Journal of Earth & Statistics
Journal homepage: http://www.Jes.arakut.ac.ir
Doi: 10.22034/JES.2023.1999733.1029

Geochemical Data Mining of Carbonate Facies of Qom Formation in the Northwest of Tafresh (Deep Basin)

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Article Info

Keywords
Geochemistry, chemical facies, Qom formation, northwest of Tafresh, region, deep basin

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Abstract

In order to investigate the data mining analysis of carbonate facies of the Qom Formation in the northwest of Tafresh, the Qom Formation was selected by 16 samples and analyzed by the XRF method. In this study, using the main and sub -elements, the initial mineralogy of the limestone in the study area was used to identify the primary mineralogy of the ancient carbonate.

A measure for differentiating modern carbonate (limestone) sediments from their prehistoric counterparts is the variation in trace element ratios between cold water and warm water sediments. This variation results from the different trace element ratios in cold water and hot water limestone carbonates, which in turn affects the structure of the carbonates The element-related data (Fe, Mn, Na, Sr) of Farmahin area and with the range of tropical temperate carbonates (Milliman, 1974), Mozdouran formation carbonates in the lower Jurassic, Ardavian tropical carbonate, Ordovician tropical carbonate with primary aragenite mineralogy (RAO, 1991), Parmin subpolar cold carbonates with calcite mineralogy (RAO, 1991), in Tasmania, Australia, and the initial aragonite mineralogy in deep-rooted limestone (mercenaries formation) have been compared.

A study of the examined area and Section type and other areas demonstrated that Permian semi-polar limestones are found in the modern-day tropical aragonitic range and are near the total carbonate samples of the modern-day temperate regions of Tasmania. This is due to the mixed calcite-aragonite mineralogy in these limestones. The measurements of the investigated region and standard areas showed that some samples are in the range of Permian cold water limestones with calcite mineralogy and have a low correlation value. This finding and experimental research demonstrate that the mineralogy of carbonates is primarily dependent on water temperature.

To comprehend their basic mineralogy, the data of the limestone related to the comparatively deeper section of the basin have been compared with the data of the calcitic carbonates of the temperate areas of their current age

Introduction

It is challenging to differentiate between the main mineralogy of aragonite and calcite in ancient limestones. The use of the x-ray diffraction curve and Mg content of ancient limestones are not very helpful in differentiating basic aragonite from calcite because the majority of ancient limestones have been impacted by metalluric or burial diagenesis and transformed into low magnesium calcite (low-Mg). In open diagenetic environments,

low Mg calcite largely maintains its stability and only experiences slight chemical changes. Aragonite carbonates are inferior models for meteorite diagenesis compared to calcite limestones (James and Bone, 1989).

1. DISCUSSION

In this research, the initial mineralogy of the format limestone was used to determine the primary mineralogy of the deep-rooted carbonates using the primary and trace elements. The element-related data (Fe, MN, NA, SR), and with the range of carbonate of the tropical and temperate regions (Milliman, 1974), Ordovician tropical carbonate with primary aragenite mineralogy (RAO, 1991), Parmin subpolar cold carbonates with calcite mineralogy (RAO, 1991), in Tasmania, Australia, and the initial aragonite mineralogy in deep-rooted limestone (mercenaries formation) have been compared.

To comprehend the temperature of the sedimentation environment, diagenesis, and geochemistry of carbonates, it is essential to differentiate aragonite from calcite. A measure for differentiating modern carbonate (limestone) sediments from their prehistoric counterparts is the variation in trace element ratios between cold water and warm water sediments. This variation results from the different trace element ratios in cold water and hot water limestone carbonates, which in turn affects the structure of the carbonates. This study aims to investigate the geochemical properties of sediments and the main mineralogical composition of carbonates using contemporary research techniques, such as the use of changes in trace elements in the examined sections.

The study region contains a portion of Chahargosh 1:250000 Qom, which is located west of Tafresh city and north of Arak city. The area's access roadways include Salafchegan-Tafresh, Tafresh-Ashtian-Farmahin, Arak-Tafresh, Tafresh-Farak village, and the currently under construction Tafresh-Noubaran road, from which is possible to reach all areas of the area via side roads and traveled earth roads (Figure 1).

