Plant Archives Vol. 21, Supplement 1, 2021 pp. 1538-1543 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
doi link : https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.242

STUDY OF THE STATE OF DEVELOPMENT OF SOME IRAQI DRIED MARSHES SOILS BY USING MINERAL INDICATORS

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ABSTRACT

This study was carry out to understand the effect of drying on some properties of marsh soils, and to show the degree of development by using minerals indictors. Four pedons of dried marshes soils have been selected from locations near two main marshes in Misan province, south of Iraq ,two represented samples (surface and subsurface) from each pedon are selected and collected in plastic bags, after sampling and preparation of soil by air drying , grinding and sieving in 2 mm sieve, the two samples placed in plastic container to keep them for physical and chemical analysis, many physical and chemical and mineralogical properties was determined , The physical properties results showed that the studied soils were fine and moderate texture. The values of bulk density were high, especially in sub horizon (C) of pedon3 The chemical properties results showed, increasing in salinity levels (EC), and $CaC0_3$ especially in the surface horizons of unreclaim soils. The cation exchange capacity was decreased with depth, while soil reaction (pH) was in the natural range of Iraqi soils. Organic matter content was decreased with depth in pedones (No. 2), due to the effect of natural conditions on the plant covering during flooding stage. The results of x-ray diffraction and weathering index showed that the drying process did not affect the mineralogical component of studied pedons, reveals that Smectite, kaolinite and Illite were the dominant minerals, in addition to small amounts of Chlorite and palygorskite.

Keywords : Minerals indicators, soil, marshes, x-ray, flooding, drying.

Introduction

The marshes in Iraq are a large ecosystems, characterized by fresh water surfaces that are distributed in three southern provinces including Misan, located between the Tigris and Euphrates rivers, on an area of about 16 thousand square kilometers. This unique ecosystem provides life for 81 species of birds and is an important stopover for migratory birds between Siberia and Africa, as well as rare species of freshwater fish, wild animals, cattle and buffaloes. It is natural, this biodiversity also provides the conditions for the profession of the basic marshland people, the cultivation of many crops, which require rich irrigation such as rice, tobacco and papyrus, where they build their homes and built by their Sumerian ancestors five thousand years ago. The result of the permanent immersion of the marshes and the anaerobic conditions caused by this phenomena leads to a number of changes in chemical , physical , microbiological , morphological and mineral characteristics of soils which is effected by marshes, the accumulation of organic matter and the rule of some of active pedogenic processes such as the process of logging leads to the processes of reduction, these process causes colors change by the wetting and drying sequence (Boorman *et al.*, 2002). The occurrence of such pedogenic processes in the marshlands causes some changes in the mineral composition of the soil as a result of the process of accumulation and decomposition of organic matter. clay portion of soil is that part which contains the finest particles and is defined as the separates covering particles with an corresponding circular diameter of less than 0.002 mm. clay can contain numerous number of minerals contain primary minerals in immature soils such as those developed on parent materials derived from sedimentary rocks. Clay minerals including Phylosilicates, especially expansible minerals such as smectite group as well as vermiculite, shows very sensitive by the surrounding in which they found. As a result of the origin of the interlayer zone, hydroxy-inter layered vermiculite and smectite are highly variable and changes in environmental conditions can be captured by the degree of interlayer packing and in the relative steadiness of the interlayer constituents . Thus interstratified clay types can be influenced by conversions in their environment as a result of changes in land use and soil managing. this paper try to explain how clay minerals in marsh soils as responding to environmental circumstances changes (Cahoon and Reed, 1996) .

The process of minerals change is one of the important things that affect the environment of the marshes and their chemical composition, which may cause an increase in some dangerous and toxic elements and may threaten the wildlife in this ecosystem. On the other hand, this process helps to get some of the minerals transformations that leads to the alteration of the minerals from resistant to weathering to weak resistance, or to the complete destruction of the mineral and may be the opposite as the continuation of the process of weathering lead to the transformation of the three-layer silicate minerals towards the two -layer minerals resistance and then to the oxides, which is the most resistant, Dent *et al* (1976). Due to the importance of the marshes especially after being listed on the list of world heritage for the year 2016 and the lack of studies of this type , this study was conducted in order to highlight the nature of the mineral composition of the marshes soils and compared to the soil near the marsh swamp did not expose to the process of immersion and compare the results to the determination of clay minerals as well as estimating of weathering indicator for the studied soils.

