Damascus University Journal of Earthquake and Disaster Research
Vo 3 number (1) -2026: 1-16

مجلة جامعة دمشق وبحوث الزلازل الكوارث
المجلد 3 العدد (1) – 2026: 1-16

Studying the impact of seismic activity on changes in the chemical elements of the Water of the dams (Rastan, Taldo, Salhab, and Abu Baara)

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Received: 29/12/2025
Accepted: 15/4/2026

Abstract:

This study examines the relationship between seismic activity and changes in the water properties of the Rastan, Taldo, Salhab, and Abu Baara dams, using data from a number of chemical element analyses of the water in the four dam reservoirs between 2020 and 2024, and linking them to seismic events that occurred during that time period. Events with magnitudes equal to or greater than 3.4 were examined. The results showed sharp changes in electrical conductivity, while ammonia generally decreased, while pH remained relatively stable. Oxygen, the oxygen needed to oxidize organic and inorganic materials, temperature, and nitrate levels increased slightly.

Keywords: Seismic activity, chemical changes, water properties, water quality, dams.

http://journal.damascusuniversity.edu.sy/index.php/index/index

ISSN (online): 3031-085X

دراسة تأثير النشاط الزلزالي على تغيرات العناصر الكيميائية لمياه سدود (الرستن، تلدو، سلحب، أبو بعرة)

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الملخص:

يدرس هذا البحث العلاقة بين النشاط الزلزالي وتغيرات خواص مياه سدود (الرستن، تلدو، سلحب، أبو بعرة) باستخدام بيانات تحاليل لعدد من تحاليل العناصر الكيميائية لمياه بحيرات السدود الأربعة بين عامي (2020–2024) وربطها مع الأحداث الزلزالية التي حصلت ضمن تلك الفترة الزمنية. وقد تم العمل على الأحداث ذات القدور التي تساوي 3.4 أو أكبر. وقد أظهرت النتائج أن هناك تغيرات حادة في الناقلية الكهربائية أما الأمونيا فكانت بانخفاض بشكل عام، بينما بقيت درجة الحموضة مستقرة نسبياً وبالنسبة للأوكسجين اللازم لأكسدة المواد العضوية واللاعضوية ودرجة الحرارة والنترات فكان ارتفاعها طفيفاً.

الكلمات المفتاحية: نشاط زلزالي، تغيرات كيميائية، نوعية المياه، سدود.

تاريخ الايداع: 2025/12/29
تاريخ القبول: 2026/4/15

Introduction:

Dams are important facilities for providing human needs (drinking or irrigation). Therefore, it is essential to study any changes that may occur in dam water quality. Water quality can be affected by natural phenomena, as an earthquake alone can cause significant changes in water properties (Koju, 2016). Kong et al. (2022) demonstrated that the June 5, 2015, earthquake had a significant impact on water quality in the Liwagu River. Through water quality monitoring in 2015, several river water quality parameters, such as turbidity, color, total dissolved solids, electrical conductivity, nitrogen content, and metal concentration, changed from one day to three months before the earthquake, lasting for about two weeks. Koizumi et al. (2019) also indicated that the hydrological changes following the 2016 Kumamoto earthquake in Japan were, primarily caused by surface phenomena caused by the earthquake. Martinez-García et al. (2015) demonstrated that atypical conductivity variations in water bodies located in areas with frequent seismic activity show a close correlation with the potential subsequent occurrence of earthquakes. They concluded that monitoring electrical conductivity in seismic areas may be a sustainable option as a preventive measure to predict earthquakes. The results of a study by Jakovljević & Lozanov-Crvenković (2015) on water quality changes after the 2010 Kraljevo earthquake showed an increase in mineral and pH values after the earthquake. This study aims to highlight the expected impact of seismic activity on the chemical properties of the water in four central dams: Rastan, Taldou, Salhab, and Abu Baara, during the period between 2020 and 2024. The study correlated seismic data with changes in water quality by analyzing several indicators, including ammonia, electrical conductivity, pH, suspended solids, and temperature.

1-Study area:

The four dams (Rastan, Taldo, Salhab, and Abu Baara) are located between longitudes 36-37 and latitudes 34-36 within the governorates of Homs and Hama. The Rastan Dam is located near the town of Rastan on the middle course of the Orontes River in the western part of Syria, 20 km south of the city of Hama. The dam lake extends towards the northwestern part of the Homs Plain. The Taldo Dam is located 2 km south of the city of Taldo in the Homs Governorate. The Salhab Dam is located in the Hama Governorate at the southern beginning of the Al-Ghab Depression on the course of the Salhab River, which is formed from a collection of springs spread on the slopes of the mountainous heights located to the south of the dam. The Abu Baara Dam is located in the Hama Governorate at the southern edges of the Al-Ghab Depression, east of the village of Maarin. The dam takes an east-west direction perpendicular to the general direction of the Abu Baara River Valley and other watercourses. Regarding the geology of the dam areas: Cretaceous, Paleogene, Neogene, and Quaternary geological deposits form the geological structure of the region.
Figure (1).
Rastan Dam: Paleogene deposits are exposed in the northeastern and southeastern parts of the region, with thicknesses consisting of calcareous and marl calcareous, and it's water-bearing. The Paleogene rocks, with their three layers, which vary in thickness from one region to another, play an important role both on the surface and as geological structures in the study area. Paleogene deposits form the large slopes in the Homs Depression, surrounded by Cretaceous deposits. Neogene deposits, with their Miocene and Pliocene layers, are also exposed over large areas of the region, whether sedimentary, represented by limestone and sandy limestone rocks (Miocene), or continental-impulsive in the Pliocene.