Studies on the Oligocene-Miocene limestones of western central Iran deserve consideration because of their size, significance as a predictor, and presence of hydrocarbon deposits. Loftus (1855) and Abik (1859) from the Urmia Lake, Tethys (1875) from Central Iran, and Ashtal (1911) from the Qom Formation were the first to record it. This stratified rock block has been known by several titles, but Ganser proposed the term "Qom Formation" for this unit in 1955.

During the oil discoveries of the Qom Formation in the south of Qom (Gansser, 1955 and Former and Sudar, 1955), six lithological units (A F) were specified in this format. Sudar (1959), while carefully studying the unit of C., divided the unit of C. to 4 units.

Bozorgia (1966), in the Kashan area, the older member can be added to the Qa'am, which has suggested that the member of the Bai Nam has been suggested. He also identified two sedimentary cycles with a advance from the south.

Berrian (1983) considers the birth of the sedimentary basin of Qom to be due to the subsishes of the young Tissi Oceanic shell under central Iran, which with the back of the back -arc spreading bow and the back of the bow. The deposits of the Qom Formation and the Alkaline volcanic processes have been accompanied by (Aghanbati, 1383). Nogel Sadat (1985),

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Further research conducted the Qom Formation and suggested three sedimentary circles that each sedimentary cycle with low marine facies began and ends with a cooling facial. The Saveh area is one of the areas where the study of the Qom Formation Deposits has long been paid to. This formation of geological maps with 1: 250000 Qom (Imami & Hajian, 1370), Saveh (Nogol Sadat et al., 1364), Hamedan (Sabzeh & House, 1369) and Buddamarhang (Blurchi & Hajian, 1358) Is placed. (Ayman Doust 288) By examining the Qom Formation in the southwest of Saveh to the southeast of Qom, 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 (Dervand Valley and Dodgen), and he considered the age of deposits in his studies, Ecinin -Bordegalin.

Also, Daneshian and Bakhtiari (2002) identified two slices in northwest of Saveh, identifying
26 sex deposits and 31 species of bentonic frameworks, and suggested the former
Bordebigalin age of the later, given the variety of diversity. And the abundance of the area of the area suggests a low -depth sedimentary environment with a hot climate. Akhray and Amini (1998), in the context of the long -standing condition of the F - Qom Member of the
Qom Formation in the Iranian Basin. Wazir and Torabi (2004) and Sarifian and Torabi (2005), Biofacs, Petropacenis and Sexing Qom, respectively, in the southwest of Ardestan and Shamal Nain, and examined the sedimentary environment of the Qom Formation in the aforementioned areas.

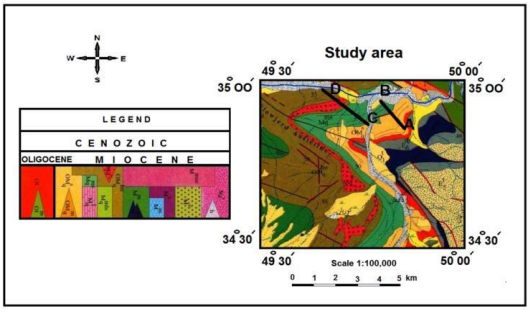


Figure 1: The location of the AB and CD area under study of the Qom Formation in the northwest of Tafresh (north of Arak) in the Geological Map of Fermin (Hajian, 1970).

2. METHOD

On the topographic map, the intended region was identified, and two sections—AB and CD— were identified for field operations. The intended samples were moved to the laboratory for examination. As part of numerous regional initiatives, the most effective grain size for collecting samples of water sediment is presented as an 80-mesh component. Geochemical samples with dimensions of -80 mesh are taken in Iran per standard practice in various geochemical projects. In this manner, the sampling site was used to gather 100–200 grams of
80-mesh waterway sediment, and the features of the sampling site and the samples themselves were documented in the description sheets. The test to determine chemical mineralogy using the XRF method. Reference standard: ASM E 1621 13- The temperature in the laboratory is 25 °C, and the humidity level is 30 percent. The result of the chemical analysis of the sample sent by the XRF device was obtained based on the wt% of the constituent elements and compounds. Some elements cannot be identified and are less than the device's measurement. The sample was located at 900 ° C for an hour to measure L.O.I (lost weight).

