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Geochemical Characteristics and Implications of The Provenance of Abu-Shaybah Formation Sandstones Wadi Greem Area in Al-Khums City

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Abstract:
The Abu-Shaybah Formation (Late Triassic) is separated into the lower and upper sections and has an unconformable relationship with the Alaziziya Formation. We looked into the main components of the formation in this study. The samples had moderate concentrations of SiO_2 and Al_2O_3, with average values of 87% and 8.7%, respectively, according to the Sandstone geochemical data. and greater amounts of Fe_2O_3 (3.1%), TiO_2 (0.21%), and the element's contents of MnO, K_2O, MgO, Na_2O, and SO_3 were around (0.1%), with P_2O_5 (0.05%) having the lowest value. Because calcite is used as a cementing agent, the CaO content of these sandstones is approximately 0.8%. Relevant geochemical element plots show that the majority of the sandstones in Abu-Shaybah are Quartz arenite kinds.

Keywords: Geochemical characteristics, Formation Sandstones, Wadi Greem, Al-Khums City.

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الخصائص الجيوكيميائية ودلالات منشأ الحجر الرملي لتكوين أبو شيبة بمنطقة وادي قريم بمدينة الخمس

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الملخص

تكوين أبو شيبة (العصر الترياسي المتأخر) له علاقة غير متوافقة مع تكوين العزيزية وينقسم إلى قسمين الجزء السفلي والجزء العلوي. وفي هذه الدراسة قمنا بدراسة العناصر الرئيسية للتكوين. تشير البيانات الجيوكيميائية للحجر الرملي إلى أن العينات تحتوي على كميات معتدلة من SiO_2 و Al_2O_3 بمتوسط قيم (88%) و (8.7%) على التوالي. وكانت أعلى قيم (3.1%) Fe_2O_3، (0.21%) TiO_2، والقيم المتوسطة نسبياً لمحتوى العنصر من MnO ، K_2O، MgO، Na2O و SO3 حوالي (0.1%)، وأقل قيمة هي (.(0.05% P2O5 تم الحصول عليها. وتبلغ نسبة CaO حوالي (0.8%) في هذه الأحجار الرملية بسبب وجود الكالسيت كمادة تدعيم. تكشف قطع العناصر الجيوكيميائية ذات الصلة أن الحجارة الرملية في أبو شيبة هي في الغالب من أنواع الكوارتز أرينيت.

الكلمات المفتاحية: الخصائص الجيوكيميائية، الحجر الرملي المتكون، وادي قريم، مدينة الخمس.

Introduction:

Numerous people have only studied the lithostratigraphic characteristics of this deposit. The geochemical study contains no current information about this deposit.

The geochemical characterization of sandstones in this paper indicates the Abu-Shaybah Formation. Clastic sediment geochemistry has been useful in assessing provenance, classification, and tectonic setting determination (Pettijohn et al., 1972; Condie, 1993).

The composition of siliclastic rocks primarily reflects the nature and proportion of their detrital components and, consequently, their provenance (Roser & Korsch, 1988). While many other factors, such as chemical weathering, transport distance, sorting processes during transport, sedimentation, and post-depositional diagenetic reactions, also affect the chemical record of clastic sedimentary rocks, their influence is minimal in the case of first-cycle sandstones.

Location map of the study area:

The study area is situated in northwest Libya, on the eastern portion of the Jabal Nafusah Mountain. To offer a representative suite of the Abu-Shaybah Formation in the Wadi Greem area near Al-Khums City, four samples in the study area will be examined, figure (1).

