Facies analysis of the Kurrush Formation, Gharian area Jabel Nafusah

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Abstract

This paper presents the facies and depositional environment of the early Mesozoic Kurrush Formation. The Early Mesozoic records of northern Gowdwana were influenced by sea level-changes during the opening of the Neotethys Ocean. These records are clearly noted in the north-western parts of Libya, which were located on the tectonically active subsiding margin during rifting, and subsequently the opening of the Neotethys Ocean basin. These records include the Triassic sedimentary facies of the so-called Kurrush Formation in the Gharian area in Jafarah / Nafusah region. Field work in the area, and petrographic studies in the area have indicated that the Formation consists of red micaceous sandstone, mudstone, and siltstone facies overlained mainly by carbonate rocks of Al Aziza Formation. These facies might have been deposited in transitional environment , possibly of delta plane. This study is intended to investe the possible influence of the tectonic activity on the depositional environment of the Kurrush Formation in the area.

Keywords: Sandstone Formation, Early Mesozoic Transitional environment, Nafusah region Libya.

1 .Introduction

The Kurrush Formation previously known as Ras Hamia Formation[1], Boutoniere and Currusc Formation [2,3,4], is the oldest Mesozoic rocks exposed in Nafusah/ Jafarah area. Although these has been controversy among these authors about having the rocks of this formation, their studies seem to describe same rock of the upper Kurrush Formation cropping out at or near small domes in Gharian and Wadi Ghan area.

according to[2,3,1,4], the Kurrush Formation consists mainly of red and brown, fine grained, micaceous sandstone with yellow to green clay and pale red to brown micaceous sandstone with minor calcarous inter beds at the top. subsurface studies by [4] on the Kurrush Formation at well A1-38 indicates that the Formation consists of 581 meter of gray, fine to coarse grained varicolored shale and sub ordinate dolomite. Most of the above mentioned studies on the upper unit of the Kurrush Formation in the Gharian area was delta with the lithological and stratigraphical description in the field, and have net attempted to utility these delta to study depositional processes that from theses rocks. This study is intended to use surface

and cahrotary data in interpretation of the depositional environment and tectonic setting of the upper Kurrush Formation.

2 .Location of study area and Exposure of Kurrush Formation.

The Kurrush Formation is the oldest Mesozoic rocks crops mostly in the Gharian area. it was previously known as Ras Hamia Formation [4]. The Kurrush Formation is exposed in four place in Gharian are, where all exposures are at ,or nearby centres of small domes (Fig.1). Two exposures are just north of Gharian town, willies on the other two just to the east of wadi Ghan Fig.1 [5]. The Kurrush Formation in subsurface oil well (A1-380 has been described by [4], who pointed that this Formation is underlined by Al Guidr Formation (well A1-38,). According to [4], the Kurrush Formation in this well consists of 581m of grey fine grained, and varicolored shale and subordinate dolomitie, while in its base tend to be constitutes of white to grey occasionally dolomitic limestone (myophozia beds).

