Soil Uniformity and identification of lithological discontinuities in some soil series of the districts surrounding the Fallujah city of Anbar Governorate.

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Abstract

To know the uniformity of soil and identification of the cases of lithological discontinuities, this study was conducted, including twenty alluvium soil series distributed geographically toward the north, south, east, and west of Fallujah. Five uniformity ratios were adopted that were applied to the soil separately. And then, the lithological discontinuities were determined in them, as well as showing the effect of fluctuation of the groundwater level in the variation of these ratios between the soil series and the district. The results showed a large variation in the uniformity value between the soil series on the location and between the district, depending on the physiographic-sub location. The result also showed a significant correlation between uniformity value and groundwater level in the region.

Key word: lithological discontinuities, uniformity value, sub-physiographic, groundwater

1- Introduction

The concept of soil uniformity was used only a few in studies of soils in the Quaternary period, based on Jenny 1941 advised of the need to study the uniformity of soil materials, which must be tested through other methods if it is possible to diagnose the lithological discontinuities that cannot be perceived in the field through the sudden change in some Characteristics and qualities. Lithological discontinuity is defined as a sudden change in the continuity of the parent material or a sudden change that can be observed in morphology or quantitatively measured, and that occurs vertically in the soil body and by the action of geological processes and expresses important pedogenic evidence, or it is a clear or sudden change in the distribution of particle sizes or mineral composition within the soil sector It may be an expression of differences in the period or source of soil formation (10) and (18). As a result of the resulting overlap and volumetric convergence in some soil partical, and similar to the aforementioned studies, (7) proposed four uniformity ratio, which are (the ratio of clay + fine silt / the ratio of silt - fine silt), the ratio of (very fine sand / coarse silt) and (the ratio of very fine sand / medium silt) and the ratio of (fine sand / very fine sand) in distinguishing the parent materials of Iraqi soils. It was concluded that the uniformity value varies according to the diversity of soil origin materials and is distributed with a general average of (0.595). (13) showed a state of texture disruption resulting from the geomorphological action by obtaining the value of uniformity, as the results proved the existence of cases of texture disruption due to geomorphological processes, and the value of uniformity reached ≥ 0.4. In the Hawija region, south of the city of Fallujah, indicated (5) found cases of lithological discontinuities resulting from overlapping geological and pedological processes that could not be realized in the field, but were detected in the laboratory, as the value of the uniformity value was $\pm$ 0.37 and by adopting the Assady and Whiteside equation, which uses the criterion of the ratio of total silt / total sand. (8) indicated that there are cases of lithological discontinuity that resulted from a geomorphological action, not pedology, in his study of the pedagogy and morphology of gypsum soils in the modern village project in Anbar Governorate, as the general average of the uniformity value standard was+ 0.83 and by adopting the Schaetzll, Assady and Whiteside equation, which uses the ratio of clay + silt/silt. soft silt. the equations used to compute the coefficient of uniformity were with a range of (0.56-6.81) and with a general average of 2.65. (6) used seven equations to detect and evaluate texture discontinuities, the results also shown that the uniformity values varied according to the different soil series. The (2) equation was used in the study by (3) to show that there is a lithological discontinuity at a rate of 25% between secondary physiographic units, rivers, irrigation levee, and basins, but this equation did not record the presence of lithological discontinuities within the units of depressions and buried marshes in some Projects within the mid Mesopotamian plain in Iraq. There are two ratios in the study by (4) on the pedology and evaluation of the lands of the East Project: (silt/sand) and (silt/sand + clay). Using this ratio, there are seventeen lithological discontinuities in the project's soil series. In contrast, the silt/sand ratio indicated more variation in the project's soils and revealed the presence of five lithological discontinuities. n the study by (12) of six types of soils in the mountains of Poland mountain with some developed parent material rich in calcium carbonate, the results showed the presence of significant changes in the volume distribution of soil particles, especially in their content of silt and sand, as well as high values of uniformity ratio and coefficient of determination of lithological discontinuities

2. Materials and methods:

Within the administrative boundaries of the Fallujah District of the Anbar Governorate, which are situated between latitudes 33' 25" 30.94° and 33' 15" 39.01°N and longitudes 43' 36" 3.92° and 43' 54" 25.28°E, four agricultural districts on both sides of the Euphrates River were selected. According to Map No. 1, it is surrounded by the districts of Ameriyat al-Fallujah in the south, the city of Karma and the city district in the north, Abu Ghraib city in the east, and the Habbaniya city in the west. These districts' lands are flat and considered a part of the floodplain unit's Iraqi Mesopotamian-mid plain. Their elevations range from (39 to 46) meters above sea level. Together with wind-deposited sediments, the sediments from the Euphrates River are the source material for the soils in these districts. The climate is arid, with an average annual rainfall of (126.9 mm) and an average annual temperature of (24.4) °C. In its lands, the following natural plants are common: *Malva spp*, *Phragmites communis*, *Tamarix manifera*, *Cyndon Dactylon* ,*AlHagi maurorm*. And some species with low densities. The region covers 6792.28 hectares in total area.

2.1 -Field work:

Four linear paths vertical to the Euphrates River, one for each region, were used to conduct a semi-detailed soil survey of the study area using the Grid Soil Survey method. After that, (47) Auger holes were opened with depths of (0–25 cm), (25–50 cm), and (50–75 cm), respectively, and their locations were pinpointed using a GPS device (map 62sc) of the GARMIN. The locations of the pedons representing the study area series were identified based on the variation in the texture class, in addition to the topographical state and the natural vegetation. According to the fundamentals in the (16), they were described morphologically. Key soil series were diagnosed and classified according to the sedimentary soil series classification system proposed by (1). Their locations were signed on soil maps at a scale of 100000: 1 using the (GIS) program, as shown in the map (2). Then soil samples were taken from each horizon, placed in polyethene bags, labelled, and transported to the laboratory for the required laboratory analyzes.

2.2. laboratory analyzes.