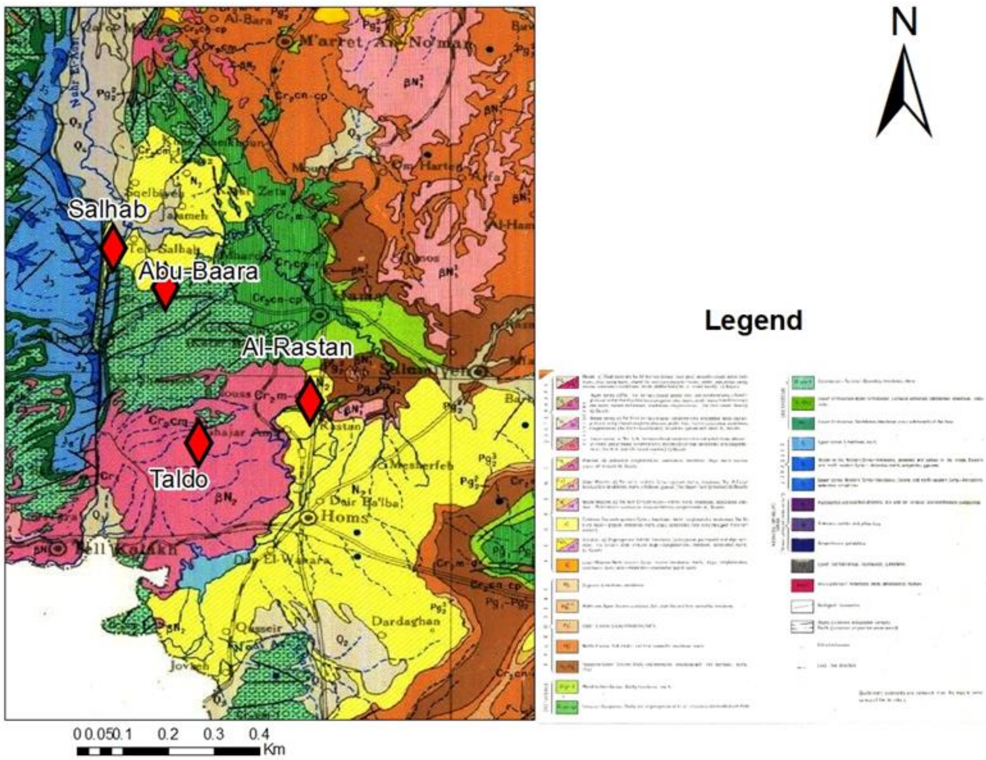

Figure (1) Representation of dam locations using a GIS program on the geological map of Syria (map according to the General Organization for Geology and Mineral Resources)

As for Taldo Dam, the Quaternary deposits consist of gravels with sandy clayey mortar. As for the Neogene deposits, they alternate between basalt of varying hardness and laterite layers and layers, consisting of calcareous marl, sandstone, and conglomerate levels.

The Cretaceous deposits alternate between gray limestone and shale layers, with dolomitic limestone, and consist of cracked, caved dolomitic limestone.

The Salhab Dam lies above mixed deposits dating back to the Lower Miocene, Upper Pliocene, and Upper Pleistocene. The lake floor is covered by these deposits, which are alluvial, and consist of medium-consolidated conglomerates composed of rounded to angular gravels and boulders with thick, sometimes layered, calcareous mortar, marl, and limestone and marl may be interspersed with deeper deposits. To the east of the dam, deposits of Upper Cretaceous age appear, dating back to the Cenomanian. The Salnafa Formation is composed of limestone, dolomitic limestone, dolomite, marly, and marly limestone layers with flint nodules. The surface formations that make up the Abu Baara Dam Lake generally consist of Quaternary alluvial deposits composed of sandstones of varying sizes and shapes, in addition to the presence of conglomerate deposits on the sides, which are silty mortar with siliceous limestone gravels. These deposits are surrounded by dolomitic limestone rocks dating back to the Upper Cretaceous (Cenomanian-Turonian), which form the basic base of the dam lake, characterized by severe cracking, erosion, and weathering, as well as advanced karst features.

2- Seismic data in the study area:

After obtaining seismic data from the National Seismological Center and the Euro-Mediterranean Seismological Center (EMSC), it was found that the number of seismic events occurring within and around the study area was 115 seismic events with varying magnitudes between (1, 2 and 3, 4). These events were represented on the GIS program (Figure 2). This research relied on seismic events with seismic magnitudes of 3.4 or greater, which were 18 seismic events in addition to the February 6 earthquake, Table (1).