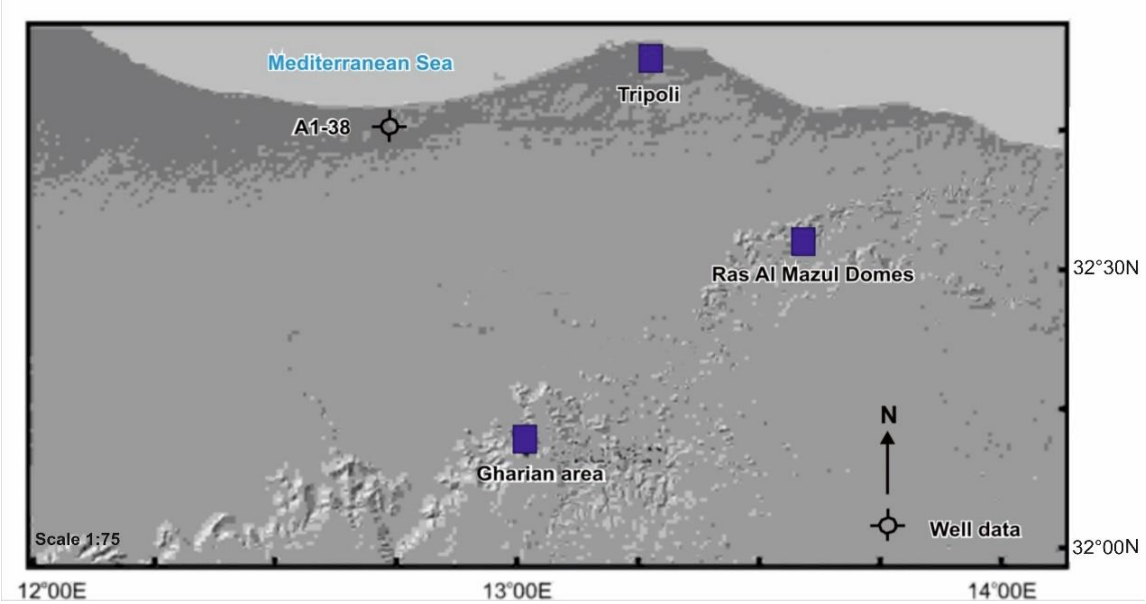

Figure 1. *DEM map showing 1) the location of the Gharian area and the Ras Mazul dome region and 2) the subsurface Al-38 oil well loction for the Kurrush Formation*

3 Field description

Exposures from three localities are used to describe the main sedimentary characteristics of the Kurrush Formation. These characteristics are summarized in Table 1.

3.1 South of the Wadi Abu Shaybah

This section is exposed in the area south of the Wadi Abu Shaybah located approximately 2.5 km to north of Gharian town. It shows the contact with the overlying Al Aziza Formation. Here, the Kurrush Formation is characterised by

facies (F-YS).F-YS is dominated by pale yellowish orange (10YR 8/6) fine-grained sandstones with minor dolomitic beds. This facies is capped by dolomitic limestone facies of the Al Aziza Formation. The maximum measured thickness of the yellow sandstone facies (F-YS) is *ca*. 0.90 m. The sandstones are massive, lack sedimentary structures and are lacking fossils and bioturbation structures.

3.2 North of the Wadi Abu Shaybah

This section is exposed along the north side of the Wadi Abu Shaybah . The main characteristics of the section are illustrated in field photographs (Fig. 2.A and Fig. 2. E) and a graphic log (Fig. 2. F). The log was recorded from the northern side of the Wadi Abu Shaybah and is characterised by reddish micaceous sandstone facies (F-SR). The maximum measured thickness of facies (F-SR) is *ca*. 1.10 m. The facies comprises moderate red coloured (10R 4/6), very fine to fine grained sandstone that displays symmetrical ripples. These have an average wavelength of 1 cm and crest height < 1 cm (Fig. 2.E). Some of the cross laminations have a north westerly palaeo flow direction (Fig. 2.F), although limited palaeocurrent analyses (n = 5) were conducted due to the poor quality of the sedimentary structures. Fossils and bioturbation were not observed in this facies.

3.3 West of the Wadi Abu Shaybah

This outcrop is exposed in the northwest of the study area along the Abu Rashada road , located approximately 1.5 km south of Kaf Kalaya The main characteristics of the section are illustrated in some field photographs (Fig. 2. C and Fig. 2. D). This section is affected by Tertiary basaltic volcanism. The outcrop is dominated by light brown (5YR 5/6) fine-grained sandstones with minor clay lenses. The maximum measured thickness of light brown sandstone (F-LS) is *ca*. 1.20 m (Fig. 2. C). This consists of fine grained sandstone and green silty claystone that displays fine parallel lamination. The average thickness of the parallel laminations is approximately 1 mm (Fig. 2. D)

