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Chemofacies of Qom formation in the Northwest of Tafresh based on geochemical data

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Abstract

The aim of this study is to analyze the chemical facies of the Qom Formation in the northwest of Tafersh based on geochemical data.
The studied area includes a part of the 1:1000000 Farmahin quadrangle geological map, which is located in the northwest of Tafersh city and north of Arak city.
The lithology of the Qom Formation in the study area consists of limestone, sandstone and marl.
The Eocene volcanic rocks with erosional discontinuity are put on top of the sediments of the Qom formation in the examined portion, which have a thickness of 473 meters. In the end, alluvial sediments covers this sequence.
For geochemical studies, 16 limestone samples were selected and subjected to primary mineralogical analysis.
To achieve the goals of this study, two sections AB and CD were selected for sampling. The desired samples were taken to the laboratory for examination. Then the collected samples were turned into powder for chemical analysis. 200 grams of each sample were crushed into powder.
The geochemical study of limestones in the studied area showed that limestones are mainly found in the semi-polar Permian region and in the present-day tropical aragonite range, and they are close to all the carbonate samples of the present-day temperate regions of Tasmania.
This feature is due to the calcite-aragonite mixed mineralogy in these limestones. Also, this study showed that some samples are in the range of Permian cold water limestones with calcite mineralogy and have a low correlation.

Introduction

Distinguishing between primary mineralogy of aragonite and calcite in ancient limestones is challenging. The use of X-ray diffraction method and the magnesium content of ancient limestones is not very useful in differentiating basic aragonite from calcite, because most ancient limestones have been affected by meteoric conditions or burial diagenesis and turned into low-magnesium (low-magnesium) calcite. In open diagenetic environments, low-Mg calcite remains largely stable and undergoes only minor chemical changes. Aragonite carbonates are inferior models for meteoric diagenesis compared to calcitic limestones.

To understand the temperature of depositional environment, diagenesis and geochemistry of carbonates, it is necessary to distinguish

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aragonite from calcite. The best criterion for distinguishing modern carbonate (limestone) sediments from their ancient counterparts is the change in trace element ratios between cold water and warm water sediments. This change is caused by the different proportions of trace elements in cold water and hot water limestone carbonates, which in turn affects the structure of the carbonates. This study was conducted with the aim of investigating the geochemical properties of sediments and the primary mineralogical composition of carbonate rocks of the study area using the changes of major and rare elements. The studied area includes a part of the 1:1000000 Farmahin quadrangle geological map, which is located in the northwest of Tafersh. The access roads of the area include the asphalted roads of Salafchegan-Tafresh, Tafresh-Ashtian-Farmhin, Arak-Tafresh, Tafresh-Frak village and the road under construction Tafresh-Nubran (Figure 1). The studies conducted on the Oligocene-Miocene limestones of central Iran have been significant due to the possibility of hydrocarbon deposits. Gansser proposed the term "Qom Formation" for these lithological units in 1955. The variety of facies features and lateral changes observed in this formation have led to the fact that no model section has been introduced for this formation so far, and only the southern slopes of the Qom Plain have been selected as a model area due to their considerable thickness and good exposures (Bozorgnia; & Stocklin, 1966). The abundant diversity of the lithological units of the Qom Formation has led to the division of this formation into smaller units, such that Furrer & Soder (1955) divided the deposits of the Qom Formation into sections a to f and stated the age as Oligo-Miocene. Furrer & Soder (1955) place the Qom Formation in the Shorab studied and defined (a) basal sandstone, (b) sandy marl, (c) alternating marl and sandstone, (d) feldspar, (e) greenish-gray marl, and (f) basal sandstone. After introducing member f, he introduced member g as the base of the Upper Red Formation, while Baghbani et al. (2009) in their second section, in addition to the classification of members a to g, stated that the deposits of member g are covered by a discontinuity of the Upper Red Formation (Bozorgnia, 1966; & Stocklin, 1971; Setudehnia, 1971, Agha-Nabati, 2010).

Berberian (1983) considers the birth of the Qom sedimentary basin as a result of the subduction of the young oceanic crust under central Iran.