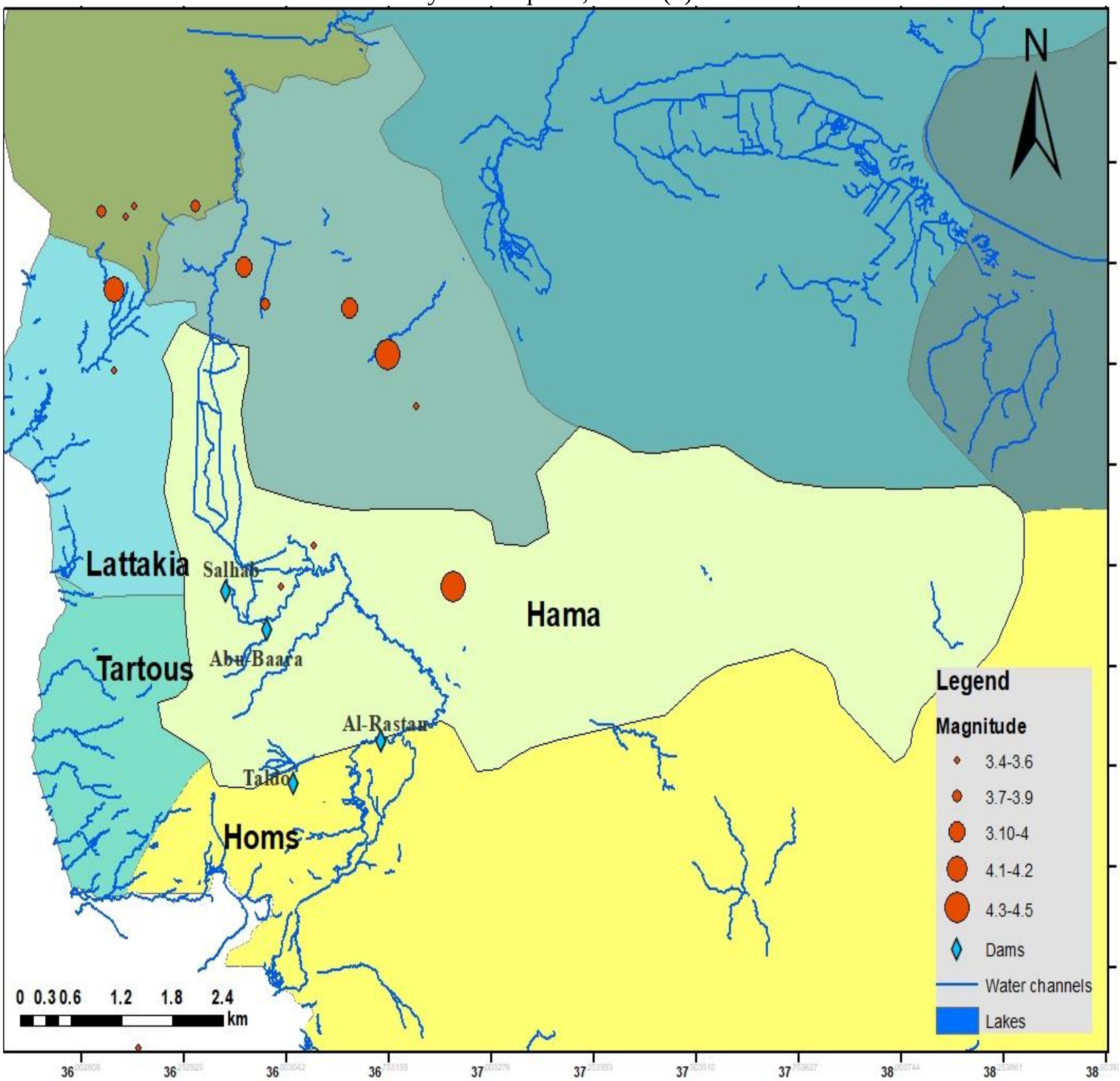

Figure (2) Representation of seismic activity between the years (2020-2024) in the study area, with dam locations indicated using GIS (seismic events according to the National Earthquake Center, EMSC).

Table (1) Seismic events ≥ 3.4 that occurred between the years (2020-2024) according to the National Seismological Center and the Euro-Mediterranean Seismological Center.in addition to the February 6 event

Number	Date	Latitude	Longitude	Magnitude (ML)
1	2020-02-22	34.34	36.14	3.4
2	2020-05-21	35.32	36.57	3.6
3	2020-07-23	34.07	36.32	3.8
4	2020-11-30	35.24	36.91	4.4
5	2020-12-22	35.86	36.4	3.9
6	2022-01-12	35.6	36.65	3.4
7	2022-04-15	35.76	36.84	4.3
8	2022-12-07	35.66	36.08	3.6
9	2022-12-15	35.78	36.656	3.9
10	2023-01-12	35.69	36.75	4.3
11	2023-02-06	37.225	37.021	7.8
12	2023-02-07	35.97	36.05	3.7
13	2023-02-08	35.59	36.82	3.4
14	2023-02-09	35.79	36.45	3.7
15	2023-02-12	35.98	36.13	3.5
16	2023-02-12	35.98	36.28	3.7
17	2023-04-08	35.96	36.11	3.5
18	2023-06-22	35.24	36.49	3.4
19	2024-02-14	35.818	36.081	4.2

Table (2) Seismic events ≤ 3.4 near the dams that occurred between the years (2020-2024) according to the National Seismological Center and the Euro-Mediterranean Seismological Center.

