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EFFECT OF SEDIMENTATION SOURCE ON THE NATURE OCCURRENCE AND DISTRIBUTION OF THE FELDSPAR IN SOME SOIL OF ALLUVIAL PLAIN IRAQ

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Abstract

The current study was conducted to find out the effect of the sediment source (sedimentary of Iraqi-Iranian borderline and Tigris River) on the content and distribution of feldspar minerals and their effect on the optical properties of these minerals in some soils of Wasit and Maysan province. Eight pedons were chosen to represent the study area, five of them represented sediments coming from the borderline, which included pedons of (Badra, Taj Al-Din, Al-Shihabi, Jassan, and Galat), while two of them represent the sediments of the Tigris River (Essaouira, Al-Dabouni). Finally, the pedon of Ali Al-Gharbi represented the mixing area of sediments of all the torrents coming from borderline and the sediments of the Tigris River. The diagnostic tests showed the presence of two types of feldspar minerals in these soils, which are Potassium feldspar (Orthoclase and Microcline), and ranges between (0-11.5%), (0-7.11%), respectively. The second type included the plagioclase minerals represented by (Albite and Anorthite) with percentages (3-21.7%) and (0-8.7%) respectively. Moreover, the results showed that the distribution of the Potassium feldspar mineral percentages was opposite to the horizontal distribution of the plagioclase minerals and for all the study soils. The Plagioclase feldspar minerals increased from the borderline towards the Iraqi lands for the soil pedons affected by the torrents coming from the borderline, while their percentages increased in the soil pedons affected by the Tigris River sediments in the south, the optical features indicated the presence of two types of Potassium feldspar minerals, which included orthoclase and microcline minerals. It was also diagnosed that there are two types of plagioclase minerals, which were altered due to the conditions of transport and sedimentation and the distance from which the particles were transported, which were distinguished by their scratched, eroded and faceted deficient. The second type, which was called the fresh, was characterized by its perfect edges and was not affected by the conditions of transport and sedimentation.
Keywords : Sedimentation Source, Nature, Feldspar

Introduction

Most Iraqi sedimentary soils are transported from places exposed to weathering, and that their origins are the result of continuous sedimentation by floods of rivers, winds, streams, and estuaries (Buringh, 1960), where the sedimentation is the last geological process and occurs after erosion processes. In addition, the sedimentation by running water is affected in quantity and quality by the speed of water flow and slope, as whenever the speed of water stream decreases or the slope of the waterway decreases or the amount of water decreases due to the loss of its kinetic energy, and the water begins to get rid of its load. Furthermore, the borderline of Iraq with Iran is especially exposed to the waves of the flood, where the amount of floods water that entered the province of Wasit and Maysan estimated by three billion cubic meters, as flood drainage amounted to 500-700 m^3 per second towards the Tigris (Al-Ruwaimi, 2015). The range of the differences and changes occurred in the body of the grain on one hand and their original shape in the grains, such as cracking on the other hand, reflect the extent of the influence of the sedimentary factor to which the granule was exposed, the time and distance that spent on its move. As sand minerals are one of the natural sources spread in the earth's crust, which are weathering products of the various source rocks, such as being igneous, sedimentary or metamorphic, which differ in their mineral content of quartz and feldspar minerals and others. The study of mineral formation is of great importance in knowing the factors of soil formation and the biological and geological changes, as well as its use as an indicator for soil formation and development through studying and analyzing mineral components. Feldspar is of great importance in studying the inheritance and development of soils, as it is considered an important genetic link in the development of mineral weathering processes. Feldspar minerals are easily weathered minerals, and this was confirmed by (Saleh and Hamid, 2008) in the study of the mineralogical composition of some series of river levees in the middle of the Iraqi alluvial plain. The decrease in its percentage was attributed to the possibility of being subjected to weathering during the transport process, and they had low stability and withstand erosion. As the nature of the mineral composition of the original rocks had a great impact on withstanding minerals to the conditions of transport and erosion, because of that the source of feldspar minerals are igneous and metamorphic rocks (Al-Mashhadi, 2003). Furthermore, (Al-Ani, 2001) found during the study of the soil in the middle of the Iraqi alluvial plain that the microcline and Albite minerals from the group of feldspar minerals, which were considered more resistant to weathering than the rest of the group members of feldspar minerals had sovereignty. However, due to the lack of available studies on feldspar minerals, especially in Iraqi soil, in addition to the multiple sources of its sedimentation in Iraqi soil, which include the sediments of the Tigris and Euphrates rivers and floods slopes in the Iraqi alluvial plain region, which originate from the mountainous hills at the Iraqi-Iranian borderline. As well as its effect on the distribution of the mineral composition of the soils located to the left, side of the Tigris River within the provinces of Wasit and Maysan. Therefore, this research aimed to investigate the distribution of feldspar minerals in soils located between the eastern Tigris River and the mountainous series of the Iraq-Iran borderline within the provinces of Wasit and Maysan. In addition to Comparing the effect of the sediment source type (the Tigris River and the torrents coming from the borderline) on the quantity and pattern of the feldspar mineral distribution in those soils and determination of the optical properties of feldspar minerals