Materials and Methods

Study area

The study area is located at the south of Iraq, and covering nearly 16.072 km^2, Misan province/Ammara city, (N 31026- 56.62= -310 27- 7.328= latitudes, E 470 43-14.138=- 470 55- 3.961=longitudes) . The climate of the region is hot and dry in summer and cold with moderately rainfall in winter. The mean annual precipitation of less than 100mm.The parent material of soils is alluvium rich in calcium carbonates, soil samples in the study area are classified as Entisols. The soil moisture and thermal regimes are torric–Aridic (see figure 1) which represent the map of study area.

Lab work:

Determination of physical and chemical properties for studied soils

Soil samples used in this study was collected from four pedons represented soil effected by main marshes in Misan province included Alhwiza and Auda marshes, samples was collected from the Ap horizon and C horizon ,samples were air-dried, crushed, sieved with a 2 mm sieve and subjected to the physical, chemical and mineralogical analysis. Particles size distribution of the soil samples was performed according to Piper (1950) and Jackson (1973). Organic matter of the soil samples determined using Walkely-Black method (Jackson 1973). Soil calcium carbonate measured by USING calcimeter method, according to Nelson (1982). Soil pH measured in 1:1 soil: water suspension using a glass electrode as reported by Mclean (1982). Electrical conductivity (EC) determined in the saturated soil paste extract using a conductivity meter. Soluble ions were also determined in the saturated soil paste extract according to Jackson (1973). The cation exchange capacity (CEC) of the soil samples was determined using NaOAC at pH 8.2 as a saturating solution and NH4OAC at pH 7.0 as a displacing solution, and then sodium was measured by flame photometer (Jackson, 1973).Mineralogy of all samples, was examined by X-ray diffraction (XRD).Clay minerals were identified after Mg-saturation followed by ethylene glycol solvation and K-saturation followed by heating to 350 and 550 (Jackson, 1965).

In order to estimate weathering index of studied soils , the study suggests to use the following equation :

$$\text{Weathering intensity index} = \frac{\text{The percentage of } 2:1 \text{ minerals}}{\text{The percentage of } 1:1 \text{ minerals}} \quad ...(1)$$

