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The Tim Mersoï Basin in Niger, a Basin with Unusual Uranium Bearing Potential

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Abstract

The Tim Mersoi Basin, a Paleo-Mesozoic sub-basin of the Iullemmedenintracratonic basin, is a basin with high potential uranium resources. This basin, is located in West Africa, in the northern part of Niger. In this basin, French companies have been exploiting uranium deposits since the 1970. This has made Niger a major uranium producer (3rd largest producer of uranium with more than 100,000 tons extracted in 2006). Uranium exports are one of the country's main sources of income in the mining industry. Today, with the depletion of the Cominak mine deposit, many questions are being asked about the survival of the uranium mining activity, as well as the survival of the large mines located in the Agadez region. This study was initiated to address this concern. The study revealed that several uranium deposits still exist in the Tim Mersoi basin, with very high grades that have never been discovered (sometimes over 5% e.g.: DASA area). This makes this basin an exceptional uranium potential basin.

Keywords: Tim Mersoï Basin, Uranium Minéralization, Unusual Uranim Bearing Potential.

Introduction

The Tim Mersoï basin, a Paleo-Mesozoic basin, corresponds to the northward extension of the Iullemmedensynclise. It is limited to the east by the Aïr Mountains, to the west by the In Guézzamridge. It extends to the northin Algeria where it is called the Tin Sérérine basin (Figure-1)[1]. In this basin, the first uranium discoveries were made in 1957 by BRGM, which targeted copper at the Azelikdome. After this discovery, prospecting campaigns were stepped up in the Agadez region and led to the discovery of the Madaouéla deposit (1963), then the Arlette deposit (Somaïr prospect, production began in 1971), the Akokan deposit (production beganin 1978) and finally the Imouraren deposit (1966). Since then, prospecting campaigns have continued in this basin, which has led to the discovery of important uranium deposits. Despite the closure of the Cominak mine (with the depletion of the uranium ore deposit), Niger still remains a source of supply for uranium ore. In recent years, with the development of very high-grade deposits (>1%), the basin still has enormous quantities of uranium.

This study, based on a compilation of exploration data (mapping, drilling, logging data) aims to show the untapped uranium potential of this Tim Mersoi Basin.

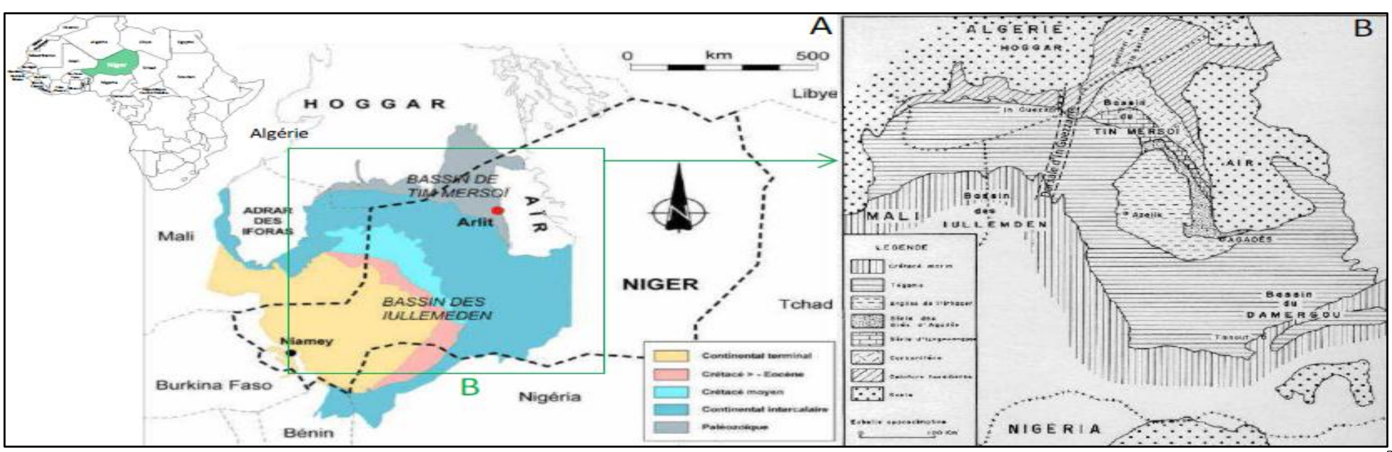

Figure-1: Location of the Tim Mersoi basin in Niger and its boundaries. The Hoggar and Aïr Mountains and the in Guezzamridge[2]. A. Modified from[3], B. Modified from[4].

Geological Setting

The Paleo-Mesozoic Tim Mersoï basin, located on the western edge of the Aïr, corresponds to a northward branch of the Iullemmedensynclise[1]. This basin has two of the characteristics of intra-cratonic basins: it is located on a stable lithosphere and it is marked by weak subsidence, preserved over a long period. As an illustration, for the period from the end of the Devonian to the Lower Cretaceous (246 Ma), the maximum thickness of the sedimentary deposits would be about 1300 m (hence an average subsidence of about 5.28 m/Ma). The sedimentary in fillingod this basin took place in three successive cycles: Carboniferous, Permo-Triassic to Jurassic, Lower Cretaceous.

The first Carboniferous cycle is characterized by the importance of continental platform facies. The sedimentary contributions would come mainly from the Aïr. While for the second cycle, also predominantly plat form, the sources of sediments are located in the SSW. The last cycle, dated to the Lower Cretaceous, is represented by a vast clayey to clayey-sandstone outwash occupying the southern part of the Tim Mersoï basin[5,6].

This Tim Mersoï basin shows adome and gutter structure with a gently slopingeasternflank up to the In Azaoua-Arlitfault-flexure. Beyond this fault, the trend is towards a deepening.