Materials and Methods

The study area was chosen within the lands located in the provinces of Wasit and Maysan, and this region represents part of the southern alluvial plain of Iraq, which is crossed by the Tigris river through the Kut Dam, at the latitude (-33.06) and (-32.08) northwards, and longitude (-44.40) and (-46.56) eastwards. Three study transects were chosen perpendicular to the left bank of the Tigris river and within the area between the left bank of the Tigris river and the mountains at the Iraq-Iran borderline in the east. The first transect extends from the Iraqi-Iranian borderline eastwards towards the Tigris river westwards, which includes three soil pedons sites, starting from the east towards the west and they are Badra (1), Taj Al-Din (2) and Essaouira (3). The second transect located to the south of the first transect and parallel to it, which includes three soil pedons sites, according to the first sequence (from east eastwards west), and represented by pedons of Al-Shihabi (4), Jassan (5), and Al-Dabouni (6). Finally, the third transect located to the south of the second transect and parallel to it, it includes two soil pedons sites, as follows: Galat (7), Ali Al-Gharbi (8). The pedons sites were chosen according to the topographical location, that is, they were divided into sites flooded with floods coming from the borderline, the pedons sites included (1,2, 4, 5, 7 and 8), while the sites that are the sediments of the Tigris river included the pedons (3,6 and 8).

Mineralogical Analysis

Pretreatment

Included the removal of the binding materials such as the dissolved salts using the distilled water according to the (Kunze, 1962) method. As well as, carbonate minerals ($CaCO_3$): by acidifying sodium acetate (Na OAC) with acetic acid to (pH 5.2) according to (Robenhorst and Wilding, 1984) method. Moreover, the organic matter was removed using 14% of NaOCl, pH 9.5 according to (Anderson, 1963) method, while the free oxides: using (C. B. D) according to (Jackson and Mehra 1960) techniques. The sand particles were separated with a wet-sieving method by means of a 50 µm diameter sieve, and then the sand fraction was examined with a petrographic microscope. As light minerals were separated from the heavy minerals of the sand using a bromoform liquid (HBR_3) with specific weight (2.89) according to the (Milner, 1962) method. Then, the sand fraction (light and heavy minerals) was scattered after being air-dried on a glass slide of (7.5 x 7.5 cm) using the Canda balsam adhesive matter with a refractive index (1.54). The glass slides were examined microscopically according to the (Brewer, 1976) method and the minerals were identified and diagnosed according to the optical properties of each mineral according to (Kerr, 1977). The samples were photographed using a German-made Lietz microscope, with a camera of the same type with a color film type (Kodack) in the College of Science - Earth Sciences Department. Then, the percentage of each mineral was calculated by performing a point counting process using a point counter device 250-300 a grain of sand/slide. Then the percentages for each mineral were calculated according to the method mentioned in (Black, 1965) using a German-made (Lietz) microscope and a camera of the same type.

Results and Discussion

The Distribution of Feldspar minerals in the studied soil

The distribution of feldspar minerals in the soils of study pedons were studied, as they were classified into two main groups:

1- Potassium feldspar group (K-Feldspar), which includes:
   a- Orthoclase Mineral
   b- Microcline Mineral
2. Plagioclase feldspar minerals group includes:
   a- Anorthite Mineral
   b- Albite Mineral

Two horizons were chosen from each pedon to study these minerals in the study soils. surface horizon A and deep horizon C2 were chosen, and the choice of the two horizons and for the mentioned depths is to know the difference in the amount of what sediments from these minerals during the old and modern sedimentary cycles. Considering that, each horizon is the product of a sedimentary cycle or multiple sedimentary cycles of a similar lifetime. The sedimentary cycle is defined as being, collecting or placing materials transported by water or wind in the form of layers that differ between them in a structure, hardness, cohesion, texture, color, and concentration, and their upper and lower borders are surfaces of incompatibility with the layers that follow.