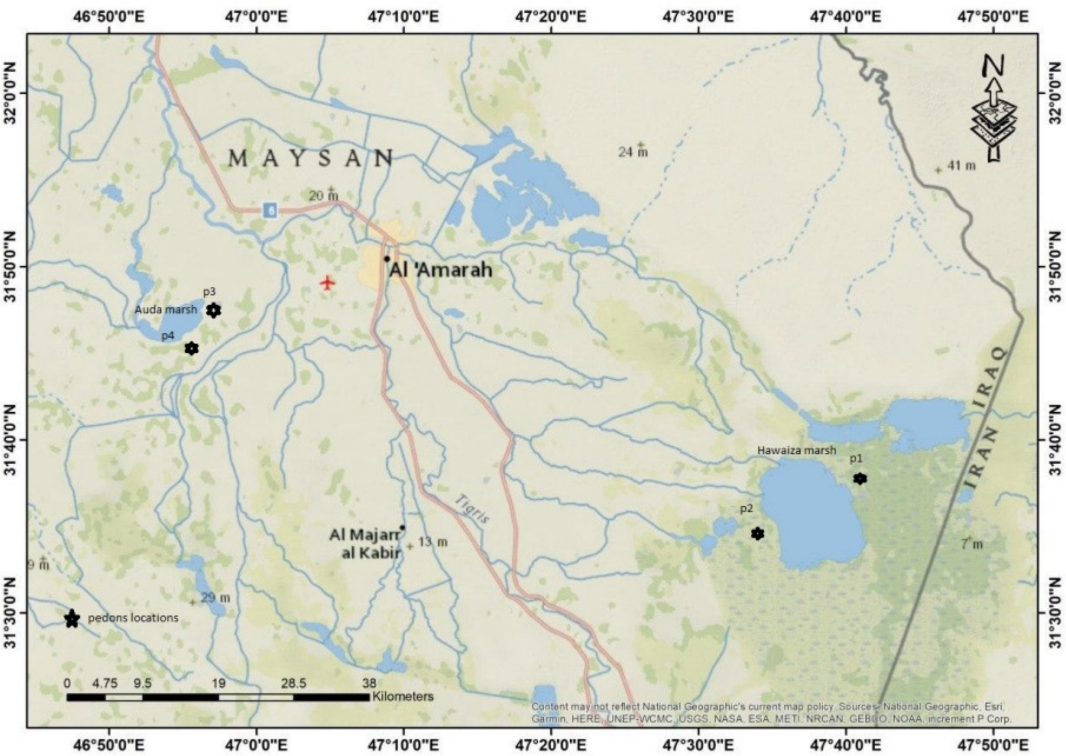


Fig. 1 : Map of study area shows pedons locations

Results and Discussion

Physical and chemical properties Results of the physical and chemical analyses of the studied soil samples are presented in Table 1 The particle size distribution of the studied soil samples shown that there are differences in the behavior of the particle size distribution for all samples which agrees with parent material composition, Table 1 shows some important properties of the studied soils. The soils belong to, Entisols according to previous studies,. Soil fractions contents ranged from 105–200 g/kg, 350–425 g/kg and 550-375 g/kg for Sand, silt, and clay respectively. Organic matter constituted 19–28 g/kg of the soils, the results show that the values of particle density ranged between 2.29-2.60 while bulk density ranged between 1.20-1.41 table 1 .

Table 1 : Some physical properties of studied soil

pedons	horizon	Bulk density gm/cm^3	Particle density gm/cm^3	Clay	Silt	Sand	Texture class
P_1	A	1.39	2.47	500	350	150	C
	C_1	1.35	2.53	510	355	135	C
P_2	A	1.34	2.29	550	350	100	C
	C_1	1.29	2.37	455	435	110	SiC
P_3	A	1.37	2.39	375	425	200	SiCL
	C_1	1.41	2.48	490	345	165	SiC
P_4	Ap	1.20	2.43	454	408	138	SiC
	C_1	1.36	2.60	493	402	105	SiC

In the other hand the results in table 2 shows some chemical properties were soil pH ranged between 7.21-8.16 , All samples were salt effected soils according to its electrical conductivity(EC) which ranged between 2-34 $ds.m^{-1}$, Cation exchange capacity ranged from 7.6 to 22 cmol/kg, all soils were calcareous and alkaline with CaCO3 content ranged from 550 to 412 g/kg . the results show the content of organic matter ranged between 15-48 $gm.Kg^{-1}$ this variation in organic content due to how these soil effected by the marsh according to its distance between soil pedon and the marsh, however, there is clear variation of soil properties between soil pedons due to the effect of flood on soil characteristics through the fluctuation of wetting and drying sequences (Crooks and Pye, 2000), (Edelman & Van Staveren, 1958), (Lu *et al.*, 2020).

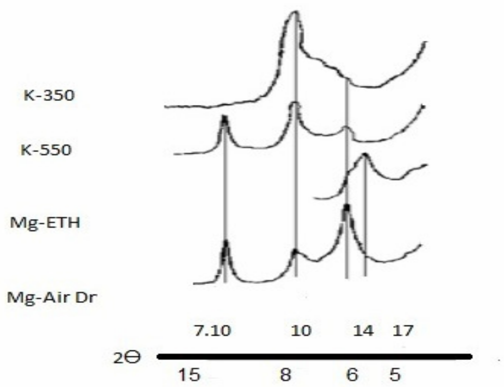
Table 2 : Some chemical properties of studied soil

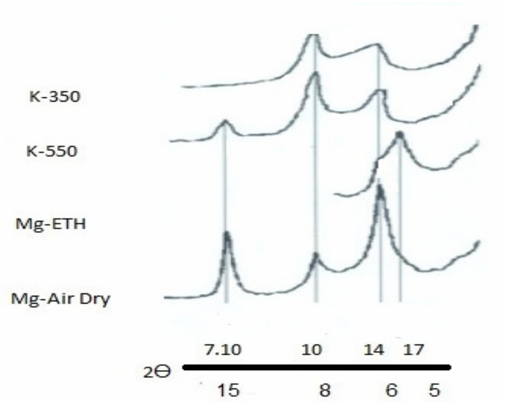
pedons	horizon	pH	ECe $ds.m^{-1}$	CEC $cmol.Kg^{-1}$	$CaCO_3$ $gm.Kg^{-1}$	O.M $gm.Kg^{-1}$
P_1	A	7.21	28	26	425	22
	C_1	7.44	10	23	412	21
P_2	A	7.65	14	19	475	48
	C_1	7.48	34	21	415	28
P_3	A	7.58	26	20	505	25
	C_1	7.85	31	17	530	20
P_4	Ap	7.56	8	19	550	18
	C_1	8.16	2	18	435	15

X-ray diffraction curves (2, 3, 4, 5) showed that there is general dominance of smectite minerals followed by illite in clay fraction, while the percentages of chlorite and kaolinite were low, the percentages of chlorite were higher than presence of kaolinite for all studied pedons.

