

EARTH SURFACE PROCESSES AND LAND FORMS OF SOUTH WEST RAZAZA LAKE-CENTRAL IRAQ

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ABSTRACT

Land forms are a result from interaction between lithosphere, atmosphere, hydrosphere and biosphere. Lithosphere composed of lithologic units and the main units of the study area are: limestone, marl, marley limestone, sandstone, pebbly sandstone, mudstone, claystone and secondary gypsum in addition to Quaternary sediments. Landforms of the study area can be subdivided according to their origin into many units: 1- Structural- denudational: plateau, mesas, hills, cliffs and wadis; 2- Denudational: desert pavement and mushroom rock; 3-Mass movements; 4- Solution: lake, salt marsh, piping caves; 5- Springs; 6- Fluvial: terraces, alluvial fan, infilled wadi, flood plain; 7- Drainage units; 8-Evaporational: sabkha, secondary gypsum; 9- Aeolian: sand dune and sand sheets; 10- Biogenic: Agamidae caves, wasp nest and termite nest; and 11- anthropogenic origin.

Key words: Earth Surface Processes, Iraq, Land Forms, Lithologic Units, Razzaza Lake.

INTRODUCTION

Land forms response to the earth surface processes which resulted from interaction between lithosphere, atmosphere, hydrosphere and biosphere. Lithosphere, part of the earth, is composed of the hard outer layer (Williams, 2012) which includes rock bed units. The main earth surface processes include erosion, transportation and deposition (Merritts *et al.*, 2010). Land forms and earth surface processes are very important for engineering constructions, and public- safety issues such as: landslides, debris flow, river flood and storm surges. Earth scientist can't understand the shaping of landforms without study and analysis of depositional environments to interpret the origin of some ancient sedimentary deposits (Bridge and Demicco, 2008). Recent landforms and sedimentary deposits can be used to reconstruct the paleogeography and paleoclimate. It can be used to determine the lifestyle, habitats and life evolution of past organisms according to fossil evidence preserved in the rock bed units (Bridge and Demicco, 2008) in addition to study and interprets the reason of desertification and sand dune migration in arid areas. Land forms and other geodiversity components: rocks, soils and water resources are considered the link between landscape and foundation of the ecosystem (Santucci, 2005). The ecologist and natural resources specialist focus their interesting on the relationship between geodiversity components and biodiversity (Stanley, 2002; Gray, 2004; Jackova and Romportl, 2008; Parks and Mulligan, 2010; Petrisor and Sabro, 2010; Mohammad and Al- Zubaidi, 2014; Al- Zubaidi *et al.*, 2014).

The aim of this study is to identify the land forms and earth surface processes to interpret their origin south west Razazza Lake.

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MATERIALS AND METHODS

Data collection depended on many field trips and field surveys to Razazza Lake and surrounded areas at the last five years to identify and recognize physical properties, chemical compositions of rocks in the field as a hand specimen or at the lab of rocks and minerals at the department of geology, college of science, university of Baghdad. As well as monitoring the interaction between physical, chemical and biological factors and evolution of earth surface processes and land forms. In addition to using geologic and topographic maps, picture shot.

Location: Razazza Lake is located south west Karbala city, between 32° 15' and 32° 45' North and 43° 25' and 44° 00' East (Fig. 1).

Climate: The area is characterized by a semi-arid environment of hot dry summer, cold dry winter with annual rainfall (109 – 122 mm) mainly during January to April and annual evaporation (3194.3 – 3332.7 mm) (Table 1).

Table (1): Climatic data at Karbala and Najaf stations (according to IGOMI, 2000)

Station	Temp. Max. (°C)	Temp. Min. (°C)	Annual rainfall (mm)	Annual evaporation (mm)
Karbala	43	6.4	109	3332.7
Najaf	44	6.4	122	3194.3

Geologic setting:

Tectonically, the studied area is located on the Abu Jir- Euphrates Fault Zone, which extended from Hit town to Al- Salman town. Occurrence of tens of water springs considered a good indicator of active fault zone (Sissakian *et al.*, 2015). The footwall on the east of the fault coincided with Karbala plateau, which are topographically highland area, while hanging wall on the west of the fault coincided with Razazza Lake and surrounded lowland areas. Rock beds units of different lithology, exposed at studied area belong to Tertiary (from older to younger) are: Dammam, Euphrates, Nfayil, Injana and Dibdibba Formations (Sissakian, 2000 ; Hassan, 2007) (Table 2). Quaternary sediments covered wide area near the lake such as gypcrete, sabkha, depression fill, flood plain and aeolian sediments (Fig. 1).