Table 1 : Percentages of feldspar minerals in the study pedons

Pedons site	Horizon	Orthoclase	Microcline	Albite	Anorthite
Badra	Ap	1.9	4.3	8.4	4.2
	C2	3.2	3.4	6.7	1.3
Taj Al-Din	A	11.5	6.1	7.3	4.2
	C2	3.7	0.4	13.4	4.7
Essaouira	Ap	3.9	0.7	13.9	3.0
	Cz2	2.5	2.5	15.1	4.2
Al-Shihabi	A	0.8	7.1	9.8	0
	Cz2	2.3	2.0	13.6	4.5
Jassan	A	0	0	3.0	7.8
	C2	0	2.6	9.1	3.5
Al-Dabouni	Ap	3.6	3.0	11.0	3.3
	C2	3.8	1.5	9.4	0
Galat	A	0	11.2	7.6	0
	C2	3.1	4.4	10.9	0
Ali Al-Gharbi	Apz	2.7	3.2	12.1	0
	Bz2	5.5	1.6	21.7	0

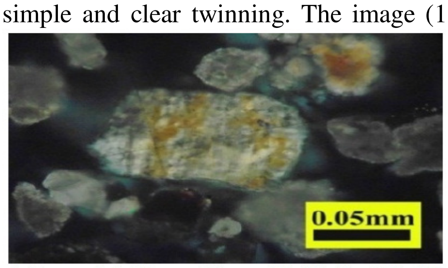
The results of Table 1 showed the vertical and horizontal distribution of the K-Feldspar (Orthoclase and Microcline) within the soils affected by the torrents coming from the Iraqi-Iranian borderline (Badra - Taj Al-Din, Al-Shihabi, Jassan, Galat, Ali Al-Gharbi), where the percentages of potassium feldspar were (0– 17.6 %) and (2.6 -7.5%), for the two horizons surface Ap and deep C2 respectively. However, the soils of the borderline pedons (Badra, Al-Shihabi, Galat) had a percentage of (6.2-11.2%) and (4.3-7.5%), which is within the same horizons for the (Taj Al-Din, Jassan, Ali Al-Gharbi) soils. Thus, they correspond in their horizontal distribution with a distribution of sand fraction particles in those soils, and it is to be expected, where potassium feldspar is one of the main components with quartz for sand particles (Krejci and Lowe, 1986; Ramasamy et al., 2010), especially in the pedons of the study soil (Al-Fatlawi, 2016). Furthermore, the results of Table 1 showed that the horizontal distribution of the potassium feldspar within the A and C horizons of the soil pedons affected by the sediments of the Tigris river (Essaouira, Al-Dabouni and Ali Al-Gharbi). It was declining to the south except for the C horizon of Al-Dabouni soil pedons, which also corresponds to the horizontal distribution of sand particles in those soils. In general, the results showed that the percentages of potassium feldspar within the pedons affected by the floods coming from the borderline were higher than their percentages within of the soil pedons affected by the sediments of the Tigris River. The reason for this may be attributed to the effect of the source distance from the sediment zone since the soils affected by the floods of the borderline are closer to the sediment sources (Zakros Mountains). Besides that, the sand particles spread in the floods which containing high levels of feldspar minerals, which leads to an increase their percentages in those soils. Brady, 1974; Agidi, 1976 pointed out that the sediment materials have properties very similar to the source, rocks, and sedimentary environments, while the soil pedons affected by the sediments of the Tigris river is very far from the sources of sediments (southeastern Anatolia heights). As the river starts to slow its speed towards the south of the Iraqi alluvial plain, which affects its capacity to transfer the particles, where the river's load consists of various sizes of materials, and the size of these transported particles has an effect on the speed of the transporter. Since each sedimentary separation has a transfer speed and transfer capacity, this capacity decreases with the speed decreasing and the maximum transfer speed is the state of the fine particles (Agidi, 1976). The results of Table 1 showed that Orthoclase percentages were superior to Microcline percentages within A and C horizons and for all study soils. Although Microcline is more resistant to weathering than Orthoclase, this is due to ordering the distribution of the substitution ratio of aluminum/silicon (Al \ Si) within the crystal composition of the mineral, where the composition of monoclinic and the substitution ratio (Al \ Si) in it is disorder. Therefore, it considered as less resistant to weathering than Microcline with a triclinic crystal structure and the substitution ratio (Al\Si) is order distribution (Merer, 2015). The high percentages of Orthoclase minerals can be attributed to its higher content of the original rock compared to the Microcline, which is less content in these