

Happening Earthquakes and its impacts on Sulaimani governorate (from 2014 to 2018)*

Ezzadin J.D. Palani¹, Omed Hamabaqi Hama Ameen²

¹Department of Geography, College of Education, University of Garmian, Sulaimani, Kurdistan Region, Iraq.

E-mail: azzadeen.jumaa@garmian.edu.krd

²Department of Geography, College of Humanities Education, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq.

E-mail: omed.ameen@univsul.edu.iq

ABSTRACT

Sulaimani governorate is located in the northeast of Iraq, between the latitudes (35°3'32"- 36°34'52") North and longitudes (44°25'52" - 46°16'11") East. The area reaches (12181.3 km²), the research shows relationship between earthquakes and tectonically movement with determining the type of earthquakes according to their location, time, and depth. The purpose of the investigation is to identify the causes of earthquake and areas where affected by the earthquake, also damages they cause to happen. This research is based on the recorded data of the Meteorological and Earthquake Station in Sulaimani Governorate with the Iraqi Meteorological organization and Seismology Department between (2014 and 2018). The total number of earthquakes that occurred during the study reaches (113) earthquakes. The highest number of earthquakes in the district Kalar and Darbandikhan have occurred, was (28, 22) of the earthquake, which makes (25%, 22%) of the total earthquake in the investigation area, and there are differences in earthquakes and recurrences due to the differences in the months and seasons of the year. The highest number of earthquakes in February, March and May reach (26, 18, 17) earthquakes and it makes (23%, 15.9%, 15.04 %) of the earthquakes in the investigation area after one. This is due to the movement of both Arabic and Iranian plates and the faults in the area and weakness of geological structure in the southern and southeast areas. As a result of the earthquake, many people were killed and many others were injured, as many as on (12 November 2017), five people were killed and (30) injured in the earthquake in Darbandikhan district, rather than collapsing of houses, damaging dams, roads and residential in the areas.

Keywords

Earth Quake, Crust, Fault, Geology Structure, Affect.

*1-Bring the Data until midyear (2018).

2- These data that received the center of earthquakes in Sulaimani province.

3- The investigation area catches up with Raparin and Garmian regim.

Introduction

The earthquake is known that it doesn't relative to a specific border or region. It is one of the natural phenomena which leave damages and remains at the time of happening according to its severeness. The damages are human, natural, and Environmental. At the time of tectonic quakes along the edge of moved plates of earth Crust, due to the pressure on the Rocks of the crust, thus a rapid movement happens along faults, Thrust faults and rocks, finally causes the release of the pressure that is pent up as a form of seismic waves. The natural factors are the most causes of earthquakes all over the world and a few of the factors are human causes. So this investigation reclines on these scientific steps to get the aims as below:

The problem of the Investigation:

Considering that, Earthquakes are phenomenon's which can't be realized and expected by human beings, despite the technologic progress in the world, so the Investigation area confronts a few earthquakes of different magnitude during (2014 to 2018), So the problem brings a few questions to include:

1. What are the indicators of the tectonic activities in the investigation and severeness.
2. Which of the areas more affected than the other area in the investigation area.
3. Where are the focuses of earthquakes that cause quakes.
4. What level do the magnitude and severeness get?
5. What are the kinds of damages of the earthquakes.
6. The investigation area might be the area of happening earthquakes and repeating in the future.

The Investigation Hypothesis

To answer the questions which are displayed in the problem of investigation area, the investigation hypothesis is formulated as the following:

1. Tectonic activities are the main causes of the severe earthquakes in the investigation area.

2. The affective asteroid of the earthquakes comprises some main cities of the investigation area, such as Kalar, Darbandikhan, Sulaimani, and Dukan.
3. There are differences in the severeness of the earthquakes in the investigation area, according to the time and places and the cities compared to the equator or earthquakes asteroid and the focus of the earthquakes.
4. The severeness of the earthquakes reaches the severe Second and weak area in the investigation area.
5. There are human and material damages due to the earthquakes in the area.
6. The investigation area is considered as an area of the frequenting earthquake in the future.

The Aim of the Investigation

The aim of the investigation the restriction of the areas which are under earthquakes influence of the investigation area, despite the factors of happening the earthquakes, then the geographical division according to the time and place, after that restricting magnitude and depth with the possibility of happening earthquakes and indicates the risks and damages of the earthquakes.