Number	Date	Latitude	Longitude	Magnitude (ML)
1	2022-08-04	35.18	36.95	3
2	2022-12-29	35.04	36.89	3.1
3	2023-06-17	35.61	36.16	2.6
4	2023-06-18	35.26	36.38	2.6
5	2023-06-22	35.19	36.57	2.8

3- Data Preparation and Work Procedures:

• Data on seismic events occurring during the period (2020-2024) were obtained from the National Seismological Center and the Euro-Mediterranean Seismological Center (EMSC) within the coordinates of the study area to determine the prevailing seismic activity during that period. This research focused on seismic magnitudes equal to or greater than 3.4, and distance was taken into account (seismic events close to the dam body).

• To study changes in the chemical elements of dam reservoirs, data from sample analysis of dam reservoirs was obtained from the General Authority for Water Resources.

• The coordinates of dam sites were also obtained from the General Authority for Water Resources. Using a GIS program, dam locations and seismic data were represented on geological and tectonic maps, and seismic events during the time period within the study area were included. • The seismic data were linked to changes in chemical elements and analyzed using Excel according to curves showing these changes over the years (2020-2021-2022-2023-2024).

4-Results:

4-1- Rastan Dam:

The changes in the results of chemical analyses of (pH, NH_4, Cond, SS, COD) for the Rastan Dam Lake were linked to the seismic events in the same time period in which the elements were studied, according to Figure (3):

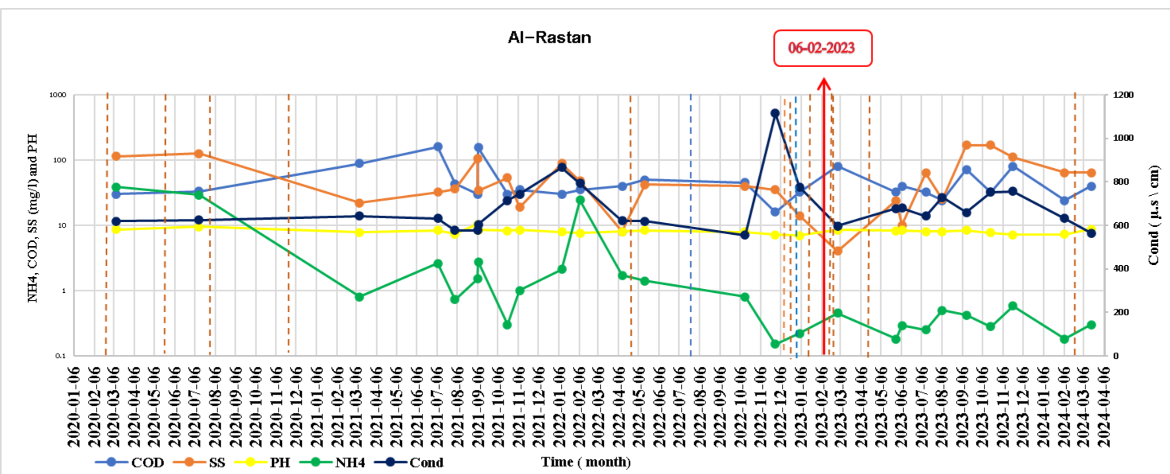

Figure (3) The curve of the change of chemical elements with seismic events during the years (2020-2021-2022-2023-2024) in the Rastan Dam. The red line is the February 6 earthquake. The brown dotted lines (seismic events).The blue dotted lines are the earthquakes near the dam site.

• Electrical Conductivity (Cond): Numerous sharp changes in the electrical conductivity concentration have been observed over the years. After the 07-01-2022 earthquake event with a magnitude of ML=3, which was close to the dam site, the value decreased (866 to 792 µ.s/cm). A sharp increase in the conductivity value was also observed from (554 to 1115 µ.s/cm) a month before the earthquake event that occurred on 29-12-2022 with a magnitude of ML=3.1, which was also close to the dam site. This difference in behavior may be related to variations in earthquake magnitude and intensity, as well as the distance from the epicenter and local hydrogeological conditions. Therefore, continuous monitoring of hydrochemical parameters during multiple seismic events, especially stronger earthquakes, is necessary to better understand the actual influence of seismic activity on water properties in dam reservoirs. Stronger seismic stress may lead to the release of dissolved ions from surrounding rocks, increasing conductivity, whereas in other cases groundwater inflow or dilution processes may cause a decrease in conductivity. Then, a decrease in the conductivity value was observed from (1115 to 777 µ.s/cm) several days after the same earthquake event. A decrease in the value (from 777 to 59 µ.s/cm) was observed after the February 6, 2023 earthquake. Following the subsequent seismic activity with several seismic events during that period, the conductivity value increased to 677 µ.s/cm. The electrical conductivity value also decreased (from 631 to 564 µ.s/cm) after the February 14, 2024, seismic event, with an ML value of 4.2. Therefore, it is possible that these sharp changes in electrical conductivity were due to seismic events, or that the seismic event was one of the factors causing these changes.

• Acidity (pH): It remained approximately within its values before and after the seismic events over the years studied, meaning that there was no noticeable effect of seismic activity on the pH value.

