کانی‌شناسی نهشته‌های گل سرشور منطقه تفرش، استان مرکزی

نوشته : بهروز رفیعی* و عباس امینی‌منش**

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Mineralogy of Shampoo-clay Deposit in Tafresh Area, Central Province

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چکیده

در این مقاله،کانسارگل سرشور در منطقه تفرش، استان مرکزی، مورد مطالعه قرارگرفته است. این مواد بخشی از سازند تخریبی سرخ زیرین متعلق به الیگوسن است که برای رسیدن به آنها چاههایی تا ژرفای ۳۰ مترحفر می‌شود. ستبرای لایه گلی در نقاط مختلف متفاوت بوده و از ۱ سانتی‌متر تا ۲ متر تغییر می‌کند. رنگ گل سبز زیتونی بوده، دارای لمس صابونی است و با جذب آب به حالت خمیری و ژله‌ای تبدیل می‌شود. از این خمیر و ژله به عنوان شامپو برای شستشوی سر و حتی بدن و نیز برای درمان برخی از بیماریهای جلدی مانند کهیر و جوش استفاده می‌شود. مطالعه دانه‌سنجی نشان می‌دهدکه ۹۲/۳ درصد از نمونه گل سرشور کوچک‌تر از ۲ میکرون است. تجزیه‌های شیمیایی، XRD و IR این بخش از نمونه بیانگر وجود حدود ۹۱ درصد مخلوط لایه نامنظم ایلیت ـ اسمکتیت دوهشت وجهی با بار لایه‌ای بالا و ۹ درصد کائولینیت است.

کلید واژه‌ها : گل سرشور، تفرش، پراش پرتو ایکس، فروسرخ و تجزیه شیمیایی

Abstract

Mineralogy of clay deposits named Gel-E-Sarshour, mainly mined in Central Province, Tafresh area, has been studied. This material is mined from Oligocene Lower Red Formation in wells up to 30 m depth. Clay layers have different thicknesses from 1 cm to 2 m in different parts. It comes in olive green and has a soapy touch. The clay will change to paste if mixed with water and used mainly as shampoo as well as treatment for some of the skin diseases. Grain size analysis has shown that 92.3% of the material is <2μ. XRD, IR and chemical analysis have established that the main constituents of < 2μ fractions of Gel-E-Sarshour are: 91 % high layer charge, dioctahedral mixed-layered illite/smectite and 9 % kaolinite.

Keywords: Shampoo clay, Tafresh, X-ray diffraction, Infrared, Chemical analysis

1. Introduction

The Gel-E-Sarshour clay is traditionally used for washing by rurals in some parts of Iran. This clay is mixed with water, then is filtered and purified and the paste-like clay is applied as a washing agent. Some people believe that this clay has therapeutic effects on some skin diseases such as rashes and acne.

The goal of the present study is to introduce stratigraphic position, mineralogy and some physical and chemical aspects of Gel-E-Sarshour clay extracted in Tafresh area, Central Province, Iran. We also suggest another application for this clay. Occurrence, geographic and stratigraphic positions of Gel-E-Sarshour and its mineralogy are different from that of investigated by Mahjoory (1996).

XRD (Italstructures, Cu Kα, 40 kV, 30 mA), IR (FTIR Shimadzu) and XRF (Philips, PW 2400) analysis were carried out for this purpose.

2. Startigraphic position

Qezeljeh village is located about 17 km NW of Tafresh area (Fig 1). The shampoo clay is mined around this village. It is found in wells up to 30m depth. The thickness of clay layers varies from 1cm to 2m in different parts. The color of shampoo clay is light olive green. The clay sample has been obtained from a well (34° 46' 39" N, 49° 51' 51" E) about 1628m above sea level. The mine occurs in lower Oligocene Lower Red Formation that is continental and consists of conglomerate, sandstone, marl and claystone. This Formation is unconformably overlain by marine Oligo-Miocene Qom Formation. The schematic stratigraphic section is illustrated according to miners (Fig. 2).

3. Material and methods

A representative sample of shampoo clay was collected. Acetic acid and H_2O_2 have been applied to remove carbonate and organic matter respectively according to Jackson (1979). Hydrometry analysis determined the amount of clay-sized particles (< 2μ fraction), and the < 2μ fraction was separated from suspension for XRD, IR, XRF analyses and CEC determination. Infrared analysis was performed according to Russell and Fraser (1994). Oriented clay aggregate was prepared for X-ray diffraction analysis as mentioned by Moore and Reynolds (1989). CEC was determined by the method introduced by Bergaya and Vayer (1997).