Diagnosing the primary Aragonitic mineralogy in deep-rooted limestone (Qom Formation in the studied field)

According to some scholars, calcite was first introduced as a significant mineral in the early and middle Paleozoic and Jurassic, and deep-rooted carbonate mineralogies have changed since the Phanerozoic (Sandberg, 1975, 1983; Wilkinson et.al. 1985). The major and trace elements as well as isotopic analyses were used in this research to examine the primary mineralogy of Qom limestone (Jurassic hips). The element-related data (Fe, MN, NA, SR) of

Farmahin area and with the range of tropical temperate carbonates (Milliman, 1974),

Mozdouran formation carbonates in the lower Jurassic, Ardavian tropical carbonate, Ordovician tropical carbonate with primary aragenite mineralogy (RAO, 1991), Parmin subpolar cold carbonates with calcite mineralogy (RAO, 1991), in Tasmania, Australia, and the initial aragonite mineralogy in deep-rooted limestone (mercenaries formation) have been compared.

Sampel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Composition	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage	Weighted Percentage
Na2O	2.8	2.79	1.2	1.19	1.2	1.19	1.01	1	1.01	1	2	1.99	0	0	1.2	1.19
P2o5	0.17	0.16	0.19	0.18	0.19	0.18	0.17	0.16	0.2	0.19	0.19	0.18	0.1	0.09	0.19	0.18
TiO2	0.66	0.65	0.65	0.64	0.60	0.59	0.31	0.3	0.61	0.6	0.66	0.65	0.31	0.3	0.66	0.65
Fe2O3	3.01	3	7.0	6.99	0.19	0.18	10	9.99	6	5.99	0.7	0.69	3.5	3.49	7.0	6.99
ZnO	0.12	0.11	0.03	0.02	0	0	0.02	0.01	0.04	0.03	0.01	0	0	0	0.01	0
SrO	0.03	0.02	0.8	0.79	0.8	0.79	0	0	0.1	0.09	0.02	0.01	0.11	0.10	0.03	0.02
Rh	0.01	0	0.01	0	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0	0.01	0	0	0
La2O3	0.01	0	0.01	0	0	0	0.02	0.01	0.02	0.01	0.01	0	0.01	0	0	0
MgO	3.01	3	4.0	3.99	3.8	3.79	3.2	3.19	5.5	5.49	3.0	2.99	2.0	1.99	3.6	3.59
Cl	0.25	0.24	0.18	0.17	0.21	0.2	0.17	0.16	0.04	0.03	0.19	0.18	0.04	0.03	0.17	0.16
V2O5	0.01	0	0.03	0.02	0.02	0.01	0.03	0.02	0.03	0.02	0.02	0.01	0.01	0	0.02	0.01
Co3O4	0	0	0	0	0	0	0	0	0.03	0.02	0.01	0	0	0	0	0
Y2O3	0	0	0.01	0	0.01	0	0	0	0	0	0.01	0	0	0	0	0
I	0.03	0.02	0.01	0	0	0	0.03	0.02	0.03	0.02	0	0	0.04	0.03	0	0
HfO2	0.01	0	0.01	0	0.01	0	0.01	0	0.01	0	0.01	0	0.01	0	0.01	0
Al2O3	12.5	12.49	13.4	13.39	12.7	12.69	12.9	12.89	13.1	13.09	12	11.99	4.5	4.49	12.9	12.89
K2O	4.5	4.49	4.0	3.99	4.6	4.59	4.5	4.49	4.0	3.99	4.0	3.99	0.96	0.95	4.5	4.49
Cr2O3	0	0	0.02	0.01	0.01	0	0.01	0	0.02	0.01	0.01	0	0.01	0	0.01	0
ZrO2	0.04	0.03	0.03	0.02	0.03	0.02	0.04	0.03	0.03	0.02	0.03	0.02	0.01	0	0.03	0.02
SiO2	42.2	42.19	15.5	15.49	12.7	12.69	12.3	12.29	45	44.99	12	11.99	9.7	9.69	12.3	12.29
CaO	8.5	8.49	47.9	47.89	49	48.99	42.3	42.29	8.03	8.02	47	46.99	44.4	44.39	48.8	48.79
MnO	0.04	0.03	0.05	0.04	9	8.99	4.08	4.07	0.05	0.04	8	7.99	0.04	0.03	8.5	8.49
CuO	0.03	0.02	0.04	0.03	0.05	0.04	0.05	0.04	0	0	0.04	0.03	0	0	0.04	0.03
Rb2O	0	0	0.02	0.01	0.03	0.02	0.03	0.02	0.03	0.02	0.02	0.01	0.01	0	0.02	0.01
BaO	0.04	0.03	0.04	0.03	0.05	0.04	0.04	0.03	0.14	0.13	0.04	0.03	0.04	0.03	0.04	0.03
PbO	0.02	0.01	0.01	0	0.02	0.01	0.01	0	0.03	0.02	0.02	0.01	0.01	0	0.01	0
SO3	2.3	2.29	2.04	2.03	2.8	2.79	2.9	2.89	2.4	2.39	0.4	0.39	0.04	0.03	0	0
Nb2O3	0	0	0.03	0.02	0.02	0.01	0	0	0	0	0.03	0.02	0.02	0.01	0	0
جمع کل	80.29	80.06	97.18	96.92	98.05	97.82	94.15	93.91	86.47	86.22	90.4	90.14	65.86	65.64	100.04	99.83
L.O.I	16.1	16.09	12.3	12.29	13	12.99	14	14.0	14.8	14.79	12.9	12.89	34.06	34.05	12.3	12.29
L.O.I	16.1	16.09	12.3	12.29	13	12.99	14	14.0	14.8	14.79	12.9	12.89	34.06	34.05	12.3	12.29