• Ammonia (NH_4): The ammonia value was parallel to the changes in electrical conductivity. A decrease in the value was observed from 38.7 to 0.8 mg/L after the November 30, 2020, earthquake with an ML=4.2 magnitude. The ammonia value also increased significantly (from 2.1 to 24.2 mg/L) after the January 7, 2022, earthquake with an ML=3 magnitude near the dam site. In the same year, the value decreased (from 24.2 to 1.7 mg/L) before the April 15, 2022, earthquake with an ML=4.3 magnitude. The ammonia value then increased after the February 6, 2023, earthquake (from 0.22 to 0.45 mg/L). The ammonia value decreased after several seismic events during the seismic activity period following the February 6, 2023, earthquake (from 0.45 to 0.18 mg/L).

• Suspended Solids (SS): The value of suspended solids increased (from 114 to 126 mg/L) following the May 21, 2020, earthquake with a magnitude of ML=3.6. The value decreased (from 89 to 48 mg/L) following the January 7, 2022, earthquake with a magnitude of ML=3, near the dam site. A significant increase (from 8 to 42 mg/L) was observed following the April 15, 2022, earthquake with a magnitude of ML=4.3. A decrease in the value (from 48 to 8 mg/L) was also observed approximately a month after this event. The value decreased (from 14 to 4 mg/L) approximately a month after the February 6, 2023, earthquake. After the February 6, 2023, earthquake, we note that a series of increases began following seismic events in 2023, with the highest value reaching 168 mg/L.

• COD values: An increase in the value (40-50) was observed after the 04-15-2022 earthquake event with a seismic magnitude of ML=4.3. An increase in COD (from 16 to double the value, i.e. 32 mg/L) was also observed several days after the 12-29-2022 earthquake with a magnitude of ML=3, which was close to the dam site. The value increased from (32 to 80 mg/L) after the February 6 earthquake, and in 2024 the value increased (from 24 to 40 mg/L) about a month after the 02-14-2024 earthquake with a magnitude of ML=4.2.

4-2- Taldo Dam:

The changes in the results of chemical analyses (pH, Cond, NH_4, NO_3, T) of the Taldo Dam Lake were linked to the seismic events in the same time period, according to Figure (4):

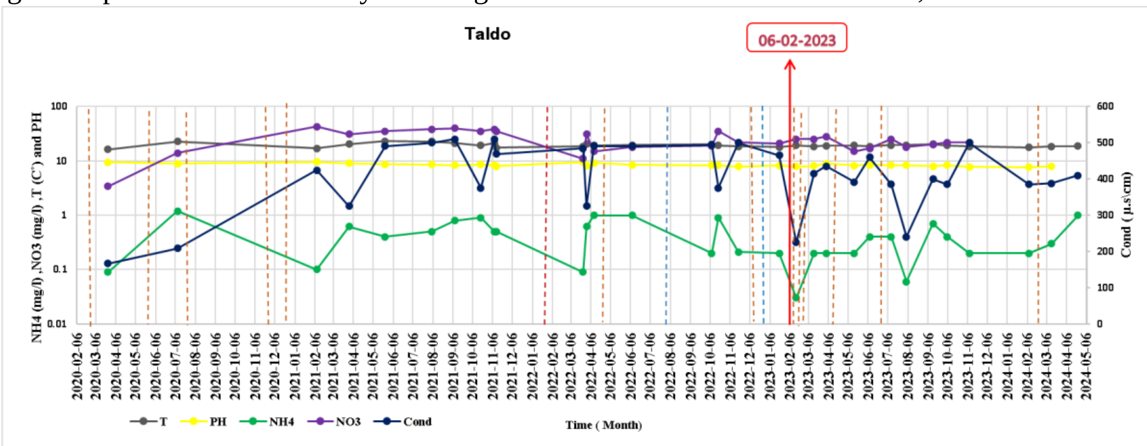

Figure (4) The curve of the change of chemical elements with seismic events during the years (2020-2021-2022-2023-2024) in the Taldo Dam. The red line is the February 6 earthquake. The brown dotted lines (seismic events).The blue dotted lines are the earthquakes near the dam site

• Electrical conductivity (Cond): It was observed that the electrical conductivity value decreased (500-465 cmµ) after the seismic event near the dam site on December 29, 2022, with an ML=3.1. A sharp decrease was also observed, starting from 465 µ.s/cm before the February 6 earthquake and reaching 255 µ.s/cm afterward. The value then increased to 415 µ.s/cm after the seismic activity that followed the February 6 earthquake during that period. Overall, there were numerous changes in electrical conductivity over the time period studied.

• Temperature (T) and nitrate (NO_3): Slight increases were observed after the seismic events of December 22, 2020, February 9, 2023, and June 22, 2023, with ML=3.9, 3.7, and 3.4.

• pH level: It remained within its values before and after the seismic events over the years, meaning that seismic activity had little impact on the pH value. Which is in between (7-8).

