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INFRACAMBRIAN ROCKS AS „EXOTIC" CLASTICS IN HASÁWNAH SANDSTONE FORMATION, WĀW AL KABIR AREA, LIBYA

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Abstract. In Cambrian aged Hasáwnah Formation from Wāw al Kabir area (Central Sahara, Lybia), among the detritic grains of the sandstone, a few „exotic" grains were identified. We described rock fragments of 0,1–1,4 mm size: biotitic granite or gneiss, quartzose micaschists, sericitic-chloritic schists, graphitic schist, blastopsamitic silt and sandstone, acide volcanic rocks, altered basic glass and chert. Part of the well rounded quartz grains shows truncated owergrowth rims. They represent, in fact, fragments of older sandstone with overgrowth quartz cement.

The microsonde analyse of an acide volcanic rock fragment resulted granodioritic (=dacitic) composition.

Part of rock fragments are originate from granite basement and its mezo-and epimetamorphic mantle, which outcrop in NW part of Dor el Gussa Arch. The anchimetamorfic silt and sandstone fragments come from Infracambrian Mourizidie Formation. It is probable, that in source area of Hasáwnah Formation, quartzose sandstone, older that Cambrian age appear. From the small unmetamorphosed volcanic rock fragments the characteristic products of a subaquatic volcanic sequence were recognized; the so-called Steinemann's trinity: basalt (basic glass!) – keratofir – chert. Thus, there are a hypothetic ophiolitic belt somewhere about here.

Key words: Libya ,Sahara, Dor el Gussa Arch, Hasáwnah Fm., Cambrian, Infracambrian, Sandstone, Blastopsamite, Acide rocks, Basic glass, Chert.

The Cambrian-Ordovician aged Hasáwnah Sandstone Formation crops out in Central Sahara forming the oldest unmetamorphosed formation of Dor el Gussa Arch (Koráb, 1984). It appears in the south-western corner of the NG 33-12 Wāw al Kabir map sheet (Turki et al., 2004, Fig. 1), where a few samples were taken for mineralogical and geochemical studies (Kalmár, 2004).

The Hasáwnah Formation (Desio, 1943) is formed by a succession of 50-20 cm thick, middle to coarse grained (no rarely, microconglomeratic) quartzose, nearly monomineralic sandstone beds, separated by thin, discontinous clayey-mica bearing films. In some outcrops, an incipient gradual sedimentation was observed, i.e. within in the same bed, the coarser grains occupy the lover part, passing upward gradually to the finer grain dimensions. The well-sorted sandstone beds alternate with bad sorted, microconglomeratic levels, often with 2-10 mm large, clayey-silty noodle-like grains. The highly maturised sediment having continental, fluvial origin was deposited in a shallow, intracontinental basin with a notable subsidence, (Füchtbauer, 1986), resulting a more than 1000 m thick detritic formation.

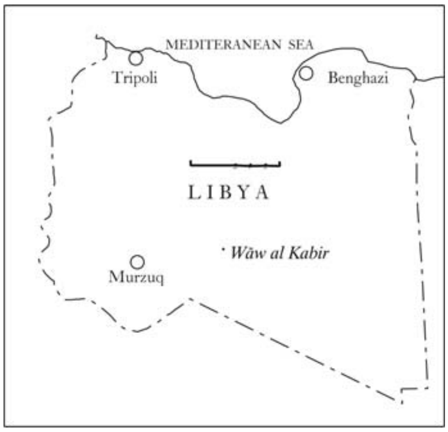


Fig. 1. Location of Wāw al Kabir area.

The primary touching cement of the sandstone is silicious (chalcedony); the secondary, pore filling cement may be goethitic, rarely carbonatic or missing. Because of they relatively high porosity, the Hasáwnah Sandstone Formation are the most important aquifer of the Central Sahara region.

1. MINERALOGIC COMPOSITION OF SANDSTONES OF HASÁWNAH FORMATION

The main clastic component, totalising 80-94% of the grains, is quartz, which forms bad rounded, mono- or polycrystalline grains, in their majority with undulatory extinction.

Examining the 0.005-0.05 mm large inclusions of the quartz grains, rock forming and accessory minerals of granitoids and of high stage of metamorphic rocks were identified: apatite, biotite, garnet, hematite, ilmenite, K-feldspar, kyanite, magnetite, muscovite, acid plagioklas, rutile, sillimanite, titanite and zircone. The old magmatic and metamorphic source area is also proved, by the presence of some free grains of feldspars, zircone, tourmaline and of fine muscovite flaks.