Thus, the main tectonic structures observed in the Tim Mersoi basin are: i. the N70°-N80° accidents (Figure-2) better known as the Tin Adrar cluster. The deformations of the sedimentary cover related to the N70° structures are characterized on the one hand by hidden structures (asyn-sedimentary play generating the formation of the "monoclinal bars" of the Akokan Unit[7]) and by dextral detachments (detachments that affect the sedimentary cover up to the Upper Cretaceous series in the basin[8-10]. At the map scale, the N70° network structures play a damping role on the operation of N30° trending flexures[3]. ii. N30° accidents (Figure-2) represented by the Madaouéla fault-flexure in the Arlit area, to the Adrar-Emoles fault-flexure in the DASA area in studying the Madaouéla-Térada N30° Beam has highlighted a direct link between the reactivation in reverse play of the N30° faults of the basement and the formation of flexures in the sedimentary cover[3,11,12]. According to this author, it is the reverse-game reactivation of basement faults "by sections" or "by segments" that cause the relay formation of flexures in the sedimentary cover[13]. iii. and the N130°-N140° faults (Figure-2) which represent, according to Valsardieu, C.[7], the replay in the cover of ancient Pan-African faults, whereas for Gerbeaud, O.[3], they are the conjugate faults of the N70° fault system. They constitute the main directions observed in the Aïr massif. In the sedimentary cover, these directions are much more discrete. The Arlitfaultis associated with numerous N150° directions in the mining area.

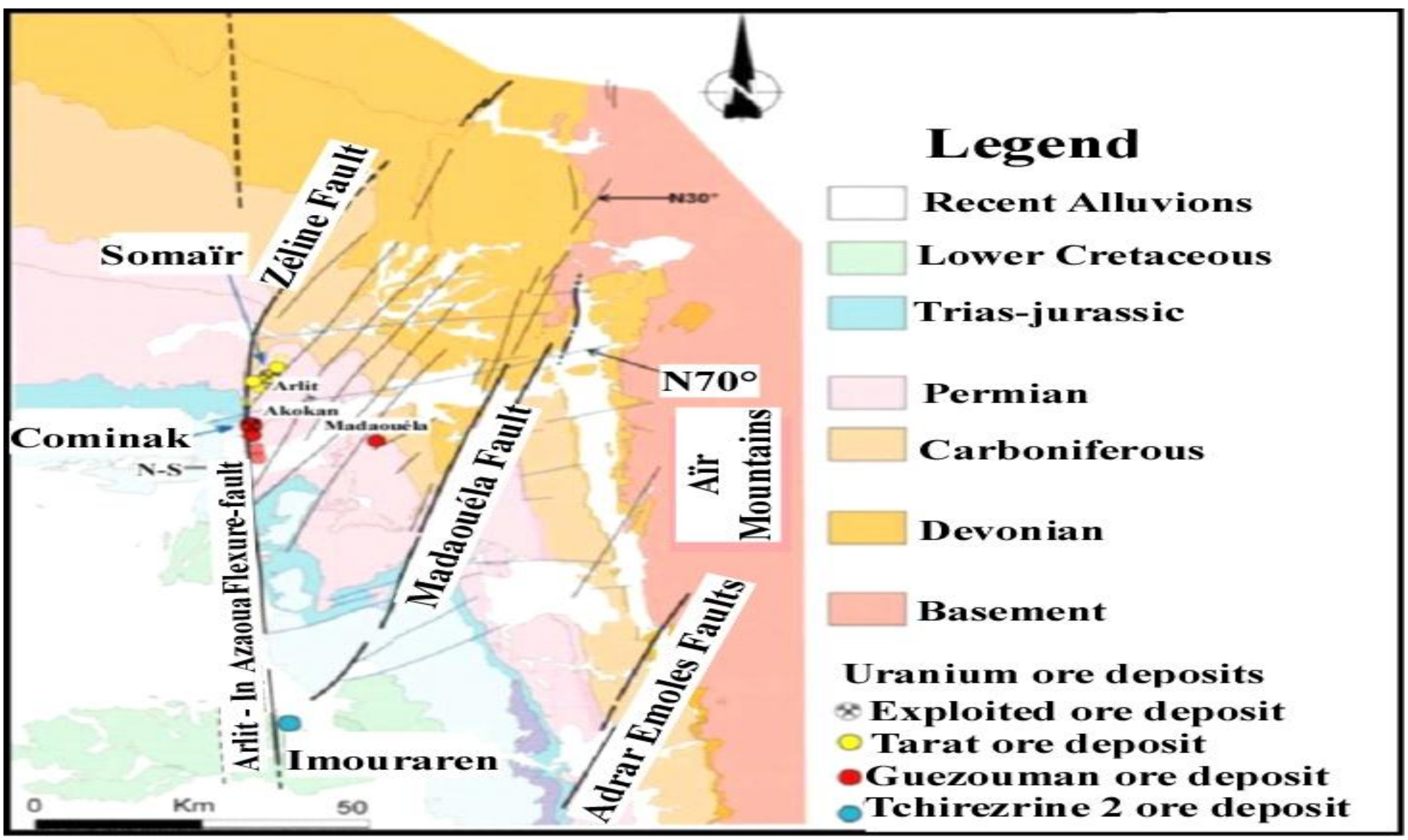

Figure-2: Geological and structural map of the edge of the Tim Mersoï basin, in the Arlit sector (geology based on the 1:100,000 "Afasto" map of the CEA; structures[10], modified), and location of the main economic or sub-economic deposits in the region.