Table 1 : The chemical composition of the shales of the study area (main and minor elements)

Mineralogy of deep basin-related Aragonite-Calcite Mixture

High-magnesium calcite (HMC), with a small amount of aragonite, is the predominant mineralogy in the mild temperate carbonates of the current period (Collins, 1988; Rao and
Adabi, 1992) while the predominant mineralogy in the marine waters of today's cool temperate areas is a blend of high-magnesium calcite to low-magnesium calcite (LMC), with trace quantities of aragonite |(Nelson, 1988; Morse and Mackenzie, 1990; Rao and Adabi, 1992).

This finding and experimental research demonstrate that the mineralogy of carbonates is primarily dependent on water temperature. As a result, in paleocarbonates, carbonates from tropical, temperate, and polar areas can be distinguished from one another using the main mineralogical identity of carbonates as well as their geochemical features (Nelson, 1978; Rao,
1981a, 1988a,b). , 1991). Bulk carbonate, micrite, intraclast, oolite, and cement samples taken from the investigated basin's deeper regions were used to study the major and trace elements.

The values of trace elements in the majority of the limestone samples show a calcitearagonite mixture mineralogy. Given that calcite is the main carbonate mineralogy in comparatively cold waters, this shift in mineralogy may be linked to seawater temperature (Rao and Adabi, 1992). By contrasting total carbonate samples from temperate areas of the modern period, diagenesis in carbonates with primary calcite mineralogy can be better understood (James and Bone, 1989). To comprehend their basic mineralogy, the data of the limestone related to the comparatively deeper section of the basin have been compared with
the data of the calcitic carbonates of the temperate areas of their current age.

3. STRASSIUM

Sr values in the bulk carbonates of the temperate regions in the present era vary between 1642 .and 5007 ppm (mean 3270 ppm).

(Rao and Adabi, 1992; Rao and Jayawardane, 1994; Rao and Amini, 1995). Rao and Jayawardane (1994) examined carbonate samples from eastern Tasmania and found that the mixed high-Mg and low-Mg calcite mineralogy causes the Sr content in aragonite-free pure calcite to vary between 700 and 2700 ppm. Since non-biotic low-Mg calcite also has low Sr values, the rise of low-Mg calcite is the reason for the decline of Sr from 2700 to 700 ppm (640 to 40 ppm).