These results indicate that smectite is one of the most dominant minerals in the clay fraction and for all studied soils, which could be diagnosed through diffraction at (14 and 17) A° in case of samples saturated with magnesium and ethylene glycol , respectively followed by kaolinite through the peak of 7 A°. Whereas, the low diffraction intensity (14 A°) and an increase in the diffraction intensity (10)A° in potassium-saturated samples indicated a decrease in the layers of smectite as a result of potassium treatment. This confirms that the existence of highly layer charge illite, and this is agreed with what Kadduo (1960) and AL-Rawi (1969) found when they studied some soils of sedimentary plain, as well as with the results of Abdullah (1982) when studying the soil of Al-Hammar marsh.

Also among the minerals prevalent in the clay fraction is the illite mineral, which can be diagnosed through peak (10 A°). The results showed that there was a presence of palecorskite in some samples of the studied pedions through the appearance of diffraction (10.5 A°). The presence of peak (14 A°) in potassium-saturated samples indicates the presence of chlorite in the clay fraction, which can be distinguished from kaolinite through the appearance of peak (14A°) in all parameters, since its stability when heating to 550° C indicates the presence of this mineral.





The dominance of smectite in the soils of the study is mainly due to the nature of the original material and the weak of the weathering condition, as well as the erosion that occurred during the transport and re-deposition of the materials of this soil. Or it may originate from the weathering of ferromagnetic minerals present in igneous and alkaline rocks scattered in the original source in northern Iraq, which represent the upper regions of the Tigris and Euphrates rivers (Kadhim, 1976). As for illite mineral, the source of its occurrence in sedimentary soils is its by accumulation due to sedimentation processes or as a result of weathering of biotite mica minerals (Nettleton *et al*., 1973), (De Arambarri & Talibudeen, 1987). Also, the sedimentary origin of clay minerals can be inferred from the presence of kaolinite. As for the presence of chlorite minerals in studied pedons, it may be attributed to its composition of smectite mineral by fixing the magnesium ion in the lattice of smectite minerals through the process of Chloritization. The results indicated that the proportions of these clay minerals do not change to a noticeable degree in the different soil of marshes, as the general picture of the distribution of clay minerals remains almost constant throughout the marshes soil.

