



Volume: 2, Issue: 6, 103-114  
June 2015  
www.allsubjectjournal.com  
e-ISSN: 2349-4182  
p-ISSN: 2349-5979  
Impact Factor: 3.762

**NOLLA Junior Désiré**  
**HELL Joseph Victor**  
**BESSONG Moïse**  
**MFOUMBENG Marie Paule**  
**EYONG TAKEM John**  
**DISSOMBO EDIMO André**  
**Noël**  
**MBANG Annie Rennes**  
**ENGOMBI Godlove**  
Institute for Geological and  
Mining Research, Yaoundé-  
Cameroon

**NGOS III Simon**  
Laboratory of sedimentary  
and petroleum geology,  
Earth Sciences Department,  
University of Maroua,  
Maroua-Cameroon

**NDJENG Emmanuel**  
Earth Sciences Department,  
University of Yaoundé I,  
Yaoundé-Cameroun

**Correspondence:**  
**NOLLA Junior Désiré**  
Institute for Geological and  
Mining Research, Yaoundé-  
Cameroon

## Lithostratigraphy of the Koum Basin (Northern Cameroon)

**Nolla Junior Désiré, Hell Joseph Victor, Ngos Iii Simon, Bessong Moïse, Mfoumbeng Marie Paule, Eyong Takem John, Dissombo Edimo André Noël, Mbang Annie Rennes, Engombi Godlove, Ndjeng Emmanuel**

### Abstract

The Koum basin is one among numerous Northern Cameroon intra-continental rifts which belong to the West and Central African Rift Systems (WCARS). The lithostratigraphic unit comprises an association of alternating sequences of sandstones, marlstones and shales. The basin lies unconformably on a plutonic and metamorphic Neoproterozoic basement. Lithofacies of this unit contain fossils such as dinosaur footprints, bivalves, conchostracans, ostracods, insects, ichnofacies, silicified wood and other plants fossils. The basin which measures about 4300 m thick has regionally been deformed into a monoclinical structure with the occurrence of localized syn-sedimentary deformational structures. The strike of beds trends at N92°E, with an average dip of 12° towards the north. The facies association of the Koum basin indicates deposition in a fluvio-lacustrine paleoenvironment. The formation is cross-cut by volcanic rocks.

**Keywords:** Cretaceous, Lithostratigraphy, monoclinical, fluvio-lacustrine

### Introduction

The Cretaceous is considered a crucial period for the geological evolution of northern and central Africa, with numerous active rifts linked to the break-up of western Gondwana and the opening of the south and equatorial Atlantic ocean. The opening of the South Atlantic Ocean during the Cretaceous led to the separation between Africa and South America with the formation of Benoue Trough<sup>[10]</sup> which bifurcates into the Cameroon territory with the formation of several cretaceous basins<sup>[12]</sup>, among them the Koum basin (fig.1). Koum basin extends some 150 km South-East of Garoua and is located in the northern region of Cameroon between longitudes 14° 07'36" and 15° 00' and latitude 08° 11'24" and 8°30'. The Koum basin is an elongated east-west rift which stretches over 90 km long by 20 km wide<sup>[3, 4, 12, 17]</sup>. The basin lies unconformably on the metamorphic (fig.2A) and plutonic (fig.2B) Neoproterozoic basement<sup>[13, 14, 15, 19]</sup> that comprises migmatized banded gneisses with alternating gneisses, granite and alkaline granites. The area of study is characterized by plains with weak slopes dominated by hillocks and a granite horst (hossere Kotapé (fig.2C)). The basin is cover by thin ferruginous hardground and recent alluviums<sup>[8, 1, 2]</sup>. Little investigation in terms of lithology has been carried out. Here, we report different sedimentary facies, draw cross-sections across the basin and give detailed description of lithofacies in order to build the lithostratigraphy of the Koum basin with the aim to map both lateral and vertical distribution of various lithofacies and diagnose their palaeo-depositional environments.

### 2. Materials and methods

The present study covers an area of about 1164,87 km<sup>2</sup> within the Cameroon Territory. Three detailed lithostratigraphic logs of the Koum basin were measured in the field, the first called Kali profile (Fig.1, AA'). The second named Gouga profile (Fig.1, BB') and the third named Mbissiri profile (fig.1, CC'). This study is based on the field description of N-S profiles across the basin, coupled with detailed lithofacies analysis and facies associations.

### 3. Results & discussion

#### 3.1 Facies description and depositional environment

Lithofacies that have been distinguished in the study area include conglomerates, sandstones, marlstones and shales, with numerous microfacies that can be distinguished in term of grain sizes, grading, color, sedimentary structures (Fig.5), the nature of interstitial cements and

matrix content especially in the conglomerate facies. A total of 08 lithofacies have been identified in the Koum basin (Table 1).

### Conglomerate facies

Two different types of conglomerate sub-facies have been identified in the basin.