From a sedimentary point of view, the sedimentary cover of this basin ranges from Cambrian to Lower Cretaceous[1,3,7,12-15]. As a result of the tectonic readjustment, all sedimentary formations of this basin come to bevel on the western edge of the Aïr massif (Figure-2). Thus, according to Moussa, Y.[1], the ante-Devonian formations only outcrop to the north of the Aïr Massif. On the other hand, very intense erosive episodes that follow the depositional periods have truncated the lithological succession in several places in the basin, thus favoring numerous erosived is continuities and even gaps in the stratigraphic scale[7]. The lithological succession of this basin is given in Figure-3. It is essentially composed of: i. the Teradahseries which rests unconformable on the Pan-African structured basement. It is composed of sandstones, conglomerates and mudstones, ii. The Tagoraseries marks at its base a transition to a fluvio-deltaic type of sedimentation which lasted from the Upper Carboniferous to the Permian. The deposits of the Arlit sector are all located in the sandstones of the Tagoraseries, contrary to the deposits of Imouraren[16]. iii. The Izegouandane series which is constituted of fluvial sandstones surmounted by fluvio-lacustrines and stone outwashings[10]. iv. The Aguelalseries formed by Teloua 1 sandstones, which are fine sandstones deposited in a continental desert environment (eolian); v. The Goufat series constituted by feldspathics and stones known as Téloua 2, surmounted by bariolateds and stones known as Téloua 3, then by a clayey term with conglomeratic intercalations to analcime (Mousseden). The depositional environment is fluvio-lacustrine. The presence of rhyolite and analcimepebbles in the deposits attests to the continuity of volcanic activity[10]. vi. The Wagadiseries characterized by deposits of fluvio-lacustrineorigin consisting of coarse sandstones and mudstones, very rich in analcime (analcimes and stones and levels of analcimolites), confirming the existence of volcanic activity, contemporary with sedimentation[17,18]. vii. The Dablaseries which consists of sandstones, clayey siltstones, argillites and analcimolites. The deposits of the central zone located south of the Arlitsector are located in this series. Among those, we can mention the Imouraren deposits located in the sandstones of Tchirezerine II. viii. This series is surmounted by irhazermud stones. It is an important clayey spreading (400 m) deposited in a palustro-lacustrine environment. ix. Finally, the Tegamaseries, consisting of medium to coarses and stones with reddish clay stone inter layers, deposited in a fluvial environment, constitutes the last deposit of the Tim Mersoï basin.

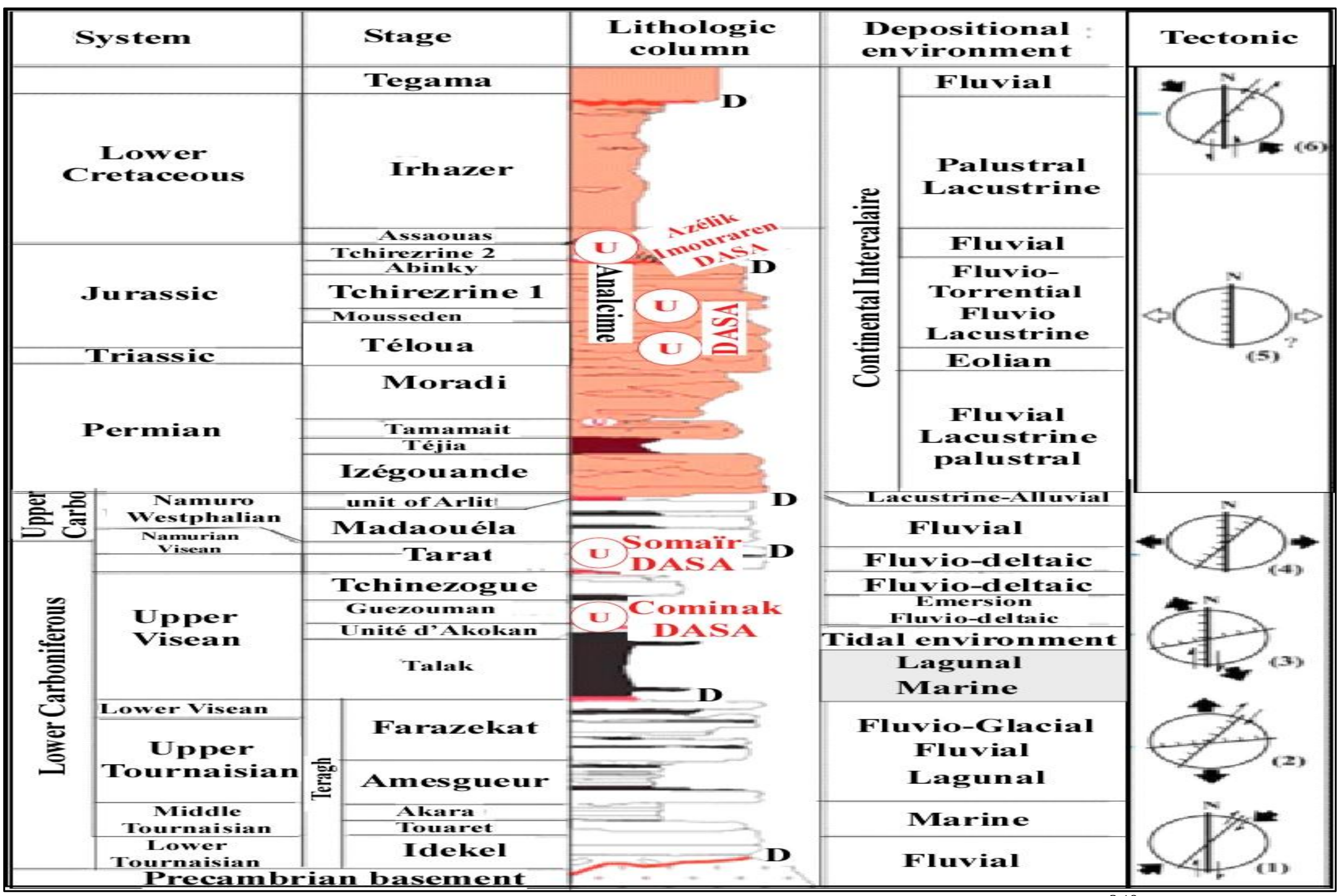

Figure-3: Litho-stratigraphic column of the Tim Mersoi basin, depositional environments and tectonic phases[3,19].

