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REVIEW CATEGORIZATION OF THE NORTH SAHARAN INTRACRATONIC BASINS AND PETROLEUM POTENTIALS

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Abstract *This paper reviews what intracratonic basins are and categorized it stating clearly the types and with the case study of the north Saharan intracratonic basins. The historical trend in North Africa is Early Precambrian to Phanerozoic Characterized by at least 7 big phases of tectonic activity: Pan-African organic, intracambrian expansion, varying scale from Cambrian to Carboniferous and Compression, mainly intraplate Late Carboniferous 'hercynian,' late Triassic Early Jurassic and Early Cretaceous Rifting, Late cretaceous - tertiary 'Alpine' compression and rifting in Oligo-Miocene. North-western areas of North Africa are heavily impacted by plate collisions during the hercynian and Alpine ages, not several of them. The region was subjected to only subtle processes involving repeated interpolate processes transpersonal and trans tensional major fault reactivation. Late Continental Carboniferous Collision between Gondwana and Laurasia contributed to Elevating and thrusting in northwestern North Africa and folding and reversing in intra-plate neighborhood. Deformation severity decreased to the east, In the Northwest, Hercynian folding and erosion replaced by subtle, low-angle erosion.*

Further south and east, discrepancies and disconformities. This geological structure is the product of the accretion of Archean and Proterozoic terranes accumulated from previous orogeny (e.g., Pan-African orogeny 900–520Ma). The sedimentary infilling trend and the existence of deformation derive therefore from recurrent gradual Paleozoic reactivation of Precambrian terrines bounded by sub vertical lithospheric fault systems. A succession of Paleozoic geodynamic occurrences (i.e., far-field organic chain, glaciation), leads to intermittent cycles of tectonic quiescence and low-rate subsidence acceleration consistent with expansion and local inversion tectonics. Ultimately, this polyphase evolution created a highly interconnected and interconnected network superimposed Paleozoic and Precambrian basins isolated by long-lived, stable basins . The petroleum potential of these basins varies according to their location. Different tectonic, thermal and sedimentary developments and the complexity of built styles. These factors combine to make conditions particularly favorable for the production and storage of hydrocarbons in the eastern Algerian basins and to the west of Libya.

Keywords *Intracratonic,,basins,,Paleozoic,,pericratonic, Reggane, Ahnet, Mouydir*

INTRODUCTION

The formal definition of a sedimentary basin is: a low region of tectonic origin in the Earth's surface, in which sediments collect. Sedimentary basins range in size from hundreds of meters tall to large parts of ocean basins. The essential element of the concept is tectonic relief creation, in order to provide both a sediment source and a relatively low place for the deposition of the sediment.Typically, the word "sedimentary basin" does not refer to fairly thin and quite large deposits on cratons of sandstone, calcareous and shale from epicontinental oceans, many of which have seen little deformation over billions of years, but rather to comparatively dense deposits in tectonically active, negative-relief areas. (But intracratonic basins are the exception)

The intracratonic sedimentary basins consist of fillings of large areas within stable masses of continental crust. They are characterized by deposits associated with continental and shallow marine paleo environments, with significant gaps in depositional mega sequences. These usually

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have circular or oval forms, and fairly gradual subsidence has long past.

Classical examples of the North Saharan African Basins include **the Reggane, Ahnet, Mouydir,Muruzq and Illizi basins (P.Perron et al 2018).**

TYPES OF INTRACRATONIC BASINS

In Africa, the Phanerozoic sedimentary basins may be either intracratonic or external (pericratonic or marginal) basins.

There is a distinction between two principal types in the intracratonic basins:

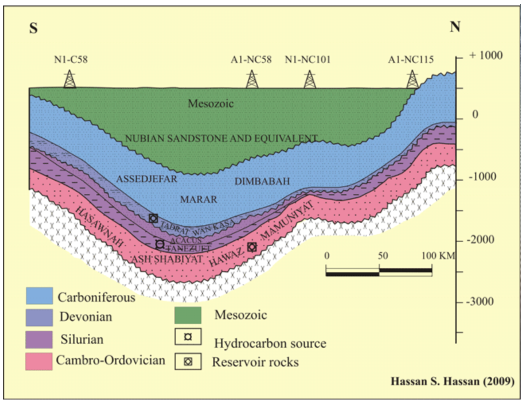
- The platform basins or syneclises are very large, with an oval or triangular shape and gently sloping flanks; they are filled with Palaeozoic series with often a Mesozoic filling on top.
- Grabens: distension characteristics of dense lacustrine brackish series, or coastal sequence; listric faults surround them. Primary stages of expansion are Upper Cretaceous and Late Tertiary (Oligocene-Pleistocene).

