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ON THE GENESIS OF THE URANIUM OCCURRENCE IN THE CARBONIFEROUS SEDIMENTS, WADI INTAHAHAH AREA, SOUTHWEST LIBYA.

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Abstract

In the course of covering the southwestern part of Libya by a systematic airborne radiometric survey, a significant group of anomalies was detected in the Carboniferous sediments. Ground verification of these anomalies disclosed the confinement of these anomalies to the limestone and sandstone beds of the Assedjefar Formation assigned to Visean-Namurian age. Uranium content as mush as 1000 PPm was detected.

The strong lithologic control of these uranium mineralization together with the lack of evidences of hydrothermal activity implies an intrinsic source for the uranium. The uranium, most likely, was transported and introduced into the sediments, by geochemically active groundwater, during their deposition. Uranium, from this solution, could have been adsorbed onto organic matter or clay minerals.

Introduction

The first discovery of uranium mineralization in southwestern Libya date from 1973 [1], but it was recorded only in the Triassic sediments exposed along the western flank of Murzuk basin. Since that time the whole area has been considered as potential for uranium and became the subject of extensive geological and geophysical exploration. However, in the course of covering the area under consideration by a systematic airborne-survey a singnificant group of anomalies was detected in the Carboniferous sediments [2]. These anomalies are encountered in the upper beds of the Assedjefar Formation assigned to Visean-Namurian age [3,4] and uranium content up to 1000 PPm is detected [1,5].

The present study is an attempt aiming at attaining a tenable explanation as to nature and genesis of these uranium mineralization. This could probably leads to more realistic approach in planning and directing of future explorations in these sediments.

Geologic Setting

The study area, herein, refered to as Wadi Intahahah area is located 100km. southwest of Al Awaynat settlement, southwest of libya. It covers about 1000sq km. of the western flank of Murzuk basin within an area covered by Carboniferous sediments represented by the Mrar, Assedjefar and Dembaba Formations. They outcrop in the form of NNW-SSE trending belt, that are conformably underlain from the west by the Devonian Ouan Kassa Formation and are unconformably overlain from the east by the Triassic Zarzaitine Formation (Fig. 1). The stratigraphy, lithology and mineralogy of these different formations are beyond the scope of this work and have been presented in various reports and papers [7,8,9]. However, the Assedjefar Formation being the hosting geological formation for uranium, has been described in more detail.

The Assedjefar Formation, within the area under consideration, crops out within a 13-18km wide, NNW trending zone. Boundaries with the underlying Mrar Formation and the overlying Dembaba Formation are conformable. The formation consists of alternating sequences of sandstone, shaley siltstone and limestone. These sequences are of regression type being characterized by the general finning and thickenning upwards [8].

The sandstones are fine- to medium-grained, of light grey to grreyish-green and yellowish brown colours. It is predominanatly constituted of quartz with frequent presence of feldspar grains, and chert and quartzite fragments. The grains are subangular to subrounded and sorting is medium to poor. Tourmaline, rutile, leucoxene, zircon, monazite, garnet, apatite and pyroxene are the accessory minerals [8]. Common to these sandstones is the local presence of thin green conglomeratic lenses interbeds, dark brown ferruginous concretions and yellowish ooliths. The

ooliths exist either in dispersed form or as filling small vugs and cavities. The rock is frequently grain-supported, cross-laminated and occasionally ripple-marked.

The limestones dominate in the upper part of the formation. They occur in massive compact, 0.5-1.5m thick, beds. The rock is of dark grey colour becomes, locally, impregnated by black veinlets that are most probably produced by ferruginous materials and organic matter. It is composed, principally, of poorly preserved fossil fragments, micritic microsparitic interclast with variable amount of terrigenous constituent up to 30%. The most frequent of these terrigenous constituents is quartz, less common are muscovite, biotite and argillaceous material [7,8,9].

The shaley siltstone, occasionally sandy, dominate in the lower part of the formation. It is of predominant green colour and is apparently devoid of macrofossils. The most frequent constituent is quartz with presence of argillized and sericitized feldspars and biotite flakes. The grains are mostly angular less commonly subangular and rounded. Cement is sparse and is composed of ferruginous and carbonate material mixed with thin argillaceous and sericite matrix [5,7,8].