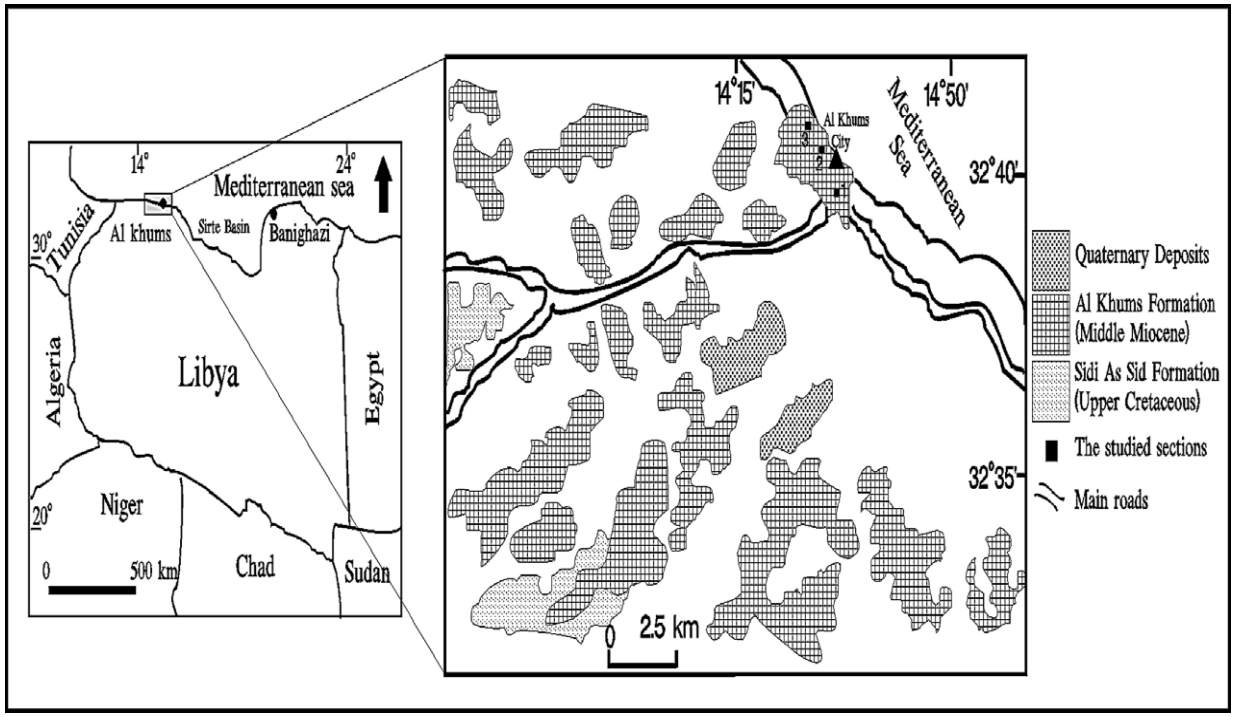

Figure 1 Location and geologic map of the study area (Modified After, Hamad, 2013).

Stratigraphic:

Only near Wadi Greem in the dissertation area's northwest do rocks of the Triassic and Jurassic ages appear. These rocks are thicker and more complete in the surrounding areas, according to reports from

several personnel. In a westerly direction, the lithology of the exposed portions is easily connected with the exposures at Jabal Nefusa (Mostafa S, 2010).

Abu-Shaybah Formation:
The type section of the Formation, which was first described by Christie in 1966, was situated in the Gharian region's Wadi Abu Shaybah. Sandstone, siltstone, and mudstone make up the formation. It can be split into two sections: the upper section is primarily composed of poorly cemented white or rose-colored sandstone that alternates with siltstone and clay, while the bottom section is composed of red siltstone with carbonate cement and sandy dolomites (Banerjerr, 1980).
According to Desio et al. (1963), the Abu-Shaybah Formation is Carnian (Upper Triassic) in age. The main portion of the Formation is positioned between two beds of carnelian material: the Alaziziya Formation below and the coquina limestone with carnelian fossils above (Assereto & Benelli, 1971) near Tarhuna Scarp. This information supports the conclusion drawn from this information.

Methodology:
Depositional settings can be inferred from field/outcrop features such as bed geometry, texture, sedimentary structure, erosional surfaces, etc. A 10× hand lens diluted HCl (for carbonate cement testing), and a grain size chart (for standardizing particle size descriptions) were used to help with the descriptions. The Geological Lab of Almergab Cement Factory gathered samples for geochemical study from beds with representative and diverse lithologies. The samples were then tested for main oxides using XRF technology.
The sandstone samples used for this research were collected from the exposed sections of Abu-Shaybah Formation along Wadi Greem Area, Al-Khums, NW Libya provided excellent exposures. The sections were logged from the base to the top and continuous records of lithologic characteristics and sampling of fresh sandstone samples were also carried out. The samples were properly kept and subsequently selected for laboratory analyses such as lithology description and X-ray fluorescence.
four sandstone samples were selected for whole-rock geochemical analysis (major oxides) using X-ray fluorescence (XRF) by the Geological Lab of Almergab Cement Factory in Al-Khums City.

Results and discussion:

Geochemical Classification :
The Abu-Shaybah Formation sandstones were classified using the geochemical classification techniques that followed Pettijohn et al., 1972, and Herron, 1988. The Quartz arenite field is where the majority of the samples are displayed on these plots (Figure 3).
four samples of clastic sandstones were analyzed for elemental variations of major and trace elements and the results are given in (Tables 1 & 2). The silica content of Abu-Shaybah sandstone shows variation ranging from (93 - 82 %). Alumina content ranges wide variation from (2 -13 %). Higher values of Fe_2O_3 (3.1 %) and very low contents of MgO, MnO, Na_2O, K_2O and SO_3 about (0.1%) are observed in the Abu-Shaybah Formation. The average CaO was (0.27 %) which is considerably low in these sandstones due to the low presence of calcite as cementing material. TiO_2 (0.3 %) due to their high quartz contents and lesser mafic components (Shilin Liu et al. 2007).

