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Occurance of Interdunal Soda Depressions in the Mangagrass Land of Yobe State and their Impact on the Economic Geology

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Abstract: ***Manga Grassland constitutes an important geologic zone and a unique landscape of interdunal soda depressions within the semi – arid southern Sahel of Yobe state, Nigeria. Two fold methodological approach; field observations and previous investigation findings were used to demonstrate the existence of these phenomena, which are believed to be controlled by complex and amalgamated factors of water balance, xeric climatic condition and nature of geology. Results of analyses of some samples of these phenomena shown they are laden with large deposits of sodium carbonates and Bicarbonates largely in form of trona, which its reserve estimate shown it be over 800 million tons abound the study area.***

Keywords: Bicarbonate, Carbonates, depression, interdunal, Manga, grassland, Soda, Sodium, Trona, Yobe, Nigeria

1. Introduction

Manga grassland is a semi-arid landscape that constitutes an important geologic zone in the north most portion of Yobe State, Nigeria. Cater (1963) described it as a unique landscape of dune filed and interdunal depressions within semi-arid southern Sahel.

1.1 Purpose

This particular paper craves to contribute to the occurrence of numerous interdunal soda (or Alkaline) depressions in this unique Geologic zone and their impact to the Economic Geology of the area.

1.2 Location

The manga grassland of the state lies between longitude 9^0 57^0E and 12 E and Latitude 13^0 07'N and 13^0 31'N, Covering parts of Yusufari,Yunusari, Karasuwa and Machina Local Government areas. However the 'mega' manga land engulfs parts of North – East arid zones of Jigawa state, Yobe state to the south, Borno state and even part of Niger Republic to the south, where manga, a sub-tribe of Kanuri is dominantly spoken.

Figure 1

1.3 Climate

Goni (1982) identified the landscape as a transitional zone with climatic condition between desert environment to the north and the more humid savanna to the south.

Temperature in this zone is apparently xeric being hot and dry most of the year, where the mean temperature in the area is about 37^0 C.

The rainfall is highly variable and was described elsewhere in some reviews of literature of the place as generally insufficient which contribute marginally to the underground storage. Characteristically evaporation is more than precipitation due to above prevailing conditions.

Manga grassland is a scrubland marked by annual grasses, different shrub types and scanty trees like Acacia thorn

trees, Date palm, Neem trees, etc, which tend to be thicker in shallow fertile depressions.

1.4 Topography

Typically the landscape exhibits sub-Saharan topographic features, where in the eastern dominant portion consist of Sand dunes often between 330m – 350m above the ground level, whereas the western portion being characterized with sand dunes with patches of Granitic rocks, which stood in an altitude of more than 350m above sea level.

Figure 2

1.5 Drainage

There is no single major river system that traverses the landscape, however system of steam channels contribute to water regime in the area.

2. Materials and Methods

The methodological approach employed to produce this work based on two-fold process:

1) Using field experience that involved direct observation and / or participant observant
2) Using previous investigation findings which the state Government had commissioned consulting firms to render manga grassland.

Geology of Manga Grassland

The unique geological zone is entirely underlain by the basement complex rocks, but apparently concealed by top overburden. On 0ne hand, in the eastern portion, being the dominant landscape, the basement is overlain by the chad formation, which in turn, more often than not, is overlain by superficial deposits i.e the eolean deposits. On the western portion, the basement is intruded by the Jurassic younger granites which in some places are either exposed to the surface due to weathering and wind effects or been concealed under the quaternary chad formation and the eolean deposits also.

Interdunal Soda (Alkaline) Depressions

There are very few occurrences of soda depressions (soda basins or depressions) in the world over. According to some authors the phenomenon is characterized by the occurrence of large deposits of sodium in form of carbonates such as trona or other complex salts. Depending on complex factors of water balance, climate conditions and geology, these phenomena can occur as major types (soda lakes) or minor types (soda depressions) and also as marine based or non-marine based.

The interdunal soda depressions of the manga grassland can be described as non-marine closed or drainless depressions intersperse in the arid zone, where as a result of ephemeral water, system of streams carrying soluble products of rock materials (in form of brine solution) believed to be concentrated.

It is believed to be attributed to incessant wind erosion processes over the adjacent sand dunes, involving wind scooping out sufficient sand to reach the water table. Goni(1982) highlighted that such processes often occur behind the first line of fore dunes. Zarma et al (2004) asserted that they are products of continued wind depletion on spot or obstacle over geologic time, where such processes denude the surface until it cut the water table.

Some findings however indicate such phenomena are controlled by the following amalgamated factors:

a) Precipitation from non-marine source of ephemeral water source (temporary or seasonal)
b) Sufficient brine solutions encapsulated in the geological formations
c) Under semi-arid condition
d) PH value of such phenomenon is above 11.5 (i.e. High alkalinity)

Cater (1994) indicated that beds of these soda depressions are composed of highly organic salt, clay, diatomite or peat. These depressions are the most fertile tracts in manga grassland, which not only support various agricultural activities but support the most abundant mineral resource of the state.

The following few soda production basins are available in:-

1) Yusufari local government area
   a) Fulkano
   b) Bultu Buriya
   c) Tamsuwa
   d) Sosono
   e) Amasawa
   f) Kwarin Jibrin
   g) Kilbuwa
   h) Tulo- tulowa 1&2
   i) Tarraram
   j) Kajajja
   k) Etc
2) Yunusari Local Government Area
   a) Kabobuwa
   b) Amasuwa 2
   c) Kwalji Maram
   d) Adin
   e) Ngursuwa
   f) Dufino
   g) Pataskum
   h) Chilam 2
   i) Etc

These are only very few examples of such major production basins in the two local Government areas of the Manga grassland.