Tectonic and sedimentary processes: No clear relation between these basins and plate tectonics. Following a heating event under the continental lithosphere they are thought to reflect very slow thermal subsidence (for times of the order of one hundred million years). But there's no understanding of the reasons for depression below the original crustal standard. Erosion appears untenable during the thermal uplift, as does lithospheric stretching. Was the lithosphere in the region underneath the basin rendered more dense? Was the lithosphere thinned from beneath by "erosion?" Whatever the reason, by cooling and isotactic adjustment the subsequent subsidence can be very well modeled. (A diastem is a brief interruption in sedimentation, with little or no erosion before sedimentation resumes.) (Craig et al 2008)

Geometry: rounded,equidimensional, hundreds of kilometers across. Sediment fill: shallow-water cratonal sediments (carbonates, shales, sandstones), thicker and more complete than in adjacent areas of the craton but still relatively thin, hundreds of meters. (Coward et al, 2003)

THE ORIGIN OF INTRACRATONIC BASINS

The origins of such basins also provided a geological mystery. At Plate Tectonics paradigm tectonic reconstructions are very difficult. Planet Extension Theory provides a logical reason for this. Earth may have a size less than the present one in the Paleozoic Period. There were no significant oceanic expansion cycles, even less what is so-called plate subduction. Continental populated ecosystems such as alluvial, fluvial and deltaic, wetlands, rivers, glacial conditions, and shallow oceans, rarely deep oceanic sedimentation, as seen before and after the Mesozoic Period. Formation of intracratonic basins would promote processes of crustal uplift buckling and bending of the marginal Rifts of arches and depressions of precursors that will later be lined of partial degradation of these arches, with episodic sedimentation of clastic and carbonate.(Boote, D et al, 1998)