Rock of the Assedjefar formation, based on previous studies were deposited in shallow marine environment of variable energy. However, the occasionally high energy depositional environment is evienced by the local cross-laminating of these sediments and by the presence of ooliths dispersions and conglomerate as well.

Uranium Mineralization

Mode of occurrence

Uranium mineralization detected in the Assedjefar Formation is almost found confined to a sequence of light-grey and greyish-green sandstone and dark-grey limestone interbeds in the uppermost level of the formation. It occurs as small highlly radioactive spots sporadically distributed within broad continuous, corresponding almost to the outcropping hostrock, anomalous zones of low to moderate radioactive intensities. At all of these spots, no visible uranium minerals have been either observed in surface outcrops or detected in trenches. Samples collected from both surface and trenches assayed 18 to 667PPm uranium [9]. Higher content, more than 1000PPm, was assayed by only two samples. The samples are defficient of thorium and the uranium exists in a state of radioactive equilibrium or desequilibrium, mostly in favour of daughter products [5,9].

Genesis

As regarding the genesis the work, so far conducted, is insufficient to erect a tenable hypothyesis about the origin of these uranium occurrences but certain possibilities can only be invoked. However, before discussing this, the following observations and constrains need to be summerized:

- No evidence of magmatic activity has been identified within the nearby areas to provide an external source for the presently located uranium mineralization.
- The Assedjefar Formation's sediments were deposited in the shallow coastal parts of an epicontinental sea, particularly along the reefs and within the back-reef basins. These semiclosed basins were most probably temporarily partly or completely infilled by streams output from the surrounding land.
- The temperature of the marine environment, at the time of deposition of the Assedjefar Formation, seems to be appreciably higher relative to the temperature dominated during the deposition of most of older formations with resulting abundance of organic life that particularly profuses in shallow, warm lagoons.
- The strong lithologic control of the uranium mineralization which is evidenced by:

i- The confinement of the uranium mineralization to descrete sequence of dark grey limestone and grey sandstone and/or greenish-grey sandstone with thin conglomerate interbeds.

ii- The lack of correlation with structural features.

iii- The widely distributed nature of these mineralization and their common occurrence in elongated or amoeba-like outline aligned parallel to regional stratification.

iv- The absence of evidence about their occurrence transgressive to bedding.

- For the assayed samples, uranium has been revealed as the principal radioactive element responsible for the anomalous radioactivity. It exists either in equilibrium or disequilibrium in favour of excessive daughter products indicating recent leaching of uranium in the surface layer and, most probably, higher uranium concentrations underneath.

From the foregoing, the strong lithologic control of these uranium mineralization together with the lack of evidences of igneous or hydrothermal activity implies on intrinsic source for the uranium. It, most likely, was transported and introduced into the sediments during their deposition and prior to lithification. Uranium could be brought into the sediments either as:

- Trace element in tuffaceous material or accessory heavy minerals that deposited contemporaneously with waterborne sediments. From these, uranium after oxidation and solution, could be transported and redeposited.
- Soluble in stream waterborne sediments.

However, the apparent absence of tuffaceous material and the presence of accessory minerals in only negligible concentrations abate the first possibility and render the second one more likely.

On the basis of the above mentioned postulation, uranium is believed to be washed out and transported, in minor traces, by geochemically active groundwaters moving from source areas that were being weathered and providing uranium in the +6 oxidation state. Uranium, from these mineralized solutions could have been retained, in the coastal semiclosed basins and lagoons, by carbonate-organic ooze that resulted in the concentration of this element in the limestone and sandstone beds formed from the mentioned ooze.

Conclusions

Uranium in the sediments of the Carboniferous Assedjefar Formation is believed to be of intrinsic origin. It, most probably, was brought into the hosting sediments during their deposition. Uranium, in minor traces, could have been transported by stream waters moving from areas that were being weathered and providing uranium in the +6 oxidation state. From these solutions uranium were adsorbed onto carbonate-organic ooze in the coastal semiclosed basins and lagoons. Such ooze were incorporated in the formation of the limestone and sandstone beds of the Assedjefar Formation and thus resulted in the concentration of the uranium in these sediments.