- **Facies Gm.** This facies occurs around the Hosséré Kotapé horst basement which outcrops at the interior of the basin. This facies is composed of a massive, ungraded, matrix-supported, poorly sorted conglomerates lacking internal stratification. The matrix is made of coarse-grained sandstone (Fig.3A).
- **Facies Gmu.** This facies appears in the North-western part of the Koum basin. It seems being the witness of a cone of alluvia. This facies is composed of a massive, ungraded, matrix-supported, poorly sorted, pebbles conglomerates. Pebbles are mainly made up of granitic clasts with few quartz and metamorphic rock fragments. The matrix presents red, ochre to brown iron oxide staining and it is made of detrital elements.

### Sandstone facies

This lithofacies is the most prominent and is represented throughout the Koum basin. It has been subdivided into four (4) based on the dominant sedimentary structures. Some of them are well hardened by a carbonate cement.

- **Facies Sm.** This facies is well represented and is composed of fine, medium, coarse to very coarse-grained sandstone lacking sedimentary structure (Fig.3B). The beds vary in thickness from a minimum of about 0.1 m to 5 m. Clast of 2-3 cm of reddish to brown argillaceous material are present in some units. Massive sandstone beds are interpreted as sand rapidly deposited directly from turbulent suspension by hyperconcentrated mass flows or subaqueous high-density turbidity currents [9].
- **Facies Sh.** This facies is made up of fine to coarse-grained horizontally stratified sandstones. The beds exhibit individual horizontal stratifications up to 3 cm thick and sometimes have planar cross-bedded facies (Sp) at the base or in the middle which bounds the horizontally stratified horizons. They occasionally show erosive contacts (Fig.3C). This facies can be attributed to planar bed flows of shallow high velocity [11].
- **Facies St.** This facies is composed of fine, medium to coarse sandstone with trough crossbedding. The dip of crossbeds range from 4° to 30°. Sometimes this facies is interbedded with facies Sp (planar cross-bedded sandstone). Colour ranges from grey to brown. Bed thickness varies between 0.3 m and several meters. Almost all bed contacts with underlying units are erosive (Fig.3D).
- **Facies Sp.** This facies consists of medium to coarse and very coarse gravely sandstones with planar cross-stratification. The dip of the planar cross-beds range from 15° to 30°. This facies commonly occurs in close association with the trough cross-stratified facies (St) and the contact between both facies is always erosive. Bed thickness varies between 0.5 m and several meters. Conversely, for fine-grained sandstone and siltstone facies (Sst), the bedforms are planar, with thinner beds (08-90 cm thick). Some of these facies effervesces with 10% HCl. Such thin sandstone beds show micro-cross-lamination, ripple marks or wave ripple (Fig.3H), dish structures (Fig.3F) and desiccation cracks (Fig.3G). It is here where we often met

fossils such as bivalves (fig.4B), chonchostracans (Fig.4D), dinosaur footprints (Fig.4C) and ichnofacies (Fig.4E).

- **Claystone and siltstone facies.** claystone and siltstone facies occur throughout the Koum basin and occurs predominantly within the middle part of the basin. Bed thickness is quite variable with minimum of 0.1 m to a maximum of 8 m. The shales are often interbedded with carbonate siltstones and laminated marlstone facies (Fig.3E).
- **Facies Ml.** This facies is made of laminated or thinly bedded claystones and is not very common in the basin. The colour varies from reddish to violet, grey green and dark grey to black. Bed thickness is quite variable with minimum of 0.1 m to a maximum of 8 m. Black shales are rich in plant fossils (Fig.4A), bivalves (Fig.4B) and insects (Fig.4F). some of these black shales are rich of pyrites granules (Fig.3E).
- **Facies Mm.** This facies is composed of claystone and siltstone and is not evenly distributed in the basin, but are confined mainly in the middle section of the basin. The colour of the claystones varies from reddish to violet and grey green to black. Bed thickness is quite variable with minimum of 0.1 m to a maximum of 8 m.

The various lithofacies described and facies associations are summarized in graphic logs drawn along geologic profiles.

### 3.2 Description of geologic profiles

Profile 1: Kali profile (AA'); Hosséré Koum-Hosséré Vindé	
A) northern margin	A') Southern margin
Location	Location
N08°24'19,5"	N08°13'30,7"
E14°20'29,6"	E14°23'25"
Altitude: 358m	Altitude: 333m

This profile is located to the western part of the Koum basin. The profile is oriented in the N-S direction, perpendicular to the general strike of the beds. The characteristic facies encountered along the profile can be divided into eight major depositional units. The basal contact with the underlying basement which is made up of granite was not seen.

The lower unit comprises massive pebble sandstone alternating with coarse and fine grained sandstone. The strike of beds is N115E10NNE.