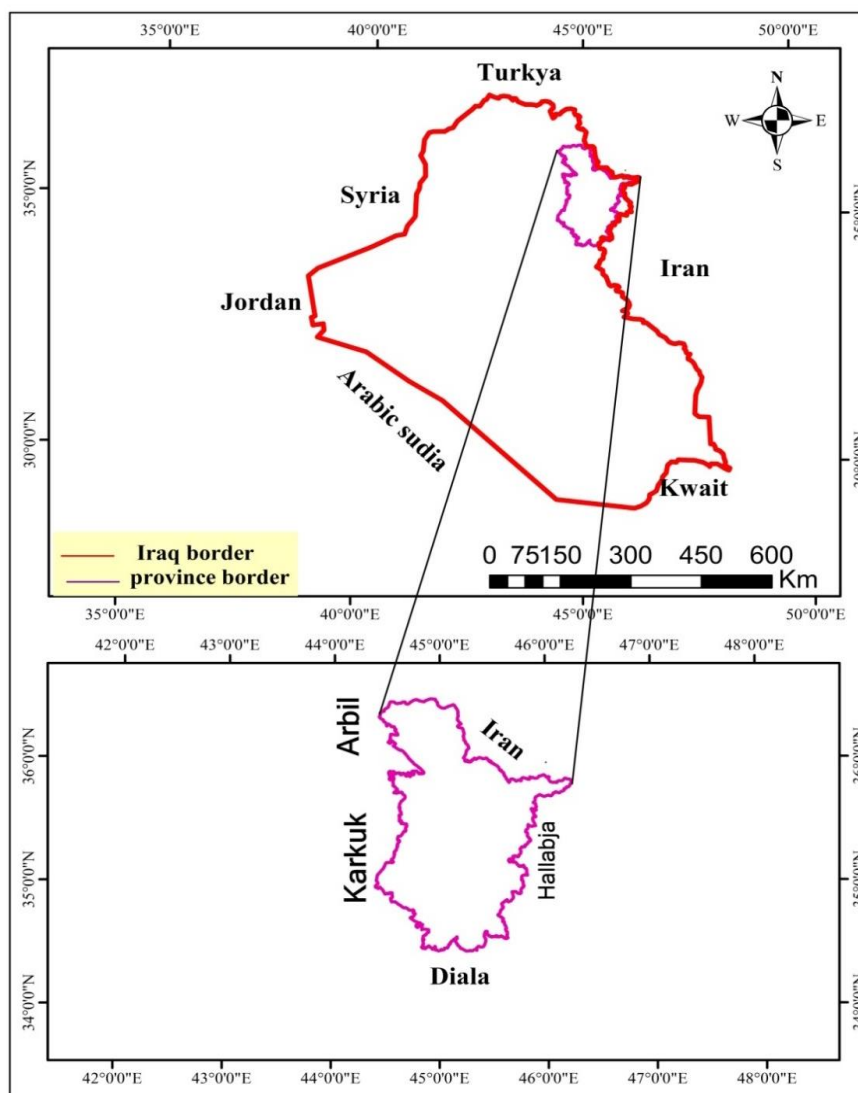
The Locational Border of the Investigation

The investigation area locates in the East-North of Iraq and the East-South of Kurdistan region between two latitude ($35^{\circ}3'32''$ - $36^{\circ}34'52''$) North and both longitude ($44^{\circ}25'52''$ - $46^{\circ}16'11''$) East. The surface area reaches (12181.3 km²) as shown on the map (1).

Its Iran border with Halabja governorate in the east and its Arbil governorate in the north and northwest and Kirkuk governorate in the west and southwest, Diala governorate in the south. We depended on the recorded Data in Sulaimani forecast and earthquake between (2014-2018). According to the Data, the asteroid of impacts, severeness, and depth of the earthquakes have been shown and found solution with solving then. The map of the geographical division of the earthquakes in the investigation area has been drawn depended on geographical information

system (Arc GIS 10.0) and pictures of (Landsat 8) and observation of (30m) high prudence for creating a locative data station and solve the

reliance data despite the geographical division the asteroids which are affected by the earthquakes in the investigation area.



Reference: the work of reaserchers depending on Kurdistan region government ,
 Minstry of municipal , municipal of Sulaimani , by using (GIS) program.