soils. Dixon et al., 1977 observed that the number of feldspar minerals present within the transported sediment depends on the nature of the original rocks and the weathering stage. As for the distribution of Plagioclase feldspar minerals (Albite and Anorthite), the results of Table 2 showed that the percentages of Anorthite mineral were ranging between (0-7.8%). Whereas the percentages of Albite mineral ranged between (3- 21.7%), and that the Albite percentages exceeded over the Anorthite, Ap, and C2 and for the study soils mainly due to the high resistance of Albite to weathering compared to the Anorthite. Numerous studies have shown that Albite is a mineral with a medium crystallization temperature and has a higher weathering resistance than Anorthite mineral, which had a high crystallization temperature (Oelkers and Schott, 1995). As the Anorthite is located at the beginning of the continuous reaction series in the Bowen's reaction series, whereas, the Albite located at the end of that series, which gives it a higher resistance to weathering than the Anorthite. The results of Table 1 by referring to the total percentages of potassium feldspar (Orthoclase and Microcline) and the sum of the percentages of the Plagioclase feldspar and compare its horizontal distribution indicated that the horizontal distribution of the Plagioclase feldspar minerals was opposite to the distribution of potassium feldspar. The percentages of Plagioclase feldspar minerals were increasing, starting from the borderline and towards the Iraqi lands, about the soil pedons affected by the floods coming from the borderline. While their percentages increased in the soil pedons affected by the sediments of the Tigris River to the south, and they were compatible with the behavior and distribution of silt separates particles in both two groups of soils (affected by the torrents and sediments of the Tigris River). The reason for this is due to its weak resistance to weathering factors compared to potassium feldspar, which makes it concentrated in the medium- coarse soil. (Parry et al., 2011) mentioned that the Plagioclase feldspar tends to concentrate within particles of silt fraction compared to the potassium feldspar minerals. Moreover, (Schaetzl and Loope, 2008) noted that the Plagioclase feldspar minerals its percentage increase within particles of fine, medium and silting sand fraction, depending on the intensity of weathering processes being less resistant to weathering than the potassium feldspar that tends to be within the coarse sand fraction . The Feldspar / Quartz ratio was used as an indicator to calculate the weathering intensity index for light minerals and for all soils of study pedons, as the weathering index values for light minerals ranged between 1.25-2.56. Table 2 results showed that these values increase with the depth of most of the study pedons except for the Al-Shihabi and Galat sits. The reason for this is due to the influence of the sedimentation factor, as the mineral content of the quartz, feldspar has already presented and transferred by the floods that coming from the Iraqi-Iranian borderline, and the sediments of Tigris River were present in these soils due to sedimentation processes and not by the effect of weathering operations. The sites of Al-Shihabi and Galat represent locations close to the sedimentation sources and due to the short transport distance, they are affected and are close to their mineral properties from the mineral composition of the parent rocks (Salih and Hamid, 2007; Easa and Al-ubaidi, 2011).

Table 2 : Weathering intensity index for light metals

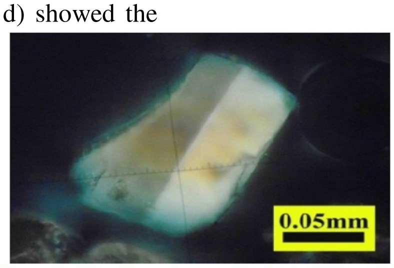
Pedon number	Horizon	Total Quartz	Total Feldspar	W.I= Quartz/ Feldspar
Badra	Ap	17.0	8.8	1.93
	C1	17.5	7.6	2.30
Taj Al-Din	Ap	15.4	10.2	1.50
	C1	15.5	9.5	1.63
Essaouira	Ap	17.5	10.5	1.67
	C1	19.0	8.0	2.37
Al-Shihabi	A	17.8	7.8	2.28
	C1	15.9	11.1	1.43
Jassan	A	19.0	8.5	2.23
	C1	20.7	8.1	2.56
Al-Dabouni	Ap	14.4	9.2	1.56
	C1	16.7	10.3	1.62
Galat	A	18.8	7.8	2.41
	C1	13.9	11.1	1.25
Ali Al-Gharbi	Ap	20.0	8.6	2.32
	C1	20.7	8.2	2.52