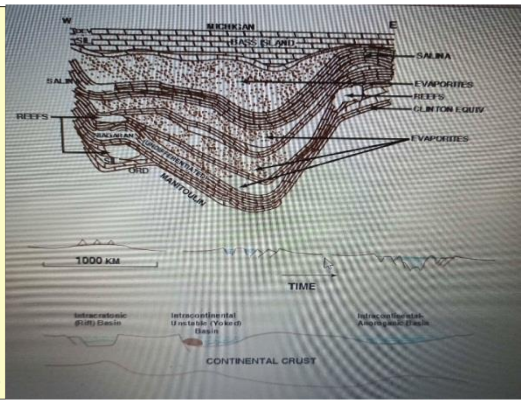


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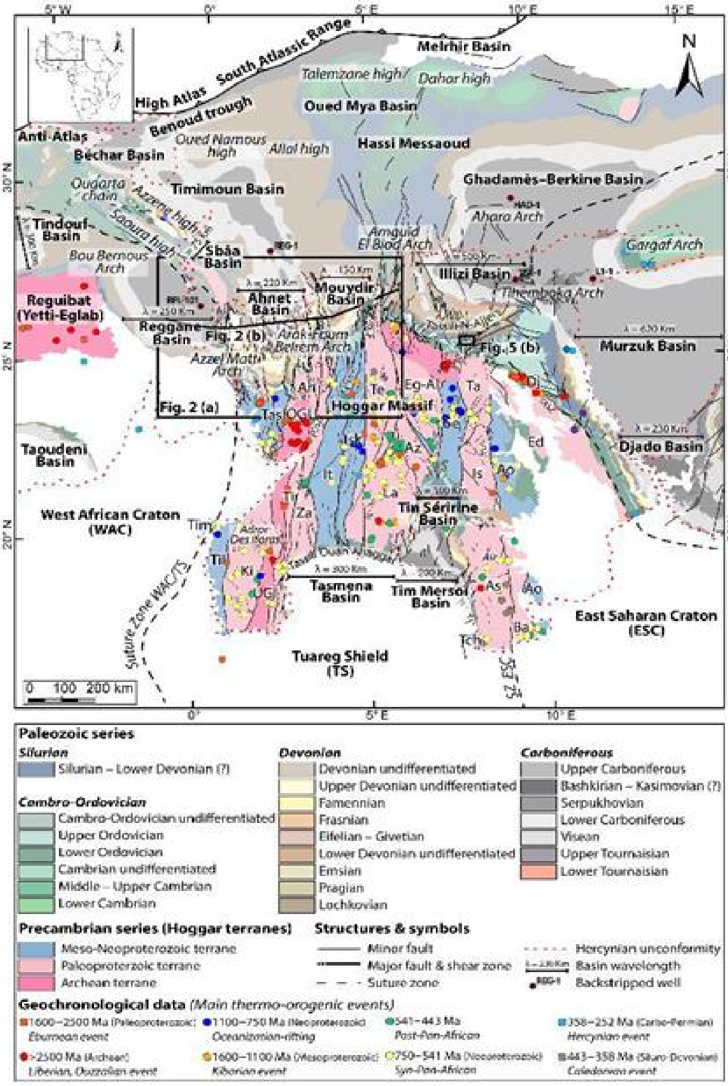
Figure1: Muruzq Basin Moving North-South. (Amended to Pallas, 1980).Typical Intracratonic Basin Model.Wide intracratonic Paleozoic Plain, straddling the Algerian, Nigerian and Chadian boundaries. The Basin is lined with sediments varying from Cambrian to Quaternary in age, with an estimated overall thickness in the central portion approaching 3000 feet.

Figure 2: location and tectonic setting of intracratonic basins; Inanorogenic areas on cratons

THE GEOLOGICAL STUDY OF THE PALEOZOIC NORTH SAHARAN PLATFORM AND THE REGGANE, AHNET, MOUYDIR AND ILLIZI BASINS



The Reggane, Ahnet, Mouydir and Illizi basins (Figs. 3and4) are located, north of the Hoggar Massif (Ahaggar). They are depressions filled by Paleozoic deposits. The basins are bounded to the south by the Hoggar Massif (Tuareg Shield) and they are separated one another by the AzzelMatti, the Arak-FoumBelrem, and the Amguid El Biod arches. The basins of Reggane, Ahnet, Mouydir and Illizi (Figs. 3 and 4) are located in the southwest of Algeria, north of the Hoggar (Ahaggar). These are depressions filled with deposits from the Paleozoic. The basins are surrounded by the Hoggar Massif (Tuareg Shield) to the south, and are divided by the arches of AzzelMatti, Arak-FoumBelrem and Amguid El Biod. (Caby et al, 1981). The Hoggar Massif is composed of several accreted, sutured, and amalgamated terranes of various ages and compositions resulting from multiple phases of geodynamic events. In the Hoggar Massif, 23 well preserved terranes were described and grouped into Pan-African Archean,Paleoproterozoic, and Mesoproterozoic – Neoproterozoic juvenile terranes (see legend in Fig . 3). The Reguibat Shield in West African Craton is made up of Archean lands in the west and Paleoproterozoicterranes in the east. (Fullagar, P.,et al 1980). **Figure 3.** Geological map of the North Saharan Paleozoic

Platform (North Gondwana) georeferenced, assembled and updated from (1) a Paleozoic subcrop distribution below the Saharan Platform's Hercynic non-conformity geology (Boote et al., 1998; Galeazzi et al., 2010),(2) a geological map (1=500 000) of Djado Basin (Jacquemont et al , 1959), (3) a geological map (1=200 000) of Algeria (Bennacef et al . , 1974; Bensalah et al . , 1971), (4) a geological map (1=50 000) of Aïr (Joulia, 1963), (5) a geological map (1=2 000 000) of Niger (Greigertt and Pougnet, 1965), (6) a geological map (1=5 000 000) of the Lower

