin, and belongs to the phyllosilicate group and is a magnesium hydrosilicate ($Si_{12}O_{30}Mg_8(OH)_4(H_2O)_4 \cdot 8H_2O$). This study aimed to determine the elemental distributions and the radiometric characterization of sepiolite samples collected from available sepiolite deposits in Turkey, particularly, Eskisehir-Beylikova (EB) and Eskisehir-Sirvihisar (ES). For radiometric analysis, each sepiolite sample collected from deposits was determined based on average gamma dose rate values using gas proportional counters (G-M). The average gamma dose rate from 9 samples in the 2 different regions were: 27.22 and 21.85 μSv/h, respectively. These results are low and below the world average (2.50 mSv).

Keywords: **Sepiolite, XRD, XRF, gamma dose rate, Eskişehir, Turkey**

I. INTRODUCTION

Sepiolite-palygorskite clay minerals are commonly associated with phosphatic sediments, salt deposits, sulphates, carbonates, zeolites, and siliceous rocks. Sepiolite is a naturally occurring clay mineral of sedimentary origin, which belongs to the phyllosilicate group. Sepiolite is a magnesium hydrosilicate $(Si_{12}O_{30}Mg_8(OH)_4(H_2O)_4 \cdot 8H_2O)$, which has a wide range of industrial applications, such as animal feed bondants, decolorization, pesticide and herbicide carries, raw materials in pharmaceuticals, cleaning, detergent, paper, paint, cosmetics, agriculture, fertilizer, livestock, rubber industries and production of ceramics, fiber and cement. **Figure 1** shows the crystalline structure of sepiolite. Each block is composed of two tetrahedral silica sheets and a central octahedral sheet that contains magnesium.

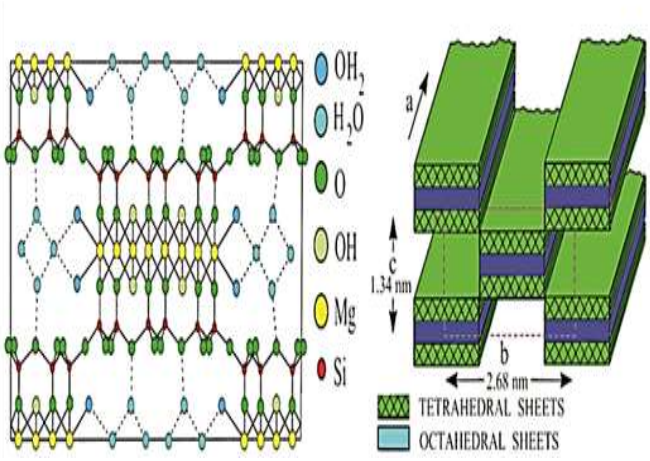

Figure 1. Crystalline structure of sepiolite (USGSOFR).

II. METHODS AND MATERIALS

In this study, the radiometric characterization and chemical compositions of sepiolite samples were determined based on available sepiolite deposits of the 9 samples from Eskisehir-Beylikova (EB) and Eskisehir –Sirvihisar (ES). The crystal structure of sepiolite is given in **Table 1**. The researchers identified sepiolite reserves and classified abundance ratios. There are several types of sepiolites that have many different formation forms defined elsewhere in the world and in Turkey. Two types of sepiolite samples mixed into molasses collected from ES and EB County of an inner province in Turkey

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Table 1. Çankırı rock salt (NACl) reserves

Properties	ES	EB
N (North coordinate)	39^0 11' 20.6016"	39^0 35' 5800"
E (East coordinate)	31^0 33' 0684"	31^0 12 ' 5056"
Average working one* (hectare)	40	50
Average total zone* (hectare)	3750	1000
Sample point	20	20
Sepiolite reserves* (mton)	1,5-2x10^6	1,5-2x10^6

were analyzed using EDXRF spectrometer. Using GM tube at 100 cm high, the average gamma activity rates values were measured from the 2 different regions, 27.22 and 21.85 (μSv/h), respectively. According to a UNSCEAR report, the average annual effective dose received by people, depending on the geographical and geological characteristic of the location, is about 2.8 mSv in total.

The Si, Al, Mg, Ca and K elements were also determined using the XRF instrument. All samples were crushed and milled to a fine powder then sieved through 1 mm mesh to remove stones and other impurities. XRF measurements are performed by Spectro Xepos model, Ametek. It uses 50 watt end window x-ray tube to excite the samples. **Table 2** demonstrates oxides elements concentrations in sepiolite samples.

III. RESULTS AND DISCUSSION

Results of the elemental composition of soils mixed with the grape molasses for sepiolite minerals from three different regions, EB and ES, are summarized in **Table 2**. These are categorized into minor, major and trace oxides concentrations and earth's crust abundance. It can be observed that, in some instances, the abundance of some oxidized elements in the sepiolite mineral are higher than the world average, which could be attributed to the inherent characteristics of the materials, traceable to the geological structure of the earth since its inception. These concentrations vary, depending on the concentration of the natural radionuclides ^{238}U, ^{232}Th and ^{40}K, present in soil sands and rocks.

The mineralogical characterization of Sepiolite was investigated using XRF analysis. Carbonate constitutes the main component of Sepiolite. Si and Mg appears in all samples studied in different proportions, and small amounts of Ca are seen in the ES and EB samples. In terms of radiometric characterization analysis, gamma activity rate of EB zone are between (9 – 37) μR/h and ES zones (10 -35) μR/h.

IV. CONCLUSIONS

Radioactive gamma release rate are below the world average (2.5 mSv/h), and therefore, with soil containing Sepiolite, is not a significant source of radioactive gamma rays that could affect agricultural crops and ultimately human health.

Table 2. Oxides Elemental analysis results sepiolite samples and earths crus abundance

Sepiloite zones	MnO	SO_3	FeO_3	TiO_2	CaO	K_2O	P_2O_5	SiO_2	Al_2O_3	MgO	Na_2O
EB1	0.01424	0.00857	1.105	0.1284	2.372	0.3926	0.04101	60.396	2.631	43.79	1.091
EB2	0.01616	0.00825	1.484	0.1722	2.372	0.4974	0.03575	56.25	2.751	23.99	0.614
EB3	0.01766	0.00825	1.543	0.1744	2.233	0.5195	0.4221	61.69	2.851	29.23	0.587
ES1	0.00442	0.00845	0.1687	0.02564	26.98	0.0078	0.03432	60.239	0.3175	22.53	0.864
ES2	0.00237	0.00557	0.1259	0.02244	4.716	0.0545	0.02159	54.29	0.4852	41.91	1.243
ES3	0.00232	0.03291	0.3054	0.04483	2.177	0.1172	0.01246	27.73	0.5779	15.81	0.735

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