Table (2): Age, thickness and description of Tertiary Formation south west Razazza Lake (Hassan, 2007; Sissakian and Mohammed, 2007).

Age	Formation	Thickness	Description
Quaternary	-	-	Aeolian, depression fill, flood plain gypcrete and sabkha.
Pliocene- Pleistocene	Dibdibba	1- 18 m	It's exposed at the upper part of Plateau near Tar Al-Sayyed. Consists of sandstone and pebbly sandstone.
Late Miocene	Injana	31 m	Its crop out at the cliff of Tar Al-Sayyed and at the adjacent isolated hills. Consists of alternation of claystone, sandstone, silty claystone, thin bed of marly limestone and secondary gypsum.
Middle Miocene	Nfayil	27 m	Its cover lowland areas adjacent to Tar Al-Sayyed. Consists of cyclic alteration of limestone and marl.
Early Miocene	Euphrates	40- 57 m	The upper part exposed and the lower part below the surface. Consists of medium bedded fossiliferous limestone.
Late Eocene	Dammam		Upper Member only is exposed in the studied area. Consists of thick bedded limestone, marl and very rare lenses of chert.

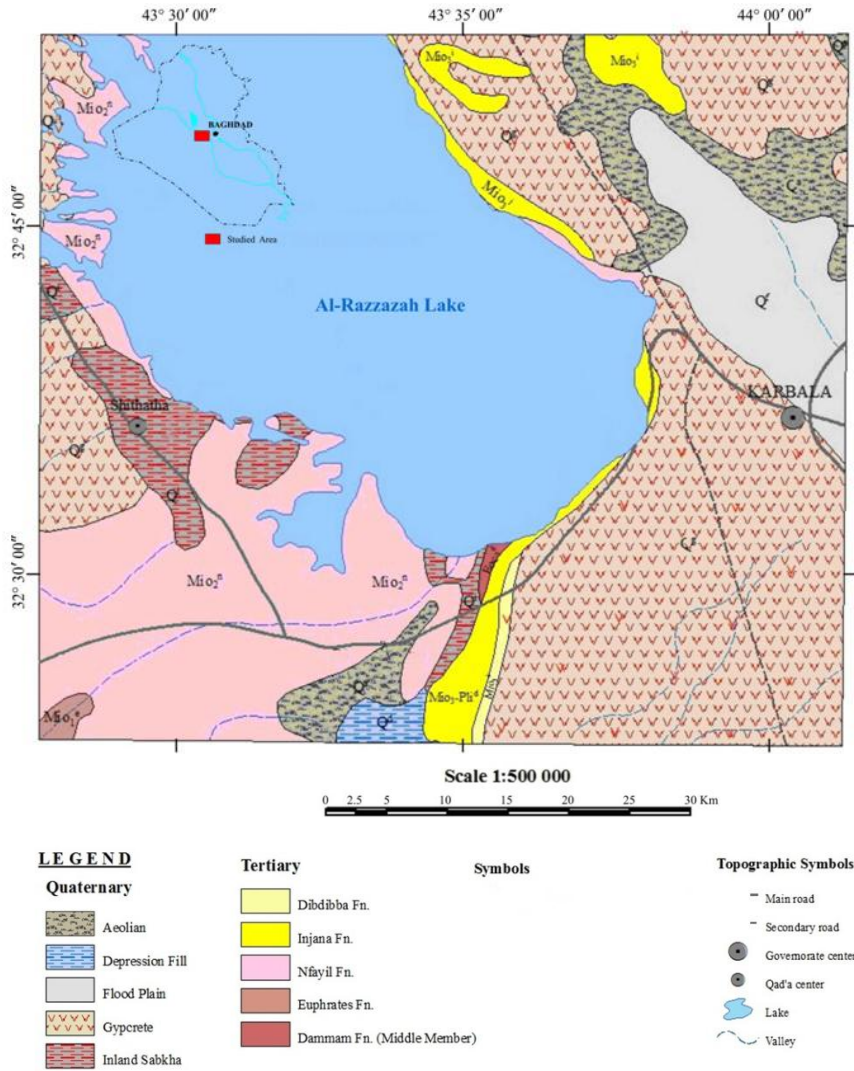


Figure (1) : Geologic map of the study area (cited by Sissakian (2000)).

RESULTS AND DISCUSSION

Landforms of the study area can be subdivided according to their origin into many units: Structural- denudational, Denudational, Solution, Fluvial, Evaporational, Aeolian, Biogenic, Anthropogenic origin.