Approche Méthodologique

A multidisciplinary approach was used in this study integrating new data (i.e., satellite images, Well logs…). Furthermore, a significant geological database (i.e., wells, geological reports) has been compiled in the course of uranium exploration since the 1959.

The sediment logical dataset is based on the integration and analysis of cores, outcrops, well logs and of lithological data. They were synthesized from COGEMA, PNC, AREVA NC, Cominak, Somair, Global Atomic Corporation, Goviex and Somina.

Results and Discussion

Uranium potential of the Tim Mersoi basin: The compilation of geological and cartographic data as well as satellite imagery from the various exploration campaigns in the Tim Mersoi basin has allowed us to propose a synthetic map showing the various uranium discoveries. These include the Imouraren deposit, the Azelikdeposit, the Madaouéla deposit, the DASA deposit and the Toulouk deposit (Figure-4).

The distribution map of uranium deposits in the Tim Mersoi Basin shows that all these deposits are located on major faults (NS, N30° or N70°). This indicates the role of tectonics in the emplacement of these deposits. In some areas, radiometric maps have revealed significant uranium deposits (Figures-5, 6, 7).

Sedimentologicalunits favorable for uranium concentration: Previous work has shown that the only facies favorable for uranium accumulation in the Tim Mersoi Basin are the Carboniferous (organic and/or pyrite-rich) and Jurassic (analcime-rich) sandstones[3,5,12,17,20-24]. The latest deposits discovered in the DASA graben reveal that all sandstone facies in the Tim Mersoi Basin are susceptible to mineralization provided conditions permit[12,15].

Thus, in the Madaouéla sector, it has been demonstrated that the mineralized facies are those of the Carboniferous (medium, grayish and stone rich in organic matter and pyrite, arkosics and stone rich in organic matter and pyrite) (Figure-8).

In the Toulouk sector, studies have shown that uranium is hosted in Jurassics and stones rich in organic matter and especially in analcime (Figure-9).

On the other hand, for the DASA sector, the studies have shown mineralized drill holes from the base to the top (up to the contact of the Irhazerargillites). Carboniferous, Triassic and Jurassic sandstones have shown exceptional grades (> 5%) (Figure-10).

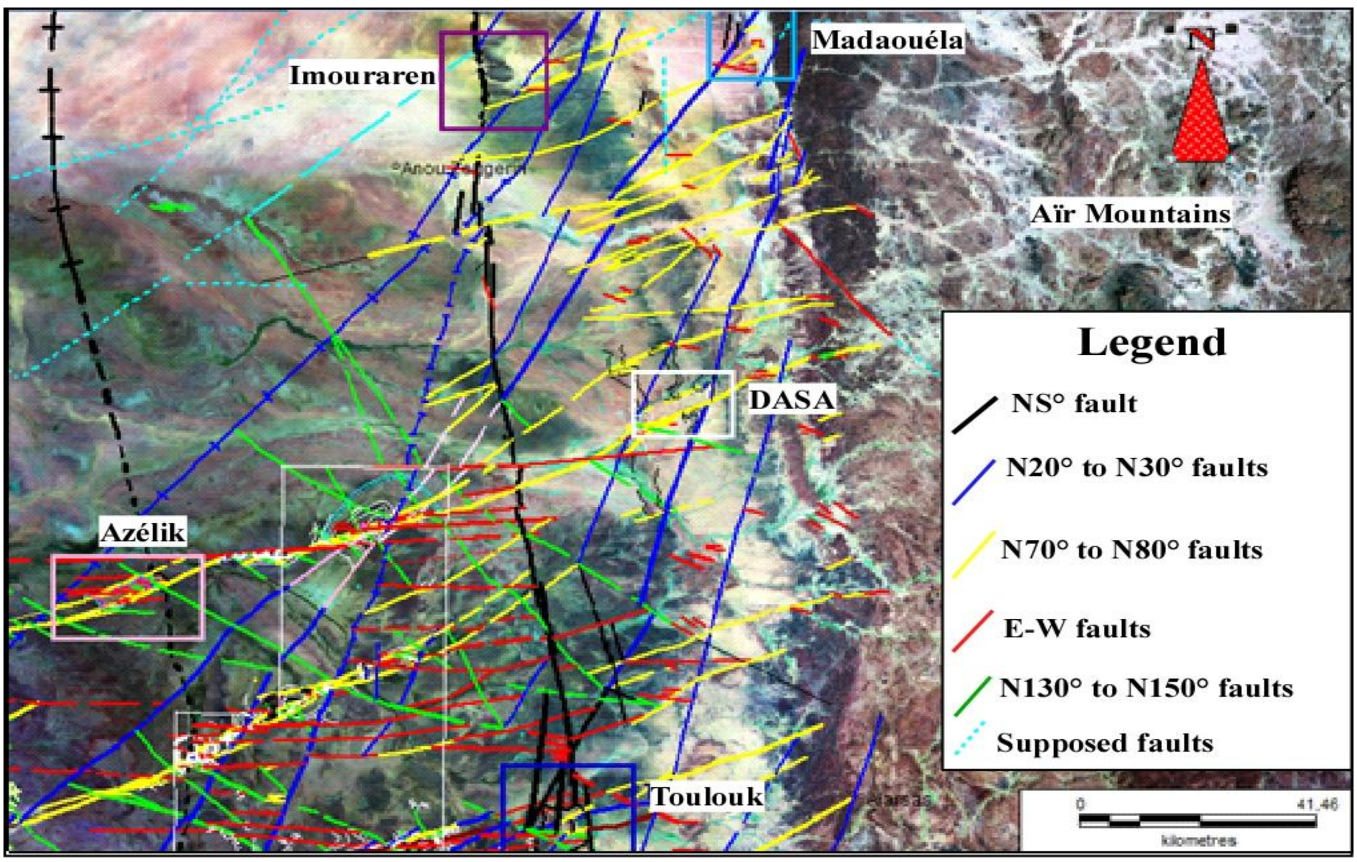

Figure-4: Map showing the distribution of major uranium discoveries in the Tim Mersoi basin.