3.4 Ras Lefa section

This outcrop is exposed in the Jafarah Plain at the Ras Lefa section, located approximately 21 km to north of Gharian town. The maximum measured thickness of facies (F-MS) is *ca* (Fig.2. B). 0.6 m.The section shows the contact between the Al Aziza and Kurrush Formations. The Kurrush Formation is characterised by facies (F-MS). F-MS is dominated by pale yellowish orange (10YR 8/6) mud and siltstone. This facies is capped by dolomitic limestone facies of the Al Aziza Formation. Fossils and bioturbation were not observed in this facies. Petrographic analysis reveals that the sandstone comprises quartz and mica grains that are angular to sub angular in shape with moderate sorting (Fig. 3). Quartz makes up approximately 92% of the grains. The quartz occurs as both mono-crystalline and polycrystalline forms (Fig. 3), but most of sandstone samples are dominated by polycrystalline quartz. Mica (muscovite) is also present and represents about 5% of total components. Feldspars are very rare (< 1% e.g. Sample K002 in Fig. 3). Rock fragments are also present and represent about 2% of total components. Furthermore, proportions (5-10%) of clay matrix were observed in the studied samples (Fig. 3).

Table 1 *Summary characteristics of the Kurrush Formation in the Gharian area*.

	Description				
Lithology	Thickness (maximum)	Grain size (Wentworth scale)	Colour (Munsell colour chart)	Sedimentary structures	Fossils
Redish sandstone (F-SR)	1.10 m	Very fine sand	10R 4/6 Moderate reddish brown	Symmetrically rippled	None
Yellow sandstone (F-YS)	0.90 m	Very fine sand	10YR 8/6 Pale yellowish orange	None	None
Lightbrown sandstone (F-LS)	1.20 m	Fine sand	5YR 5/6 Light brown	Cross-laminated	None
Paleyellowish orange (10yr 8/6) mudstone	0.6 m	Mud	10YR 8/6 Pale yellowish orange	None	None