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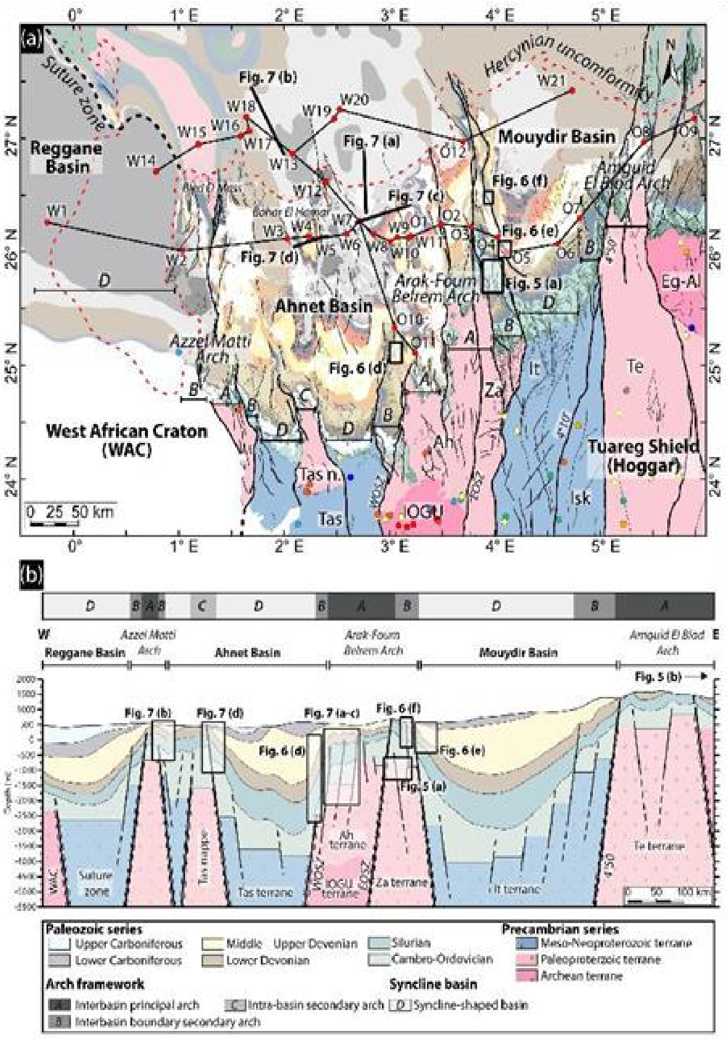
Paleozoic of central Sahara (Beuf et al., 1971);

THE STRUCTURAL AND TECTONO-SEDIMENTARY DEVELOPMENT OF THE NORTH SAHARAN AFRICAN PLATFORM

Throughout the Phanerozoic, North Africa was part of a single lithospheric layer, and hence its structural growth was largely regulated by intraplate processes. An exception to this is the extreme northwest portion of the area (Moroccan Meseta, Atlas Mountains) that was involved in two phases of plate collision between Gondwana/Africa and Laurasia/Europe during the 'Hercynian' and 'Alpine' periods. Additionally, there is a graben network around the Mediterranean edge, which is connected to the separation of various terranes from North Africa during the Triassic-Jurassic.The North Saharan Platform's structural architecture is characterized by basins that are mostly circular to oval, structured by major faults often associated with wide asymmetric folds shown by three major trends.(Ghuma, M. et al, 1978)



The timing of tectonic events in North Afrika coincide closely with the major events of the division of the African, Laurentian, and Eurasian tiles in Gondwanaland and Pangea. North Africa's Mesozoic-cenozoic geological past may be related to three consecutive rifting events that lead to the development of the Equatorial, South and North Atlantic and the resulting opening and eventual closure of the Tethyan Basin. (Logan, P.et al 1998) This tectonic polyphase evolution culminated in the formation of the present network of largely interconnected Palaeozoic sedimentary basins, isolated by the action of lifts. (Makhous, M., et al 1997)**Figure 4. (a) Geological map of the Paleozoic of the Reggane, Ahnet, and Mouydir basins. For the legend and references see Fig. 3. (b) An E–W cross section of the Reggane, Ahnet, and Mouydir basins associated with the different terranes and highlighting the classification of the different structural units. Localization of the interpreted sections (seismic profiles and satellite images). W represents well and O represents outcrop. See Fig. 3 for location of the geological map A and cross section B.**

DISCUSSIONS

The formation of a complicated network of intertwined and superimposed precambrian and palaeozoic basins, separated by long and stable Palaeo peaks, was the product of the poly-phase growth in Northern Africa. The petroleum capacity of these basins depends on their diverse