The unit above is composed of an alternance of carbonate fine-grained sandstone, siltstone, shale and marlstone. Black shale facies of the profile are rich in plant fossils, insects (4F) and pyrite granules (Fig.3E). In this bed, units are affected by desiccation cracks and ripple marks. In some facies desiccation cracks are filled up with carbonate cement and exhibit syn-sedimentary deformational structures (Fig.3I). The shale facies, siltstone and marlstone contain bivalves and chonchostracans. The strike of bed is between N95°E12°N and N115°E12°N with many tectonic fractures: N38°E, N40°E, N110°E.

The third unit is an alternating sequence of planar and trough cross stratifications and massive fine to coarse-grained sandstones. The strike of beds is N85°E15°N.

The fourth unit is a sequence of carbonate siltstone interbedded with siltstone. Some facies are rich in fossils such as bivalves and chonchostracans.

The fifth unit is composed of massive coarse to pebble-grained sandstone.

The sixth unit is composed of massive siltstone, trough cross-laminated carbonate siltstone rich in desiccation cracks, ripple marks and dish structures. This unit also enclose bivalves.

The seventh unit is composed of fine to coarse-grained sandstone with planar, horizontal and trough cross-laminated structure. The apparent dip is 20°.

The eighth unit is composed of claystone interbedded of fine to medium sandstone which show load casts. On top there is massive, pebble conglomerate which seems like been the witness of a cone of alluvia. From this profile the thickness of the Koum basin is about 3500m (Fig.6).

**Profile 2:** Gouga profile (BB'); Hosséré Koum – Southern margin

B) northern margin	B') southern margin
Location	Location
N08°25'05,1"	N08°12'36,4"
E14°27'02,3"	E14°30'31,9"
Altitude: 406m	Altitude: 373m

This profile is located to the middle part of the Koum basin. The profile is oriented in the N-S direction, perpendicular to the general strike of the beds. The characteristic facies encountered along the profile can be divided into eight major depositional units. The basal contact with the underlying basement which is made up of orthogneiss was not seen. From the bottom to the top we have:

The lower unit is composed of fine grained sandstone interbedded of siltstone. The strike of beds is N65°E11°NNW. The second unit is composed of fine-grained sandstone with massive, planar and trough crossbedded structures interbedded of carbonate siltstone or carbonate sandstone. In this unit some beds are affected by dessiccation cracks and ripple marks. Fossils are made of bivalves, chonchostracans and ichnofacies (fig.3G)

The third unit comprises massive and planar pebble and coarse-grained sandstone alternating with fine grained sandstone.

The fourth unit is composed of shales interbedded of trough crossbedded carbonate sandstones with erosional surface on the top and bivalves as fossils.

The fifth unit is composed of trough crossbedded coarse-grained sandstone surmounted by planar crossbedded fine-grained sandstone.

The sixth unit is composed of shale and marstone interbedded with carbonate siltstone where many tracks of dinosaur footprints are observed and dessiccation cracks (Fig.4C).

The seventh unit is composed of massive and trough cross-bedded coarse to pebble-grained sandstone interbedded by fine grained sandstone and siltstone.

The eighth unit is composed of marlstone (Ml) with dessiccation cracks cross-cut by a volcanic dyke (Fig.3J) which has a strike of N145°E. This volcanic dyke (Vd) which show many cracks effervesces with 10% HCL due may be to its weathering. The marlstone which is in contact with the dyke have change their color from brown to black due to their proximity with magma. Bivalves are presents in these marlstone (Fig.7).

**Profile 3:** Mbissiri profile (CC'); Hosséré Koum – Hosséré Kombaméri

C) northern margin	C') Southern margin
Location	Location
N08°25'00,1"	N08°14'30,4"
E14°33'43"	E14°36'42,1"
Altitude: 397m	Altitude: 383m

This profile is oriented in the N-S direction, perpendicular to the general strike of the beds. This profile is unlike the others

because it encounters a horst inside the basin. So, there are two contacts with the underlying basement. The first one is the contact with the horst made up of granite. This contact was seen and it is an unconformity due to breaks with the strike of N75°E30°NNW, N210°E, N230°E, N45E25NW (Fig.2C). This basement is also cross-cut by a vertical volcanic dyke. The second contact with the underlying basement which is made up of orthogneiss in which margin of the basin was not seen. The characteristic facies encountered along the profile can be divided into nine major depositional units.

The first unit which surrounded the horst is made up of massive conglomerate (Fig.3A) above which there is a massive coarse-grained sandstone whose colour varies from grey to brown.

The second unit is composed of carbonate sandstone interbedded with fine-grained sandstones. The strike of beds vary from N93°E13°N to N83°E12°N. The structure of these beds are massive or horizontally stratified with erosive contacts. This unit is rich in fossils like ichnofacies, bivalves and conchostracans.

The third unit is composed of an alternance of coarse and fine-grained sandstone interbedded with siltstone with bivalves.

The fourth unit is composed of carbonate siltstone interbedded with coarse to pebble-grained sandstone beneath them we have a carbonate sandstone with bivalves. The strike of beds vary from N100°E09°N to N55°E12°NW.

The fifth unit is composed of planar and massive fine-grained sandstone surmounted with coarse to pebble-grained sandstone. The strike of bed varie from N80°E08°N to N 85°E15°N.