Soil samples were air-dried and ground using a wooden mallet. In order to get it prepared for physical measurements for soil classes and texture classes, it was first put through a sieve with a (2 mm) diameter and then kept in plastic boxes. Using the gravitational sediment method, the fraction of silt particals was estimated for coarse, medium, and fine silt according to the periods for each partical. Using sieves with sizes of (50,250,100,500,1000,2000 micrometres), the sand partical was divided into five sections (50-100,100-250,250-500,500 1000,1000 - 2000 micrometres), and the percentage of each sand partical was estimated in accord with the Baucose methods described in (9).

3.2 -Statistical Analysis:

The following equations were used to calculate the values of uniformity and lithological

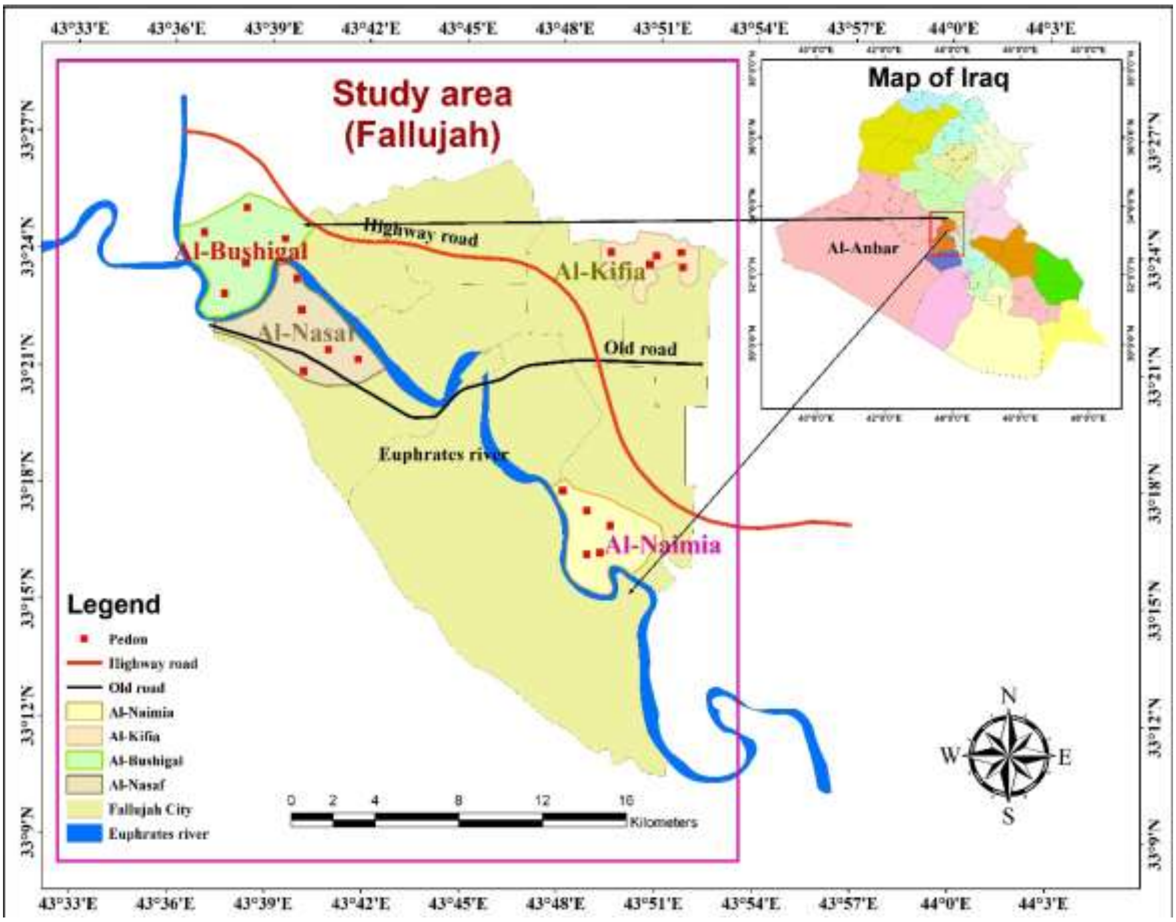

Fig (1): Map of the study area

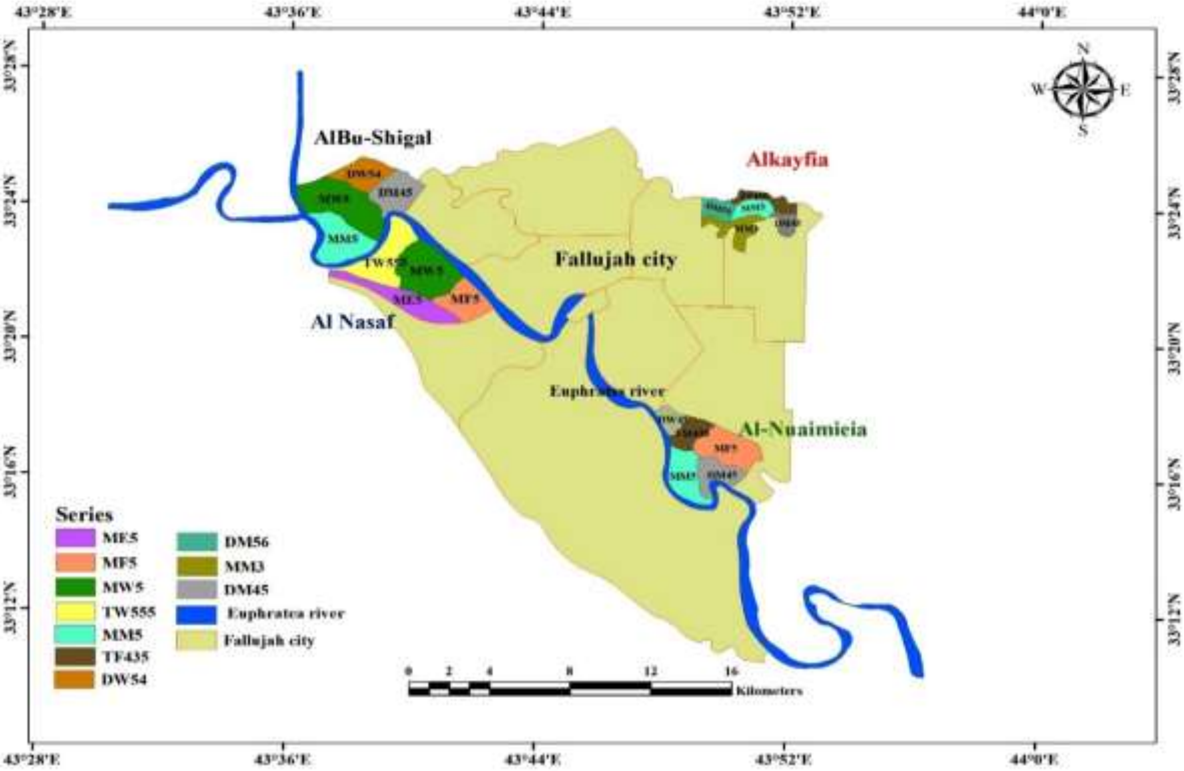

Fig (2): Map of the study districts

discontinuities in the study districts according to the results of the volumetric analysis of the soil particales:

. **1-** The equation described by (15)

Uniformity values (U.V) and lithological discontinuities = 1 - (upper horizon (very fine sand ratio -sand ratio) / (very fine sand + silt ratio) / (lower horizon (very fine sand ratio - sand ratio) / (very fine sand + silt ratio)

2- The equation described by (2)

The values of uniformity (U.V) and lithological discontinuities = 1 - (the upper horizon (sand ratio / silt ratio)) / (the lower horizon (sand ratio / silt ratio)

3. The equation described by (11)

Uniformity values (U.V) and lithological discontinuities = 1- (the upper horizon (silt ratio) / (the lower horizon (clay ratio + silt ratio)

4. The equation described by (17)

The Uniformity values (U.V) and lithological discontinuities = 1 - (upper horizon (fine silt ratio + clay ratio)) / (lower horizon (fine silt ratio + silt ratio))

5- The equation described by (11)

The Uniformity values (U.V) and lithological discontinuities = 1 - (the upper horizon (coarse silt ratio) / (the lower horizon (fine silt ratio)

The statistical program was used, "Genestat", to find the statistical relationships between the soil partical, which were represented by finding the value of the least significant difference for the proportions of uniformity between the series of the study districts.

3- Result and discussion:

Table (1, A-B-C-D) shows the results of the size distribution of soil particles. The pedons of each district varied in their content of the three partical (sand, silt, and clay). The average uniformity values for the different soil classes in the studied soil series are shown in Table No. 2. The (ME5)series excelled the other studied soil series in(5Al-Nasaf) district, with an average of (17.97). There were no significant variations in that district in the remaining soil series. While the soil series in (17 Al-Bushjal and Al-Nuaimiya) districts was excelled by the (MM5) soil series, with average values of (27.42 and 24.73), the rest of the series in those two districts did not show any significant differences. The soil series (DM56 and MM5) excelled the other soil series in the (Al-Kayfiyah) district, with average of (6.36 and 5.81), respectively, and showed significant differences between the soil series of this district.

These series, which have a single layer, moderate drainage, and a silty loam texture, may have excelled expectations due to their location inside the river basin unit, which increased the percentage of soft and very fine partical within the volumes of very fine sand and silt partical.

Table (1-A) Size distribution of soil partical (gm. kg-[1]) of 5Al-Nasaf district.

District	Series	Pedon No.	Horizon	Total clay	Silt				Sand						Texture Class
					F(1)	M(2)	C(3)	Total	V. F(4)	F(5)	M(6)	C(7)	V. C(8)	Total	
AL.Nasaf	TW555	P1	AP	64	74.2	285.8	368	728	32	118	24	19	15	208	SiL
			C1	88	98	109	338	545	45	12	11	173	126	367	SiL
			C2	113	38	176	279	493	11	6	6	152	219	394	L
			C3	113	124	138	481	743	29	3	9	21	82	144	SiL
			C4	114	188	209	380	777	6	7	2	38	56	109	SiL
	MW5	P2	AP	174.5	18	39	147.5	204.5	51	104	143	231	92	621	SL
			C1	138	53	236	352	641	13	5	7	53	143	221	SiL
			C2	112	76	215	443	734	7	11	12	24	100	154	SiL
			C3	123.5	78	114.5	427	619.5	1	3	1	73	179	257	SiL
			C4	159.5	176	199	384.5	759.5	18	0	7	24	32	81	SiL
		P4	AP	187	53	78	120	251	157	174	90	141	0	562	SL
			C1	136	86	157	322	565	186	92	1	8	12	299	SiL
			C2	161	257	225	184	666	81	78	0	14	0	173	SiL
			C3	88	38	78	201	317	176	382	37	0	0	595	SL
			C4	112	106	155	480	741	36	82	25	0	4	147	SiL
		P3	AP	133	88	167	259	514	149	134	38	23	9	353	SiL
			C1	110	103	217	423	743	83	52	3	5	4	147	SiL

			C2	150	96	186	520	802	27	4	6	7	4	48	SiL
			C3	135	114	156	451	721	77	39	15	8	5	144	SiL
			C4	137	136	180	508	824	2	5	2	5	25	39	SiL
	MF5	P5	AP	162.0	98.8	136.5	292	245	227	187	85	71	29	593	SL
			C1	123.2	11.4	62.4	528	601.8	183	78	4	8	2	275	SiL
			C2	111.0	64.6	101.4	392	558	236	91	2	0	2	331	SiL
			C3	199.4	114	210.6	404	728.6	53	12	1	5	1	72	SiL

Table (1-B) Size distribution of soil particles (g. kg-1) of 17 Al-Bushjal District