• Ammonia (NH_4) concentration: A significant decrease in ammonia was observed before the February 6 earthquake (which may be an indicator for earthquake prediction). A decrease in the value (0.4-0.04 mg/L) was also observed after the June 22, 2023, seismic event, with an ML=3.4. The contrasting behavior of ammonium in Taldo Dam could be attributed to several factors related to the seismic event itself, Therefore, the response of ammonium to seismic activity is not uniform but may depend on the interaction between earthquake parameters (magnitude, distance, wave type) and the dominant ammonium source at the time of the event

4-3- Salhab Dam:

The changes in the results of chemical analyses of the elements (pH, NH_4, Cond, SS) of the Salhab Dam Lake were linked to the seismic events in the same time period, according to Figure (5):

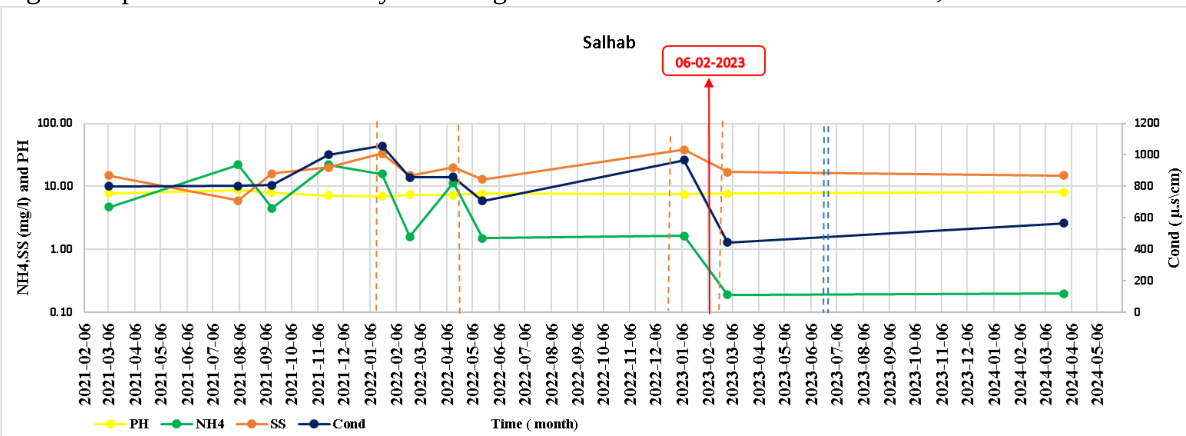

Figure (5) The curve of the change of chemical elements with seismic events during the years (2020-2021-2022-2023-2024) in the Salhab Dam. The red line is the February 6 earthquake. The brown dotted lines (seismic events). The blue dotted lines are the earthquakes near the dam site

• Electrical conductivity (Cond): There were sharp changes, both increases and decreases. It was observed that after the January 12, 2022, earthquake, with a magnitude of ML=3.3, its value decreased (1059–856 µ.s/cm). We also observed a sharp decrease after the February 6 earthquake (from 968 to 445 µ.s/cm).

• Acidity (pH): It remained within its pre- and post-earthquake values.

• Ammonia concentration (NH_4): There was a decrease in the value (from 15.8 to 1.6 mg/L) after the January 12, 2022, earthquake with a magnitude of ML=3.3. A further decrease in the ammonia value occurred after the April 15, 2022, earthquake with a magnitude of ML=4.3 (from 11.4–1.5 mg/L). A decrease was also observed after the February 6 earthquake (from 1.64 to 0.19 mg/L).

• Solids Suspended Solids (SS): The total suspended solids (SS) value increased after the January 12, 2022, earthquake by ML=3.3 (20-33 mg/L). However, a decrease in the SS value was observed after the April 15, 2022, earthquake by ML=4.3 (20-13 mg/L). A decrease in the SS value was observed after the February 6, 2022, earthquake (from 38 to 17 mg/L). Previous studies have indicated that total dissolved solids also increase the electrical conductivity concentration, meaning there is a mutual relationship between the two indicators. Taking into consideration that the dam lake water has experienced periods of drought over the years and has also experienced periods in which the reservoir reached below the dead volume. Which may effect on the results. In general SS and conductivity may change independently or even in opposite directions depending on which process dominates after each seismic event.

4-4- Abu Baara Dam:

The changes in the results of chemical analyses of chemical elements (pH Cond, NH_4,) of the Abu Baara Dam Lake were linked to the seismic events in the same time period, according to Figure (6):