In modern calcitic bryozoans with elevated magnesium, the maximum Sr values of 2700 ppm are almost identical to the Sr value of 3000 ppm (Milliman, 1974).

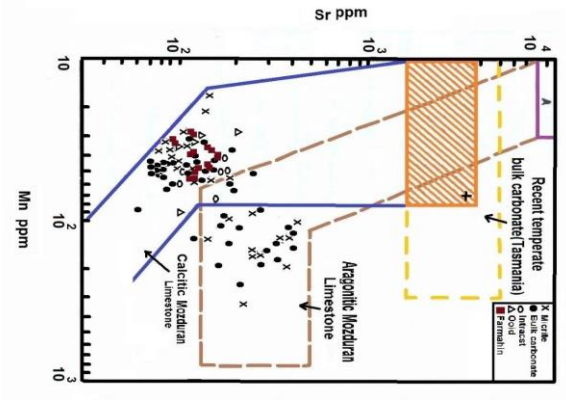


Figure 2: Sr and Mn changes in limestone in the study area.

Qom Formation in the study of the Aragonitic Limestone Rangers (ADABI and RAO, 1991), the total carbonate samples of the present -day temperament (RAO and Adabi, 1992) and the Aragonitic specimens of the present tropical regions (A; Milliman , 1974) compared.

It is worth noting that due to the combined mineralogy of aragonite and calcite, the majority of

the limestone samples are found below and some are within the aragonite range of Qom carbonates.

Figure 2's categories and symbols are similar to some of those used here.

In comparison to their aragonite equivalents found in the shallower portion of the basin, the majority of the limestone samples found in the deeper regions of the basin have lower Sr values (mean 340 ppm).

As was already stated, the percentage of Sr in carbonates is influenced by their mineralogy and the depth of the water, i.e. it diminishes as aragonite content or water depth increases.

As a result, the rise in water level and the increase in calcite mineralogy (HMC + LMC) in comparison to aragonite mineralogy in the shallow portion of the region account for the low abundance of Sr in these samples (Adabi and Rao, 1996).

4. SODIUM

In limestone samples found in the deep portion of the basin, Na concentrations range from 44 to 525 ppm (mean 144 ppm) (Figure 2). The Sr-Na ratios in these limestones show a systematic decline in both Sr and Na elements as a result of the growing impact of non-marine diagenesis (Figure 3).

The identical dissociation factors of these two elements in carbonate minerals are most likely the cause of the positive correlation between Sr and Na values in this graph.

Most of the information in this figure is found in the Permian semi-polar cold water limestone region, while some are found in the Mazdooran aragonitic limestone range. Mazdooran aragonite limestones are found in the Qom (Farmahin) formation, which is a component of the Permian cold-water limestone regions. The combined mineralogy of calcite and aragonite in these limestones may be the cause of this issue.

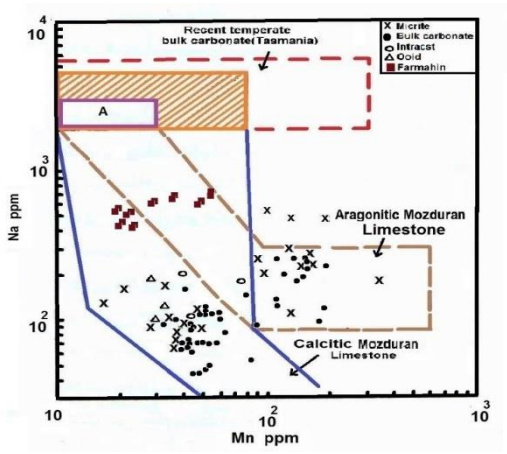


Figure 3: Na and Mn changes in the study area.

Changes of Na and Mn of Qom formation are located at Farmahin in the upper part of Mazdooran limestone in the deeper part of the basin. It should be noted that some of the examples are embedded in Mazdooran aragonite limestone and some are found on top of Mazdooran limestone, indicating mixed calcite-aragonite mineralogy in these samples.