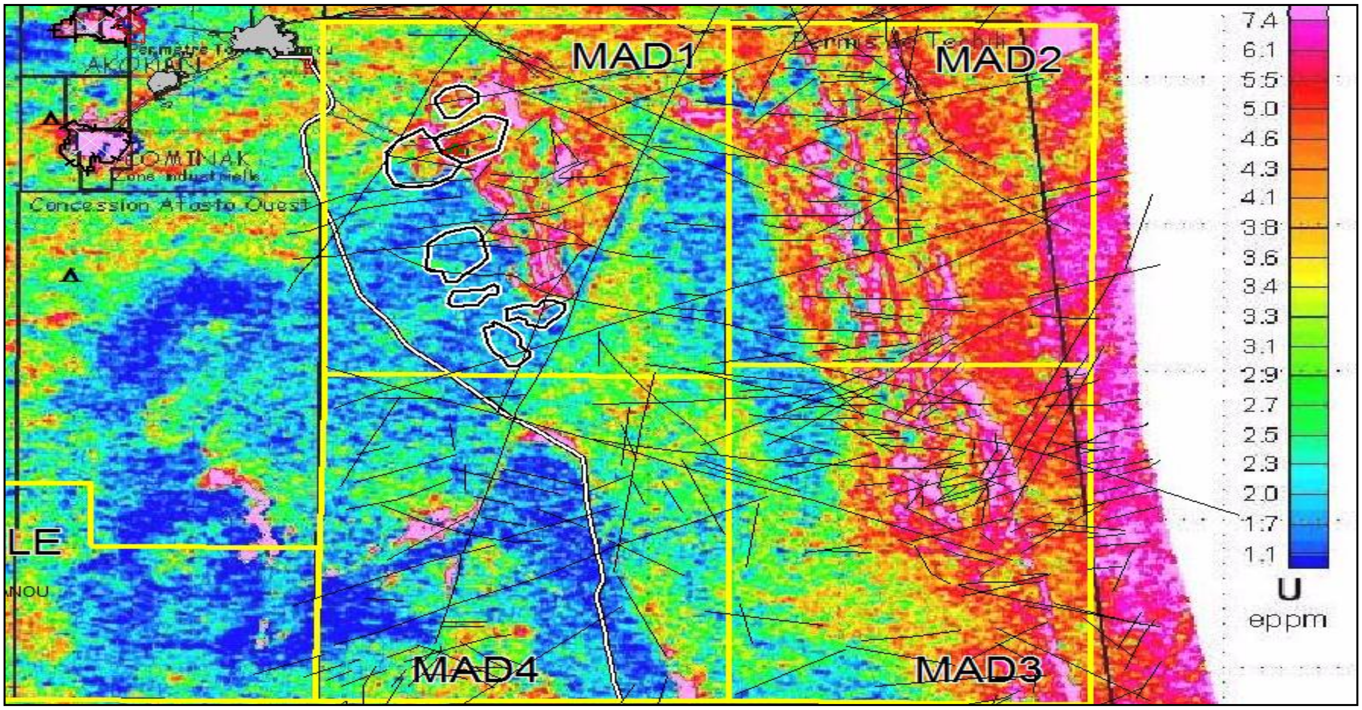

Figure-5: Radiometric map showing the distribution of uranium mineralization in the Madaouéla area (Goviexinternal data).