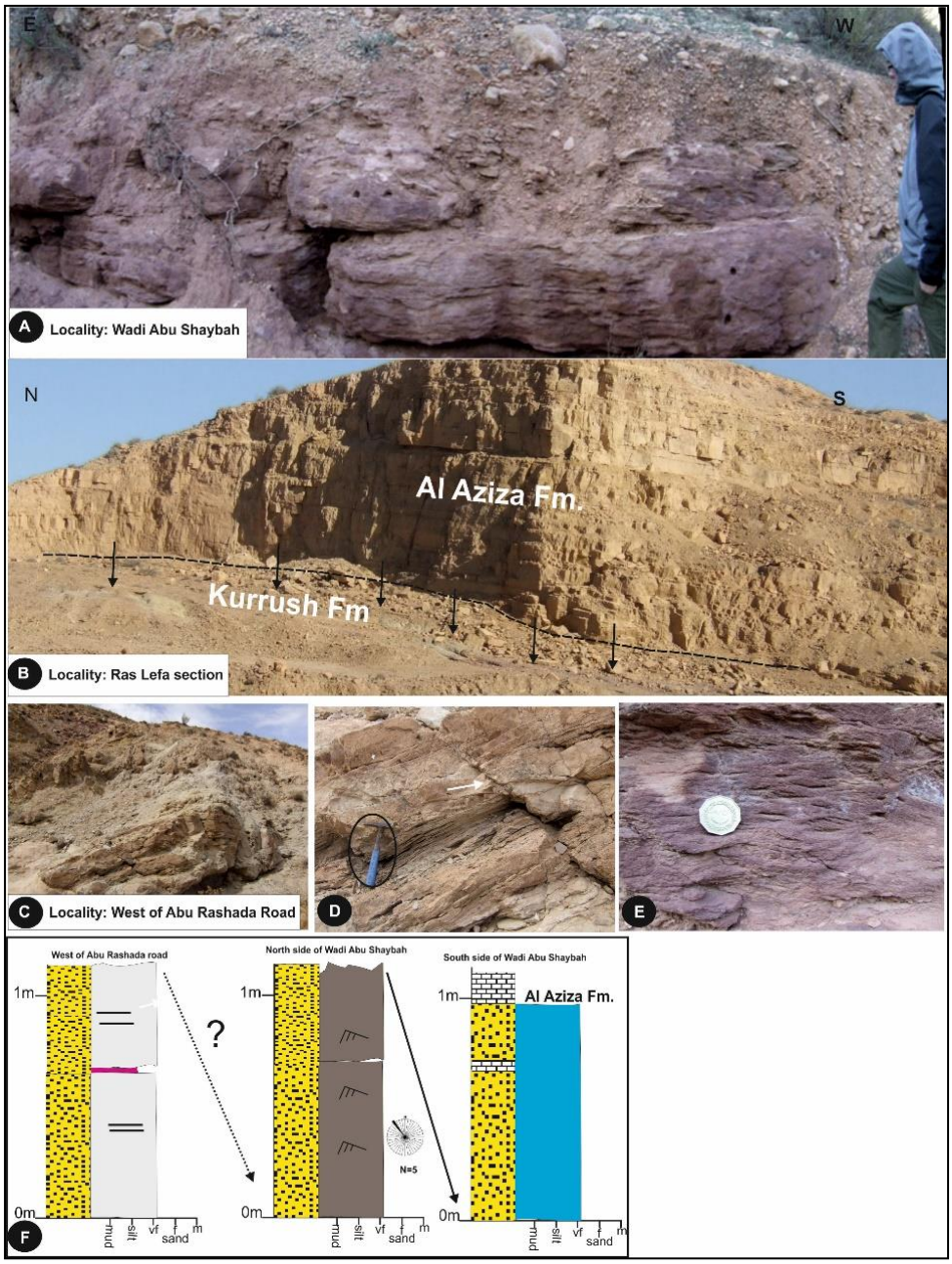

Figure *2* ***A:*** *General view of Reddish sandstone (F-SR) exposed in Wadi Abu Shaybah, person's height = 1.82 m.****B:*** *View of the Ras Lefa section showing the Kurrush Formation with the overlying Al Aziza Formation.* ***C:*** *General view of light brown sandstone* ***(****F-LS****)*** *exposed in west of Abu Rashada road..****D:*** *Parallel lamination exposed in the Kurrush Formation (west of Abu Rashada road.). Hammer circled for scale. Fault has NW trend (white arrow).* ***E:*** *View of symmetrical ripples in the Kurrush Formation (coin = 2.5 cm diameter)* ***F:*** *Sedimentary logs from the north and south of Wadi Abu Shaybah and west of Abu Rashada locations.*