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1. **Structural- denudational origin:** There are 5 types; plateau, mesas, hills, cliffs and wadis.

Plateau: Karbala (Tar Al- Sayyed) plateau (Plate 1- a) is the only plateau in the studied area which formed part of Karbala- Najaf Alluvial Fan. The length of the Karbala plateau cliff is more than 105 kilometers, maximum high is more than 21 meters and its direction is NE- SW covered by gypcret (Sissakian *et al.*, 2015) and the rock bed units exposed on the cliff are belong to Injana and Dibdibba Formation. Karbala Plateau is dissected by many flat dry wadis, with a few tens of meters length, and has gentle to medium slope.

Mesas: Some mesas developed within Nfayil Formation. The top rock of these mesas composed of hard limestone.

Hills: Some hills belong to Injana Formation isolated from the plateau by erosion, range in high from few to more than 20 meters which consist of claystone, sandstone and mudstone. Other hills belong to Nfayil Formation occurred far away to the west of the plateau, range in high from few to more than 10 meters which consist of limestone and marl.

Cliffs: Many cliffs developed on the western sides of the Karbala plateau within upper part claystone of Injana Formation (Plate 1- b). These cliffs are usually vertical because it is the result from the intersection of two sets of joints perpendicular to the horizontal bedding plains. Cliffs suffering from the pass movement.

Wadis: The plateau dissected by many flat, gentle slopes wadis (Plate 1- c), that declines to the west toward Razazza Lake. Rainy water cannot flows on these wadis due to lack of rain fall and percolation of water in the friable sandstones of Dibdibba Formation on the plateau and in the aeolian sand sediments deposited on the wadis.

2. **Denudational origin:** There are two types: desert pavement and mushroom rock.

Desert pavement: It is desert surfaces covered with closely packed sub- angular to sub-rounded pebbles, which formed by the gradual removal of medium, fine and very fine particles of sand and leave the pebbles, about 5 centimeters in length, which originated from Dibdibba Formation or from Karbala- Najaf Alluvial Fan. Desert pavement is developed on the surface of the some hills west of and on the eastern part of Karbala- Shithatha road (Plate 1- c) particularly, against Al- Qatara.

Mushroom rocks: It is look likes mushroom, from which its name was derived, naturally formed when the wind agent bears and moves sand particles on the earth surface, up to 50 centimeters in high, to abrasion the clayey limestone and marly claystone of the upper part of Injana Formation (Plate 1- d) which crop out on the plateau on the both sides of Qatarat Al- Imam Ali wadi and other wadis near Al- Tar caves.

3. **Mass movement:** According to Varnes (1978) and Summerfield (1991) in Gray (2004), some mass movements observed in the study area such as: rotational slide, fall and subsidence (Plate 1- b) (Table 3).

Table (3): Mass movements of studied area.

Mechanism	type of mass movement	materials	nature of movement	rate of movement
slide, rotational	slump of rocks	mudstone	rotational movement of rocks on the concave plain	moderate or slow
Fall	fall of rocks	Separated blocks	vertical fall of blocks, like column	extremely rapid
Subsidence	cavity collapse	Mudstone and marly limestone	collapse of soil and mud rocks on the cave bottom	Extremely slow

4. **Solution origin:** There are three types; lake, salt marsh and piping caves.

Lake: There are three groups of lineaments affected and fractured rock bed units of the study area to form Razazza Depression in addition to Habbaniya and Tharthar depression in the north. Lineament trends are: east- west, north east- south west and north west- south east (Al-Kubaisi *et al.*, 2014). One of the lineaments trend is parallel to the Razazza Depression trend, north west- south east. Rock bed units underlined Razzaza Depression consists mainly of carbonate rocks belong to Nfayil Formation (M. Miocene) and/ or Euphrates Formation (E. Miocene). Then after the depression fed by underground water via fractures and from surface water of ephemeral streams to form Razazza Lake. Water chemical analysis of near shore and off shore samples shows sulphite- chloride type, and shows sodium- calcium for near shore and sodium- calcium- magnesium type for off shore, and pH of near shore and off shore samples are alkaline 8.11 and 7.19 respectively. The T. D. S. for near shore and off shore is 2917 ppm. and 29956 ppm. respectively (Jassim and Al- Zubaidi, 2013).

Salt marsh: Some small lowland filled by spring water to form salt marshes which cover by reeds (Plate 2-b). Locals used them for buffalo breeding and used water for washing building sand.

