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The Occurrence of Palygorskite in Sarir Sahara Soils

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ABSTRACT

In this short communication, the palygorskite minerals of Sarir Sahara soils were clarified by differential thermal analysis, infra-red study and electron microscopy. The differential analysis study of the clay fraction reveals endothermal peaks at 200–300 and 400–500°C. These endothermal peaks are characteristics of palygorskite. The infra-red study of the clay fraction upon deuteration revealed that the three bands associated with palygorskite are 2625, 2650, and 2670 cm^{-1}. Varification of palygorskite minerals in these soils were also done by using electron transmission microscope studies. Particles with fibrous morphology characteristics of palygorskite are shown.

In a paper published in the Libyan Journal of Agriculture (1978) Abdelgawad et al. mentioned the palygorskite minerals as a part of clay components of Sarir soils. This was based upon X-ray diffraction data. The reflections at 10.5 and 6.44 were attributed to palygorskite of the oriented samples. There is overlaping of 10.5 and 6.44°A with other minerals such as mica, illite and feldspar, respectively. At that time the presence of palygorskite was suggested in these soils. The origin of palygroskite in these soils was also discussed. Several authors (2, 3, 4, 6, 11, 12, 13) studied the origins of palygorskite in soils and sediments. The purpose of this short communication is to clarify the presence of palygorskite in these soils and also to discuss its origin.

Soil samples used in this study are the same as used in the paper published in 1978. The selected soil samples are based upon their mineralogical properties and possible presence of palygorskite. Samples from Faregh soil series are used in this study from a depth of 0–25, 25–60 and 60–150 cm. Soils from Sarir soil series are from 8–26 and 72–150 cm depth. Preparation of the soil for mineralogical analyses included the removal of carbonates with IN NaOAC at pH 5, removal of organic matter with H_2O_2, removal of free iron oxides with dithionite, citrate bicarbonate and fractionation by wet seiving sedimentation and centrifugation (7).

Fourty mg of the Na-saturated <2 um fractions from selected samples were equilibrated over a saturated solution of Mg $(NO_3)_2$ and used for differential thermal

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analyses. Ground ignited Al_2O_3 was used as a reference in the R.L. stone DTA apparatus and the heating rate was set at 12°C/min.

Infra-red spectra was run on self-supporting films prepared by drying suspensions into thin plastic film and pealing-off the resulting clay film. Samples were ammoniated in a small glass vacuum cell with IRTRAN window for IR scanning. Samples were vacuated and then ammoniated from an attached bottle of NH_3, until all water had been removed.

Deutration was done by pealing the film into a steel enclosed Taflon bomb with about 0.2 ml of D_2O and was given heat at 250°C for at least four hours. After deutration, samples were exposed to H_2O vapour to assure displacement of all D_2O, except the stable structure O.D.

Droplets of diluted suspensions of Na-saturated <2 um fraction were dried on 300 mesh from var coated copper grids and examined by using an Hitachi Hu-IIE transmission electron microscope.

The DTA, IR and electronmicroscope data studied herein is only for these soil layers, that X-ray data (1) shows possible presence of palygorskite. Among those represented one of their DTA, IR and electron-micrographs are included in this study.

The differential thermal analyses data is represented in Fig. (1). Sarir soil series are represented by (a) and (b) for the depths of 8–26 and 72–150 cm, respectively. Faregh soil series are represented by (c) and (d) for the depths of 0–25 and 60–150 cm, respectively. The data show endothermal peaks at 80–200, 200–325 and 400–540°C, and an exothermal peak, at 925°C. The diagnostic peaks for palygorskite in this study are at 200–325°C and 400–540°C. These endothermal peaks are due to the loss of