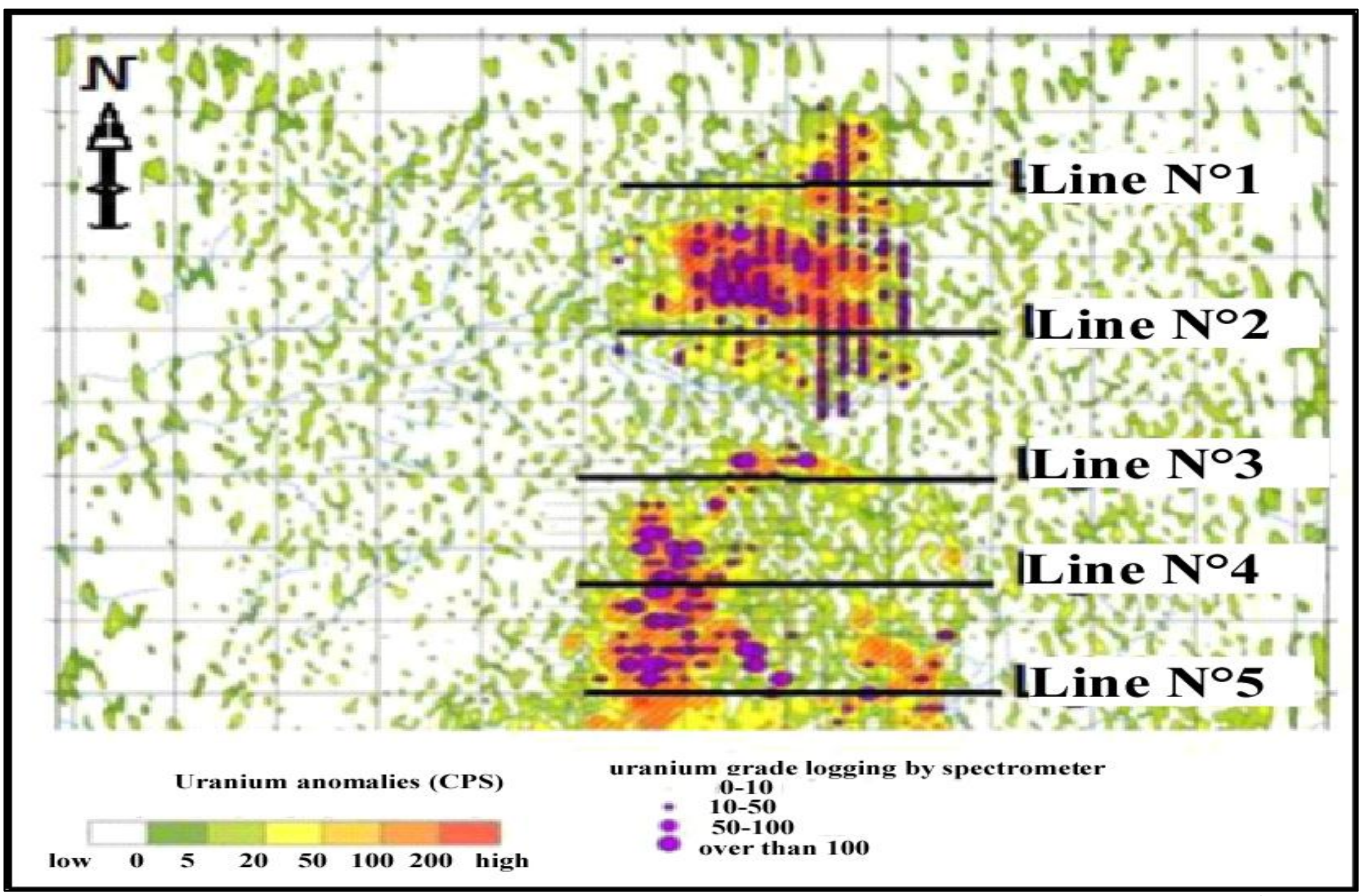

Figure-6: Surface anomaly map showing the layout of the drill hole sections (GPB internal data, modify from[20]).

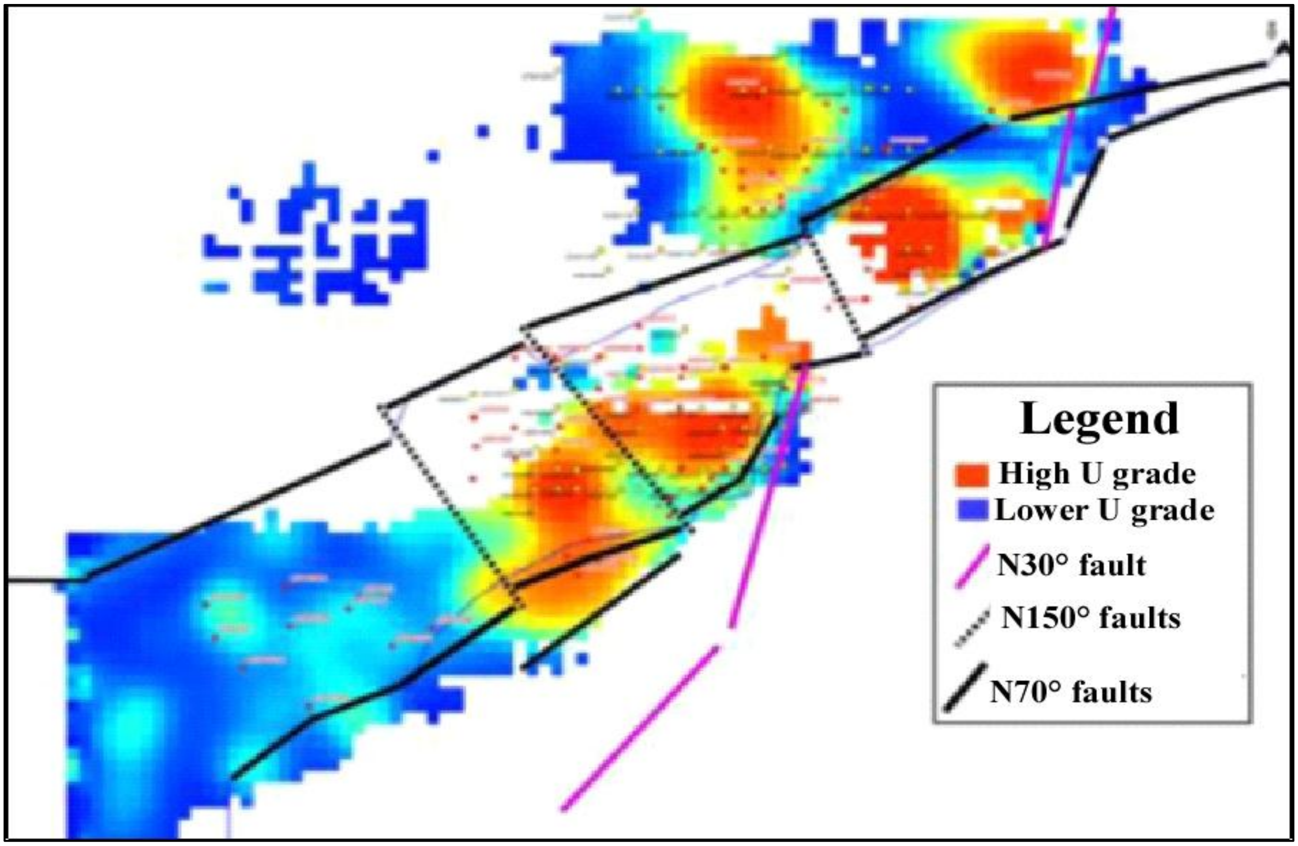

Figure-7: Distribution map of mineralization in the DASA area[12].