Table 1 The Chemical Composition of Samples.

Chemical composition	Al_2O_3	Ca O	Fe_2O_3	K_2O	Mg O	Mn O	Na_2O	P_2O_5	SO_3	SiO_2	TiO_2	Total
Sample # 1	12	0.01	0.7	0.1	0.1	0.1	0.1	0.06	0.1	86	0.3	99.57
Sample # 2	13	0.8	3.1	0.1	0.1	0.1	0.1	0.08	0.1	82	0.2	99.63
Sample # 3	8	0.2	1.1	0.1	0.1	0.1	0.1	0.05	0.1	90	0.3	100.15
Sample # 4	2	0.08	1	0.1	0.1	0.1	0.1	0.03	1	93	0.1	97.61

Table 2 The Chemical Composition of Samples.

Ratio	Na_2O / K_2O	SiO_2 / Al_2O3	Fe_2O_3 / K_2O	Al_2O_3 / SiO_2	K_2O / Na_2O	K_2O / Al_2O	Fe_2O_3 + MgO	Al_2O_3 /TiO_2
Sample # 1	1	7.17	7	0.14	1	0.008	0.8	40
Sample # 2	1	6.31	31	0.16	1	0.008	3.2	65
Sample # 3	1	11.25	11	0.09	1	0.013	1.2	26.6
Sample # 4	1	46.50	10	0.02	1	0.050	1.1	20

Based on well-classified scattergrams showing log (SiO_2/Al_2O_3) vs. log (Na_2O/K_2O) and log (SiO_2/Al_2O_3) vs. log (Fe_2O_3/K_2O), samples from the Abu-Shaybah Formation sandstones were chemically classified (figures 2 & 3). The scattergram of log (SiO_2/Al_2O_3) versus log (Na_2O/K_2O) indicates that the majority of the sandstones in the samples under study belong to the Quartz arenite.

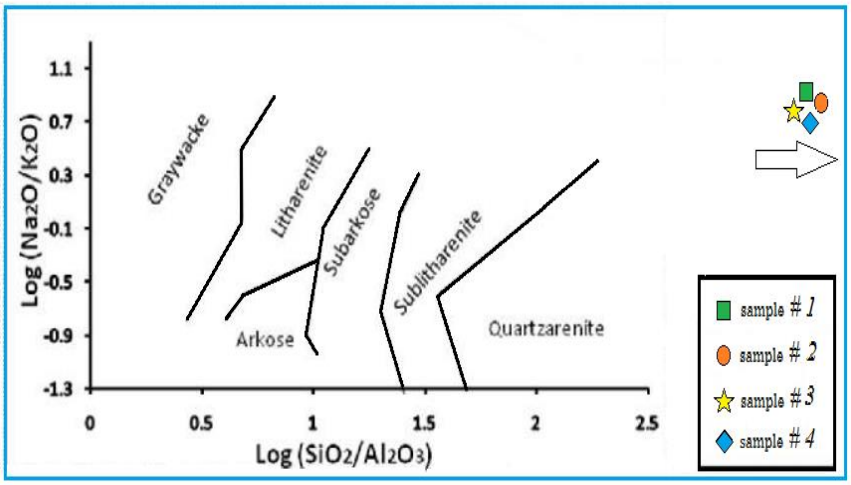

Figure 2 Chemical classification of the Abu-Shaybah Formation based on log (SiO_2/Al_2O_3) vs. log (Na_2O/K_2O) diagram of (Herron, 1988).

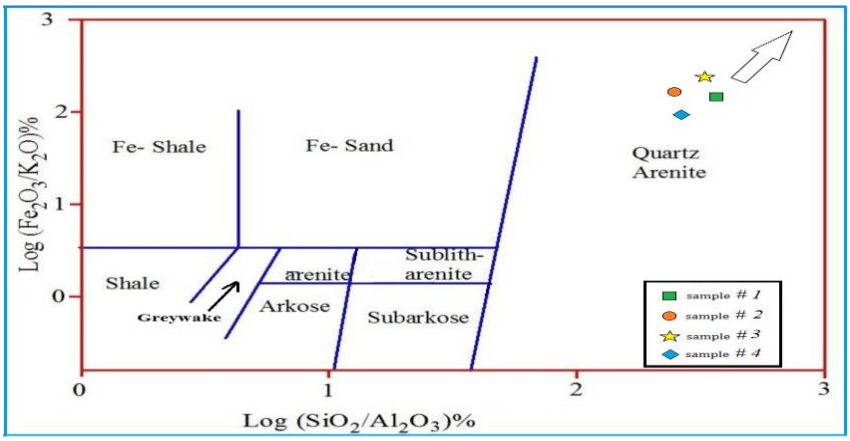

Figure 3 Chemical classification of the Abu-Shaybah Formation based on log (SiO_2/Al_2O_3) vs. log (Fe_2O_3/K_2O) diagram of (Herron, 1988).