Nogul Sadat (1985) conducted further research on the Qom Formation and proposed three sedimentary basins, each sedimentary cycle starting with shallow marine facies and ending with gypsum and anhydrite lagoonal facies.

Imendoust (2006) investigated the Qom formation in the southwest of Saveh to the southeast of Qom, and the sedimentary environment of the Qom formation was introduced as the edge of the Qom shelf.

Karimi Mossadegh (1) also studied the Qom Formation in the southwest of Saveh and west of Qom and in his study he considered the age of the deposits to be Aquitanian-Burdigalian.

Also, Danishian and Bakhtiari (2001) identified 26 sediments and 31 types of benthic framework, identified two sections in the northwest of Saveh and suggested the age of Burdigalian earlier and the abundance of the area indicates a shallow sedimentary environment with a warm climate. Okhravi and Amini (1377), on the long-term status of F-Qm from the Qom formation in the Iranian Basin. Vaziri and Torabi (2002) and Seyrafian and Torabi (2003) investigated the sedimentary environment of the Qom formation in the southwest of Ardestan and north of Nain, respectively.

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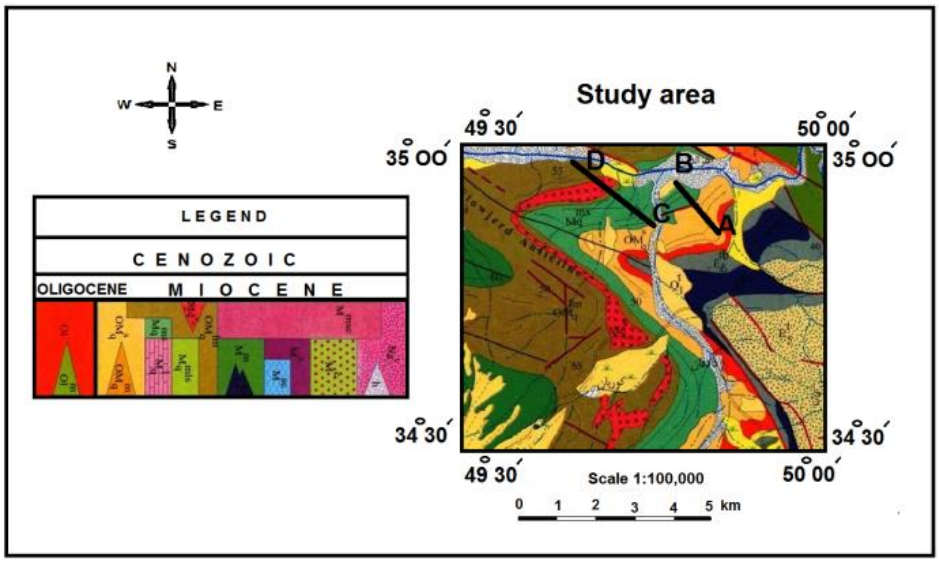

Figure 1: The position of two points AB and CD of the studied area of Qom formation in the southwest of Saveh (north of Arak) in the geological map of Farmahin (Hajian, 1970).

Methodology

To achieve the goals of this study, two sections AB and CD were selected for sampling.

The desired samples were taken to the laboratory for examination. Then the collected samples were turned into powder for chemical analysis. 200 grams of each sample were crushed into powder.

The chemical mineralogy determination test was performed using the XRF method and based on the reference standard ASM E 1621 13 at a laboratory temperature of 25 degrees Celsius and a humidity level of 30%.

The result of the chemical analysis of the sent sample was obtained by the XRF device based on the weight percentage of the constituent elements and compounds. Some elements cannot be identified and are less than the device measurements. The sample was heated at 900°C for one hour to measure L.O.I (lost weight).

Discussion

The figure 2 shows the changes of Fe, Mn, Na, Sr elements in the collected samples. According to this figure, the highest value is 183.6 ppm and the lowest is 100 PM. The highest amount of sodium is 876 ppm and the lowest is 640 ppm. The highest amount of manganese is 69.3 ppm and the lowest amount of manganese is 29.6 ppm. The highest amount of iron is 3254 ppm and the lowest amount of iron is 1406 ppm.