The sixth unit is composed of carbonate sandstone surmounted with claystone and siltstone with beds striking at N85°E12°N

The seventh unit is composed of an alternance of fine-grained sandstone, coarse and pebble-grained sandstone and siltstone. The strike of bed varie from N85°E15°N to N95°E10°N.

The eighth unit is composed of carbonate sandstone interbedded with carbonate claystone, claystone and siltstone with bivalves (fig.4B) as fossils with beds striking at N125°E12°NNE.

The ninth unit is composed of horizontally fine-grained sandstone and siltstone surmounted on planar, trough cross-laminated and massive coarse to pebble-grained sandstone. The strike of bed vary from N75°E15°NNW to N95°E10°N with microfractures trending at N125°E, N25°E and N70°E (Fig.8).

Adjacent graphic logs show a marked correlation between facies, with basin-wide vertical and lateral extensions. The basal conglomeratic unit donnot outcrops to the margins basin except around the granitic horst (Hosséré Kotapé) at the interior of the basin.

The fine, coarse to pebble sandstone facies are marked by erosional surfaces. Planar and trough cross-laminated facies exhibit minor dip angles of 4 to 30°.

The fluvial depositional unit is defined by massive (Sm), horizontally (Sh), planar (Sp) or trough cross-laminated (St) fine to coarse-grained sandstone which sometimes is fining-up sequences. These facies are characteristic of fluvial depositional environments. The base of each depositional sequence is successively covered section. Lacustrine depositional unit is defined by shale, marlstone, silty claystone, carbonate siltstone and carbonate sandstone facies which form thick depositional sequences within the basin and are thought to be deposited during maximum flood episodes. These facies are indicative of lacustrine environments. Most of these facies are indurated by carbonate cement with dessiccation cracks, ripple marks, dish structures and contain

fossil bivalves, conchostracans and ichnofacies. The diagnosis of sedimentary facies of the Koum basin reveals lithostratigraphic units which can be grouped in terms of depositional environments into fluvial unit interbedded with lacustrine units. The Koum basin-fill is composed of an alternation of fluvial and lacustrine depositional environments. Desiccation cracks indicate a deposition under a very weak water section and repeat emersion. The frequency of desiccation cracks, dinosaur footprints suggest that the sediment were exposed. Thus, indicating they settled in a temporarily submerged environment and later subjected to infiltration and evapotranspiration [7]. we are in a flood plain environment or in an intertidal environment. The shale facies of the Koum basin has various color which varies from reddish to violet and from grey green to black. The reddening of certain facies is due to the oxidation of the beds with the production of iron oxides which are responsible for this coloration or the presence of an iron-rich cement [5]. The black color of some shale is due to the presence of organic matter because low contents of organic matter (approximately 1%) are enough to colour a sediment in black [5].

The black shale in the lower part of the basin are thinly laminated. They also contain reduced iron in the form of pyrite indicating little bioturbation or storm disturbance [16]. The pyritic black shales were deposited under anaerobic conditions [16]. The presence of black shale also pleads in favour of a confined basin or a deep environment where water was stratified so that the bottom was anoxic. The black shales are rich in organic matter and proved at least temporarily anoxic conditions [16].

### 3.3 Palaeontology

Fossils recovered from this study include vegetal plants (Fig.4A), bivalves (Fig.4B), dinosaur footprints (Fig.4C), chonchostracans (Fig.4D), silicified wood [8], ostracods [6], ichnofacies (Fig.4E) and insects (Fig.4F) which are found preserved in shales, marlstones and carbonate sandstones. The abundance of ichnofacies in the clayey and silty levels prove that these sediments were bioturbated. The vertical shape of these trace fossils suggest that they are ichnofacies to skolithos [21]. They latter indicate an intertidal environment.

### 3.4 Tectono-stratigraphic setting

Number of strike of bed = 59

The strike of beds trends at N92°E (Fig.9A), with an average dip of 12° towards the north (Fig.9B). Results from structural information show that Koum basin has regionally been deformed into a monoclinical structure. The overall outcrop distance or length of the Kali profile is 16835 m. The schematic geological section of the Kali profile shows that sediments are made up of an alternation of sandstones, marlstones and shales (Fig.10A). This length represents the width of outcrop. knowing that the thickness (e) is equal to the width of outcrop (l) multiplied by the sine of the dip, the thickness (e) can be calculated from the equation:

$$e = l \times \sin 12^\circ$$

$$e = 16835 \text{ m} \times \sin 12^\circ = 3500,19 \text{ m}$$

The thickness of the Koum basin along the Kali profile is 3500 m (Fig.6).

The overall outcrop distance of the Gouga profile is 20681 m,  $e = 20681 \text{ m} \times \sin 12^\circ = 4299,82 \text{ m} \approx 4 \text{ 300 m}$ . The thickness of the Koum basin following the Gouga profile is around 4 300 m (Fig.7). The schematic geological section of the Gouga profile shows that sediments are made up of an alternation of sandstones, marlstones and shales. All these sediments are cross-cut by volcanic dyke (Fig.10B).