District	Series	Pedon	Horizon	Clay	Silt				Sand						Texture Class
					F	M	C	Total	V.F	F	M	C	V C	Total sand	
AlBu-Shigal	MW5	P6	AP	135.0	62	108	200	370	224	175	43	32	21	495	L
			C1	110.0	87	113	420	620	206	61	0	3	0	270	SiL
			C2	95.0	21.4	82.6	556	660	123	77	32	8	5	245	SiL
			C3	95.0	84.9	153.1	522	760	94	40.7	6	4	0.3	145	SiL
	MW5	P7	AP	230.0	35	49	308	392	89	227	51	11	0	378	L
			C1	129.0	82.8	81.2	396	560	116	104	45	32	14	311	SiL
			C2	104.0	91.8	153.2	340	585	179	95	30	2	5	311	SiL
			C3	106.0	123.6	202.6	434.8	761	74	44	7	6	2	133	SiL
			C4	107.0	41.8	152.1	595.1	789	48	50	4	2	0	104	SiL
	DE54	P8	AP	193.0	38	89	360	487	171	120.2	22	1.8	5	320	L
			C1	69.0	92.8	140.2	529	762	103	58	5	3	0	169	SiL
			C2	95.0	37.6	225	496.4	759	94	39	3	6	4	146	SiL
			C3	145.0	61	147	478	686	103	58	4	3	1	169	SiL
			C4	143.0	38	83.1	154.9	276	215	284	43	25	14	581	SL
			C5	118.0	17.6	66.8	90.6	175	162	29	511	2	3	707	SL
	MM5	P9	AP	109	21.4	39	681.6	742	86	47	10	6	0	149	SiL
			C1	134	19	58.5	610.5	688	88	41	28	17	4	178	SiL
			C2	108	21	118	648	787	73	24	6	2	0	105	SiL
			C3	132	82.8	101.2	628	812	42	10	4	0	0	56	SiL
	DM45	P10	AP	96	17.6	77.4	364	459	104.8	180.5	15.6	46.1	98	445	L
			C1	97	34.2	181.1	267.7	483	260	148.7	5	4.3	2	420	L
			C2	122	163.4	307.6	262	733	89.9	46.3	5.9	1.9	1	145	SiL
			C3	144	176.1	199.9	348	724	34.1	67.3	12.6	13.5	4.5	132	SiL

Table (1-C) Size distribution of soil partical (g. kg^{-1}) in Al-Nuaimiya district.

District	Series	Pedon	Horizon	Total Clay	Silt F	Silt M	Silt C	Silt Total	Sand V.F	Sand F	Sand M	Sand C	Sand V.C	Total sand	Texture
AlNuaimieia	DW45	P11	AP	80	80.4	154.7	176.9	412	186.9	231.1	30.5	15.9	43.6	508	L
			C1	131	44.2	142.9	224.9	412	297.3	127	15.6	14.5	2.6	457	L
			C2	107	31.2	72.8	506	610	168.8	54.7	18.2	23	18.3	283	SiL
			C3	107	39	139	481	659	130.2	59.7	18.8	15.8	9.5	234	SiL
			x̄	**106.3**	**48.7**	**127.4**	**347.2**	**523.3**	**195.8**	**118.1**	**20.8**	**17.3**	**18.5**	**370.5**	**SiL**
	TM435	P12	AP	110	3.8	27.2	354	385	210.9	234.8	55.6	0.3	3.4	505	L
			C1	105	41.8	80.1	298.1	420	286.2	164.2	16.4	4.3	3.9	475	L
			C2	83	7.6	12.8	50.6	71	79.3	637.2	121.9	4.7	2.9	846	LS
			C3	81	45.1	142.9	564	752	70.8	48.1	40.3	0.6	7.2	167	SiL
			x̄	**94.8**	**24.6**	**65.8**	**316.7**	**407**	**161.8**	**271.1**	**58.6**	**2.5**	**4.4**	**498.3**	**L**
	MF5	P13	AP	110	11.3	50.7	238	300	260.1	287.2	36.2	4.9	1.6	590	SL
			C1	84	34.2	106.8	458	599	118.9	189.1	4.2	4.8	0	317	SiL
			C2	94	30	248.7	499.3	778	65	46.6	3.2	5.4	7.8	128	SiL
			x̄	**96**	**25.8**	**135.4**	**398.4**	**559**	**148**	**174.3**	**14.5**	**5**	**3.1**	**345**	**SiL**
	DM45	P14	AP	135	5.1	137.9	354	497	224.4	125.1	11.2	2.1	5.2	368	**L**
			C1	85	31.1	108.9	282	422	312.1	166.8	10.1	1.2	2.8	493	**L**
			C2	85	37.4	168.3	540.3	746	98.2	65.5	1.7	1	2.6	169	**SiL**
			x̄	**101.7**	**24.5**	**138.4**	**392.1**	**555.0**	**211.6**	**119.1**	**7.7**	**1.4**	**3.5**	**343.3**	**SiL**
	MM5	P15	AP	166.8	3.8	113.1	616.0	732.9	64.4	29.3	3.5	1.3	1.8	100.3	**SiL**
			C1	149.8	26.6	137.5	586.0	750.1	74.7	17	1.7	3.7	3	100.1	**SiL**
			C2	157.5	11.4	148.5	576.0	735.9	56	32.7	1.2	9.1	7.6	106.6	**SiL**
			C3	171.5	30.4	168.2	562.0	760.6	39.9	18.9	3.4	2.2	3.5	67.9	**SiL**
			x̄	**161.4**	**18.1**	**141.8**	**585**	**744.9**	**58.8**	**24.5**	**2.5**	**4.1**	**4**	**93.7**	**SiL**

Table: (1-D) Size distribution of soil particles (g. kg-1) of Al-Kayfiyah district.