Map 1. The geographical location of Sulaimani province

1. The Geographical Division of Earthquakes of Sulaimani Governorate

The number and frequenting of earthquakes haven't been divided equally in Sulaimani governorate and there are differences in the number of the earthquakes which have been happened in varied places of the area and reached (113) earthquakes as shown on the table (1) and map (2), Most of the earthquakes happened in Kalar city which were (28) earthquakes and (%25) of all earthquakes. Darbandikhan city was the

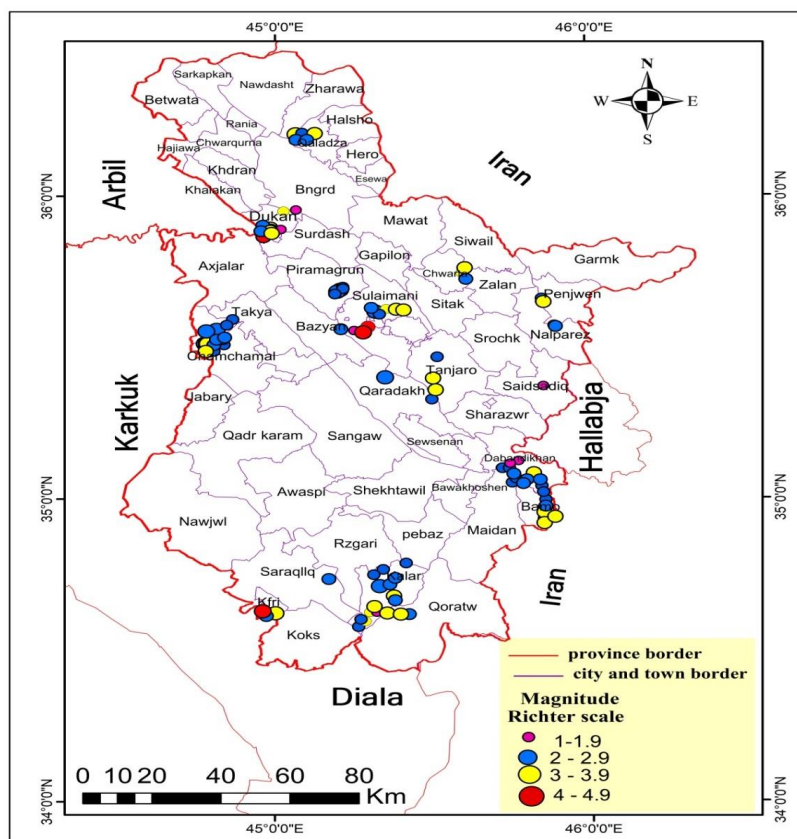
second area of the earthquakes when got (22) earthquakes and comprise (%22) of all the earthquakes. The least earthquakes have been recorded in Sharbazher, Qaradakh, Saidiadiq in comparison with the areas where earthquakes have been recorded and sequencing numbers are (2,2,1) and the percentage are (%1.76, %1.76, %0.88). Most of the earthquakes are located in the south, southeast, and the sequencing earthquakes got (57). The factors of been earthquakes and frequently referred to as the fault of the earth's

crust, and the adjacency areas from the collision area of Arabic and Iran plates.

Table 1. The geographic division of earthquakes in Sulaimani governorate between years (2014 – 2018)

Total	November	October	September	August	July	June	May	April	March	February	January	December	Location
16	-	1	-	1	3	1	3	6	1	-	-	-	Sulaimani
28	-	1	-	-	1	4	1	1	13	5	2	-	Kalar
12	-	1	1	-	-	1	3	1	1	2	2	-	Chamchamal
22	-	-	-	1	-	2	6	3	1	5	4	-	Darbandikhan
1	-	-	-	-	-	-	-	-	-	1	-	-	Saidsadiq
3	-	-	-	-	1	-	-	-	-	2	-	-	Piramagrun
3	-	-	-	-	-	-	1	-	-	-	1	1	Arbat
4	-	-	-	-	1	-	-	1	-	2	-	-	Penjwen
12	-	-	-	-	1	-	-	3	-	8	-	-	Dukan
3	1	-	-	-	-	-	1	-	1	-	-	-	Kfri
2	-	1	-	-	-	1	-	-	-	-	-	-	Qaradakh
2	-	-	-	-	-	1	-	-	1	-	-	-	Sharbazher
5	1	-	-	-	-	1	2	-	-	1	-	-	Qaladza
113	2	4	1	2	7	11	17	15	18	26	9	1	Total

Reference :1- Iraqi Government, Ministry of transportation and communication, forecast and seismological network, part recording earthquake, 2018.
 2-Kurdistan Region Government, Ministry of transportation and communication, Sulaimani forecast and earthquakes station, 2018.



Reference: the work of reaserchers depending on Sulaimani forecast and earthquakes with Iraqi seismological network by using (GIS) program.

Map 2. The Geographical division of earthquakes of Sulaimani province between years (2014-2018)
2. The Time Division of Earthquakes in Sulaimani Governorate

Frequenting earthquakes are varied according to the months and seasons of the year in Sulaimani governorate as shown in Table (2) and maps (3A, 3B, 3C, 3D), Most of the earthquakes happen in February and the number of earthquakes record (26) which is (%23) of all the earthquakes. March and May are considered as the second and third months of happening earthquakes which are (18, 17) and comprise (%15.9, %15.4) percentage of earthquakes in Sulaimani governorate. The least earthquakes have been recorded in January and September that is (1) earthquake with (%0.88) percentage.