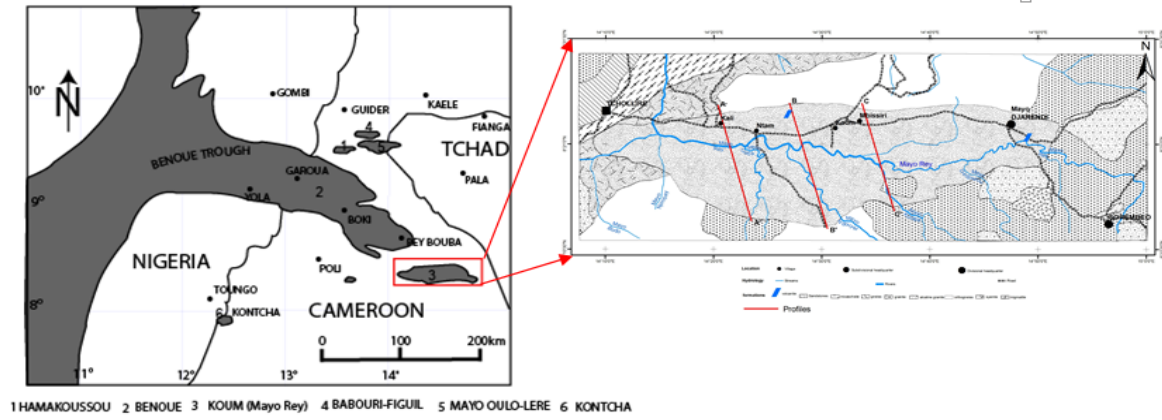
We could not calculate the thickness of the basin through the Mbissiri profile because of the presence of the Hosséré Kotapé horst and others in the basin (Fig.10C).

The Koum basin measures about 4300 m thick and has regionally been deformed into a monoclinical structure with a general strike of beds trending at N92°E, with an average dip of 12° towards the north with syn-sedimentary deformational structures. The Koum basin has a horst (hosséré Kotapé) which is made up of granite which has fractures reminding us the strike of beds of sedimentary facies, meaning that the regionally deformation which transform the basin into a monoclinical structure also affect the horst. We are therefore in presence of remains of intra-continental rifts which belong to the West and Central African Rift Systems (WCARS).

## 4. Tables and Figures

**Table 1:** Classification scheme of the main lithofacies of the Koum Basin

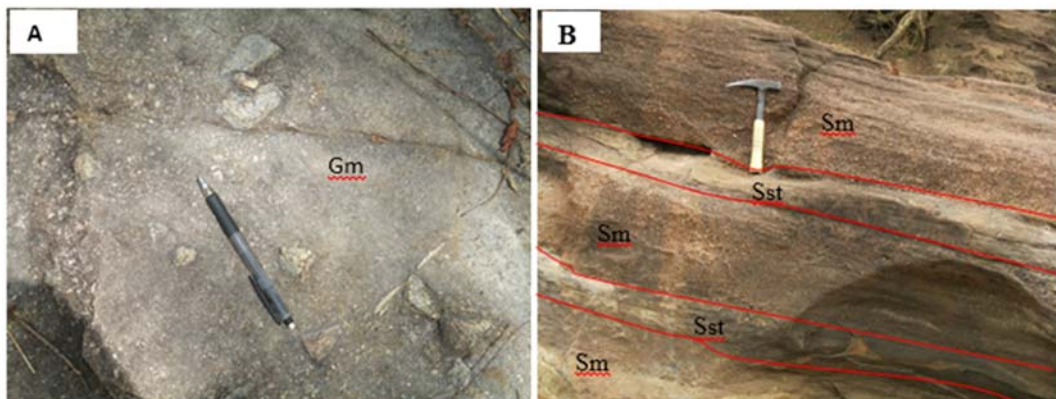
Facies	Facies code	Description
<b>Conglomerate facies (G)</b>	Gmu	Massive, ungraded, matrix-supported, poorly sorted, pebble conglomerate
	Gm	Massive, ungraded, clast supported, matrix-suported, polygenic-conglomerate
<b>Sandstone facies(S)</b>	Sm	Massive, fine to coarse sandstones with no sedimentary structure
	Sh	Horizontaly laminated, fine grained sandstone
	St	Trough crossbedded, fine to very coarse-grained sandstone
	Sp	Planar crossbedded, fine to very coarse-grained sandstone
	Ml	Laminated mudstone
<b>Claystone facies(M)</b>	Mm	Massive, structureless mudstone