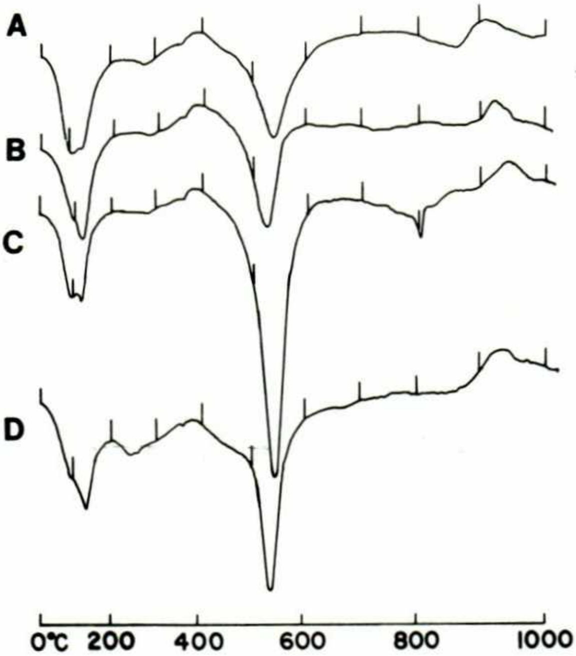

Fig. 1. Differential thermal analysis of SARIR and Faregh soil SERIES. A + B for SARIR soils samples 8–26 cm and 72–150 cm. C + D for Faregh soil samples for the depth of 0–25 cm and for 60–150 cm.

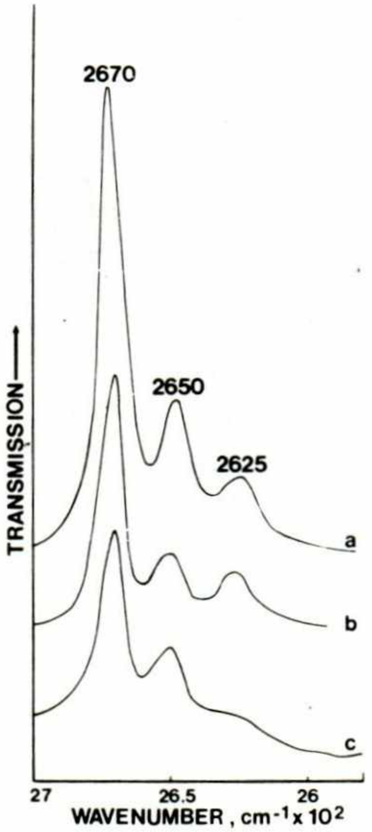

Fig. 2. Infra-red deuterated studies a, b for SARIR soil samples depths 8–26 cm and 72–150 cm respectively. For Faregh soil SERIES 2C for the depth 60–150 cm.

zeolitic water and the channel edge of the structural water of palygorskite. The 925°C exothermal peak is due to the formation of other mineral forms. The endothermal peaks from 80–200 and 550°C are due to smectite and kaolinite. The diagnostic endothermal peaks in this study of palygorskite had also been assigned (8).

The infra-red deuterated of selected <2 um clay fraction are shown in Fig. (2a, b, c) for the 8–26 and 75–150 cm depth for Sarir soil series and for Faregh soil series, Fig. (2c), for the depth 60–150 cm. The clay fraction samples are deuterated to see the structural hydroxyl and none were remnantes of the coordinated or zeolitic water. Samples were deutrated at 250°C. Palygorskite with the structural OH present as OD, but with all water presented as H_2O. The OD spectra as shown in Fig. (2) have the following reflections: 2625, 2650 and 2670^{-cm}. The 2670^{-1} is due to Al Mg–OH or Al $Fe^{+2} \pm OH$. The 2625 cm^{-1} is due to Fe^{+3}, $Fe \pm ^2(OH)$ (12).