Structural formula was calculated as described by Ross and Hendricks (1945) and taking advantage of the semiquantitative method used by Weir et al. (1975), the proportion of all kinds of present clay minerals was determined.

4. Results and discussion

4.1 X-ray diffraction pattern

The oriented aggregate of shampoo clay was taken into X-ray diffraction studies (Fig. 3). The strong 13.69, 5.26 and 3.27 Å peaks and relatively weak 9.50 Å peak in ethylene glycol-solvated case (Fig. 3.2) are related to mixed-layered illite/smectite. The most characteristic peak is 5.26 Å (Moore and Reynolds, 1989). Using 9.50 (001/002 Ill/S) and 5.26 Å (002/003 Ill/S) peaks, the estimated percent of illite in the mixed-layered illite/EG-smectite is 70-80 % (Środoń, 1980). The 7.30 and 3.61 Å peaks indicate that kaolinite is also present.

4.2 Infrared spectra

Figure 4 shows IR spectra of shampoo clay. Mixed -layered illite/smectite is distinguished according to the absorption bands near 3627 and 1029 cm^{-1}, bands near 914 and 836 cm^{-1} (related to AlAlOH and AlMgOH deformation bands respectively), weak band at 756 cm^{-1} in high sample concentration (Fig. 4.1) and 1030, 522 and 470 cm^{-1} in low sample concentration (Fig. 4.2). The IR spectrum of illite/smectite interstratification closely resembles that of Cheto-type montmorillonite, but the weak band near 756 cm^{-1} separates these minerals from each other (Russel and Fraser, 1994). Sharp bands at 3694 and 3927 cm^{-1} belong to kaolinite.

4. 3 CEC determination

According to granulometry data, 92.3 % of the particles are smaller than 2 μ in shampoo clay. As mentioned before, the < 2 μ fraction consists of 91 percent Mixed-layered illite/smectite and 9 percent kaolinite. The CEC was determined around 48 meq/100gr. The presence of illite in mixed layer and also kaolinite cause CEC decrease.

4.4 Chemical composition

The chemical analysis results for major oxides and some elements present in shampoo clay are shown in table 1. The chemical constituents of clay were corrected for kaolinite to determine the structural formula of illite/smectite. The structural formula for a 2:1 silicate, based on 11 oxygens, 8 from the tetrahedral sheets and 3 from the octahedral sheet is as follow:

$$\overset{0.466}{(Ca^{2+}_{0.084}\ Na^{+}_{0.020}\ K^{+}_{0.278})}\ \overset{-1.256}{(Al^{3+}_{1.207}\ Mg^{2+}_{0.274}\ Fe^{3+}_{0.181}\ Ti^{4+}_{0.008})}\ (Si_{4.190}\ O_{10})\ (OH)_2$$

Exchange capacity is 0.49 M^+ per half unit cell which arises from octahedral sheet, mainly by substitution of Mg^{2+}, Fe^{3+} and some Ti^{4+} for Al^{3+}. There is no substitution for Si^{4+} in tetrahedral sheets. The excess Si in the formula probably indicates the presence of amorphous silica in the sample.

The high K_2O content (relative to smectite) also confirms the presence of illite associated with smectite in mixed-layered illite/smectite.

From environmental point of view, the heavy metal contents of shampoo clay are lower than those of the world normal soils (Adriano, 1986).

5. Conclusion

Based on X-ray diffraction and infrared analysis, chemical data and granulometry results, 92.3 % of the shampoo clay, extracted in Tafresh area, consists of clay-sized particles (< 2μ), in which mixed-layered illite/ smectite and kaolinite are present, this has already been introduced as montmorillonite (Geological Survey of Iran, 1977). Therefore 84 % of the whole sample is random mixed-layered dioctahedral illite/smectite with high layer charge.

This material is used as hair and body shampoo and also as a treatment for some skin diseases in Tafresh and nearby cities. Considering the chemical data and the amount of heavy metals in shampoo clay, we suggest applying this material in oil refinery and decoloring industries.