Provenance:
The provenance of the source region has been determined using the geochemical characteristics of clastic rocks (Condie et al. 1992). Condie and Wronkiewicz (1990) have estimated that certain ratios, namely SiO_2/Al_2O_3 and K_2O/Na_2O, can be used to infer evolutionary changes in the provenance and composition. Plagioclase is present in very tiny amounts in the clastics of the Abu-Shaybah Formation, which are generally rich in quartz and include a significant amount of K-feldapar.
The relationships between a few main oxides are used as geochemical proxies to reassemble the tectonic history and source rock types. This is due to the fact that the distribution of major, trace, and rare earth elements in clastic sediments can reveal information about the origin of the source region and depositional site. The examined sandstones showed extremely low levels of CaO and MgO. The existence of iron mineral cement and the effects of subaerial weathering are connected to the iron oxide amounts observed in samples. Abnormally low levels of MgO, MnO (0.10%), and P_2O_5 (0.05%) suggest that deposition occurred in freshwater continental settings. (2010) Pearce et al.

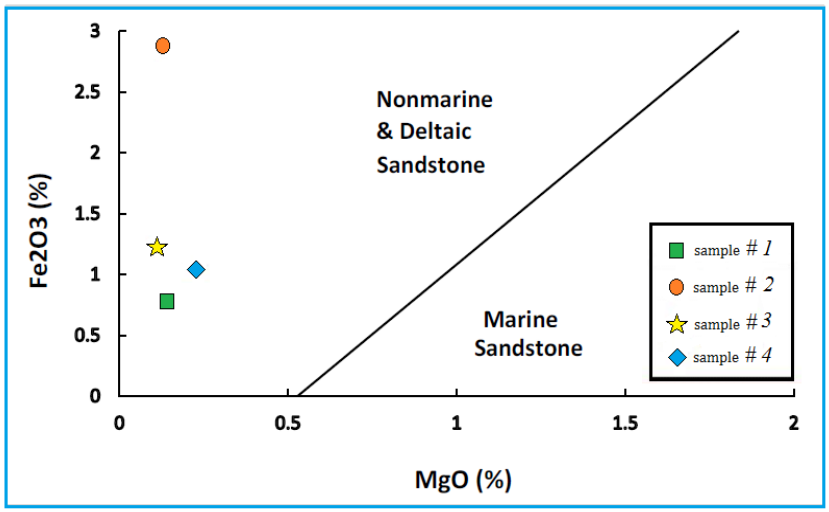

Figure 4 Binary diagrams showing characterization and differentiation of marine from non-marine environments (after Ratcliffe et al. 2007).

Al_2O_3/TiO_2 ratio can be used for provenance reconstruction and it increases from (3-8 %) for mafic igneous rocks, (8-21%) for intermediate rocks and (21 – 70%) for felsic igneous rocks (Armstrong-Altrin et al., 2017). In this study, the calculated Al_2O_3/TiO_2 (20–65%); average of about 37 %, Table 3) showing the source of Abu-Shaybah Formation was from felsic igneous rocks.

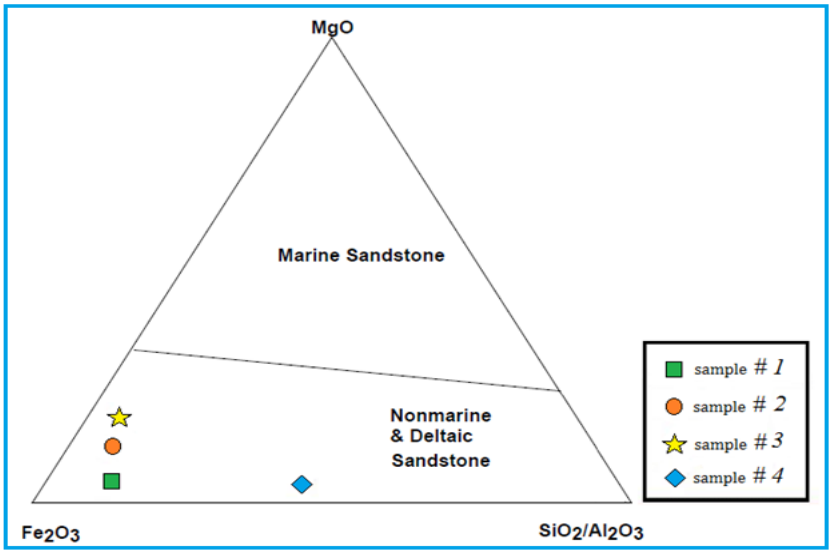

Figure 5 Ternary diagram showing characterization and differentiation of marine from non-marine (after Ratcliffe et al. 2007).

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