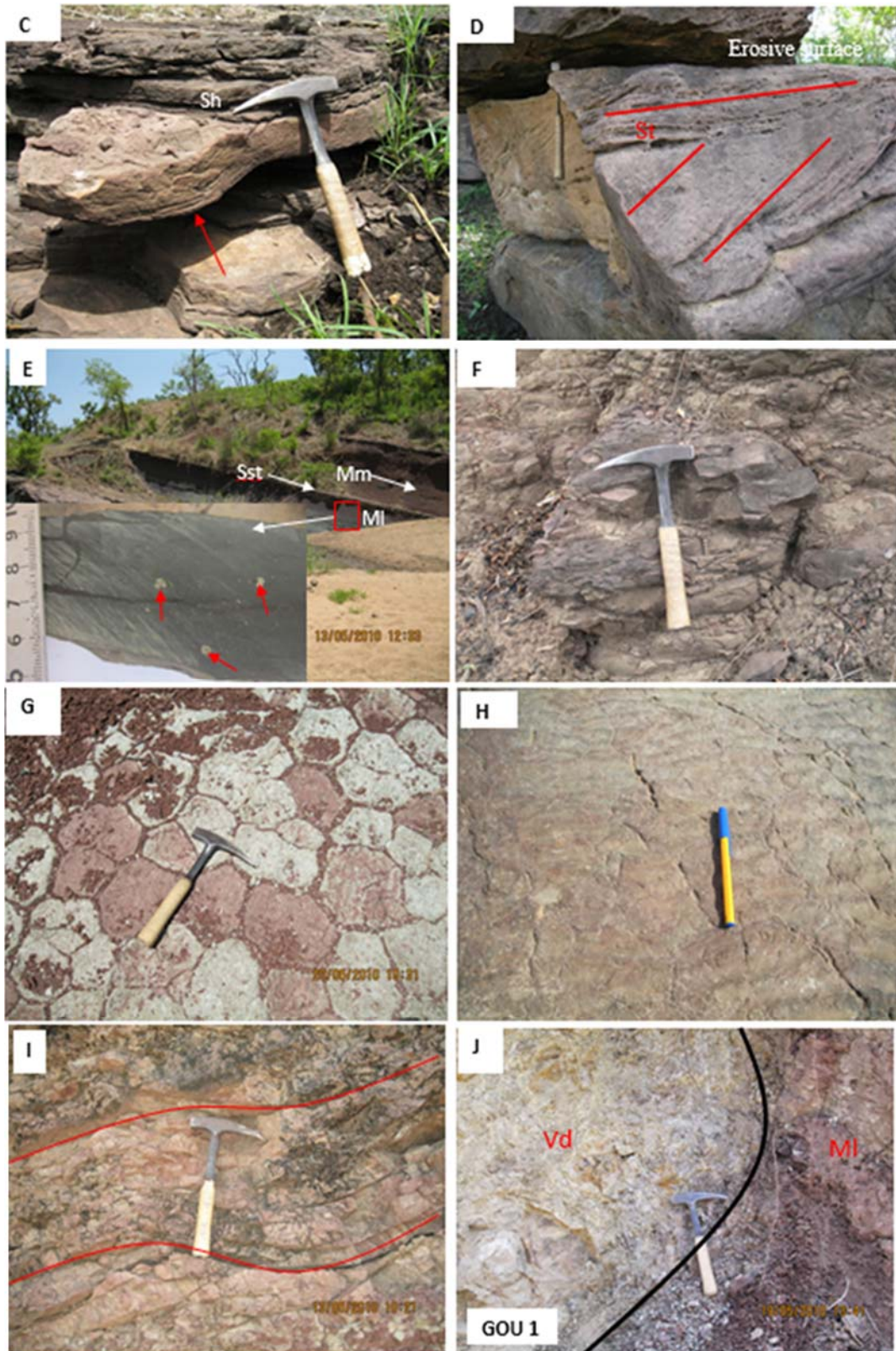


**Fig1:** location of the Koum basin with relationship to the Benue Trough (schwoerer (1965), modified).

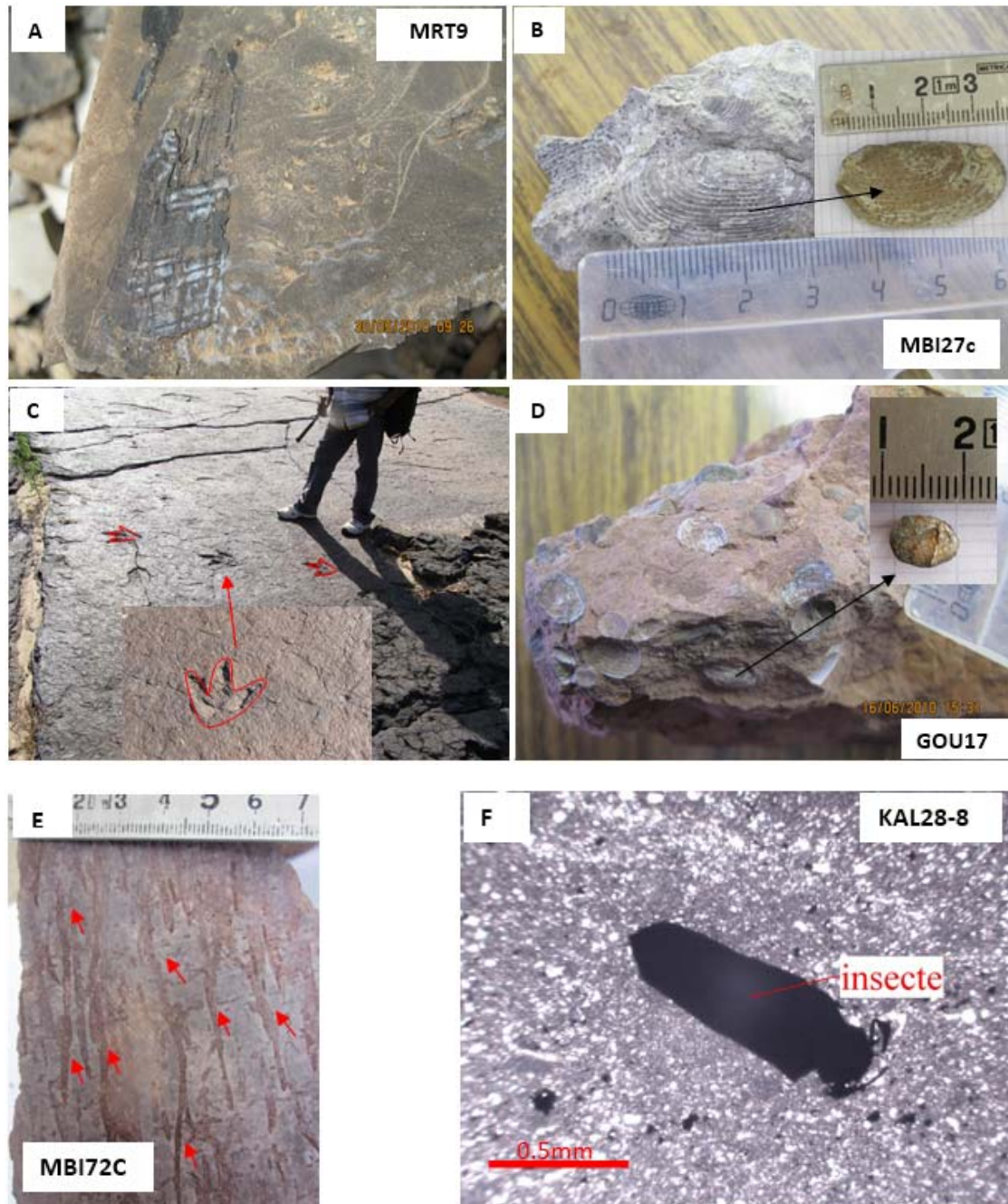


**Fig 2:** Some examples of basement facies. **A.** gneiss in the northern part of basin. **B.** red granite in the southern part of Kali profile. **C.** granite horst (Hosséré Kotapé) in the middle of the basin.

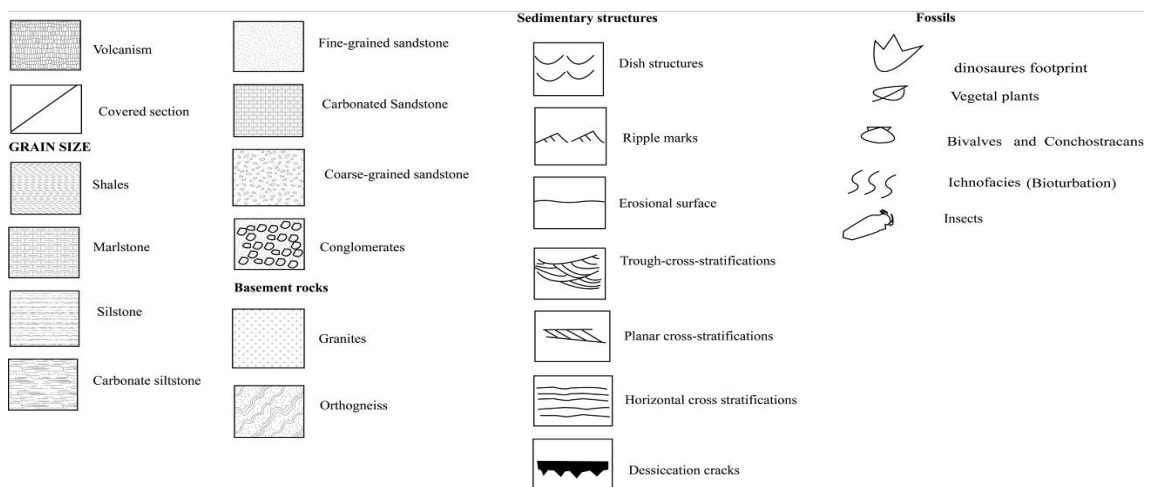




**Fig 3:** a selection of facies of Koum sedimentary basin. **A-** polygenic conglomerates consisting of quartz and granite clasts in sandstone matrix. **B-** layers of fine sandstone and siltstone (sst) which are cemented by carbonate and underlying a massive sandstone (Sm). **C-** planar cross-stratified sandstone (Sp) where we observe a loadcast (arrow). **D-**trough-cross bedded sandstone (St) with an erosional surface above. **E-**reddish to grey-black laminated claystone (MI) interbedded with siltstone (sst). The massive black shale is rich of pyrite (red arrows). **F-**dish structure in a siltstone. **G-**desiccation cracks. **H-**ripple marks. **I-**syn-sedimentary deformational structures in reddish siltstone. **J-**volcanic dyke (Vd) cross-cutting reddish siltstone (MI).