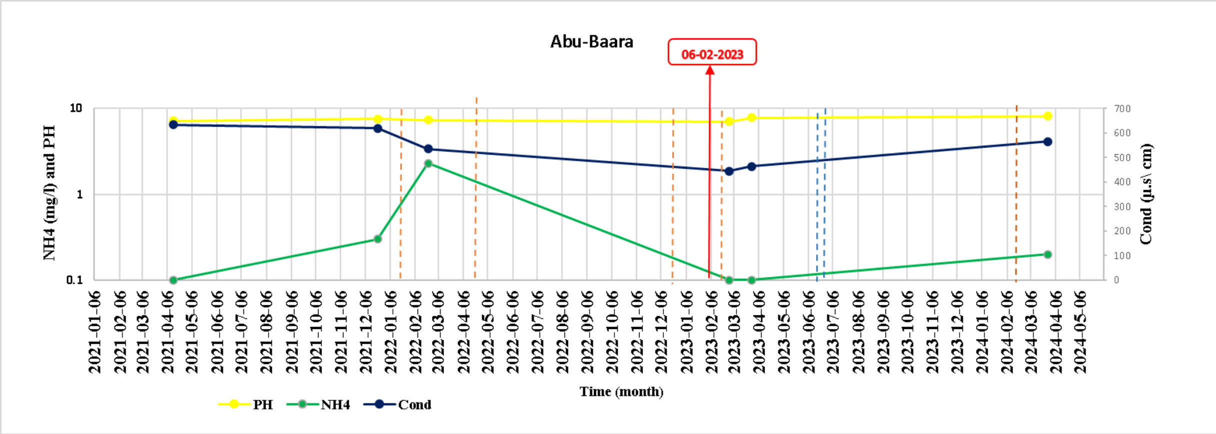

Figure (6) The curve of the change of chemical elements with seismic events during the years (2020-2021-2022-2023-2024) in Abu Baara Dam. The red line is the February 6 earthquake. The brown dotted lines (seismic events).The blue dotted lines are the earthquakes near the dam site

• Electrical conductivity (Cond): A decrease in the conductivity value (620-535) was observed after the January 12, 2022, earthquake, with a magnitude of ML=3.3. An increase in the electrical conductivity value was observed after the February 6, 2022, earthquake (from 444 to 466 µm/cm). It was also observed that after several events occurred near the dam site during the period of seismic activity following the February 6, 2023, earthquake, the conductivity values were gradually increasing.
• Acidity (pH): It remained within its values before and after the earthquakes, but a slight increase in its value was observed after the February 12, 2023, earthquake.
• Ammonia (NH_4) concentration: An increase in the value was observed after the January 12, 2022, earthquake, with a magnitude of ML=3.3 (0.3-2.3 mg/L).
• Note that the dam lake water has experienced periods of drought over the years, and there have also been periods in which the storage lake reached below the dead volume.

4-5-Possible geochemical mechanisms explaining the observed variations:

The variations observed in the chemical parameters of dam water before and after seismic events may be related to several geochemical and hydrological processes triggered by tectonic stress. Before earthquakes, increasing stress within rocks may lead to the formation or expansion of microfractures, which enhances the circulation of groundwater and facilitates the release of dissolved ions from surrounding rocks into the water system. This process may explain the sudden increases observed in electrical conductivity before certain seismic events. In other cases, decreases in conductivity may occur due to the mixing of different water sources. Changes in ammonia (NH_4) concentrations may be associated with disturbances in the nitrogen cycle within the reservoir environment. Conversely, decreases in ammonia may occur due to oxidation processes or dilution effects following changes in water circulation. Similarly, variations in suspended solids (SS) may result from sediment resuspension caused by seismic shaking or changes in water inflow after earthquakes. The different responses observed between the Rastan, Taldo, Salhab, and Abu Baara dams may be explained by variations in geological formations, reservoir depth, sediment composition, and hydrological conditions.However, these variations should be interpreted with caution because other environmental factors such as rainfall, reservoir level changes, and seasonal variations may also affect water chemistry

5- Discussion of the results:

By studying the relationship between changes in chemical element values (electrical conductivity, pH, chemical oxygen saturation, ammonia, and suspended solids) in the Rastan Dam and the seismic events that occurred between 2020 and 2024, the following was observed:

Sharp changes in some cases in the electrical conductivity concentration (cond) before the seismic events that occurred during the period between 2020 and 2024 within the dam area, with magnitudes ranging from 3.4 to 4.4. These values then decreased after these seismic events, particularly after earthquakes near the dam site. This was indicated by a study (Martínez-García et al., 2015) on atypical changes in water conductivity before approximately 241 earthquakes in a seismically active area in Mexico. The study linked these changes to the site's proximity to a seismically dense area or to the influence of electromagnetic fields resulting from rock movement. The pH level remained within its values before and after the seismic events that occurred between 2020 and 2024, which ranged between 3.4 and 4.4. As for the ammonia (NH_4) concentration, we note that it gradually decreased before these seismic events and continued after them, especially those close to the dam site. It was observed that after the 07-01-2022 seismic event near the dam site, with an MW=3, the ammonia value increased significantly, possibly due to this earthquake being very close to the dam site.

Before the seismic events, there was a gradual decrease in the values of suspended solids (SS) after several seismic events, especially after the February 6 earthquake. We note that a series of increases began after the seismic events in 2023. This is consistent with the results of a study conducted by Kong et al. (2022) on the effects of the Liwago River's water quality following the earthquake in Malaysia on June 5, 2015, with a magnitude of Mw = 6.0. According to this study, changes in water quality were a direct result of the earthquake or an indirect result (such as subsequent rainfall that increased sediment transport).

The chemical oxygen demand (COD) values, which are required to oxidize organic and inorganic materials, increased after the earthquake, while before the earthquake, they were within their values. This may be due to the impact of the earthquake on organic materials.