In some samples, the well rounded quartz grains show zoned owergrowth rims, which were truncated during the last erosional processes. Thin, micronic iron oxide films cover the quartz grain below the overgrowth rims and into the rims, marking the successive quartz zones (Plate I, photo 1.). It is very probable, that these grains are originated from an old quartzous (red) sandstone, with owergrowth quartz and iron oxide cement.

2. ROCK FRAGMENTS AS "EXOTIC" DETRITIC GRAINS

Apart from the quartz (quartzite) grains and from the other rare free minerals, in sandstones of the Hasáwnah Formation a few rock fragments appear. Because of their petrography gives same indications to the geology of the areas existing before the sedimentation of the Hasáwnah Formation, we focused our attention on them (Kalmár, 2004).

The rock fragments form lens-like or irregular, angular grains, measuring 0.1-1.6 mm. Often, around them micron sized limonite films or 0.01-0.03 mm thick deferrised, light rims appear.

In our samples, the following rock fragments were identified:

Biotitic granite or gneiss. In sample No. 7018/1/1, one 0.25x0.75 mm large, elliptic grain is formed by a clear quartz which is indented with small microcline, and other, smaller sericitized plagioclase grains. Inside the feldspar grains, little, drop-like quartz grains, and in the large quartz grain, a few muscovite, biotite and zircone inclusions appear (fig. 2).

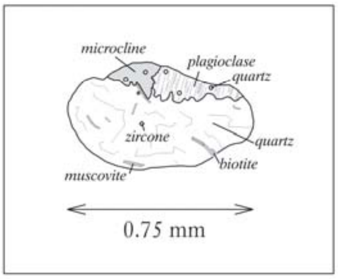


Fig. 2. Quartz grain with microcline and plagioclase: fragment of granitoid rocks of Upper Proterozoic Metamorphic basement

Microcline with quartz inclusions and perthitic separations were found in some samples.

All of these grains are, in fact, the fragments of granitoid rocks and/or biotitic gneiss of the basement.

Quartzose micaschist. It was identified as irregular, angular fragments of polycrystalline quartz with oriented muscovite and light brown biotite sheets, the last are with fine sagenite crystals and dark lamellae. The micas form 0.05-0.15 mm thick, slightly waved films.

Sericitic and sericitic-chloritic schists. They are present in four samples as 0.2-1.4 mm large lens-like, grey-green, fragments, often with dark brown limonitic crusts. Under microscope, they consist of fine-grained quartz, small, oriented sericite and chlorite scales, zircone, titanite and dark minerals.

Graphitic schist. Two small, lens-like, dark grains were identified in sample No. 7014/1/1 with indented quartz, sericite flacks and very fine graphite grains forming waved strips in the quartz groundmass.

Blastopsamitic silt and sandstone. It appears as angular, quadrangle like fragments, with fine, slightly rounded quartz grains in basal, sericitic-limonitic matrix with oriented structure (Table I., photo 2).

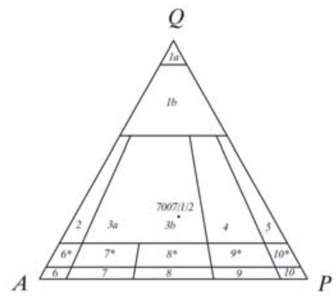
Acide volcanic rocks. The 0.2-1.1 mm large, horn-like, light yellow or pink grains in any cases are perceptible to the naked eyes. The microscopic study evidenced the presence of hemihedral quartz, anhedral feldspar (Plate I., photo 3) and hemihedral dark minerals (possibly highly transformed biotite or amphibole). The microlitic, coalescent groundmass is formed by quartz, sericite and dark powder. In the electron microscope photos of the groundmass (Plate I., photo 4), euhedral magnetite, quartz and feldspar grains and sericete lamellae appear.

The results of the EDAX microsonde analyses from the grains in the sample

No. 7007/1/2 are presented Table 1. The normative minerals, calculated from the analytical data plots in Streckeisen's diagram (IUGS, 1972, Fig. 3) in the filed of monzo-granodiorite (=dacite).

Altered basic glass. Rare, 0.1-0.5 mm large rounded, dark fragments, consisting of dark minerals (magnetite?), fine sheets of chlorite and sericite?, with thin limonitic crusts (Plate I., photo 3, dark).

Chert. It appears frequently both in finer and coarser grain classes, as well rounded, colourless or light brown grains, consisting of radial chalcedony lamellae and small dark mineral bowls. Coalescent, grey, cryptocrystalline silica grains are present, too.



FFig. 3. Streckeisen's diagram recommanded by IUGS (1972), with the composition of the sample No. 7007/1/2. A, alcaline feldspars; P, plagioklase; Q, quartz. 1a-10 diferent granite, sienite, granodiorite and diorite types; 3b, granodiorite (=dacite).