Most earthquakes recorded in spring season reached (50), it has been considered as the season of most earthquakes which comprise (%44.24) of all the earthquakes in the investigation area. Winter is the second season of earthquakes which reaches (36) ones and comprise (%31.85) of all earthquakes in the governorate.

The least earthquakes have been recorded in autumn which got (7) earthquakes which are (%6.19) percentage of all the earthquakes in the governorate.

Some Scientists think that earthquakes are caused by the forecast and weather factors. The earthquakes which happen in the Northern Hemisphere in winter due to the strong cyclone which causes the change of Atmospheric pressure, as the number of earthquakes increases with the rising of changes increasing.

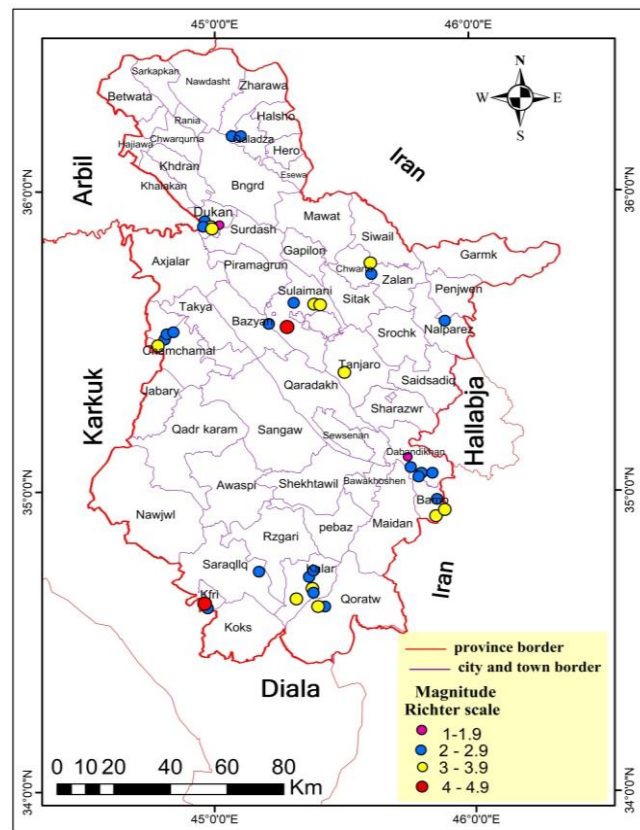
Additionally cyclone and the changes of atmospheric pressure aren't considered as main factors of being earthquakes but a helpful factor of happening earthquakes in the areas which are weak tectonically. The quantity and frequencies of the earthquakes in the raining season impact the water leakage in the reservoirs of groundwater and then press the area which has been built weak geologically thus confronts cracks and rift, with any movement of the area, the collapse would happen and cause earthquakes in the area.

Table 2. The total months, seasons, and years of earthquakes in Sulaimani governorate between years 2014) (2018 –

Total yearly	Total season	November	October	September	Total season	August	July	June	Total season	May	April	March	Total season	February	January	December	Magnitude
7	-	-	-	-	3	1	-	2	2	-	2	-	2	2	-	-	1-1.9
69	4	-	3	1	11	1	4	6	31	14	8	9	23	16	6	1	2-2.9
32	3	2	1	-	5	-	2	3	15	3	4	8	9	6	3	-	3-3.9
5	-	-	-	-	1	-	1	-	2	-	1	1	2	2	-	-	4-4.9
113	7	2	4	1	20	2	7	11	50	17	15	18	36	26	9	1	Total

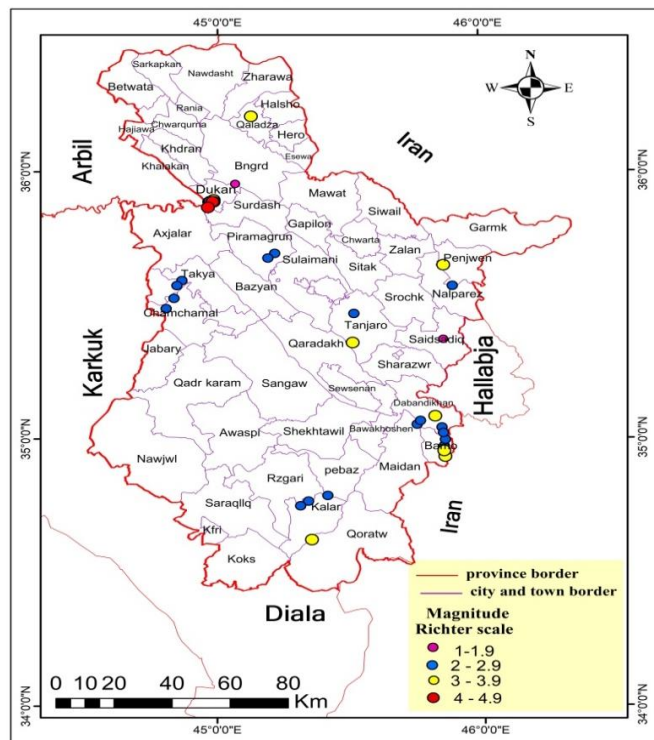
Reference: Iraqi Government, Ministry of transportation and communication, forecast and seismological network, part recording earthquake, 2018.