By studying the relationship between changes in chemical element values (electrical conductivity, pH, temperature, nitrate, ammonia) of the Taldo Dam and the seismic events that occurred between 2020 and 2024, the following was observed:

Sharp changes in the electrical conductivity concentration (cond) before the earthquakes and a decrease in it after the earthquakes, especially after nearby earthquakes. It was noted that before the February 6 earthquake, the value had clearly decreased. This was demonstrated by the results of a study (Martínez-García et al., 2015) on atypical variations in water conductivity before the earthquake in Mexico on January 21, 2015, with a magnitude of Mw 4.1. It should be noted that the decrease in electrical conductivity after earthquakes is not a universal pattern, but occurs in specific cases depending on factors such as earthquake proximity, magnitude .

A gradual A clear decrease in the electrical conductivity (Cond) and ammonia (NH_4) concentrations occurred before the February 6 earthquake. A slight increase in temperature (T) and nitrate (NO_3) concentrations was also observed after the seismic events. This may be due to the mixing of water with organic materials, which altered the concentration values due to the earthquake movement. Prior to the seismic events, these values were within their normal values. This was indicated by a study conducted by Koizumi et al. (2019) on hydrological changes following the Kumamoto earthquake of M 7.3 on April 16, 2016 in Japan.

The pH level remained within its pre- and post-seismic values. As for ammonia (NH_4), there was an increase in values after the nearby seismic events, and it was noted that before the February 6 earthquake, the value had clearly decreased. This is consistent with the study conducted by Kong et al. (2022) on the effects of the Liwagu River water quality after the 6.0 magnitude earthquake that occurred on June 5, 2015, in Malaysia.

By studying the relationship between changes in chemical element values (electrical conductivity, pH, suspended solids, ammonia) of the Salhab Dam and the seismic events that occurred between 2020 and 2024, the following was observed:

A gradual rise in electrical conductivity (Cond) concentration values before the earthquakes, followed by a decline after the earthquakes, especially after the February 6 earthquake. This was indicated by the study (Martínez-García et al., 2015) on atypical variations in water conductivity before the earthquake in Mexico on January 21, 2015, with a magnitude of Mw 4.1. This observation is preliminary and not consistently supported across all events. Further monitoring with higher temporal resolution is needed to confirm this trend.

The pH level remained within its pre-earthquake values, and a decline in ammonia (NH_4) concentration values after the seismic events, especially after the February 6 earthquake. Before that, there were several changes in values. This is consistent with what was concluded in the study (Kong et al., 2022) on the effects of the Liwago River water quality after the earthquake in Malaysia. Suspended solids (SS) values began to gradually rise before the seismic events and continued to rise after the seismic events. However, a decrease in values was observed after the February 6 earthquake. This was indicated by (Kong et al., 2022) in their study of the effects of the Liwago River water quality after the June 5, 2015, earthquake of magnitude 6.0 in Malaysia. The study also indicated that total dissolved solids also increases the electrical conductivity concentration, and the volume of rainwater may be a factor in this change. Note that the dam lake water has experienced drought periods over the years and also experienced periods in which the storage level reached below the dead volume.

By studying the relationship between changes in chemical element values (electrical conductivity, pH, ammonia) of the Abu Baara Dam and the seismic events that occurred between 2020 and 2024, the following was observed:

Electrical conductivity (Cond) values increased after seismic events near the dam. A decrease in the electrical conductivity (Cond) concentration was observed after several seismic events, while before the earthquakes, it remained within its values. This was indicated by a study (Martínez-García et al., 2015) on atypical variations in water conductivity before the earthquake in Mexico on January 21, 2015, with a magnitude of Mw 4.1.

The acidity (pH) level remained within its values before and after the earthquakes, but an increase was observed after the February 6 earthquake. This is consistent with a study (Kong et al., 2022) on the effects of the Liwago River water quality after the earthquake that occurred on June 5, 2015, with a magnitude of Mw 6.0. In Malaysia.

Ammonia (NH_4) concentrations gradually increase before seismic events, especially those close to them. These levels continue after earthquakes, but a decrease was observed after the February 6 earthquake and this is likely due to the exceptional magnitude of this earthquake.

Note that the dam's lake water has experienced periods of drought over the years, and there have also been periods when the reservoir reached below the dead volume.

6- Conclusions:

By studying the It was found that electrical conductivity (Cond) values changed significantly before earthquakes, either by a sudden drop or a sudden increase in values in all dams. And a significant drop in electrical conductivity (Cond) and ammonia (NH_4) values occurred before the February 6 earthquake at the Continuous monitoring of water chemistry in dam reservoirs located in seismically active regions may provide useful indicators that could contribute to future earthquake precursor studies.

The acidity level (pH) remained within its pre- and post-earthquake values in all dams studied (Rastan, Taldo, Salhab, and Abu Baara). So we can say that the seismic activity have no effect on acidity level.

Suspended solids (SS) values were gradually rising before the seismic events and continued after the seismic events in both Rastan and Salhab dams.

Chemical oxygen saturation (COD) values increased. The required oxidation of organic and inorganic materials (COD) after the seismic events, while before the seismic events, there was no noticeable change.

The Nitrates values (NO_3) increased after the seismic, and there was a slight increase in temperature (T) after the seismic.

The interaction between seismic activity and these parameters is correlated to earthquake characteristics, site geology, reservoir properties, and hydrological conditions and this explains the variable responses between dams and seismic events.

Funding: This Research is funded by Damascus University-Funder no (501100020595).

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