Figure 3 shows the ratio of Sr/Mn, Sr/Na elements. Based on this figure, the highest amount of sodium is 0.2622 ppm and the lowest amount is 0.1356 ppm. The highest amount of strontium to manganese is 0.5347 ppm and the lowest layer to manganese is 0.1677 ppm.

In this study, the analysis of geochemical data using the amounts of major and rare elements was used to determine the primary mineralogy of deep carbonates. Data related to iron,

manganese, sodium and strontium elements with tropical and temperate carbonate range (Milliman, 1974), tropical Ordovician carbonate with primary aragonite mineralogy (RAO, 1991), cold subpolar Permian carbonates with calcite mineralogy (RAO, 1991), in Tasmania, Australia, and the mineralogy of early aragonite in deep limestones is compared.

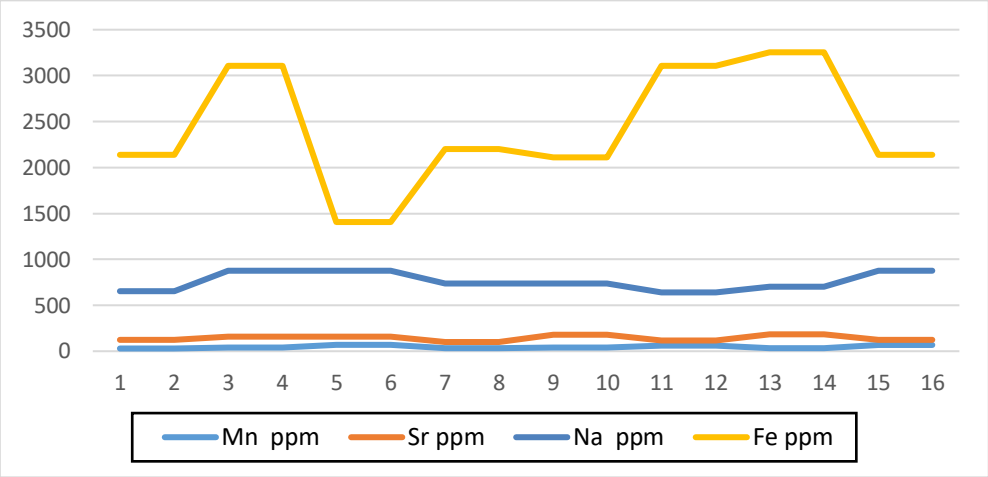

Figure 2: Diagram of changes of elements in lithological units of the studied area

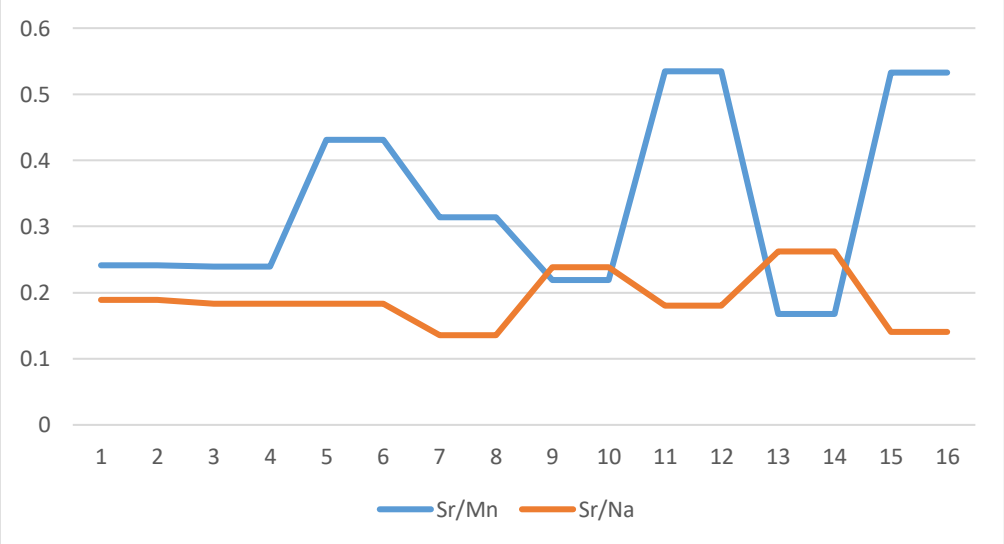

Figure 3: Diagram of element ratio changes in lithological units of the studied area