Distract	Series	Pedon	Horizon	Total Clay	Silt				Sand						Texture
					F	M	C	Total	V.F	F	M	C	V.C	Total sand	
Alkayfia	TF435	P16	AP	75	34.2	125.8	208	368	205.6	286.1	32.1	21.2	12	557	**SL**
			C1	75	16	69	404	489	114.8	257.9	24.1	24.1	15.1	436	**L**
			C2	99	27.8	113.6	142.6	284	285.1	322.9	7.1	1.9	0	617	**SL**
			C3	74	121.6	231.2	429.2	782	26.8	106.6	3.2	6	1.4	144	**SiL**
			x̄	**80.8**	**49.9**	**134.9**	**296**	**480.8**	**158.1**	**243.4**	**16.6**	**13.3**	**7.1**	**438.5**	**L**
		P17	AP	148	72.2	144.3	239.5	456	103	226.3	38	18.8	9.9	396	**L**
			C1	99	17.8	119.2	344	481	118	219.3	52.4	23.9	6.4	420	**L**
			C2	100	30.4	93.6	463	587	104	17.1	189	2.9	0	313	**SiL**
			C3	99	123	267	372	762	41.6	81.7	15.5	0.2	0	139	**SiL**
			x̄	**111.5**	**60.9**	**156**	**354.6**	**571.5**	**91.7**	**136.1**	**73.7**	**11.5**	**4.1**	**317**	**SiL**
	MM5	P18	AP	123	90.3	179.7	434	704	26.4	120.1	9	10.7	6.8	173	**SiL**
			C1	100	73.8	263.2	396	733	49	61.5	40.1	14.9	1.5	167	**SiL**
			x̄	**111.5**	**82.1**	**221.5**	**415**	**718.5**	**37.7**	**90.8**	**24.6**	**12.8**	**4.2**	**170**	**SiL**
	DM56	P19	AP	129	13.8	213.2	468	695	39.7	83.7	36.2	13.4	3	176	SiL
			C1	104	144.4	50.6	520	715	89.6	66.8	14.2	10.4	0	181	SiL
			C2	293	46.6	160.4	324	531	56	95.2	15.8	9	0	176	SiCL
			x̄	**175.33**	**68.27**	**141.4**	**437.33**	**647.0**	**61.77**	**81.9**	**22.07**	**10.93**	**1**	**177.7**	**SiL**
	MM3	P20	AP	154	7.6	42.4	112	162	340.8	233.1	74.8	35.3	0	684	SL
			C1	129	11.4	38.6	188	238	181.6	344.5	88.3	18.6	0	633	SL
			C2	130	40.6	21.2	202	262	200.2	159.4	121	108.5	18.9	608	SL
			x̄	**137.67**	**19.87**	**34.07**	**167.33**	**220.67**	**240.87**	**245.67**	**94.70**	**54.13**	**6.30**	**641.67**	**SL**

In the total silt/total sand ratio approved by the researcher Whiteside and Al-Assady (1982) and in (5Al-Nasaf) district, the soil series (ME5) excelled on the rest of the soil series in the district with an average amount of (9.87). No significant differences appeared between it and the soil series (MW5). The results of the least significant difference test showed significant differences between them and the district soil series. In the districts of (17 Al-Bushjal, Al-Naimiya and Al-Kayfiyah) the results showed, as shown in Table (1), excelled the soil series (MM5), with averages of (7.71, 8.23, and 4.23), respectively. The results of the least significant difference analysis showed no significant differences between this series and the rest of the soil series of (17 Al-Bushjal and Al-Nuaimiya) districts. While in (Alkayfia) district, this series showed no significant differences between it and the (DM56) series. While the rest of the series shows significant differences with both series.

The variation in these ratios can be related to the series' dispersed location in the four districts relative to the sedimentation source and its occurrence within the river basin's physiographic unit, as well as the quantity and quality of materials transported by the river during the flood seasons.

In the ratio of (coarse silt/fine silt) approved by Rutledge (1985), the soil series of district (5 ALNasaf) showed excelled the (MF5) series on the rest of the soil series of the district with an average moment of.(14.72)

While the series (MM5) showed, it excelled the rest of the soil series of (17Al-Bushjal and Al-Nuaimiya) districts, with averages of (25.61 and 63.29), respectively. The results of the least significant difference test showed that there were significant differences between them and the soil series of the two districts.

The (5 ALNasaf) district series excelled the (MF5) series on the rest of the district's soil series with an average (14.72) in the (coarse-to-fine silt ratio) Researcher by Rutledge (1985). This series showed significant differences between it and the rest of the district’s series, which did not show significant differences between them.

While the series (MM5) showed it excelled over the rest of the soil series of(17Al-Bushjal and Al-Nuaimiya) districts, with averages of (25.61 and 63.29), respectively, the results of the least significant difference test showed that there were significant differences between them and the soil series of the two districts.

Whereas in the (Al-Kayfiyah) district, the series (DM56) excelled in an average ratio of (14.82) over the rest of the province's soil series. No significant differences appeared between it and the series in that district.

The quality of the carrier load, the speed of the transport momentum, which results in the deposition of the coarse silt separator, leaving only the fine silt separator, as well as the nearness and distance from the source of sedimentation, are all causal factors for the variation in this ratio between the district soil series.

In the ratio of (total silt/silt + clay) approved by Researcher Mokma and Cremeen (1986), the soil series of(5, Al-Nassaf, 17Al-Bushjal and Al-Nuaimiya) districts showed complete uniformity in this ratio with near averages distributed in a range of (0.87 - 0.74) for all soil series of these districts. The least significant difference analysis results showed no significant differences between these districts' soil series.

In the (Al Kayfiyah) district, all of its series showed uniformity of this ratio, except the soil series (MM3), where the ratio was distributed with an average output of (0.61). The results of the least significant difference analyses showed that there are significant differences between them and the district soil series. The high amount of silt separated in all pedons of the series of the study district may be responsible for the total uniformity in this ratio between the soil series of the study area. This is due to a rise in this partical in the waters of the Euphrates River. In the ratio of (clay + fine silt / the ratio of total silt - fine silt) approved by the researcher Stewart (1975), the soil series of the study (5 Al-Nasaf, 17 Al-Bushjal and Al-Nuaimiya) districts showed the uniformity of their parts in this ratio and with averages distributed in a range (0.72 - 0.22) for all series These counties are raised. The least significant difference analysis results showed no significant differences between these districts' soil series. The Alkayfia district soil series were unique in their non-uniformity in this ratio, as they were distributed in a range of (0.81-0.31). And it showed the excellence of the soil series (MM3) in this ratio to the rest of the soil series of the district area. It may be attributed to the non-uniformity of the soils of the district of Al-Kayfiyah to the different sources of sedimentation in it, as the soils of the district are sourced from the

Table (2): The test of the least significant difference between the averages of the ratios of uniformity the soil classes and according to the series of the study districts