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tectonic, sedimentary and thermal nature and their structural complexity. The major paleozoic rock sources, the Ordovician basal Silurian and the Devonian (Frasnian) organic-rich shale seem to have been one of the primary controls on hydrocarbon prospectively.The present maturity is generally close to that of these Paleozoic rocks. Therefore, at a national scale, basal Silurian "hot-shales" (where they occur, for the most part) appear only in "the gas zone" or to be over mature at the northeastern ends of Mesozoic early-to-middle (e.g., the Essaouira and Tindu basins), while they are actually only inside the petroleum output window or, if they are located, in the southeastern field (e.g. the Murzuq and Kufra basins) The condition is, naturally, a little more complex at a more local stage. The lower Palauzoic origins rocks in Morocco, for example, are typically contained in the "carbon slot" in the Doukkla Basin where the Permotriassic, Jurassic, is situated.

CONCLUSIONS

Over the past years, the discovery and development of the Palaeozoic Hydrocarbon Sites of North Africa has led to a combination of factors. • The expansion of the region's petroleum infrastructure. • Succeeds in discovery of new works, particularly in the Ghadames Basin north (under triassicevaporitis), and in the Murzuq Basin Ordovicians. • Amendments to hydrocarbon regulations in Algeria (the nation that has the largest number of Paleozoic basins in the region). This speeding up shows every indication of continuity, particularly now that a series of explorations have begun by the Libyan Government

It is clearly of vital interest to consider the forces that govern the background of location and distribution of hydrocarbons in Precambrian and Paleozoic environments. In particular, the significance of the patterns in the deformation 's severity across North Africa was highlighted in this study.

AUTHOR

Humphrey B. Kunghe is the author of this review article and the paper is based on other publish works

REFERENCES

1. P.Perron et al Influence of basement heterogeneityon the architecture
2. Craig, J., Rizzi, C., Said, F., Thusu, B., Luning, S.,Asbali, A. I., Keeley,M.L.,Bell,J.F.,Durham,M.J.,andEales,M.H.:Structural styles and prospectivity in the Precambrian and Palaeozoic hydrocarbon systems of North Africa, Geol. East Libya, 4, 51– 122, 2008.
3. Coward, M. P. and Ries, A. C.: Tectonic development of North African basins, Geol. Soc. Lond. Spec. Publ., 207, 61–83, https://doi.org/10.1144/GSL.SP.2003.207.4, 2003.
4. Boote, D., Clark-Lowes, D., Traut, M., 1998, Paleozoic petroleum system of North Africa, In: Petroleum Geology of North Africa (eds. MacGregor, D.S., Moody, R.T.J and Clark-Lowes, D.D.), J. Geol. Soc. London, Spec. Publ., 132, 7-68.
5. Caby, R., Bertrand, J., Black, R., 1981, Pan African ocean closure and continental collision in the Hoggar-Iforas segment, central sahara, In: Precambrian Plate Tectonic (ed. Kroener, A.), Elsevier, Amsterdam, 407-434.
6. Fullagar, P., 1980, Pan African Age granite of notheastern Africa: new or reworked sialic materials? The Geology of Libya, (eds. Ghuma Salem, M. and M. Busrewil, M.), vol. III, 1051-1058.
7. Ghuma, M., Rogers, J., 1978, Geology, geochemistry and tectonic setting of Benema batholith, Tibesti massif, southeastern Libya, Bull. Geol. Soc. Am., 89, 1351-1058.

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www.uijir.com

8. Logan, P., and Duddy, I., 1998, An investigation of the thermal history of the Ahnet and Reggane basins, central Algeria, and the consequences for hydrocarbon generation and accumulation, in MacGregor, D.S., Moody, R.T.J., and Clark-Lowes, D.D., eds., Petroleum geology of North Africa: The Geological Society of London, Special Publication No. 132, p. 131–155.
9. Makhous, M.,Galushkin, Y.I., and Lopatin, N., 1997, Burial history and kinetic modeling for hydrocarbon generation, part II—Applying the GALO model to Saharan basins: American Association of Petroleum Geologists Bulletin, v. 81, no. 10, p. 1679–1699.