Early aragonite mineralogy in deep limestone

According to some researchers, calcite first appeared as an important mineral in the Early and Middle Paleozoic and Jurassic, and carbonate mineralogy has changed since the Phanerozoic (Sandberg, 1975, 1983; Wilkinson et al., 1985). Major and rare elements were used to investigate the primary mineralogy of Qom limestone. Data related to the Fe, Mn, Na, Sr elements of the studied area and with the range of temperate tropical carbonates (Milliman, 1974), carbonates of the Mozdouran Formation

in the Lower Jurassic, tropical Ordovician carbonate, tropical Ordovician carbonate with primary aragonite mineralogy (Rao, 1991), cold subpolar Permian carbonates have been compared with calcite mineralogy (Rao, 1991), in Tasmania, Australia, and early aragonite mineralogy in deep limestones (Mozdouran Formation).

Strontium

The amount of Sr in the total carbonate samples (Bulk) of the tropical regions of the present is between 8,000 and 10,000 ppm in change (Milliman, 1974), while in the total carbonate specimens the present -day carbon regions have less range and between 1642 to 1642 to 5007 ppm (average 3270 ppm) fluctuates (Figure 2). The amount of Sr varies depending on the mineralogy of carbonates.

The amount of Sr increases with an increase in aragonite levels and decreases with increased calcite. The abundance of Sr is also directly related to the increase in seawater temperature (Morse and Mackenzie, 1990).

Usually, semi -stable CaCo3 minerals are changed to calcite during metauric or burial diagezes, and so the amount of Sr in diagonal calcite depends mainly on the partition coefficient and their focus on diagonal solutions.

Since the Sr distribution coefficient is less than 1 and its focus on meteorical water is insignificant, the resulting diagonal calcite will have a low focus.

The value of the Sr and in study area is between 100 and 183 ppm (average 141 ppm) in change (Figure 2). The Sr values of these samples are much lower than the equivalent values of their present, because the Sr decreases significantly during meteoric diagrams.

Sodium

Na values in calcareous samples in the deep part of the basin are between 44 and 525 ppm (average 144 ppm) in change (Fig. 2).

Drawing of Sr-Na values in these lime indicates a systematic decrease in the amount of both Sr and Na elements, probably due to an increase in the effect of non-marital diagnosis (Fig. 6).

In this chart, a positive relationship between Sr and Na values is probably due to the similar separation coefficients of these two elements in carbonate minerals. In this form, most of the data is located within the range of cold -water limestone rocks of the Permin, and some are located within the range of limestone Aragonitic mercenaries.

The Qom formation in study area is located in the lower part of the permian cold water limestone areas, Mozdouran aragonite limestone. This may be due to the mixture aragonite and calcite in these limestone.

Manganese

Mn values in the total carbonate specimens of the present temperature regions vary from 1 to 311 ppm (average of 69 ppm) 1. The focus of the Mn on the limestone studied area in question is between 29.6 and 69.3 ppm (average of 64.25 ppm) in change (Figures 5 and 6). Mn values increase with decreased aragonite percentage (RAO and ADABI, 1992) and increase with the effect of metauric water. 2. Mn focus also decreases with increased sedimentation rate (Pingitore Etal., 1988; Mucci, 1988). Usually in carbonate near the beach due to the abundance of mn and Fe (amini and rao, 1998).

Sr-Mn changes

The diagram of Sr-Mn changes in the studied limestone is presented in Fig. 4.

Figure 2 shows that the carbonate samples of the study are located in the range of granted limestone of Gordon ordovivian with aragonitic mineralogy. The area with criteria shows that the area studied is within the area of ordovivian Aragonitic limestone and is generally low in the area.

Qom Formation in the study area with Aragonitic limestone ranges of Mozdouran (Adabi and Rao, 1991), total carbonate samples of the recent temperament (Rao and Adabi, 1992) and Aragonitic samples of the recent (Milliman, 1974) is compared.