C+fsi / Si-fsi	Si / Si +C	Csi / Fsi	Si / S	Si+V.Fs / S-Vfs	Series	District
0.37	0.87	4.33	3.71	4.36	TW555	ALNasaf
0.52	0.78	5.66	3.96	4.68	MW5	
0.40	0.84	4.03	9.87	17.97	ME5	
0.70	0.77	3.31	2.35	4.79	MW5	
0.72	0.76	14.72	3.60	14.83	MF5	
0.48	0.24	10.99	6.17	12.79	L.S.D	
0.37	0.84	10.05	2.75	9.57	MW5	AlBu-Shigal
0.43	0.81	7.01	3.61	8.00	MW5	
0.48	0.77	7.57	2.67	7.97	DE54	
0.22	0.86	25.61	7.71	27.41	MM5	
0.41	0.84	8.02	3.18	7.24	DM45	
0.22	0.10	10.00	3.57	13.90	L.S.D	
0.36	0.83	8.96	1.67	5.18	DW45	AlNuaimieia
0.58	0.74	29.87	1.56	3.63	TM435	
0.27	0.83	17.03	2.83	6.23	MF5	
0.26	0.84	23.01	2.56	6.56	DM45	
0.25	0.82	63.29	8.23	24.73	MM5	
0.40	0.14	55.42	2.78	7.00	L.S.D	
0.33	0.84	10.00	1.92	3.03	TF435	Alkayfia
0.35	0.83	10.23	2.42	3.86	DM45	
0.31	0.87	5.09	4.23	5.81	MM5	
0.45	0.78	14.82	3.64	6.36	DM56	
0.81	0.61	12.07	0.35	1.18	MM3	
0.23	0.11	13.2	2.14	1.48	L.S.D	

wind sediments coming from Al-Karma Island and Island the Saqlawiya, which are topographically higher than the Al-Kayfiyah district. And the addition of successive river sediments from the Euphrates River and the Karma stream, as well as the occurrence of the (MM3) series within the transitional region between sedimentary and desert regions.

To make a comparison between the districts of the study soils in uniformity ratios, as

shown in Table (3), it became clear from the table that the excellence of (17 Al-Bushjal) District in the ratio approved by Schaetzll (1998), Whiteside, Al-Assady (1982), Mokma, and Cremeen (1986), with averages of (10.3, 5.26, and 0.83), respectively.

The statistical analysis results showed no significant differences between the soil series of these districts in the mentioned ratio. While the Al-Nuaimiya district excelled in the ratio adopted by the researcher Rutledge (1985) with a general average of (30.7), and while Al-Nasaf 5 district excelled the rest of the districts in the ratio adopted by Stewart (1975) with a general average of (0.53), and the least significant difference indicated the presence of significant differences between it and (17Al-Bushjal and Al-Nuaimiya) districts. There were no significant differences between it and the(Al-Kayfiyah) district.

The reason for the variation in the uniformity of the partical ratios between the districts mentioned above may be due to the approaching and moving away from the source of sedimentation or the effect of the river meander belts in the river as well as the effect of the momentum of the occasional moving floods, in addition to the effect of wind transfers.

Given the importance of the role of groundwater and its fluctuation within the boundaries of the study areas, the statistical analysis results indicated the effect of groundwater level fluctuation on the uniformity of the soil classes. Table (4) shows the correlations obtained between the study districts' soils and their groundwater level.

As it is clear that there is a significant correlation between the ratio of total (silt/silt + clay) in the soils of(5 Al-Nasaf) district, by the amount of coefficient determine the ability (R^2 = 0.59) and in the district of(Al-Kayfiyah) (R^2 = 0.47). The ratio of total clay + fine silt/total silt - fine silt showed a highly significant correlation coefficient in the series of (17 Al-Bushjal and 5 Al-Nasaf) districts with an amount of R^2=(0.49 and 0.51) respectively, and a significant correlation coefficient in the districts of (Al-Nuaimiya and Al-Kayfiyah) with an amount of R^2 (0.81 and 0.93), respectively, and a significant correlation coefficient in (Al-Naimiya and Al-Kayfiyah districts with R^2= (0.49 and 0.51), while the (coarse silt/fine silt ratio) showed a significant correlation coefficient with a determination coefficient(R^2 = 0.62) in the soil series of (5Al-Nassaf) district.
The role of wetting and drying processes, their impact on pedochemical weathering within the bodies of those soils, as well as the materials and salts it adds during its fluctuation, may be the cause of the variations in the effect of the ground water fluctuation on the ratio of uniformity.

To prove and evaluate the state of texture discontinuity in the soil, which resulted from geomorphological rather than pedological activities, some of these ratios were used to find the values of the lithological discontinuity.

According to the formula (degree of similarity + No similarity = 1), in the case of No similarity = 1- degree of similarity, Table (5) shows the values of the lithological

Table (3) Test the least significant difference between the averages of the study districts.

C+fsi / Si-fsi	Si / Si +C	Csi / Fsi	Si / S	Si+V.Fs / S-Vfs	District
0.53	0.81	6.1	4.74	9.1	ALNasaf
0.37	0.83	11.4	5.26	10.3	AlBu-Shigal
0.35	0.81	30.7	3.38	9.7	AlNuaimieia
0.44	0.79	10.7	2.36	3.9	Alkayfia
0.16	0.06	12.03	2.34	5.93	L.S.D $_{0.05}$

Table (4) Comparing the uniformity values statistically with the fluctuation of the ground water level

W.T(cm)	C+fsi / Si-fsi	Si / Si +C	Csi / Fsi	Si / S	Si+V.Fs / S-Vfs	Series	District
140	0.37	0.87	4.33	3.71	4.36	TW555	ALNasaf
250	0.52	0.78	5.66	3.96	4.68	MW5	
200	0.40	0.84	4.03	9.87	17.97	ME5	
200	0.70	0.77	3.31	2.35	4.79	MW5	
100	0.72	0.76	14.72	3.60	14.83	MF5	
	0.48	0.24	10.99	6.17	12.79	L.S.D	
160	0.37	0.84	10.05	2.75	9.57	MW5	AlBu-Shigal
170	0.43	0.81	7.01	3.61	8.00	MW5	
200	0.48	0.77	7.57	2.67	7.97	DE54	
160	0.22	0.86	25.61	7.71	27.41	MM5	
160	0.41	0.84	8.02	3.18	7.24	DM45	
	0.22	0.10	10.00	3.57	13.90	L.S.D	
170	0.36	0.83	8.96	1.67	5.18	DW45	AlNuaimieia
110	0.58	0.74	29.87	1.56	3.63	TM435	
75	0.27	0.83	17.03	2.83	6.23	MF5	
120	0.26	0.84	23.01	2.56	6.56	DM45	
120	0.25	0.82	63.29	8.23	24.73	MM5	
	0.40	0.14	55.42	2.78	7.00	L.S.D	
70	0.33	0.84	10.00	1.92	3.03	TF435	Alkayfia
100	0.35	0.83	10.23	2.42	3.86	DM45	
90	0.31	0.87	5.09	4.23	5.81	MM5	
90	0.45	0.78	14.82	3.64	6.36	DM56	
110	0.81	0.61	12.07	0.35	1.18	MM3	
	0.23	0.11	13.2	2.14	1.48	L.S.D	