2-Kurdistan Region Government, Ministry of transportation and communication, Sulaimani forecast and earthquakes station, 2018.



Reference: the work of reaserchers depending on Sulaimani forecast and earthquakes with Iraqi seismological network by using (GIS) program.

Map 3a. The Geographical division of earthquakes in spring season of Sulaimani province between years (2014-2018)



Reference: the work of reaserchers depending on Sulaimani forcast and earthquakes with Iraqi seismological network by using (GIS) program.

Map 3b. The Geographical division of earthquakes in winter season of Sulaimani province between years (2014-2018)

3. The Geographic Division of Earthquakes in Sulaimani Governorate According to Magnitude

The number of earthquakes that have happened in the Sulaimani governorate is changed according to the time and place.

Most earthquakes that have happened in (2 -2.9) Magnitude and reach (69) earthquakes and comprised (%61) percentage of the whole earthquakes in the governorate as it's shown on Table (3). Then the second grade of earthquakes with (3 – 3.9) Magnitude and reached (32)

earthquakes which comprised (%24.4) percentage of the whole earthquakes of the governorate. The least earthquakes with (4 – 4.9) Magnitude have happened and reached only (5) earthquakes which comprised (%4.4) of all the earthquakes in the governorate. Most of the earthquakes got the levels which couldn't be realized by humans and only (37) earthquakes have been recorded in a grade which could be realized by a human that was between (3 – 4.9) Magnitude, This is because Sulaimani governorate is somehow stable tectonically and the earthquakes are caused the impacts of movement Arabic and Iranian plates.

Table 3. The locative division of earthquakes according to Magnitude in Sulaimani governorate between Years (2014 – 2018)

Total	4 – 4.9	3 – 3.9	2 – 2.9	1 – 1.9	Location
16	2	5	8	1	Sulaimani
28	-	11	16	1	Kalar
12	-	2	10	-	Chamchamal
22	-	3	17	2	Darbandikhan
1	-	-	-	1	Saidsadiq
3	-	-	3	-	Piramagrun
3	-	2	1	-	Arbat
4	-	1	3	-	Penjwen
12	2	4	4	2	Dukan

3	1	1	1	-	Kfri
2	-	-	2	-	Qaradakh
2	-	1	1	-	Sharbazher
5	-	2	3	-	Qaladza
113	5	32	69	7	Total

Reference: 1- Iraqi Government, Ministry of transportation and communication, forecast and seismological network, recording earthquakes part, 2018.

2-Kurdistan Region Government, Ministry of transportation and communication, Sulaimani forecast and earthquakes station, 2018.

4. The Geographic Analysis of the Depth Earthquakes in Sulaimani Governorate

The depth of earthquakes is one measure that Marks the damages of the earthquakes. The earthquakes which have been happened in Sulaimani governorate are considered as a (surface earthquakes)* , the average depth of earthquakes in Sulaimani governorate reached (6.34375 km) as shown in Table(4). The highest level of depth has been recorded in February and March and reached (15.225, 11.8) km and the lowest level of depth has been recorded in November and December and reached (2, 1.25)

km. Regarding the depth of the earthquakes according to the season, the most level of earthquake depth have been recorded in winter and the average of the depth got (7.225 km). Then the least level of depth has been recorded in autumn which got (4.425 km). There are differences in the depth of earthquakes according to the Magnitudes. So the average of earthquakes with (4 – 4.9) Magnitude could reach (1.15 km) and the average depth of the earthquakes with (2 – 2.9) Magnitude could reach (14.85 km). The earthquakes and there near to the earth's surface impact human activities and duties in the area.