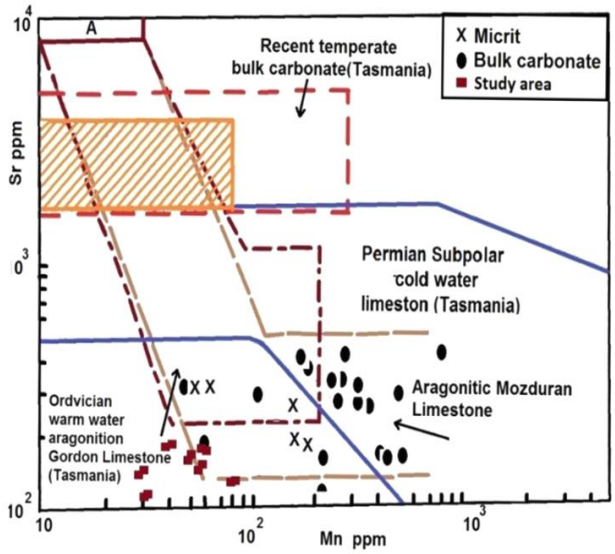

Figure 4: Comparison of Sr and Mn values in calcareous rocks of the study area related to the shallow section of the basin (adabi and rao, 1991).

Note that most calcareous samples are located at the bottom and some within the Aragonite carbonate range of Qom, which is probably due to the mineralogy mixture of aragonite and calcite.

As mentioned earlier, the focus of the Sr in carbonate depends on their mineralogy and water depth, meaning that it decreases by reducing aragonite levels or increasing water depth.

Therefore, the low concentration of Sr in these samples is due to increased water depth and increased calcite mineralogy (HMC + LMC), compared to aragontic mineralogy in the shallow section of the basin (Adabi and Rao, 1996).

Na-Mn changes

Changes Na and Mn Figure 5 changes Na and Mn values in Qom's limestone in the study area.

According to the above figure, samples are located in the range of Tasmania's Gordon limestone with Aragonitic mineralogy.

Comparison of the study area sequence with criteria area shows study lithology is aragonite mineralogy.

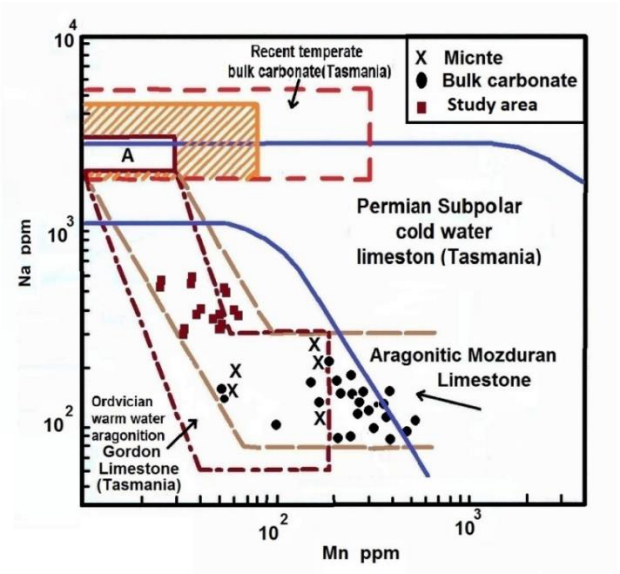

Figure 5: Changes of Na and Mn values in the limestone of the study area related to the shallow part of the basin and the symptoms used are similar to Fig. 2.

Sr-Na changes

Changes Sr and Na The diagram of Sr-Na changes in the studied limestone is presented in Fig. 2.

According to Figure 6, in the Qom Formation, most samples are located within the grassland of Gordon with Aragonitic mineralogy. (Adabi and Rao, 1991). The most of the data is in the range

of semi -polar limestone and is lower than it and has a low correlation coefficient.

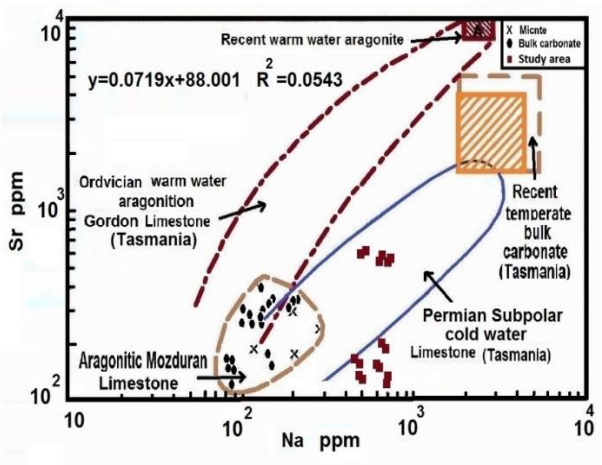

Figure 6: Sr and Na changes in limestone in the study area.