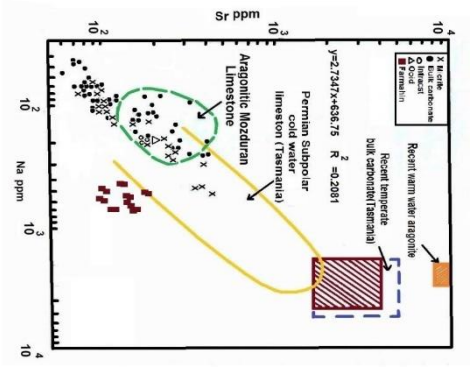


Figure 4: Sr and Na changes in limestone in the study area.

In the Qom Formation of studied area, located in the lower part of the cold water limestone ranges of the Permian, Mazdooran aragonite limestones are found in the Qom Formation of the study area and compared to aragonite samples from tropical regions of the present age and total carbonate samples from temperate regions of the present age.

In addition, some samples fall into the lowest category of Mazdooran aragonite limestone, while others fall into the category of Permian cold-water limestone with calcite mineralogy.

The mixed mineralogy of calcite and aragonite in these limestones may be the cause of this issue.

5. MANGANESE

Mn concentrations in samples of total carbonate from temperate regions today range from 1 to 311 ppm (mean 69 ppm) (Rao and Adabi, 1992; Rao and Jayawardane, 1994; Rao and Amini, 1995).

The examined limestone's Mn content ranges from 29.6 to 69.3 ppm (with a mean of 64.25 ppm) (Figures 2 and 3).

Mn values increase with decreased aragonite percentage (RAO and ADABI, 1992) and increase with the effect of metauric water. 6 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).

The variations of Sr and Mn in these samples (Figure 4) from the limestones of the Qom
Formation in the studied area have been compared to those of the aragonite limestones of the Mazdooran Formation (Adabi and Rao, 1991), the total carbonate samples from the temperate regions of the present era (Rao and Adabi, 1992), and the aragonitic samples from tropical
regions of the present age (A; Milliman, 1974).

It is worth noting that due to the mixed aragonite-calcite mineralogy, the majority of the limestone samples are found below and in some cases inside the aragonite range of Qom
carbonates.

Drawing Na versus Mn values (Figure 4) also demonstrates variations in Na and Mn in the Qom Formation above Mazdooran limestones found in the basin's lower region. It should be noted that some of the samples are embedded in Mazdooran aragonite limestone and some are found on top of Mazdooran limestone, indicating mixed calcite-aragonite mineralogy in these
samples.

6. IRON

Iron levels in Qom Formation, the research region, range from 1406 to 3254 parts per million (ppm), with a mean of 560 ppm (Figure 5). Non-carbonate elements, which are more suggestive of a damaging origin, are frequently possible in carbonate facies. Figure 5
illustrates the relationship between variations in Fe and Mn.

Since the concentration of iron rises with diminishing acid-insoluble materials (IR) and rising water depth, the low concentration of iron in these samples can be related to a shallower water depth and less detritus penetration. Due to the impact of non-marine diagenesis, the
quantity of Fe has risen in the studied limestones along with the increase in Mn (Figure 5).

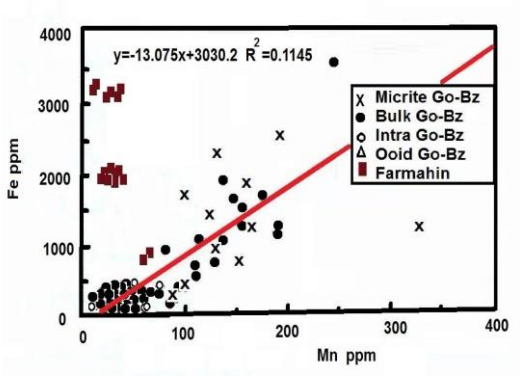


Figure 5: Fe changes vs. Mn in calcareous samples located in the study area

Fe versus Mn ratio changes in limestone samples taken from the deep part of the basin. In this graph, notice how iron and manganese have a positive correlation.