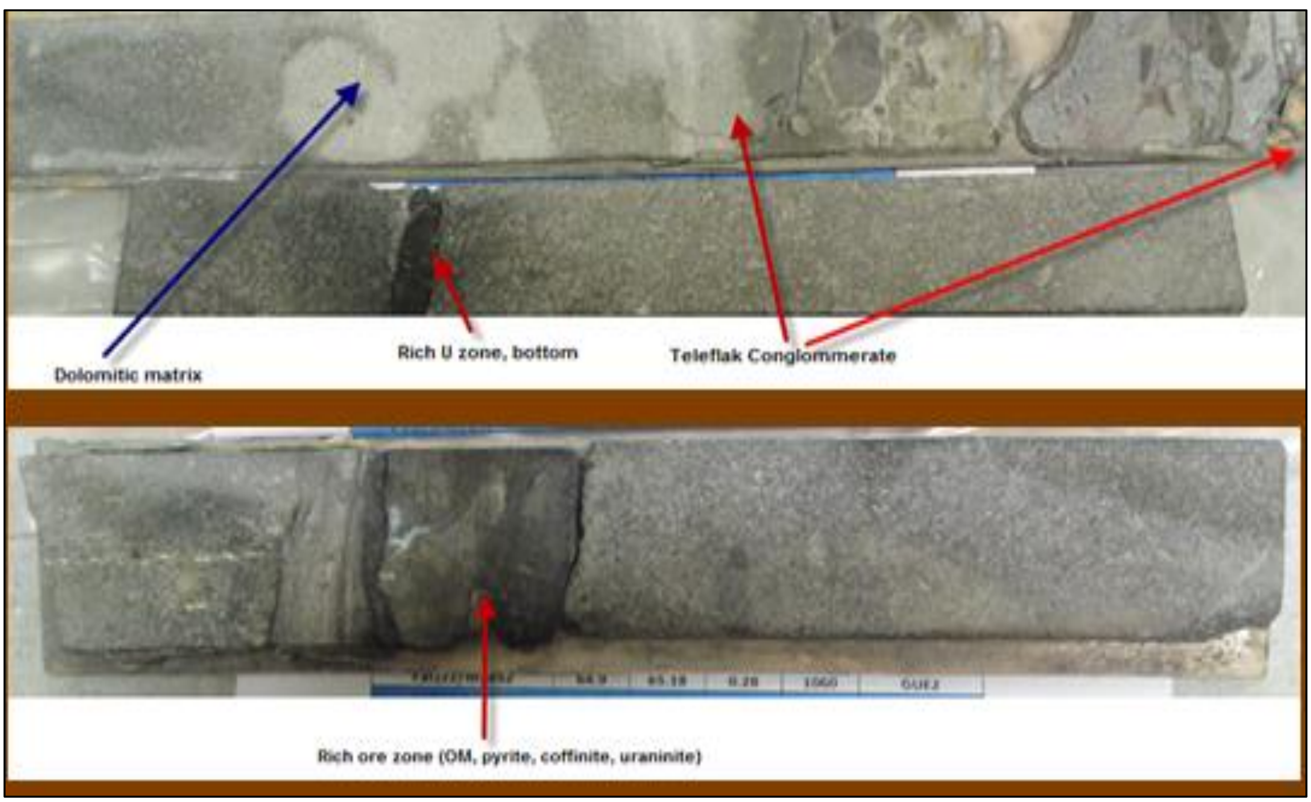

Figure-8: Typical core samples uranium bearing zones of Madaouéla area (Goviex Data).