Piping caves: It is irregular caves with different sizes (Plate 1- b), developed by solutions effect on claystone (Hassan and Al- Khateeb, 2005) or by karstification on marly limestone (Sissakian, 2016) of the upper part of Injana Formation that occurred on Karbala plateau.

5. **Springs:** More than 20 water springs structurally controlled by Euphrates (Abu Jir) Fault Zone, occurred in studying areas such as: Seeb, Zarga (blue), Hamra (red) and lubruca, plenty of water (Plate 2- a) on which Ain Al- Tamur Town (Shithatha) was established. Involved springs dried after 2003 when the local gardeners digging deep water wells, more than 150 meters. In spite of chloride and sulphate water type, but it is used for irrigation of fruit gardens and vegetable farms. Mentioned springs related to Euphrates and Dammam reservoirs, which feed by precipitation fall on the west area near Iraqi border with Saudi Arabia.
6. **Fluvial origin:** There are five types of fluvial origin land form; terraces, alluvial fan, infilled wadi and flood plain.

Terraces: Wadi terraces are developed on large ephemeral wadis such as wadi Al- Ubaidh.

Alluvial fans: Alluvial fan topography is common on some ephemeral wadis west of Shithatha plain such as Tabbal and Al- Ubaidh. The involved fan coalesced together to form

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bajada on the plain, comprise poorly sorted and poorly cemented sediments which include gravels consist of limestone and chert (Hamza, 2007).

Infilled wadis: The infilled wadis developed on main ephemeral wadis like; tabal, Ubaidh and Ghadaf. Involved wadis trends usually parallel to each other because they are controlled by the same topographic slope direction from the west to the east. Thickness of the involved sediments ranges from some centimeters till few meters, in Wadi Al- Ubaidh (Hamza, 2007).

Flood plain: Large ephemeral stream is subjected to periodic flood, then after fine sediments are deposited on the wadi sides such as sand, silt and clay. Sediment thickness varies from less than one meter to few meters (Hamza, 2007).

7. **Drainage units:** Many ephemeral streams drain from the west into the Razazza Lake, such as: Ubaidh (Plate 2- a), the nearby one, Hzimi, Ghadaf, Abu Mindhar, Meela, Tabbal, Hamir and Saffawiyat (Sissakian, 2007).
8. **Evaporational origin:** There are two types; sabkha and secondary gypsum.

Sabkha: It consists of sulphate- chloride types, resulted from the high rate of evaporation and developed as a thin laminae on recent sediments or among particles of muddy and sandy soil on beach of Razazza Lake (Jassim and Al- Zubaidi, 2013), and on the lowland which seasonally filled by water west of Shithatha plain. The source of the brine is the saturated water of Razazza Lake (Hamza, 2007), underground and spring water.

Secondary gypsum: It is related to sandstone rock bed units of Injana Formation, exposed on the cliff (Plate 2- c). Calcium sulphate may be derived from Nfayil Formation, underline Injana Formation, by solution, then after deposits after a high rate of evaporation.

9. **Aeolian origin:** The land form result from aeolian processes is sand sediment such as trapped dune, shadow dune, barchans and sand sheet.

Aeolian sand sediments resulted from the accumulation of sand grains on three areas: dry beach, wadis and plateau. On dry beach sand sediments accumulated near the lower part of the wadis particularly near Al-Qatara (Qatarat Al-Imam Ali), (Plate 2- d) trapped by Tamarix tree to form trapped dunes or deposited behind it to form shadow dunes or far away to form barchans with thickness range from a few centimeters to more than 2 meters. On the wadi, sand sediments move upward like fluid flow in channel, controlled by wind direction (NW), from downstream to upstream as a sand sheet; or hanging on the gentle slope topography. On the top of plateau sand sediments trapped by *Haloxylon salicornicum* to form trapped and shadow dunes in addition to sand sheet, thickness of mentioned sediments up to 1 meter.

10. **Biogenic origin:** Organism when move on the earth surface produce trails and trucks or makes tunnels and burrows for food, reproduction and shelters. Phanerozoic sedimentary rocks contain track ways and burrows which called trace fossils. Recent biogenic structures (land forms) control by many factors: grain size and composition of sediments, temperature, water level, salinity, food supply and habitats (Bridge and Demmico, 2008). The biogenic landforms occurred in the study area produced by vertebrates and invertebrates organisms are:

Uromastix microlepis (Agamidae): It has predilection for burrow a shelter on the top of Karbala Plateau among Dibdibba Formation and Quaternary sediments which comprises coarse sand and pebbles on flat open environment of sparse trees of *Haloxylon Salicornicum*.