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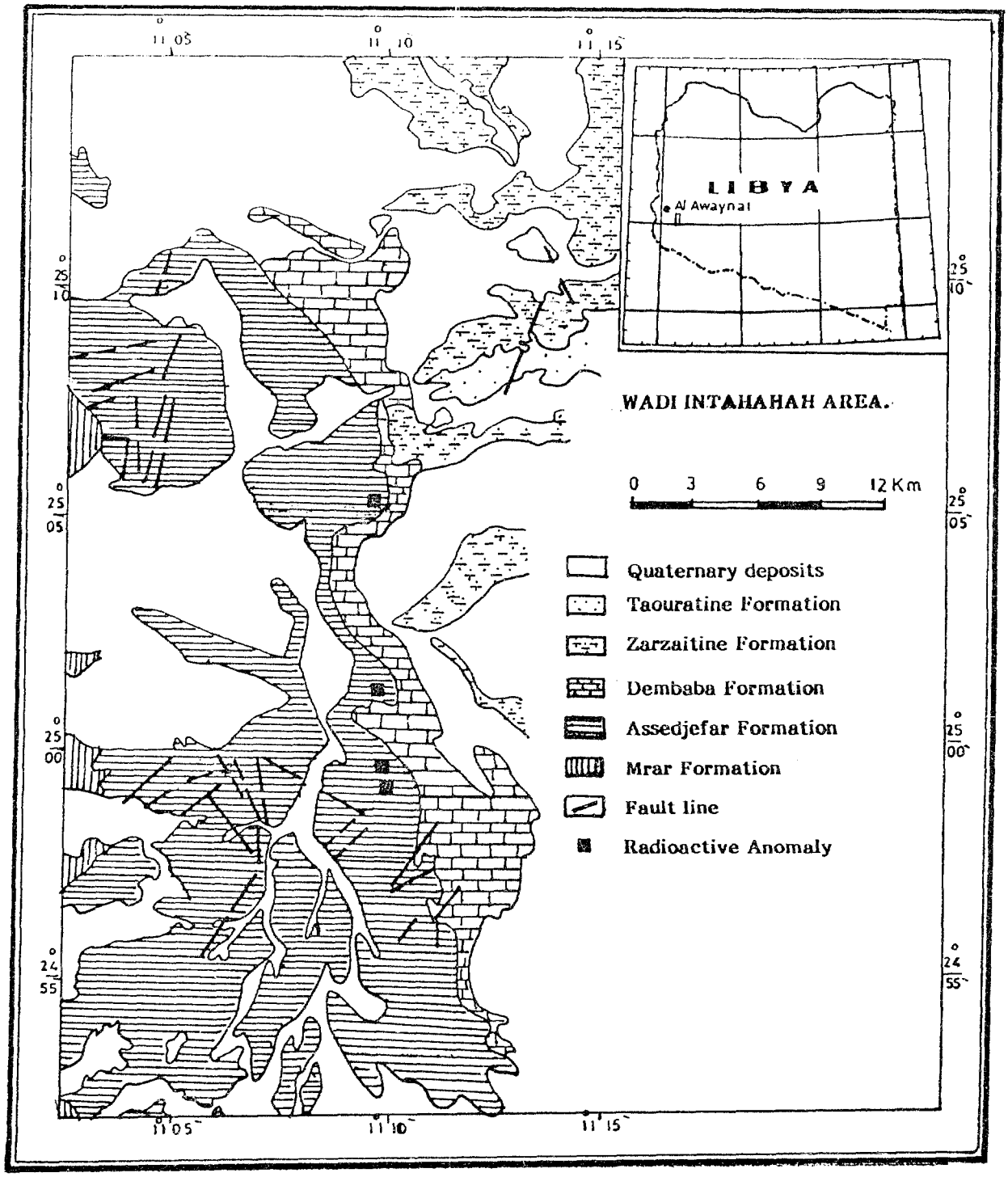

FIG.1: GEOLOGICAL MAP OF WADI INTAHAHAH AREA