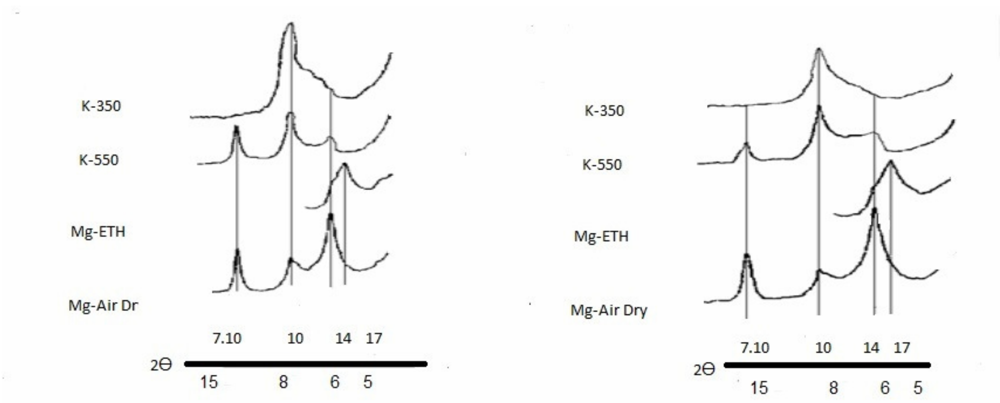


Figure 2 : x-ray diffraction of clay fraction for pedon 1 , 2

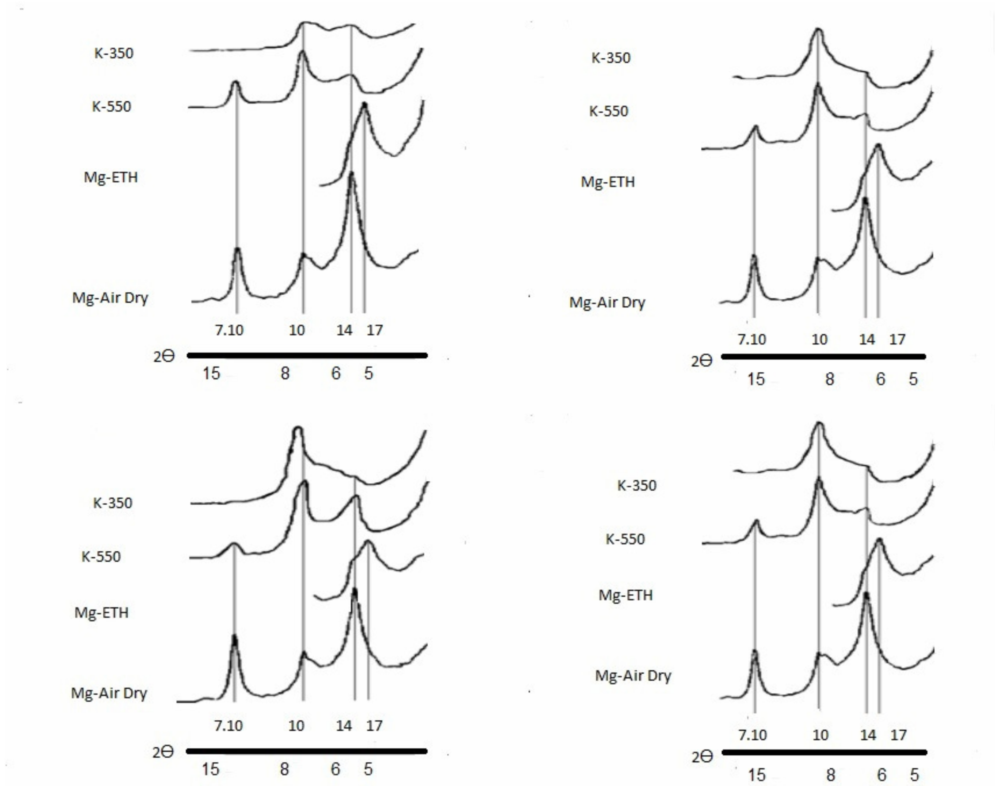


Fig. 3 : x-ray diffraction of clay fraction for pedon 3 , 4.

The results in table (3) showed that the highest values of weathering index recorded in pedon 3 which was 0.724 and 0.667 for A and C1 horizons respectively followed by pedon 2 by recording 0.558 and 0.538 for A and C1 horizons respectively, lower values was found in pedon1 and pedon 4, this results reveals that the degree of weathering highly correlated with the distance of each pedon from the marsh, were pedon 2 and pedon 3 was the nearest to the wetland , and this is expected because the effect of water on the degree of leaching and weathering of 2:1 clay minerals toward 1:1 minerals which was clear in the x-ray diffraction analysis (Bartholdy & Christiansen ,2012).

Table 3 : Clay minerals percentage(%) and estimated weathering index for studied pedons

pedons	horizon	Smectite	Kaolinite	chlorite	Illite	Palygorskite	Weathering index
P_1	A	21	28	30	11	10	0.389
	C_1	23	26	28	15	8	0.351
P_2	A	42	43	10	10	15	0.558
	C_1	35	35	10	8	12	0.538
P_3	A	38	42	10	5	5	0.724
	C_1	32	40	8	10	10	0.667
P_4	Ap	27	31	22	12	8	0.449
	C_1	25	30	15	20	10	0.429

Conclusions

According to the mineralogical analysis and the type and percentage of clay minerals this study indicated that the studied soils are undeveloped soils through the domination of 2:1 clay minerals and reduction of 1:1 minerals which consider clear indicator for low weathering index because the climatic conditions which characterized by low precipitation and high temperature .

The study revealed that there is clear effect of the drying process on the mineral composition of marsh soils as a results of changes in surrounding environment especially chemical effect, this effect include pH and Eh potential which consider the key parameter for oxidation reduction processes, as well as the effect of movement of water molecules in and out the interlayer silicate minerals resulting in wetting and drying consequences , most effect group of this phenomenon is the smectite clay minerals which characterized by expansibility as 2:1 minerals, the state of development of studied soils according this study consider in the first stage of development which we can call it immature soils.

There are some indicators can be used to diagnose the degree of weathering and transformation of clay minerals in marsh environment by using x-ray diffraction curves.

Acknowledgement

Many thanks to the university of Misan and the staff members of geography department at the college of basic education, all my appreciation to all my staff members by support me by any way.

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