discontinuity of the soil series of the district in the study area. These values were calculated by adopting the value of (the ratio in the upper horizon/the same ratio in the lower horizon -1). The value of discontinuity < 0.6 was determined by (Schaetzll, 1998) in the Alfisols soil series, while the value of the discontinuity was determined as 0.37 in the Conver – Break store series by Whiteside and Assadi (1982), and both Rutledge (1985) and Al-Aqili (2002) determined the value of the discontinuity by ≥ 0.4 in the loess sediments and the soil series of the river and irrigated basins east of the Euphrates from the center of the Iraqi mid Mespotamine plain, using the equation formula proposed by Schaetzll. As for Al-Rawi (2003), he suggested using uniformity values of 0.38 by

Table (5) The values of the uniformity coefficient and the identification of lithological discontinuities in the soil series of the study area

District	Series	Pedon	Horizon	Scheatzal 1988 $1-\frac{Si+vfs}{S-vfs}$	Whiteside et al 1986 $1-\frac{Si}{S}$	Cremen and mokma $1-\frac{Si}{Si+c}$	Stewart 1975 $1-\frac{C+fsi}{Si-fsi}$	Rutledge 1985 $1-\frac{Csi}{fsi}$
[illegible]	TW555	P1	AP/C1	-1.36	-1.35	-0.07	0.50*	-0.44
			C1/C2	-0.38	-0.19	-0.06	-0.27	0.53*
			C2/C3	0.80*	0.76*	0.07	0.13	-0.89
			C3/C4	0.11	0.28	0.00	0.25	-0.92
	MW5	P2	AP/C1	0.86*	0.89*	0.34	-2.22	-0.23
			C1/C2	0.37	0.39	0.056	-0.1	-0.14
			C2/C3	-1.08	-0.98	-0.05	0.22	-0.07
			C3/C4	0.80*	0.74*	0.00	0.35	-1.51
	MW5	P4	AP/C1	0.84*	0.76*	0.30	-1.63	0.40*
			C1/C2	0.18	0.51*	0.00	0.55*	-4.20
			C2/C3	-5.88	-6.26	-0.04	-1.27	0.86*
			C3/C4	0.83*	0.89*	0.10	-0.32	-0.17
	ME5	P3	AP/C1	0.74*	0.71*	0.09	-0.58	0.28
			C1/C2	0.67*	0.70*	-0.03	0.06	0.24
			C2/C3	-2.31	-2.34	0.00	0.15	-0.37
			C3/C4	0.46	0.76*	0.02	-0.02	-0.06
	MF5	P5	AP/C1	0.84*	0.81*	0.28	-6.74	0.94*
			C1/C2	-0.02	-0.3	0.00	0.36	-6.63
			C2/C3	0.79*	0.83*	-0.05	0.29	-0.71
Al-Bushjal	MW5	P1	AP/C1	0.83*	0.67*	0.14	-0.73	0.33
			C1/C2	-1.01	0.14	0.02	-1.06	0.81*
			C2/C3	0.62*	0.49*	0.02	0.33	-3.22
	MW5	P2	AP/C1	0.52	0.42*	0.22	-0.68	-0.84
			C1/C2	0.40	0.04	0.05	-0.10	-0.29
			C2/C3	0.59	0.67*	0.03	-0.11	-0.05
			C3/C4	0.05	0.25	0.00	-0.80	0.75*
	DW54	P3	AP/C1	0.66*	0.66*	0.22	-1.13	-0.66
			C1/C2	0.20	0.13	-0.03	-0.33	0.57*
			C2/C3	-0.37	-0.28	-0.07	0.45*	-0.68
			C3/C4	-7.92	-7.46	-0.26	0.57*	-0.92
			C4/C5	-1.16	0.92	-0.10	0.12	0.21
	MM5	P4	AP/C1	-0.52	-0.29	-0.04	0.10	0.01
			C1/C2	0.68*	0.48*	0.05	0.42*	-0.04
			C2/C3	0.56	0.48*	-0.02	0.14	-3.07
	DM45	P5	AP/C1	0.65*	0.10	0.00	0.00	-1.64
			C1/C2	0.69*	0.77*	0.03	-1.00	-3.89
			C2/C3	-0.92	0.08	-0.04	0.00	0.19

Al Naimia	DW45	P1	AP/C1	0.58	0.10	-0.11	0.00	0.57
			C1/C2	0.35	0.58*	0.11	-1.00	0.69*
			C2/C3	0.10	0.23	0.01	0.00	-0.32
	TM435	P2	AP/C1	0.46	0.14	0.03	0.23	-12.07
			C1/C2	-17.70	-10.00	-0.74	0.73	-0.07
			C2/C3	0.98*	0.98*	0.49*	-6.94	0.47*