Sr/Mn changes vs. Mn

The changes of Sr/Mn and Mn in the limestone samples of the Qom Formation in the target area show that they are in the range of warm water aragonite limestone belonging to the Ordovician period (Adabi and Rao, 1991) and the aragonite limestone of the Mazdooran Formation. (Rao and Adabi, 1992).

Drawing of Na values against Mn (Fig. 5) also shows that the changes of Na and Mn in Qom are the study area above the limestone of the mercenaries located in the deeper part of the basin.

Note that some samples are located at the top of the limestone of mercenaries and some in the range of aragonite Mozdouran limestone, which indicates a mixture of aragonite and calcite in these samples.

Figure 5 shows that most samples are located at the bottom of the Aragonitic Gordon limestone and away from the total carbonate specimens of the recent temperate regions. The study area and criteria show (Farmahin, 2015) is in the Ordovician limestone area with Aragonitic mineralogy.

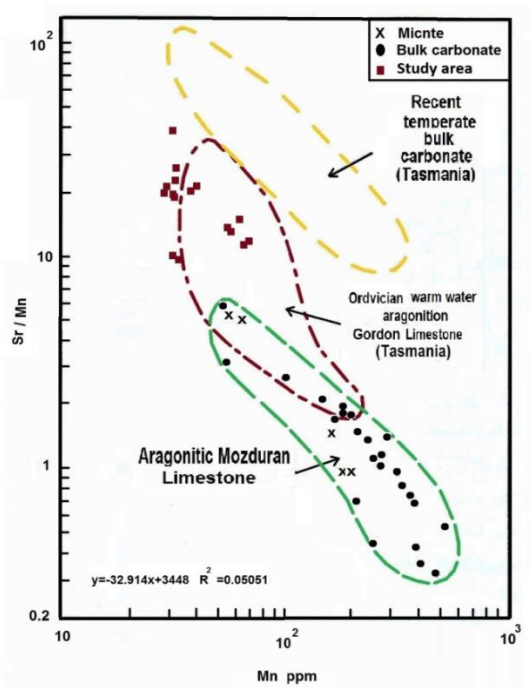

Figure 7: Sr/Mn changes against Mn in Qom Formation Lime Stones (shallow section of the basin) compared with the total carbonate specimens of temperate regions and tropical Aragonite limestone (Gordon) (Rao, 1991).

Sr/Na changes vs. Mn

Figure 6 indicates Sr/Na changes against Mn in Qom Formation Limestone in the northwest of Tafresh.

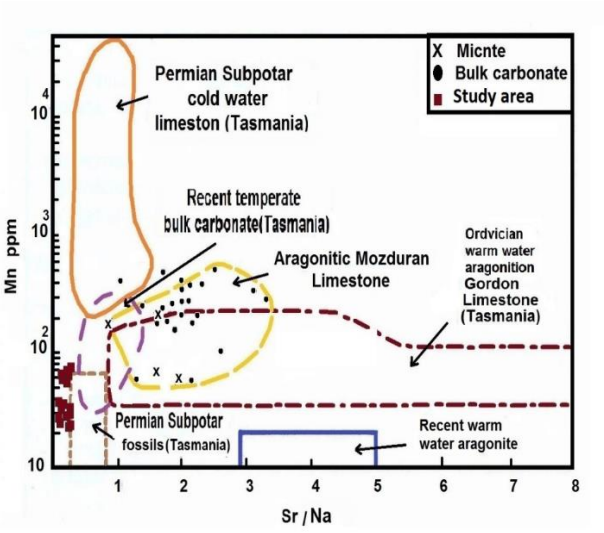

Figure 8: Sr/Na changes vs. Mn in limestone in the study area Related to the shallow section of the basin.