Figure 3: Interdunal soda basins surrounded by vegetables

Some Results of Analysis of the Soda Depressions of Manga Grass Land

Edmands and Parrot (1992) using x-ray diffraction analysis reported trona (sodium carbonate salt) with traces of guylusite. Goni (1997) analyzed some samples and identifies the evaporites as natron (sodium carbonate/ bicarbonate).

In 1992, Unimaid Consult under took an analysis of some samples of the soda basin by using polarizing microscope and gave the following percentage ranges:

Calcite/ dolomite	60-90%
Quartz	15-20%
Opaque	1-10%

Besides, the above report substantiated the availability of over 800 million tons of trona in the production basins of this zone.

In fact, workers like Agbo et al (1993) conducted Hydro geological studies in this area where in one way or the other their results of findings are in favor of high Alkalinity content.

Impact of soda basins on the Economic Geology of the state

Trona (Na_2 $H(co_3)_2.2H_20$) is not only present in the production soda basins of manga grassland but abundantly presents contribution to most viable single economy to the people of this semi-arid zone. It is a less common special of carbonate group.

PARAGENESIS: Trona occurs as evaporite mineral, which is a sedimentary deposit of soluble salt or brine that becomes concentrated from the evaporation of standing water.

Trona owes its paragenesis from the soda basin as a result of weathering of rock products that empty into the drainless depression. Sometimes the minerals are found in association with other minerals like marl, peat, halite, etc.

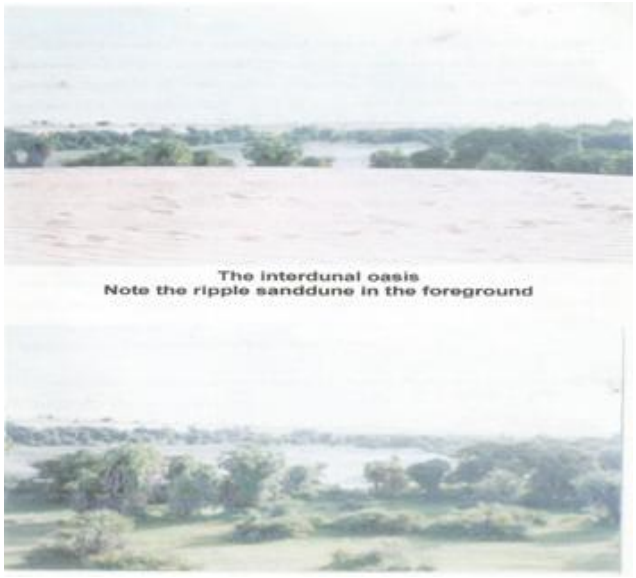

Figure 4: Production basin of trona

Breakthrough in the Production of Trona

As far back as 1991 mining of trona had been a seasonal activity when evaporation took place in the production basin. However following a project sponsored by North East Arid Zone Europeans programs (NEAZEP), the organization was commissioned to establish five tube wells in the soda oasis of kaska a small village under Yusufari local government, this led to pioneering transfer of tube well technology where we employed small drilling rig DR 200 in the execution of the project. Similarly later, a team was mobilized to Yunusari local government, where we established wash bores in the soda basins of 'Ngor fanna' village and one other 'Ngor' village near Yusufari town. Henceforth the idea of using these technologies (tube well and wash bore) become apparent. This transfer of technology greatly facilitated and transformed mining of trona from seasonal to weekly activities or even less. Now tubewells and washbores have been established in major production basins of the state and even in the neighboring production basins of Niger republic.

Economic Importance of Trona

One of the most important uses of trona is the production of industrial substance called soda Ash, which has wide applications in the making of glass, soap, detergent, industrial chemicals (caustic soda, sodium silicate, etc.)

3. Discussion / Recommendation

1) From all these results and major findings it has become clear that there are numerous soda laden depressions that have large deposits of sodium in form of carbonates and hydro carbonates in the manga grassland.
2) Economic geology of the soda lakes are not only confined to production of trona, because in 1994 another Unmaid Consult report substantiated availability of marl deposits at Dara, Wanganga villages and host of other locations. The report further established the fact that the mineral is more suitable for production of ordinary Portland cement than the limestone found in the other parts of the state.

3) In 2005 silica sand was encountered hosted in the chad formation of manga grassland of Machina Local Government area of Yobe State, the sample was taken to Nigerian Mining Corporation Jos, where the result of the analysis shows that the mineral has over 95% purity and conforms to the ideal fraction of glass making.
4) Recently oil was found in the manga grassland of Niger Republic which is in the immediate neighborhood of manga grassland of Yobe State, Nigeria.
5) Due to intrusion of Younger Granites in manga grassland of Machina portion, there could be possibility of obtaining other minerals of economic importance. Similarly the rocks can serve in making quarry materials and lapidary work like tile making.
6) The biggest challenge facing the huge soda basins of manga grassland is ecological problem, where most of the production basins are becoming diminishing or losing in totality due to desertification effects.

3.1 Recommendations

1) There is the need for further investigation and research activities in the landscape of manga grassland so as to unveil its hidden mysteries.
2) The Federal Government is advised to harness the huge sodium deposits or trona abound the manga grassland for the purpose of establishing intended fertilizer and other related companies in the country.
3) The state Government is also advised to establish soda ash plant in Yusufari as it intended to establish before.

4. Acknowledgement

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