The limestones of the Qom Formation have a low correlation value and are not linked to the deep section of the basin, as shown by the Magasieh (studied area) and Section type regions.

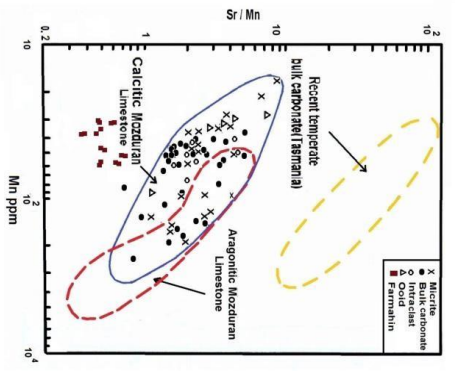
Sr/Mn ratio

The ratio of Sr/Mn declines as aragonite dissolves and calcite precipitates due to a reduction in Sr concentration and a rise in Mn concentration, respectively.

Therefore, a reasonable way to measure how much limestone is dissolving is to analyze the ratio of Sr/Mn versus Mn (Rao, 1991). The graph of variations in Sr/Mn versus Mn demonstrated that most of the data are outside and some are inside the region of the aragonite limestones of Mazdooran (Figure 6). This could explain why calcite is more common than aragonite in terms of material richness. Because of their similar mineralogy, the majority of the limestone data in this figure exhibits a pattern resembling the total carbonate samples from the temperate marine regions of the modern era.

Figure 6: Sr/Mn and Mn changes in the limestone of the study area

The variations in Sr/Mn and Mn in the limestone



found in the research area in the lower portion of the basin are compared to ranges of total carbonate samples from temperate areas of the current age and aragonite limestones from the Mazdooran Formation. The data in the studied region are outside of Mazdeoran's range for aragonite and carbonate, which can serve as evidence for the combined calcite-aragonite mineralogy.

7. SR/NA RATIO

The Sr/Na ratio is low in tropical aragonite carbonates of the current age (mean of about 4) but higher (mean of about 4) in temperate calcite carbonates. The Sr/Na ratio of calcite remains from the Permian semi-polar areas is extremely low (about 0.5). (Figure 7, Rao, 1991).

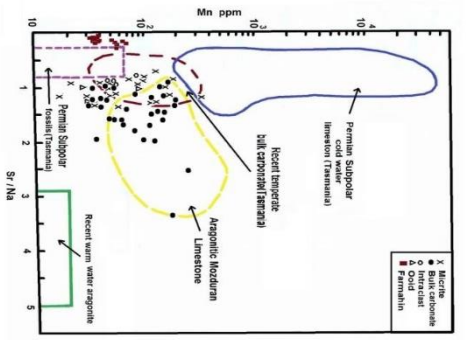


Figure 7: Mn changes vs. Sr/Na in limestone in the study area Located in the deeper parts of the basin.

The majority of the data are out of range because of calcite mineralogy concerning samples of total carbonate from temperate regions today, and some samples are out of range because they are Mazdooran limestone with aragonite mineralogy.

According to the diagram of Sr/Na vs. Mn (Figure 7), most of the examined limestone data in this area of the basin are outside the range of total carbonate samples from temperate areas with calcite mineralogy, and some are put close to the range of limestone with aragonite mineralogy. This suggests that the majority of the investigated limestones are made mostly of the mineral calcite, with varying quantities of aragonite (Adabi and Rao, 1996).

8. 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.

Mixed aragonite-calcite mineralogy (deeper part of the basin)

The dominant mineralogy in the sea waters of the cold temperate regions of the present era is a mixture of high-magnesium calcite to low-magnesium calcite (LMC) with trace amounts of aragonite. The main mineralogy in the carbonates of the warm temperate regions of the present era is calcite with high magnesium along with some aragonite. Bulk carbonate, micrite, intraclast, oolite, and cement samples taken from the investigated basin's deeper regions were used to study the major and minor elements.

In contrast to the aragonite samples from the shallow portion of the basin, the values of minor elements in the majority of the limestone samples suggest mixed calcite-aragonite mineralogy. Since non-biotic low-Mg calcite has low Sr values in the same quantity, the rise of low-Mg calcite decreases Sr from 2700 to 700 ppm (640 to 40 ppm).