Table 1

Chemical analyse of one rock fragment

(sample No 7007/1/2)

EDAX		Calculated oxides	%	Normative minerals	%
Elements	%				
Si	31.8	SiO2	68.19	tit	0.53
Ti	0.2	TiO2	0.38	fs	3.14
Al	8.0	Al2O3	15.20	hy	11.21
Fe	1.6	Fe2O3	2.26	or	10.27
Mg	2.4	MgO	4.02	ab	26.41
Ca	3.8	CaO	5.26	an	19.90
Na	2.2	Na2O	2.98	sil	8.61
K	1.4	K2O	1.71	q	19.93
		Streckeisen's diagram (%)		Q	26.05
				A	37.59
				P	36.37

EDAX microsonde analyse: Debrecen Science University, Hungary

3. **DISCUSSION**

In despite of the high maturisation of the original sediments, the presence of grains originated from the well-known Precambrian basement (i.e. the biotitic granite or gneiss, micaschist and sericitic, chloritic and graphitic schists) was expectable. The list of the inclusions in the quartz grains, which was presented above, confirms that the Hasáwnah sandstones are originated from a cratonised old basement, such as which outcrops in the north-western part of Dor el Gussa Arch (Turki et alli, 2003), between Wadi Qussah and Qrarat Waddan (NG 33-8 Al Haruj al Abiah map sheet). The presence of anchi-metamorphosed blastopsamite does not surprise us: such rocks (in Mourizidie Formation) appear not far from the outcropping area of Hasáwnah Formation.

The stratigraphic column of the Infra-Cambrian and older formations could be completed with (i) unmetamorphosed volcanic rocks and (ii) with a very low metamorphosed quartzose-limonitic sandstone level, older, than the Hasáwnah Formation (Fig. 4.)

From the small fragments reworked in sandstones of the Hasáwnah Formation, the characteristic products of a subaquatic volcanic sequence can be reconstituted; the so-called Steinemann's trinity: basalt (basic glass!) – keratofir – chert.

The further research in the Central Sahara Area will localize this old volcanic belt, which could be an ophiolitic suture line crosscuting the Infra-Cambrian craton.

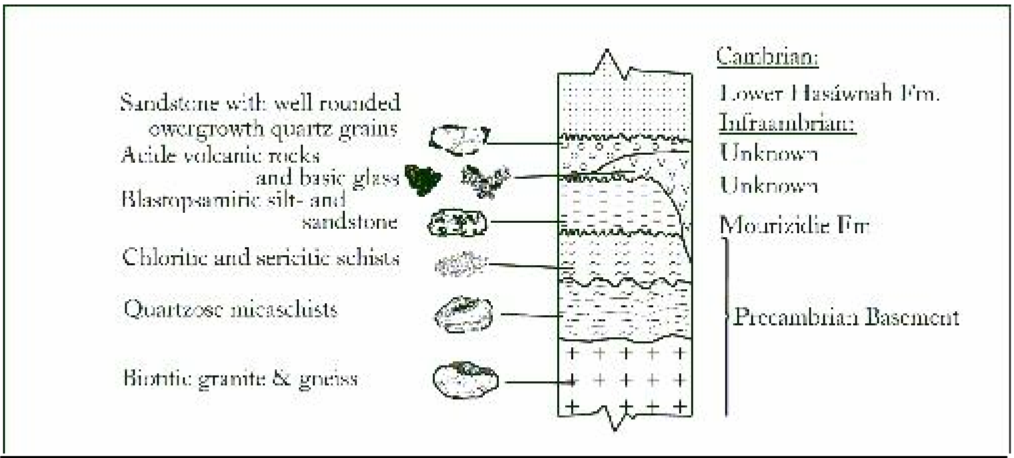


Fig. 4. Hypothetic stratigraphic column with Cambrian and older formations of the Central Sahara Region

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CAPTION OF MICROGRAPHS

Photo 1. Truncated owergrowth quartz rims (↓) with incorporated iron oxide grains and crusts. Sample No. 7014/1/1, + nichols, 32x.

Photo 2. Blastopsamite fragment: angular quartz grains (q), in slightly oriented sericitic groundmass with limonite pigmentation. Sample No. 7007/1/1, + nichols, 32x..

Photo 3. Angular fragment of acide volcanic rock, with quartz (q), plagioclase (pl) and microlitic, sericitized groundmass. Dark, rounded fragment of basic volcanic glass (g), with fine, chlorite (chl) and sericite (s) flacks. Sample No. 7018/1/1, + nichols, 32x.

Photo 4. EDAX micrograph of groundmass of acide volcanic rock fragment. q, quartz; fp. Feldspar; mg, magnetite; s. sericite.

Plate I