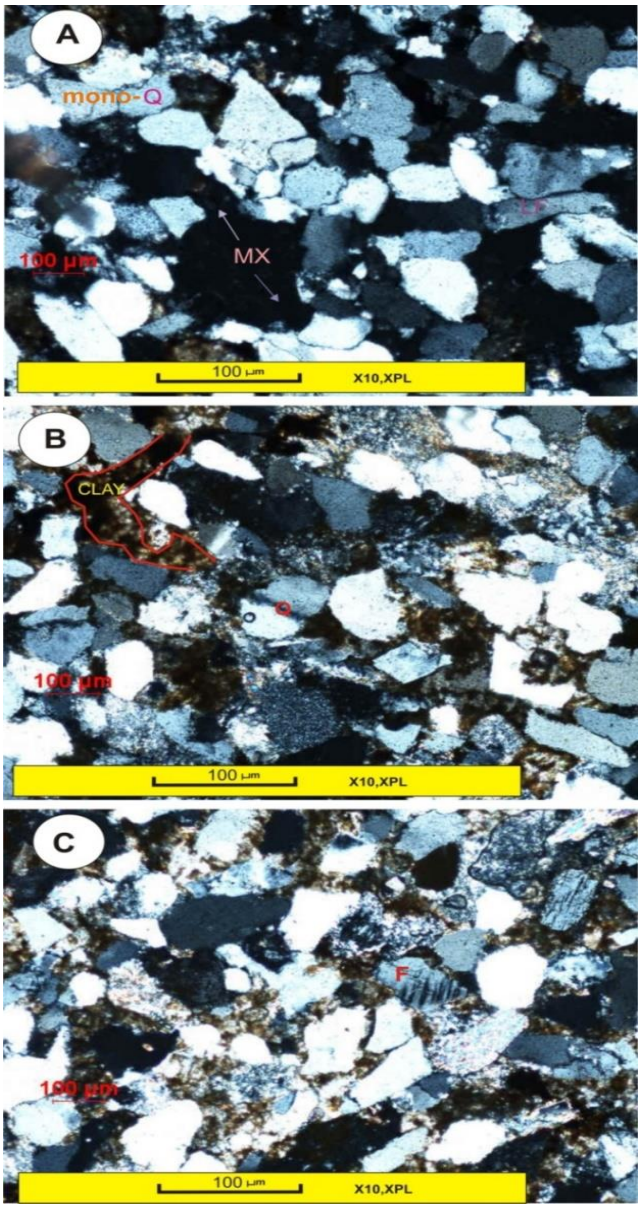

Figure 3. *Thin sections of the Kurrush Formation from west of the Abu Rashada road.* ***A:*** *Microphotograph of sample* ***K001*** *taken under crossed polars illustrate moderate sorted.* ***B*** *and* ***C:*** *Microphotographs for sample* ***K002*** *and* ***K003*** *taken under crossed polars, illustrating clay and feldspar crystal at the right top of the view (****C****)*

4. Interpretation

4.1 Depositional environment

The textural characteristics observed in the southern part of Kurrush Formation show an overall fine-grain size indicative of a relatively low energy environment [6,7]. The occurrence of minor dolomitic beds within these sediments could suggest a shallow marine shelf setting. However, the lack of sedimentary structures makes palaeogeographic reconstruction difficult. The oil well data from the Jafarah basin which includes the presence of the *Myophoria* bivalve [4] provides clearer evidence for a marine setting [8]. The mud facies of the Kurrush Formation from the Jafarah

Plain is interpreted as a flood plain environment. Deposition of mud usually occurs under low energy conditions with low flow velocity. However, the sedimentological characteristics of the red sandstone in the Wadi Abu Shaybah indicate deposition within a continental environment. Textural characteristics show an overall fine grain size reflecting low energy depositional environment. Evidence from thin sections further supports a continental environment for Northern Wadi Abu Shaybah and West of Abu Rashada road, which the sediment possibly derived locally from quartzites or quartz rich metamorphic rocks. The presence of small-scale symmetrical ripples is typical of elements of shallow water waves [9] . However, it is not possible to be more precise about whether the environment is continental (e.g. lacustrine) or marine (e.g. tidal etc.). Siltstones often relate to fluvial environments with over bank flooding or low energy parts of a deltaic system [10,11,12] . Furthermore, delta plain settings often include low energy environments such as tidal flats and swamps. The upper part of the Kurrush Formation contact with Al Aziza Formation is transitional from marine clastics to marine carbonates. Therefore, the Kurrush is probably deposited in a marginal continental environment, possibly a delta plain setting, with facies changes possibly reflecting localised sea level oscillations. In the Jafarah Basin sub-surface record (A1-38) a marine incursion is indicated by the presence of dolomitic limestone and the bivalve Myophoria [4,12,13]. The upper part of the Kurrush Formation outcrops in the Gharian area of Jabel Nafusah regain where it is represented by micaceous red sandstones. Textural characteristics show an overall fine grain size reflecting low energy depositional environment. Evidence for continental environments is based on 1) grain size; 2) colour; 3) palaeocurrent trend and the absence of fossils. Figure. 2 shows that the Kurrush Formation is dominantly marine environment in the Jafarah Plain and becomes marginal marine in the Gharian area.

4 Conclusions

The sedimentary facies and depositional systems were analysed to provide palaeoenvironmental and palaeogeographic reconstruction for the study area. For the purpose of this study, the Kurrush Formation is not described using fully developed facies analysis and this is due to poor exposure of facies. The Kurrush is probably deposited in continental to nearshore environments

A number of important conclusions can be drawn from this study:

1) During the lower Triassic the Gharian area is a very low continental margin setting.

2) The sedimentary facies and depositional systems were analysed to provide palaeoenvironmental and palaeogeographic reconstruction for the study area. A shallow shelf sea (Neotethys) existed to the north and allows a major regressive event, with development of: The Kurrush Formation (marginal continental environment possibly delta plain).

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