Table 4. The average depth (km) months, seasons, and years of earthquakes of Sulaimani governorate between years (2014-2018)

Average depth (km)	4 – 4.9	3 – 3.9	2 – 2.9	1 – 1.9	Magnitude
1.25	-	-	5	-	Desember
5.2	-	-	20.8	-	January
15.225	7.8	15.6	15.6	21.9	February
7.225	2.6	5.2	13.8	7.3	average
11.8	6	15.2	26	-	March
5.2	-	7	11.7	2.1	April
3.25	-	5.7	7.3	-	May
6.75	2	9.3	15	0.7	average
9.5	-	11.4	20.6	6	June
5.45	-	5.4	16.3	-	July
6	-	-	12	12	August
6.975	-	5.6	16.3	6	average
6.225	-	-	24.9	-	September
5.05	-	2.2	18	-	October
2	-	8	-	-	November
4.425	-	3.4	14.3	-	average
6.34375	1.15	5.875	14.85	3.5	Total yearly

Reference: 1- Iraqi Government, Ministry of transportation and communication, forecast and seismological network, part recording earthquake, 2018.

2-Kurdistan Region Government, Ministry of transportation and communication, Sulaimani forecast and earthquakes station, 2018.

5. The Factors that cause Earthquakes in Sulaimani Governorate

Some factors cause to happened earthquakes in Sulaimani governorate such as:

a. Natural Factors

Naturally, the investigation areas locate east and northeast of Iraq, east and southeast of Kurdistan region so it's in the mountain s area and partial mountains area in the unstable asteroid, specifically sliding rocks asteroid which includes the north and northeast of Iraq as a narrow asteroid and high mountain area which is called the severe bending and faults with anticline and syncline zones.

So the investigation area is known as a complicated area. It's a Trans located area between the alpine geosyncline plate of Zagros Series Mountains and the Arabic plate.

By depending on recorded Data in the Sulaimani forecast weather and earthquake station, the investigation has shown that the earthquakes focus located in faults area and some of them located in low curvature plains in the south of the investigation area, this is due to the horizontal movement between the Arabic and Iranian plates. Researches proved that the Arabic plate moves toward the Iranian plate about (2 cm a year).

1. Faults

The faults are made due to the unstable of the earth's center and the movement of the rocks in

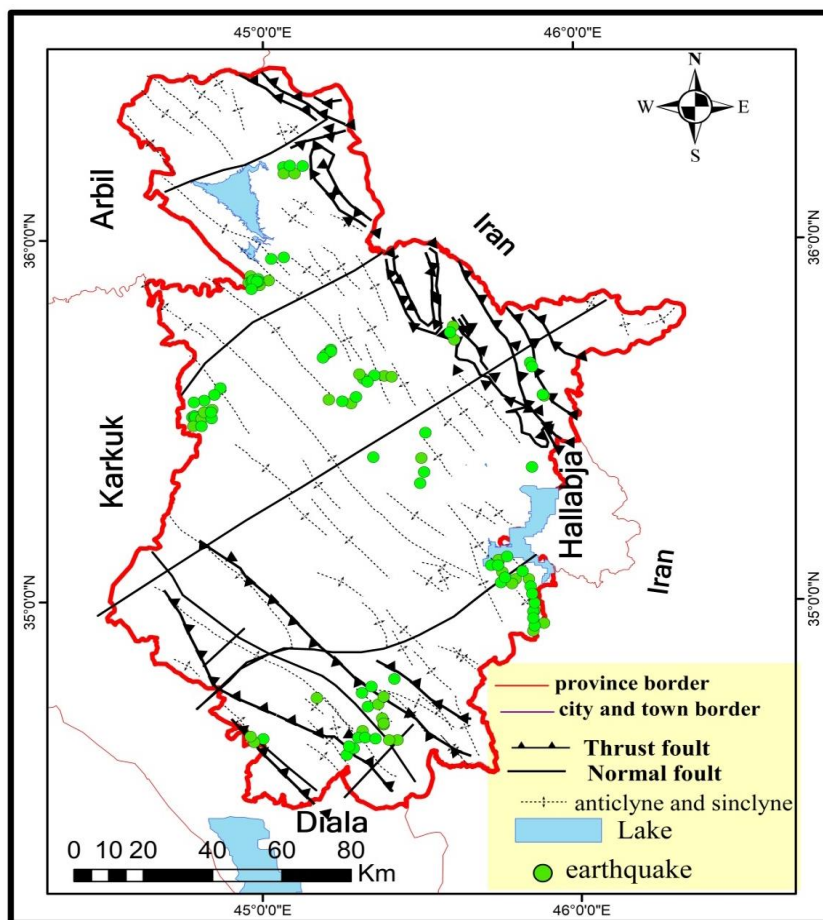
the earth's crust and the gravitation and pressure. Some faults can be found in the investigation area so as shown on the map (4), so these faults impact the movement of the earth's crust and happen earthquakes in the investigation area. The faults can be divided into some types includes:

a. thrust Faults

Thus the type is considered as a thrust fault where movement and transport of the great rocks can be realized, one of the sides of the fault slides on another stable side, this is called sliding scape. The movement of that stuff is considered a few centimeters to a few meters, this fault happens on sedimentary rocks surface and fundamental rocks located in the northeast and northwest of the investigation area. So the length of the fault is (755.3 km).