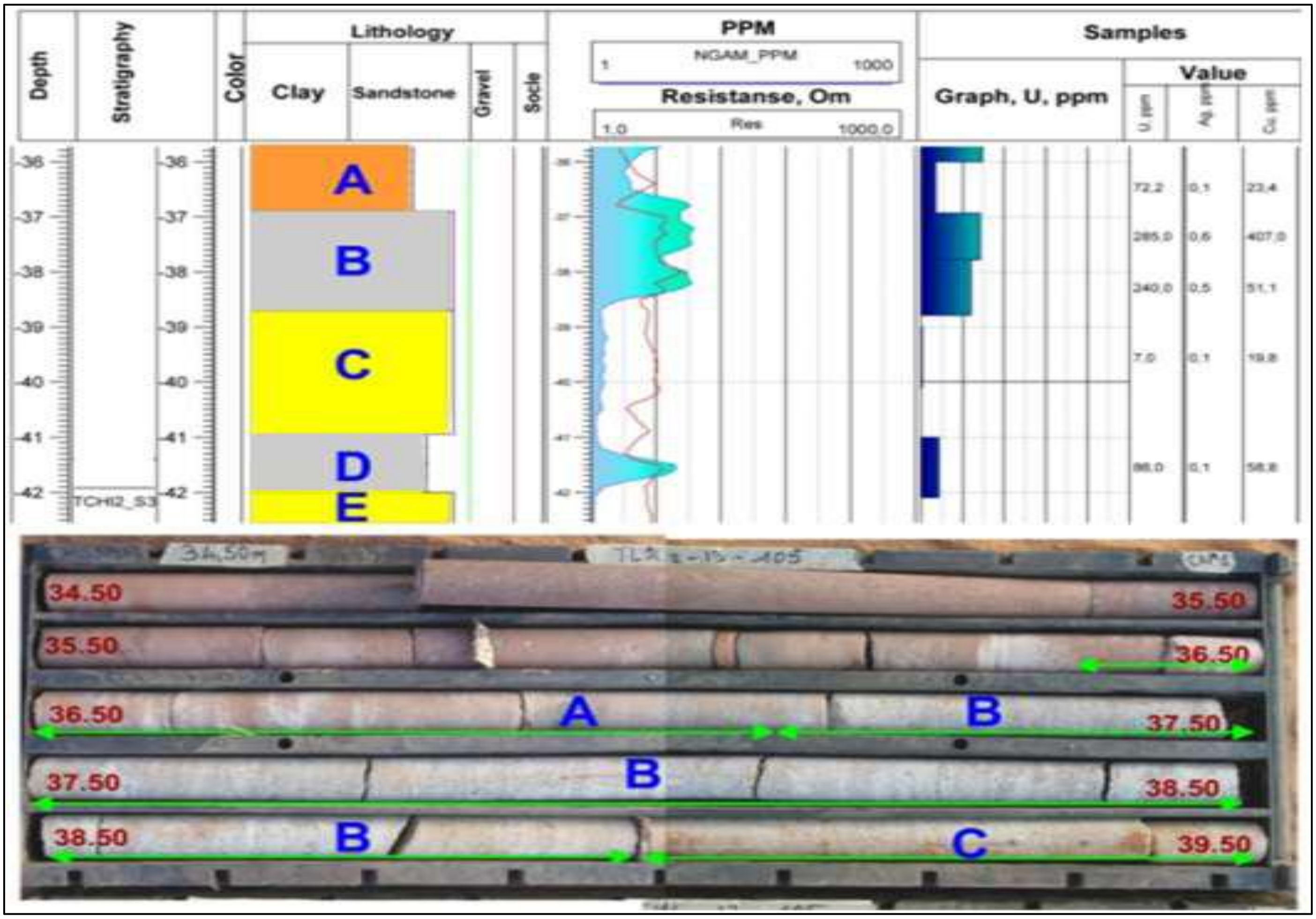

Figure-9: Correlation between lithological and logging data and the results of the chemical analysis of the Toulouk sector.

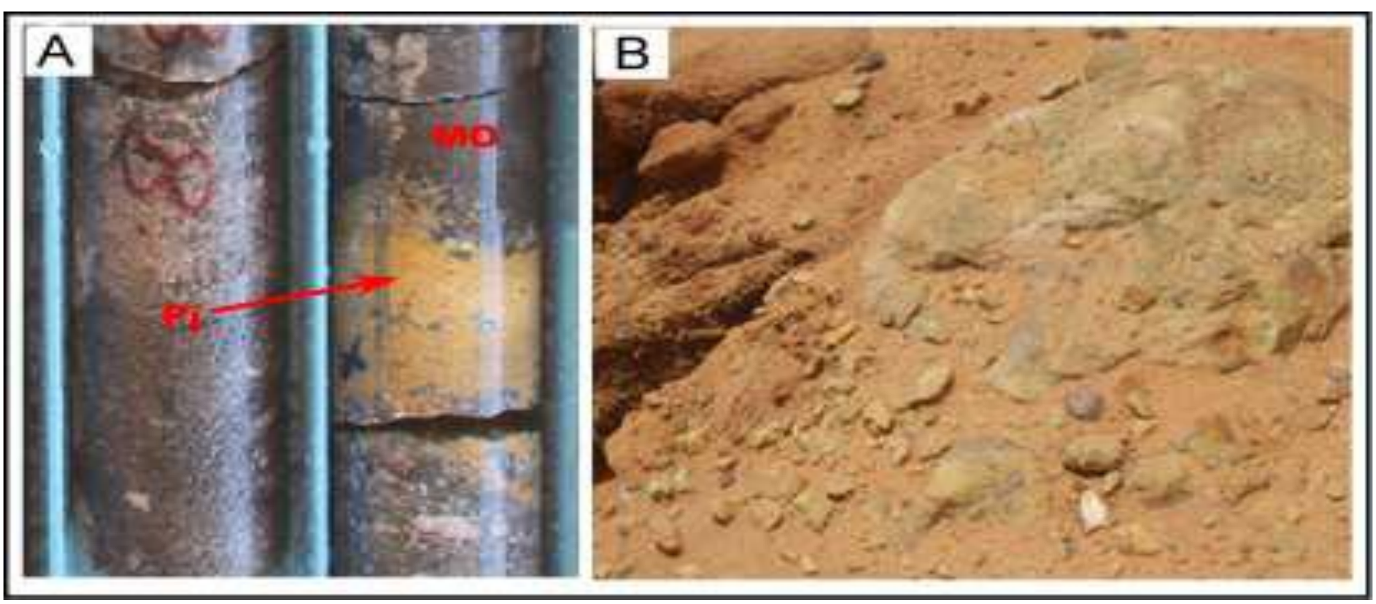

Figure-10: (A) Medium to coarse sandstone of the Triassic series rich in organic matter (OM) and yellow product (Pj) (hole ASDH563). (B) Uranium-rich, clay-cemented, medium to coarse sandstone (Tchirezrine 2 outcrop)[12].

Mineralogy and geochemistry of uranium in the Tim Mersoi basin: The uranium mineralogy of the main deposits discovered is quite similar. Thus, for the Imouraren uranium deposit, the minerals are: metatyuyaminite and uranophane. These are mainly U6+ uranium minerals.

For the DASA uranium deposit, analyses have shown that for Jurassic mineralization, there are both U^{4+} minerals (pitchblende and coffinite) and U^{6+} minerals (Uranophane, Brannerite, etc.).

Geochemical data have shown that several associations are possible. Those from the work of Sani, A.[12] showed: i. U, Zr, Pb and Mo for carbon if erousmineralizations, ii. U, Zr, Pb, V, Zn and Cu for Triassicmineralization, iii. U, Zr, Pb, Cu, Zn and As for Jurassicmineralization.

Conclusion

This study, based on the compilation of data, shows that despite the depletion of the Akouta uranium deposit, the Tim Mersoi Basin contains more uranium reserves. Significant exploration work must bedone to uncover as yet unidentified reserves. Already with the discovery and trend towards exploitation of the DASA and Madaouéla deposits, this shows that this basin is full of significant uranium resources. This makes this basin a basin with unprecedented uranium potential.

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