With a decline in aragonite content or a rise in water depth, the concentration of Sr in carbonates diminishes depending on their mineralogy and water depth. The similar dissociation factors of these two elements in carbonate minerals are most likely the cause of the positive correlation between Sr and Na values in this graph. Mazdooran aragonite limestones are found in the Qom formation (studied region), which is a component of the Permian cold water limestone ranges. This is due to the combined calcite-aragonite mineralogy in these limestones.

Changes of Na and Mn in Qom Formation:

The fact that some of the samples are embedded in Mazdooran aragonite limestone and some are found on top of Mazdooran limestone suggests that these samples contain mixed calcite-aragonite mineralogy.

9. SODIUM

In limestone samples found in the deep portion of the basin, Na concentrations range from 44 to 525 ppm (mean 144 ppm) (Figure 2). The Sr-Na ratios in these limestones show a systematic decline in both Sr and Na elements as a result of the growing impact of non-marine diagenesis (Figure 3).

Changes of Sr and Na in the Qom Formation:

The investigated region is situated in the lower portion of the Permian cold water limestone ranges, aragonitic limestones of Mazdooran, and it has been compared with aragonite samples from tropical regions of the present age and total carbonate samples from moderate regions of the present age.

Some samples fall into the lower range of Mazdooran aragonite limestones and some samples are in the lower range of Permian cold-water limestones with calcite mineralogy. This is due to the mixed calcite-aragonite mineralogy in these limestones.

The variations of Sr and Mn in these samples (Figure 4) from the limestones of the Qom Formation in the studied area have been compared to those of the aragonite limestones of the Mazdooran Formation (Adabi and Rao, 1991), the total carbonate samples from the temperate regions of the present era (Rao and Adabi, 1992), and the aragonitic samples from tropical regions of the present age (A; Milliman, 1974).

10. IRON

Iron levels in Qom Formation, the research region, range from 1406 to 3254 parts per million (ppm), with a mean of 560 ppm (Figure 5). Non-carbonate elements, which are more suggestive of a damaging origin, are frequently possible in.

Due to the impact of non-marine diagenesis, the quantity of Fe has risen in the studied limestones along with the increase in Mn (Figure 5).

The limestones of the Qom Formation have a low correlation value and are not linked to the deep section of the basin, as shown by the Magasieh (studied area) and Section type regions.

Due to the mixed mineralogy of aragonite and calcite, the majority of the limestone samples are found below and some are found within the aragonite range of Qom carbonates in the changes of Sr and Mn.

Some samples are found above the Mazdooran limestone and some are within the range of the Mazdooran aragonite limestone when the values of Na versus Mn are plotted, indicating the combined mineralogy of calcite and aragonite in these samples.

In the studied limestones, the quantity of Fe has increased with the rise of Mn due to the impact of non-marine diagenesis because the concentration of iron grows with rising water depth and decreases the percentage of acid-insoluble materials (IR).

According to the graph of variations in Sr/Mn versus Mn, most of the data are outside and some are inside the region of the aragonite limestones of Mazdooran. This could explain why calcite is more common than aragonite in terms of material richness.

Sr/Na ratio: It is low in the temperate calcitic carbonates of the present era (the mean of about 1), while it is higher in the tropical aragonitic carbonates of the current era (the mean of approximately 4). The Sr/Na ratio of calcite fossils from Permian semi-polar areas is extremely low (about 0.5).

Mn changes vs. SR/NA It shows that most of the studied limestone data in this part of the basin is outside the total carbonate specimens of the present -day temperate areas with calcite mineralogy, and some next to the limestone range with mercenary aragenite mineralogy.

Mn vs. Sr/Na changes

It demonstrates that the majority of the examined limestone data in this area of the basin lie outside the range of total carbonate samples from temperate regions with calcite mineralogy and some are located near the range of limestones with aragonite mineralogy.

Acknowledgments :

The respected officials of Payam -e -Noor University of Damghan, Payam Noor University, helped the authors in this study.

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