Silicification in the Cyrenaican Miocene Carbonate-Evaporite Sequence, NE Libya: Origin, Occurrence, Facies, and Sea Level Relationship

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ABSTRACT

This work investigates the distribution, occurrence, and origin of silica in the Cyrenaican Miocene shallow marine carbonates along a 135 km strike section, and its relation to the depositional facies and the sequence stratigraphic framework. Twenty-nine detailed measured stratigraphic field sections, 14 gamma-ray profiles, and four carbon stable isotope curves were used to define the Cyrenaican Miocene detailed facies relationships and their sequence stratigraphic context. The Ar-Rajmah Group Cyrenaican Miocene facies consists of red algal reefs, bioclastic packstones, oolitic grainstones, and microbialites that are associated with evaporites and siliciclastics. These facies are arranged within two second order supersequences that comprise six third order sequences. A total of 503 rock samples were collected for thin section petrographic analysis and x-ray fluorescence (XRF) geochemical analysis.

As observed in the field, silica is very common in the ramp crest oolitic grainstone facies and peritidal microbialite facies, but rare in the subtidal red algal and bioclastic packstone facies. The silica commonly occurs as chert nodules of reddish-bluish light gray color in the ramp-crest and peritidal facies and is whitish light gray color in the subtidal facies. In addition, the silica forms in up to 20 cm thick, discontinuous layers in the porous mixed microbial-oolitic grainstone facies.

In thin section, the silica forms as disseminated silica, microquartz, and chalcedonic quartz. It replaces matrix, grains, cements, and even forms authigenic fan-shaped chalcedonic cement that filled up pore spaces. In the paragenetic sequence of the Cyrenaican Miocene, silicification always comes as the last replacement process after dolomitization, dedolomitization, and gypsum replacement.

All studied silica samples are length slow while the gypsum plate is inserted in the XPL position. A study of all 503 samples did not reveal any evidence of a biogenic origin for the silica. However, the XRF analysis of the same samples did reveal a linear rela-


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The relationship between aluminium and silicon ($R^2 = 0.8143$). The relationship, as empirically determined, is $\text{Al (wt. %)} = 0.1646 \times \text{Si (wt. %)} + 0.11405$.

In the Cyrenaican Miocene carbonate-evaporite sequence, the diagenetic silica occurrence and distribution are strongly facies controlled and have no correlation with the sequence stratigraphic surfaces or systems tracts. Also, the silica originated from continental weathering rather than being biological, as evidenced by the strong direct proportional geochemical relationship between the silicon and aluminum, as well as the petrographic analysis.
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origin, occurrence, facies and sea level relationship

Abstract

This work investigates the distribution, occurrence, and origin of silica in the Cyrenaica Miocene shallow marine carbonates, along a 135 km strike section, and its relation to the depositional facies and the sequence stratigraphic framework. For this purpose a multi-disciplinary approach was taken, including geochemical and petrographic analyses, diagenetic studies, and stable isotope analyses. The results of this study provide insights into the processes that controlled silica deposition and its relationship to the depositional environments and the sequence stratigraphic framework.

Introduction

The Cyrenaican Miocene Carbonate-Evaporite Sequence is a significant deposit of carbonate-evaporite rocks in the Northern Cyrenaica, NE Libya. The sequence is characterized by a diverse range of depositional facies, including shallow marine carbonates, evaporites, and siliciclastics. The sequence is also characterized by a complex sequence stratigraphic framework, which is critical for understanding the depositional environments and the controls on the deposition of silica.

Methodology

The study was conducted over a 135 km strike section, and included a variety of techniques to investigate the occurrence and distribution of silica. These techniques included field observations, core analysis, sample preparation, and lab analysis. The lab analysis included petrographic and diagenetic studies of 503 hand samples, thin sections, and 14 spectral gamma-ray profiles. The results of this study provide insights into the processes that controlled silica deposition and its relationship to the depositional environments and the sequence stratigraphic framework.

Results

Silica was documented in all depositional facies of the Cyrenaican Miocene carbonate sequence of the Ar-Rajmah Group. However, silica is common in the porous ramp diameter and as discontinuous layers of up to 20 cm thick. Silica chert nodules in the ramp-crest and peritidal facies are of reddish-bluish light gray color and in the vertical profiles.

Discussion

The distribution and occurrence of silica in the Cyrenaican Miocene Carbonate-Evaporite Sequence is strongly facies controlled and has no correlation with the sequence stratigraphic surfaces or systems tracts. This is explained by the detailed regional facies relationships within their sequence stratigraphic framework. The facies analysis, depositional environments, and sequence stratigraphic framework were used to understand the processes that controlled silica deposition and its relationship to the depositional environments and the sequence stratigraphic framework.

Conclusion

The study provides insights into the processes that controlled silica deposition and its relationship to the depositional environments and the sequence stratigraphic framework. The results of this study are important for understanding the depositional environments and the controls on the deposition of silica in the Cyrenaican Miocene Carbonate-Evaporite Sequence of NE Libya.