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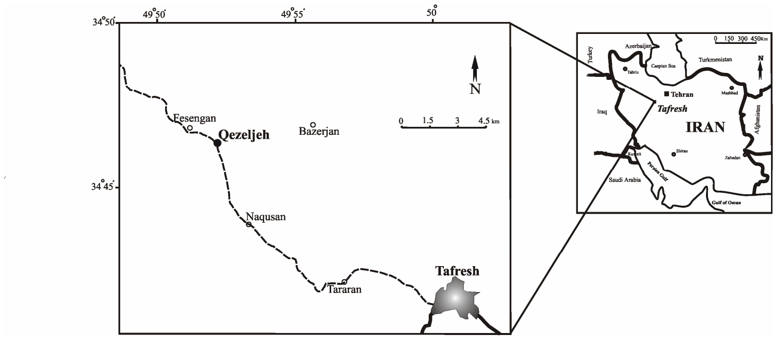

Fig. 1- Map of Iran showing Tafresh area and location of shampoo-clay deposits .

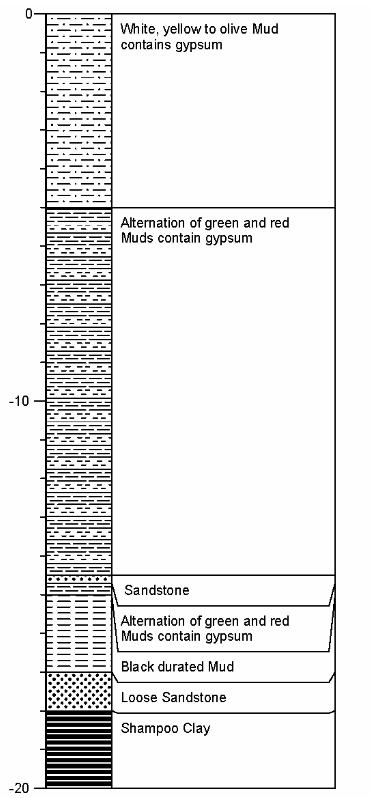

Fig. 2 -Stratigraphic section of the upper parts of the Lower Red Formation, drawn as quoted by local miners, and the position of shampoo-clay layer.

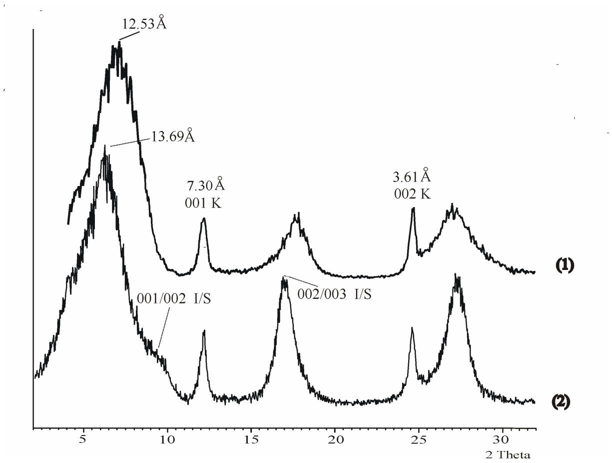

Fig. 3- X-ray diffraction patterns of clay deposit. (1) air dried and (2) ethylene glycol-solvated sample.

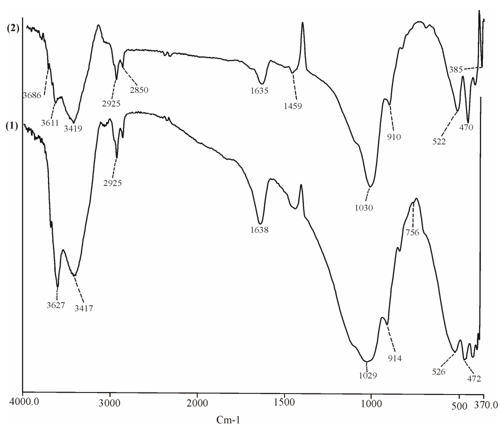

Fig. 4- Infrared spectra of shampoo clay. (1) High sample concentration and (2) low concentration.

Table 1- Chemical composition of < 2µ fraction of shampoo clay in Tafresh.

Constituent	Clay (%)	Constituent	Clay (ppm)	Constituent	Clay (ppm)
SiO_2	65.86	Cl	122	Ce	46
Al_2O_3	18.62	S	6	La	18
Fe_2O_3	3.53	Rb	175	Co	15
MgO	2.70	Sr	202	Cr	1
CaO	1.14	V	27	Cu	7
K_2O	3.19	W	< 1	Nb	8
Na_2O	0.16	Y	24	Ni	74
TiO_2	0.166	Zr	228	Pb	10
MnO	0.004	Zn	190	U	2
P_2O_5	0.056	Mo	< 1	Th	33
L.O.I	4.56	Ba	71		

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