Determination of the optical features of feldspar minerals

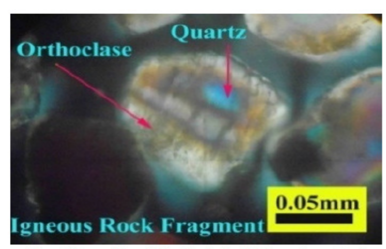
Through the process of examination using a polarized light microscope, some morphological features of feldspar mineral particles were diagnosed, and the same pattern was followed in determining the properties of roundness and sphericity. The images (1, a, b) showed the optical features of Orthoclase in the study pedons, which appears in a transparent to foggy color and in some soils, it appears gray, its crystals almost prismatic in shape, where the mineral is characterized by the presence of simple twining, and its cracked is clear in both directions. The first is perfect, the second is less perfect, and some mineral particles of the Altered Orthoclase are characterized by their scratched, corroded and incomplete edges, and the presence of black or gray spots on the surface of the mineral. This is due to the Alteration state that occurs in the mineral to convert to other minerals, it could be changed to kaolinite minerals, sericite by weathering factors, especially the chemical ones, or it could be converted to other more stable minerals (Issa, 2001; Al-Fatlawi, 2002). The other type of mineral is Fresh Orthoclase, which its particles have perfect edges, and do not contain spots with multiple colors, and are characterized by simple and clear twinning. The image (1, c, d) showed the optical features of Microcline in the studied slides, which they are colorless to foggy, or it could be pale yellow, and it is half translucent to translucent, as well as, its luster is glassy, pearly, with a low n ▪ balsam, and it is characterized by low double refractive. One of the most important characteristics of this mineral, which distinguishes it from Orthoclase, is the phenomenon of cross twinning. , as well as its apparent cracking in both orthogonal directions which gave it the quadrille structure (Isa, 2001; Jasim, 2017). As well as the presence of some black spots on the surface of a mineral, which is a type of alteration present in this mineral, which is known as paralleled lines, As for the Plagioclase feldspar minerals diagnosed depending on the phenomenon of repeated twinning, which is a distinctive characteristic of these minerals. As well as, the angle of extinction that ranged between (12°-20°), and low double refractive, as the Albite mineral characterized by the phenomenon of twinning, which is characterized by lines resulting from the Albatian twinning on the surfaces, resulting from the cleavage. This is easily observed in thin slides under the polarized microscope (1, e, f), and this is what distinguishes it from the feldspar potassium minerals.



Altered Microcline Al-Shihabi C2

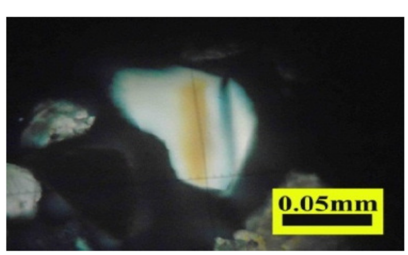


Fresh Orthoclase Galat C2 (b)

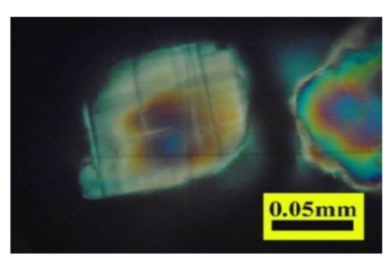


Orthocla Taj Al-Din Ap(a)

Altered Plagioclase
Ali Al-Gharbi C2 (f)



Fresh Orthoclase
Essaouira Ap (e)



Altered Microclin
Jassan C (d)

References

Al-Agidi, W.K. (1976). Proposed soil classification at the series level for Iraqi soils 1. Alluvial soils. Baghdad university, college of Agric. Tech. Bull.No. 2, Baghdad.