b. Normal Fault

In this type of fault, the movable side of the fault moves downwards the stable side of the fault. The bevel of the most fault got (60) degree. Normal faults can be found in the plenty of the investigation area and reach (578.32 km) long. These faults pass this area in some directions, from northeast to southwest as seen on the map (4). There are two normal faults in Kalar town, from southeast to Northern west considering map (4), and realize some connections between the investigation areas faults and the earthquakes in the areas are mostly near the faults and in the area of the fault.



Reference:work of reaserchers depending on:
 1-Varoujan K.Sissakian,Geological map of Erbil - Mahabad Quadrangles, sheet NJ -38-14 and Baghdad NJ-38-15,ATATE Establishment of Geological servay andMining,1997,Scale 1:250000.
 2- using program (Arc GIS 10.0)

Map 4. The Geographical division of earthquakes and parallel to faults, anticlyne and sincline and lakes of Sulaimani province between years (2014-2018)

We conclude that the investigation area is mostly known (geological structure line) as a result of the tectonic movement that has been happened in the past and continuous till now. The line phenomenon is paralleled with each other. They take roles in the ground and surface quakes in the area.

The line phenomenon's are the of unstable of the area and cracked area, thus the population realizes the low, medium and high quakes, so the causes slide the slope versants which are weak and not tight, and affect the population and building around the versants. Now the investigation area is affected by the earthquakes and would happen strongly again.

b. Human Factors

Human work and activities are the causes that impact the happening of earthquakes and increasing earthquakes in the investigation area. The activities can be realized as the followings:

1. **Bund and Dams:** Darbandikhan and Dukan and Bawashaswr lakes affect eroding and leakage of water toward bedrock layers and then melting and weaken limestone's and calcareous rock and lead to happen earthquakes in the area, this is because the front land of lakes are lower and the slope of layers are collateral at some time gathering the most of water impacts the atmosphere and press the lower layers, thus earthquakes would happen in the area. The earthquakes around the dams prove the facts that the dams impact

happening earthquakes, even if this helps to create the earthquakes as shown on the map (4).

2. Human activity in extracting the natural Material such as mine, water, oil and a large quantity of natural gas affect earthquakes and unbalance the earth, so resulting the local quakes happen in the area. Drought and diminution of precipitation and extracting of groundwater and digging an artesian well in different areas of the governorate. On the other hand, digging out oil and natural gases are considered as a helpful factor of happening earthquakes in the investigation area.

6. The Damages of Earthquakes in Sulaimani Governorate

The investigation of earthquakes and specifying their location and Magnitude are the fundamental points that must be known about them, to indicate the impacts humans and their activities.

There are variations in repeating and locations of happening earthquakes in the investigation area. The earthquakes effects are changed according to the locations, the most important effects of the earthquakes in the investigation area:

1. Death and Injury of the Population

In the consequences of the earthquakes which have been recorded in the governorate. some people died and many others injured as the earthquakes happened in Darbandikhan on (12-11-2017).

On 12-11-2017 resulting the death of (5) citizens and injuring (30) ones, despite injuring in different places of the governorate.

2. Destruction, Cracks, and Breaking of Buildings and Establishments

Some houses were destroyed due to the earthquakes which happened in the area; especially the houses of the villages that have been built from mud (clay), bricks and reeds, A large number of houses have been destroyed in the villages around Darbandikhan town so left material and human damages .

At the same time, there were a few houses which have been destroyed in the cities and towns such as Darbandikhan as shown in Figure (1), despite the cracking of walls and columns of the houses and buildings and disfigure the face of the buildings as shown in figure (2).



Figure 1. Collapse buildings by an earthquake in Darbandikhan town

Take a photo at 13/11/2017



Figure 2. The folded and destroyed building faces by the earthquake

Take a photo at 13/11/2017

3. Equipment, Furniture, and Markets

Due to happening of the earthquakes in the investigation area, several material damages are

found, especially equipment, furniture, markets goods, which have been falling down at the time of happening earthquakes and left damages as shown in Figure (3).