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Sediments are consolidated by gypcret to be suitable substrate for digging by animals and not collapse (Plate 1- a). The shelter has a perimeter wall composed of excavated sediments. Above mentioned habitat similar to Mahazat as- Syd, in Saudi Arabia (Willms *et al.*, 2010).

Wasp nest: It is observed on the friable fine sandstone of the middle part of Injana Formation on the west side of Al- Tar Cave hill on Karbala Plateau. The females of the sphecid wasps burrows its nest in sand and soil or in wood (Murray, 1940; Gillot, 2005; Augul, 2013).

Termite nest: Termite workers build and maintain their nest or a house for colony. It uses sand, soil, mud, chewed wood, saliva and faeces to produce an elaborate structure to protect living spaces and void water (Harris, 1956). The nest of ground dweller termite is connected with underground structure to get proper temperature and humidity, which may be tens of meters long, to reach the ground water level (Ptacek *et al.*, 2013).

Termites nest observed on the Tamarix tree branch occurred on the dry beach between Razazza Lake and plateau. The wall structure of the nest around the branch is built by coarse sand, and connected with ground for saving life and breeding.

11. **Anthropogenic origin:**

Human activities, regarded as anthropogenic factor, alter the earth surface, in addition to abiotic and biotic factors (Lorant, 2012), and also influence and accelerating alterations of natural environment directly (excavation, quarries, dams, tunnels, waste dumps, landfills, embankments and others) or indirectly (grazing, deforestation and irrigation). Anthropogenic landforms result from changes on the earth surface by human due to his daily needs (Ursu *et al.*, 2011). Anthropogenic landforms include: nontanogenic (mining), industrogenic, (industrial), urbanogenic (settlement), traffic, water management, agrogenic, tourism and sports (Szabo *et al.*, 2010). Such approach needs to use GIS techniques to achieve such structures.

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Plate 1



a. Karbala plateau



b. Cliff



c. Wadi



d. Mushroom rocks

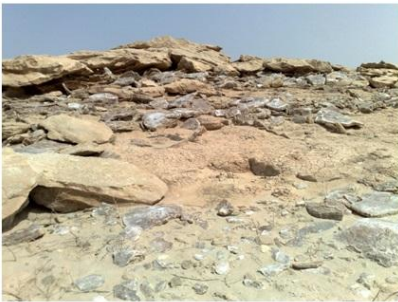
Plate 2



a. Dry spring



b. Salt marsh



c. Secondary gypsum



d. Sand sediments

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العمليات السطحية والأشكال الأرضية جنوب غرب بحيرة الرزازة – وسط العراق
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الخلاصة

تتكون الأشكال الأرضية من تفاعل مجموعة من الأغلفة مثل الغلاف الصخري، والغلاف الجوي، والغلاف المائي، والغلاف البيولوجي. ويتكون الغلاف الصخري من الوحدات الصخرية وأهم هذه الوحدات في منطقة الدراسة هي: الصخور الكلسية، والمارلية، والكلسية المارلية، والرملية، والرملية الحصوية، والغرينية، والطينية، والجسيم الثانوي، إلى جانب رواسب العصر الرباعي. ويمكن تقسيم الأشكال الأرضية لمنطقة الدراسة استناداً إلى أصل نشوءها إلى عدة وحدات: ١- الوحدات التركيبية- التعرؤية، مثل الهضاب الكبيرة والمتوسطة، والتلال، والجروف الصخرية، والوديان. ٢- الوحدات التعرؤية، مثل البلاط الصحراوي، وصخور شبيهة الفطر. ٣- وحدات حركة الكتل. ٤- وحدات المحاليل، مثل البحيرة، والاهوار الملحية، والكهوف الانبوبية. ٥- وحدات الينابيع. ٦- الوحدات النهرية، مثل المصاطب، و المراوح الغرينية، والوديان المملوءة، والسهول الفيضية. ٧- وحدات التصريف. ٨- الوحدات التخرية، مثل السبخة والجسيم الثانوي. ٩- الوحدات الهوائية، مثل الكتلان الرملية، والصفائح الرملية. ١٠- وحدات من أصل بيولوجي، مثل كهوف الأروال، واعشاش الزنابير، واعشاش الأرضة. ١١- وحدات من أصل الإنسان. وتهدف هذه الدراسة إلى تحديد العمليات السطحية والأشكال الأرضية الناتجة منها.