Al-Ani, Qusay Abdul-Zaraq (2001). Space alternatives and modifications represented in soil surveys in the middle of the Iraqi sedimentary plain. Ph.D. thesis. College of Agriculture - University of Baghdad.

Al-Fatlawi, Lama Abdullah Al-Sakban Al-Abadi (2016). The effect of the sedimentation source on the chemical and mineral properties and the condition of the heavy elements in some soils of Wasit and Maysan governorates. Ph.D. thesis. College of Agriculture - University of Baghdad.

Al-Fatlawi, Lama Abdullah Al-Sakban. (2002). The content and distribution of feldspar minerals in some sedimentary soils. Master Thesis. College of Agriculture - University of Baghdad.

Al-Mashhadi, J.A.A. (2003). Heterogeneous changes between the archaeological ruins and Al-Araqib from the Latifiya Project in the Southwest. Ph.D. thesis - Soil Department. College of Agriculture - University of Baghdad.

Al-Ruwaimi, K. (2015). Natural Resources. Maysan Investment Commission website

Al-Ubaidi, B.S. and Salman, K.I. (2011). Mineral composition of fine sand separation in some Iraqi gypsum soils. Tikrit University Journal for Agricultural Sciences, 11(1): 205.2.

Anderson, J.U. (1963). An improved pretreatment for mineralogical analysis of samples containing organic matter. Clays clay min. 10: 380 –388.

Black, C.A. (1965). Methods of soil analysis. part 1. Physical properties Amer Soc. Agron. Inc. publisher, Madison Wisconsin, USA.

Brewer, R. (1976). Fabric and mineral analysis of soils. Robert E.Krieger publishing company. Huntington. N.Y

Buringh, P. (1960). Soil and soil condition in Iraq. Ministry of Agriculture, Baghdad, Iraq.

Isa, S.K. (2001). The presence and nature of feldspar minerals in some soils of the sedimentary plain. Iraqi Agricultural Science Journal, 23(6): 3.

Jasim, H.K. (2017). The sedimentology, Industrial, and environmental studies of the dune fields in Missan, Thi-Qar and Samawa districts, Southern Iraq. Ph.D. thesis. University of Baghdad, Iraq, 301.

Kerr, P.F. (1977). Optical mineralogy. McGraw-Hill Book Co. Inc. New York, U.S.A.

Krejci, M.E. and Lowe, R.L. (1986). Importance of Sand Grain Mineralogy and Topography in Determining Micro-Spatial Distribution of Epipsammic Diatoms. J.N. Benthological Soc., 5(3): 211-220.

Kunze, G.W. (1962). Pretreatment for mineralogical analysis. Reprint of Section prepared for methods monograph published by the Soil. Sci. Soc. of Am. 13 P.

Mehra, O.P. and Jackson, M.L. (1960). Iron oxide removal from soils and clays by a dithionite–citrate system buffered with sodium bicarbonate. Clays Clay Miner., 7: 317–327.

Milner, H.B. (1962). Sedimentary Petrography. 4th. Ed. Murby and Co. London.

Oelkers, E.H. and Schott, J. (1995). Experimental study of anorthite dissolution and the relative mechanism of feldspar hydrolysis. Geochimica et Cosmochimica Acta., 59(24): P5039-5053.

Parry, S.A.; Hodson., M.E.; Oelkers, E.H. and Kemp, S.K. (2011). Is silt the most influential soil grain size fraction? Applied Geochemistry, 26: P119-122.

Ramasamy, V.; Suresh, G.; Meenakshisundaram, V. and Ponnusamy, V. (2010). Distribution and characterization of minerals and naturally occurring radionuclides in river sediments. Carpathian Journal of earth and environmental Sci., 5(1): 41-48.

Robenhors, M.C. and Wilding, L.P. (1984). Method to Obtain Carbonated Free Residues from Lime Stone and Petrocalcic Material. Soil Sci. Soc. Am. J., 84: 216-219.

Saleh, the hopes of Muhammad and Ahmed Saleh Muhaimid (2008). A study of the nature of the mineral formation of some river hill chains in the middle of the Iraqi sedimentary plain, University of Baghdad - College of Agriculture.

Schaetzl, R.J. and Loop, W.L. (2008). Evidence for an eolian origin for the silt-enriched soil mantles on the glaciated uplands of eastern Upper Michigan, USA. Geomorphology. 100(3-4): P285-295.