Most data related to Qom limestone in the study area above the semi-polar limestone (RAO, 1991), and near the total carbonate specimens of the present-day Tasmania (RAO and Adabi, 1992; Rao and Jaywardane , 1994; rao and amimi, 1995) This may be due to the mineral mineral mineral mineral and aragonity in these limestone.

The study area and criteria show (Farmahin, 2015) Some samples are in the range of cold -water limestone with calcite mineralogy with low correlation coefficient.

Relationship of destructive elements in the shallow areas of the basin

Iron

Iron values in Qom Formation Limestone in the study area are between 1406 and 3254 ppm (average 3033 ppm) in change. There is very little information on the amount of iron in the shallow marine carbonate aragonite of the present hot water. In the studied limestone, due to the increase in the effect of metauric diagrams, iron values increase with increased Mn values (Fig. 7).

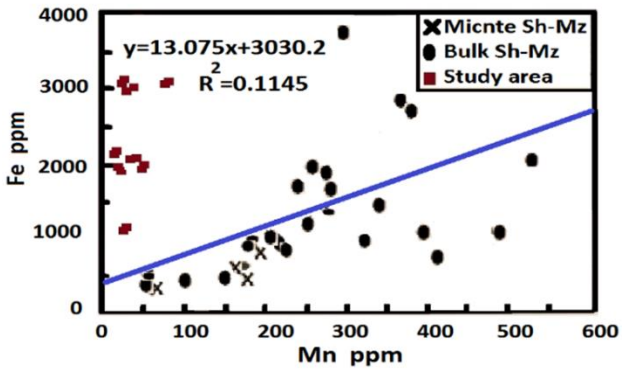

Figure 9: Fe and Mn changes in calcareous rocks of Qom

Iron concentration is usually increased by increasing the percentage of insoluble residue (IR) in acid, as iron may be added to the solution through the dissolution of non -soluble substances in acid. Therefore, it is best to skip carbonate specimens that contain non -acidic materials (> 15 %). In carbonate facies, it is usually the possibility of the presence of non -carbonate elements, which are more expressive of destructive origin. For this purpose, in this study, the relationship between Fe and Mn changes is presented in Figure 7.

The subject of the study area and the areas of the criteria give the calcareous rocks of the Qom Formation (the shallow part of the basin and the coefficient of the coefficient).

Sr/Mn ratio to Mn

In the diagram of the relative changes of Sr/Mn to Mn (Fig. 8), some limestone data are inside and some are under the range of Gordon Aragonitic limestone, which is due to the low Sr value compared to the Mn in mercenary lime samples Be.

In this diagram, the total carbonate specimens of the present -day marine seas are located above the range of limestone stone of Gordon and the limestone of mercenaries, as the recent marine carbonate is not affected by the diagnosis processes and thus more Sr than Mn.

Figure 8 shows that most samples are located at the bottom of the Aragonitic Gordon limestone and away from the total carbonate specimens of the present -day temperate regions.

Mineralogy of the area sequence is Ordovician limestone with aragonitic mineralogy. In the Treasury Aragonitic limestone the present is the low amount of Mn and the ratio of Sr/Na high (about 3 to 5), while calcite calcite limestone traces of the present -day Mn value and ratio of Sr/Na low (about 1) Is (Figure 9).

Sr/Na Changes versus Mn (Fig. 8) Factory in the study area of semi -polar limestone (RAO, 1991), Treasury Aragonitic Range (A; Milliman, 1974) and nearly Carbonate Tasmania's moderate areas (Rao and Adabi, 1992; Rao and Jaywardane, 1994; Rao and Amimi, 1995)

In the study area, some samples are in the range of cold -water limestone with calcite mineralogy and low correlation coefficient. The depth of the basin) also had primary aragonite mineralogy.