District	Series	Pedon	Horizon	Scheatzal 1988 $1-\frac{Si+vfs}{S-vfs}$	Whiteside et al 1986 $1-\frac{Si}{S}$	Cremen and mokma $1-\frac{Si}{Si+c}$	Stewart 1975 $1-\frac{C+fsi}{Si-fsi}$	Rutledge 1985 $1-\frac{Csi}{fsi}$
Al Naimia	MF5	P3	AP/C1	0.53	0.73*	0.17	-1.00	-0.57
			C1/C2	0.72*	0.69*	0.01	-0.24	0.20
	DM45	P4	AP/C1	-0.24	-0.57	0.05	0.07	-6.65
			C1/C2	0.66*	0.80*	0.08	-0.76	0.37
	MM5	P5	AP/C1	0.32	0.02	0.02	0.04	-6.36
			C1/C2	-1.10	-0.09	-0.01	-0.04	0.56*
			C2/C3	0.45	0.38*	0.00	0.18	-1.73
Alkife	TF445	P1	AP/C1	0.13	0.41	0.05	-0.74	0.76*
			C1/C2	-0.10	-1.43	-0.18	0.61	-3.92
			C2/C3	0.75*	0.92*	0.19	-0.63	-0.45
	DM45	P2	AP/C1	0.04	0.00	0.01	-1.28	0.83*
			C1/C2	0.40	0.39*	0.02	-0.09	-0.27
			C2/C3	0.60*	0.66*	0.05	0.34	-4.04
	MM5	P3	AP/C1	0.25	0.07	0.03	-0.35	0.1
	DM56	P4	AP/C1	0.39	0	0.03	0.52*	-8.42
			C1/C2	-0.8	-0.31	-0.36	0.37	0.48*
	MM3	P5	AP/C1	-0.59	0.37*	0.22	-0.7	0.11
			C1/C2	0.18	0.12	0.03	0.19	-2.31

adopting the ratio (coarse silt / fine silt) in separating the sedimentary soil series developed from materials of gypsum origin and determined the value of the general uniformity coefficient for most Iraqi soils by (0.59). A general average value of the uniformity index values was suggested, with each value depending on the ratio used, because of the wide range in which the uniformity values appeared, as shown in Table (5). The value of the discontinuity of the research soil series is (±0.39), which is very near to the ratio suggested by Al-Aqili (2002)., and if we want to know the best criterion for the uniformity of the soil series of the study districts, we can see that when taking the average ratios used in Table (6).

Table (6): The values of the uniformity coefficient for the equations used in the study districts

No	Equation	Uniformity
1	Scheatzal ,1988 (1- Si+V.Fs /S-V. Fs)	±0.26
2	Whiteside et al ,1986 1- (Si / S))	±0.06
3	Cremeen and Mokma 1- (Si+C)	±0.02
4	Stewart , 1975 1- (C+ FSi / Si –Fsi)	±0.41
5	Rutledge, 1985, 1- (Csi /Fsi)	±1.22
	Mean	±0.39

4.REFERENCES

1- Al- Agidi, W. K. (1976). Proposed soil classification at the series level for Iraqi soils, 1. Alluvial soils. Baghdad University, College of Agriculture. Technical Bulletin, 2, 3-40.

2- Al- Assady, G.H., and E.p. Whiteside, 1982.Composition of Conover- Brookston map unite in south eastern Michigan.S.S.S.A.P.46(5)1043-1047.

3- Al Azzawi, Haider Hassan Falah Hassan. 2017. The effect of the physiographic location on some soil characteristics and the ability of the land to produce barley and cotton crops in some projects within the sedimentary plain in Iraq. Master Thesis, College of Agriculture, University of Anbar.

4- Al- Hiti, Abdel-Samie Jassim Abdel-Samie. 2018. Pedagogy and morphological evaluation of lands east of Al-Haffar in Al-Diwaniyah Governorate. Master Thesis, College of Agriculture, University of Anbar.

5- Al Issawi, Dawood Fayyad Obaid. 2011. Characterization and Classification of Some Soil Series and Land Evaluation of Hawija Region, South of Fallujah, Master Thesis, College of Agriculture, University of Anbar.

6- Al -Mahlawi, Hussam Naji Mikhlif Hammadi. 2015. Monitoring and assessing the state of land degradation in the Al-Rutka Basin, western Iraq, using remote sensing techniques and geographic information systems. Master Thesis, College of Agriculture, University of Anbar.

7- Al- Rawi, Muthanna Khalil Ibrahim. 2003. Characterization and distribution of parent materials for some sedimentary soils and their impact on soil properties. PhD thesis, College of Agriculture. Baghdad University

8- Al -Rubaye, Arkan Ali Muhammad. 2011. The pedagogy and morphology of gypsum soils in Al-Asriyyah village project - Al-Anbar governorate. Master Thesis, College of Agriculture, University of Anbar.

9- Black, G. R. 1965. Bulk density. In Black, C. A. et al. (eds.) Methods of soil analysis, Agron. Mono. No. 9: 374-390. Am. Soc. Agron. Madison.

10- Buol, S. W., & Hole, F. D. (1989). Genesis of Soil and Classification. 3rd Iowa University Press, Ames, Iowa, 50010, 111-113.

11- Cremeens, D. L., & Mokma, D. L. (1986). Argillic horizon expression and classification in the soils of two Michigan hydrosequences. Soil Science Society of America Journal, 50(4), 1002-1007.

12- Kowalska, J. B., Kajdas, B., & Zaleski, T. (2020). Lithological indicators of discontinuities in mountain soils rich in calcium carbonate in the Polish Carpathians. Journal of Mountain Science, 17(5), 1058-1083.

13- Rahal, Nadhum Shamkhi, and Walid Khaled Al-Akidi. 2010. Pedagogy of materials of the origin of some series in the river and irrigated basins from the center of the Iraqi sedimentary plain. Al-Taqni Magazine, Volume 23, Issue 2, pp. 157-170.

14- Rutledge. E. M; L. T. West and M. Omakupt. 1985: Loess deposits on apleistocene age terrace in eastern arkanses. Soil. Sci. soc.Am. J. vol. 49: 415- 419.

15- Schaetzl, R. J. (1998). Lithological discontinuities in some soils on drumlins: theory, detection, and application. Soil Science, 163(7), 570-590.

16- Soil Survey Manual, Soil Science Division Staff.2017. Agriculture Handbook No. 18.US Department of Agriculture.

17- Stewart Jr, H. B. (1958). Sedimentary reflections of depositional environment in San Miguel lagoon, Baja California, Mexico. AAPG bulletin, 42(11), 2567-2618**.**

18- WRB, I. (2014). Working Group. (2014). World Reference Base for Soil Resources. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports, (106).