Although the data of infra-red study confirmed the presence of palygorskite with the DTA study, confidences about the existence of these minerals in these soils are confirmed once again by the electron microscope study, the fibrous morphology of the palygorskite is shown. Examples of electronmicrographs are shown in Fig. (3a, b) (a) 8–26 cm depth for Sarir soil series and (b) 60–150 cm depth for Faregh soil series. Particals, with fibrous morphology characteristics of palygorskite are also shown in

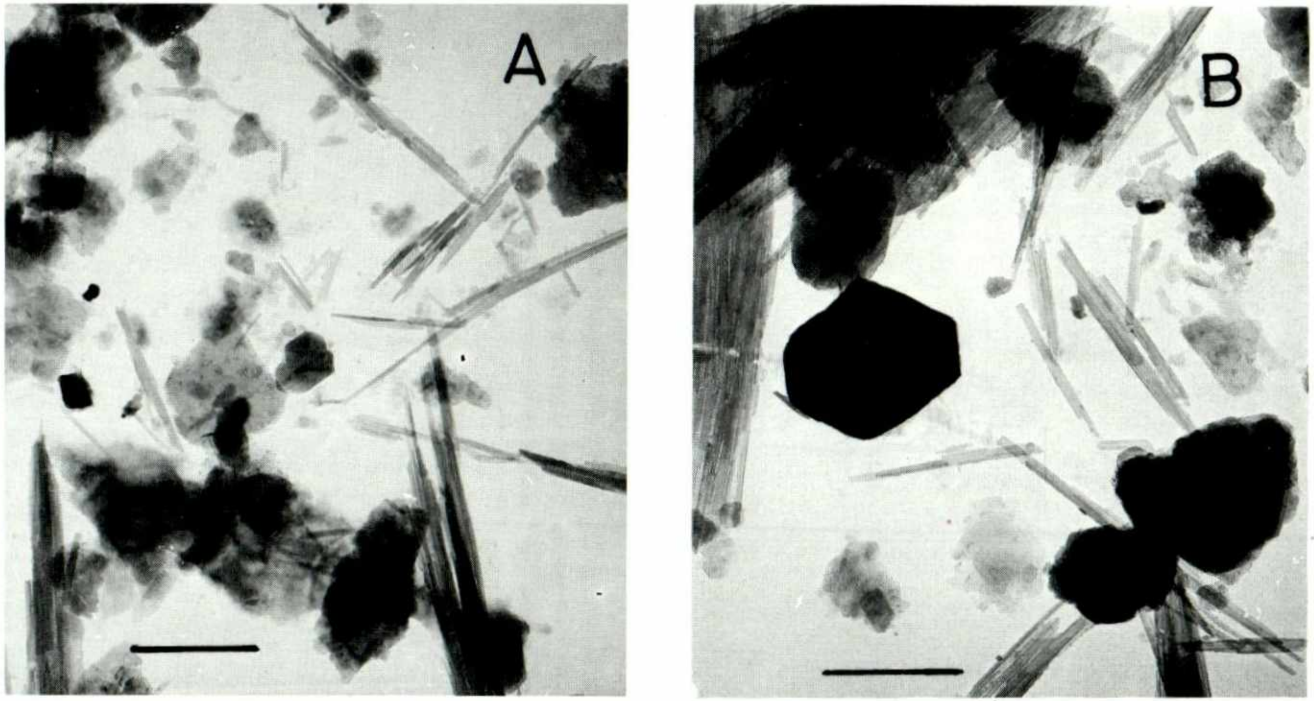

Fig. 3. Electron Micrographies for SARIR and Faregh Soil SERIES.
A. For Faregh soil SERIES depth 60–150 cm.
B. For SARIR soil SERIES depth 0–26 cm. The DARK BARS represent 0.5 um.

Fig. 3(a) and (b). Bundles of palygorskite fibers are shown in this study. In certain cases the bundles are associated with semectte-like material.

Although the conditions for formation of palygors-kite in situe are fit according to the stability diagrams (11) and the high magnesium concentrations in Sarir soil series are sufficient for the formation of palygorskite in this area. Evidence of its pedogenic is still uncertain, since these soils are reworked material with aeolian and alluviation process.

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وجود معدن الباليوجروسكايت في تربة السرير

الجيلاني محمد عبد الجواد

في هذا البحث تم التعرف عن وجود معدن الباليوجروسكايت بواسطة جهاز التحليل الحراري الجزئي ، جهاز فوق الحمراء وجهاز الميكروسكوب الإلكتروني وهو استمرار لبحث سابق نشر بمجلة العلوم الزراعية لسنة ١٩٧٨ .