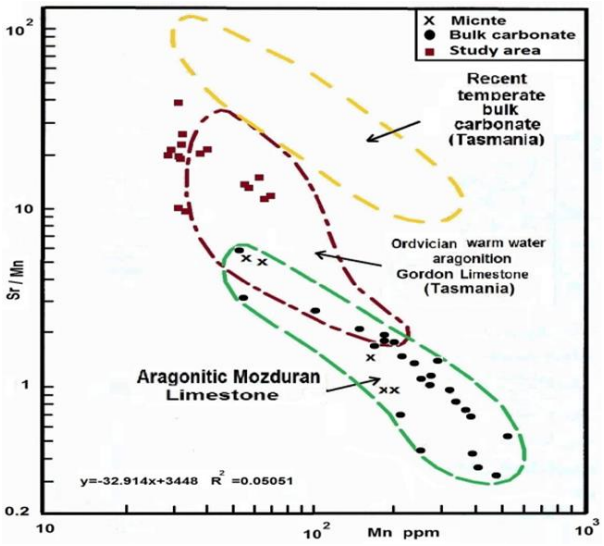

Figure 10: Sr/Mn changes against Mn in the limestone of the study area (shallow basin).

Note that Qom data (the study area) is located at the bottom of the Aragonitic Gordon limestone and away from the total carbonate samples of the present -day temperate regions. The area limestones are in the Ordovician limestone area with aragonitic mineralogy.

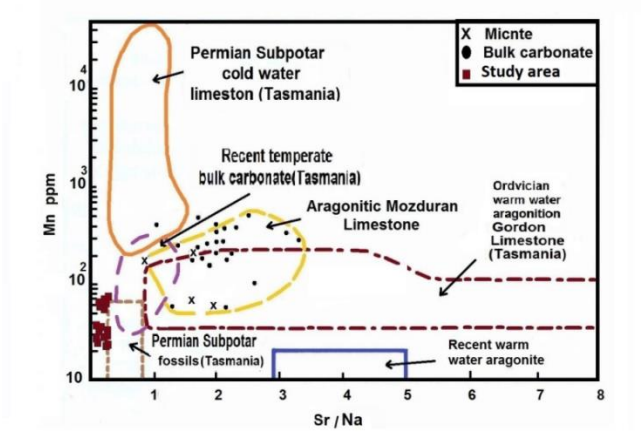

Figure 11: Sr/Na changes against Mn in the limestone of the study area (shallow section of the basin).

Most data related to Qom limestone in the study area above the semi-polar limestone (Rao, 1991), and near the total carbonate specimens of the present -day Tasmania (Rao and Adabi, 1992; Rao and Jaywardane , 1994; rao and amimi, 1995).

Conclusion

The Eocene volcanic rocks with erosional discontinuity are put on top of the sediments of the Qom formation in the examined portion, which have a thickness of 473 meters. In the end, alluvium covers the sediments, leaving them exposed. Using major and minor elements, the primary mineralogy of limestone was used in this research to comprehend the primary mineralogy of paleocarbonates. Chemical data (Fe, Mn, Na, and Sr) has been compared to the carbonate ranges of the areas' current ages.

Changes Sr-Mn of the study area is in the area of Ordovician limestone of Aragonitic and is generally low in the area.

Changes Na – Mn of studied area is located in the area of Gordon Tasmania with Aragonitic mineralogy.

Changes Sr – Na of the study area and benchmark areas show, most of the data is within the range of semi -polar limestone and lower than it and has a low correlation coefficient.

changes Sr/Mn against Mn shows the study of the area studied is within the Ordovician limestone area with aragonitic mineralogy. Sr/Mn changes against Mn: The study of the area studied is within the Ordovician limestone area with aragonitic mineralogy.

Changes Sr/Na shows the present covenant is Tasmania. The subject of the study area and the criteria show that some samples are in the range of cold -water limestone with calcitic mineralogy with low correlation coefficient.

In relation to the destructive elements, the iron values in the Qom Formation Limestone in the study area are between 1406 and 3254 ppm (average of 3033 ppm) in change. In the studied limestone, due to the increase in the effect of metauric diagrams, iron values increase with increased Mn values. In carbonate facies, it is usually the possibility of the presence of non -carbonate elements, which are more expressive of destructive origin.

Relative changes in Sr/Mn shows the total carbonate specimens of the present -day marine seas are located above the range of limestone stone of Gordon and the limestone of mercenaries, as the present -day marine carbonate is not affected by the diagnosis processes and thus more Sr than Mn.

Changes Sr/Na Against Mn shows formation sequence of study area is Permian Semi-Polar Limestones, the Aragonitic Range range of the present and close to the total carbonate specimens of the recent temperature of the present Tasmania.

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