Figure 3. Fall down material when the earthquake happened

Take a photo at 13/11/2017

4. The Damages to the Roads

As a consequence of earthquakes, many land sliding and falling rocks have been recorded in the area and different pales of the investigation area

and left many damages of roads service projects and the public necessities such as in Zmnako Mountain near Darbandikhan Dam in Figure (4 and 5).



Figure 4. Rockslide and debris flow in Zmnako Mountain Darbandikhan Dam

Take a photo at 13/11/2017



Figure 5. Fall down rocks in Zmnako mountain and demolition parks and breaking cars

Take a photo at 13/11/2017

5. The Damages of the Bridges and Dams

Bridges and Dams are among the projects that confront damages and destruction, due to the earthquakes, especially if it hasn't been observed Scientifically when build, Darbandikhan Dam is

one of the Dams in the investigation area which got damages and destructions left on the columns as it is shown in figure (6). The up word way of the Dam has been cracked this is because of the left effects of Zmnako mountain on the left side of the Dam.



Figure 6. Folded Baranan Mountain and body Darbandikhan Dam

Take a photo at 13/11/2017

6. The Psychological Problems and Fearless with Anxiety

One of the damages of earthquakes is the fearless, anxiety, and psychological tension for the people and made them leave their houses and stay intent

due to afraid of falling and destruction of the roof and equipment of the houses and building these situations aren't related to the specific time and seasons but anytime earthquakes happen, these situations with happen again, as it's shown in figure (7).



Figure 7. Leave there houses and stay in the tent

Take a photo at 13/11/2017

Conclusions and Recommendations

There is a difference in a place and time of the occurrence of earthquake and repeating them or their difference in the depth and magnitude of their occurrence in the investigation area, the most of earthquakes occurred in Kalar and Darbandikhan districts. The earthquake occurred and it repeated (28,22) times this number of earthquakes reaches (25%, 22%) of the earthquakes in the area, also time of the occurrence of earthquakes in the wet seasons (winter and spring) reached (86) earthquakes and it makes high percentage which reaches (76.09%) earthquakes of the area. In the same way, there is a difference in the magnitude of the earthquakes and the number of the earthquakes which has the magnitude between (1-2.9) according to the Richter scale It reaches (76) earthquakes and (67.25%) of the earthquakes in the area, and those earthquakes which felt by humans was between (3-4.9) magnitude, their number reaches (37) earthquakes and it makes (32.75%) of the earthquakes in the investigation area. Also, the depth of the earthquakes is different in a way deepest earthquakes in the area occurred in both February and March and reach (15,225, 11.8) km after one. There is difference in a time, place, number, depth, and magnitude of earthquake occurrence effected by some reasons such a how far is from faults, dams, the difference in rate of precipitation according to seasons. Also the investigation area is a part of unstable asteroid according to geological structure. so we must be

www.psychologyandeducation.net

aware while building a houses, the roads of transportation and dams to reduce the effect of earthquake, although the human and their activity be far apart from this damage.

Earthquakes division according to the dept

Earthquake type	Earthquake deep
Surface earthquake	Less than (70 km)
Mediocre earthquake	Between (70-300) km
Deep earthquake	More than (300 km)

Reference: Jalal Al-Dabik, Earthquake and its Risk Mitigation, Faculty of Engineering, An-Najah National University, 2009, p.17.

References

- [1] Sissakian, Varoujan K., Geological map of Erbil-Mahabad Quadrangles, sheet NJ-38-14 and Baghdad NJ-38-15, *ATATE Establishment of Geological servay and mining*, 1997, scale 1:250000.
- [2] Hafez, Imad Abdel Fattah Saleh. (2008), *Geomorphology of Mount Umm Khuthaib in the northwest of the Sinai Peninsula*, Master Thesis, Faculty of Arts, Bani Sayouf University, P. 81.
- [3] Judat, Joudet Hassanein (1998). *Landmarks of the Earth's Surface*, Modern University Office, PP. 274-275.
- [4] Al-sanawy, Sahl and Others. (1979). *General Natural and Historical Geology*, Edition 1, University of Baghdad, P. 346.

- [5] Agha, Shahir Jamal. (1995), *The Earthquake, Its Reality and Its Effects*, A World of Knowledge, Kuwait, P. 155.
 - [6] Iraq, Government. (2018). *Ministry of Transport and Communications, Iraqi General Authority for Meteorology and Seismic Monitoring*, Seismic Monitoring Division, 2018.
 - [7] Iraqi Kurdistan Region (2018), Ministry of Health, the General Directorate of Health of Sulaimani, the Directorate of Health of Darbandikhan.
 - [8] Al-Dabik, Jalal. (2009). *Earthquake and its Risk Mitigation*, Faculty of Engineering, An-Najah National University, P.17.
-