**Fig 4:** Fossils of the Koum basin. **A-**vegetal plant. **B-**bivalve. **C-**dinosaur foot print. **D-**conchostracans. **E-**ichnofacies. **F-**micrograph of insect.



**Fig 5:** some keys and symbols used in the text.

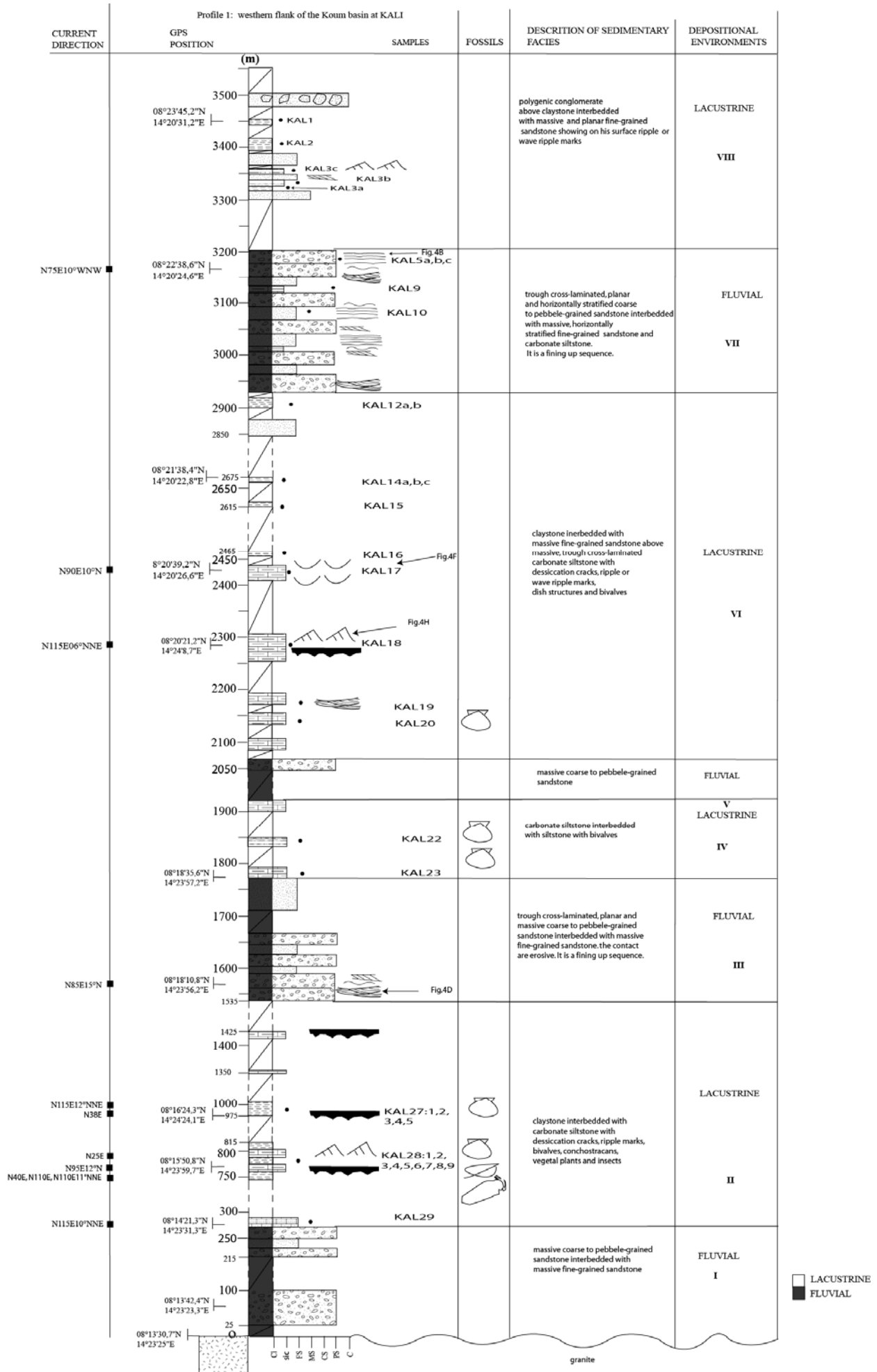


Fig 6: lithostratigraphic log of the Kali profile

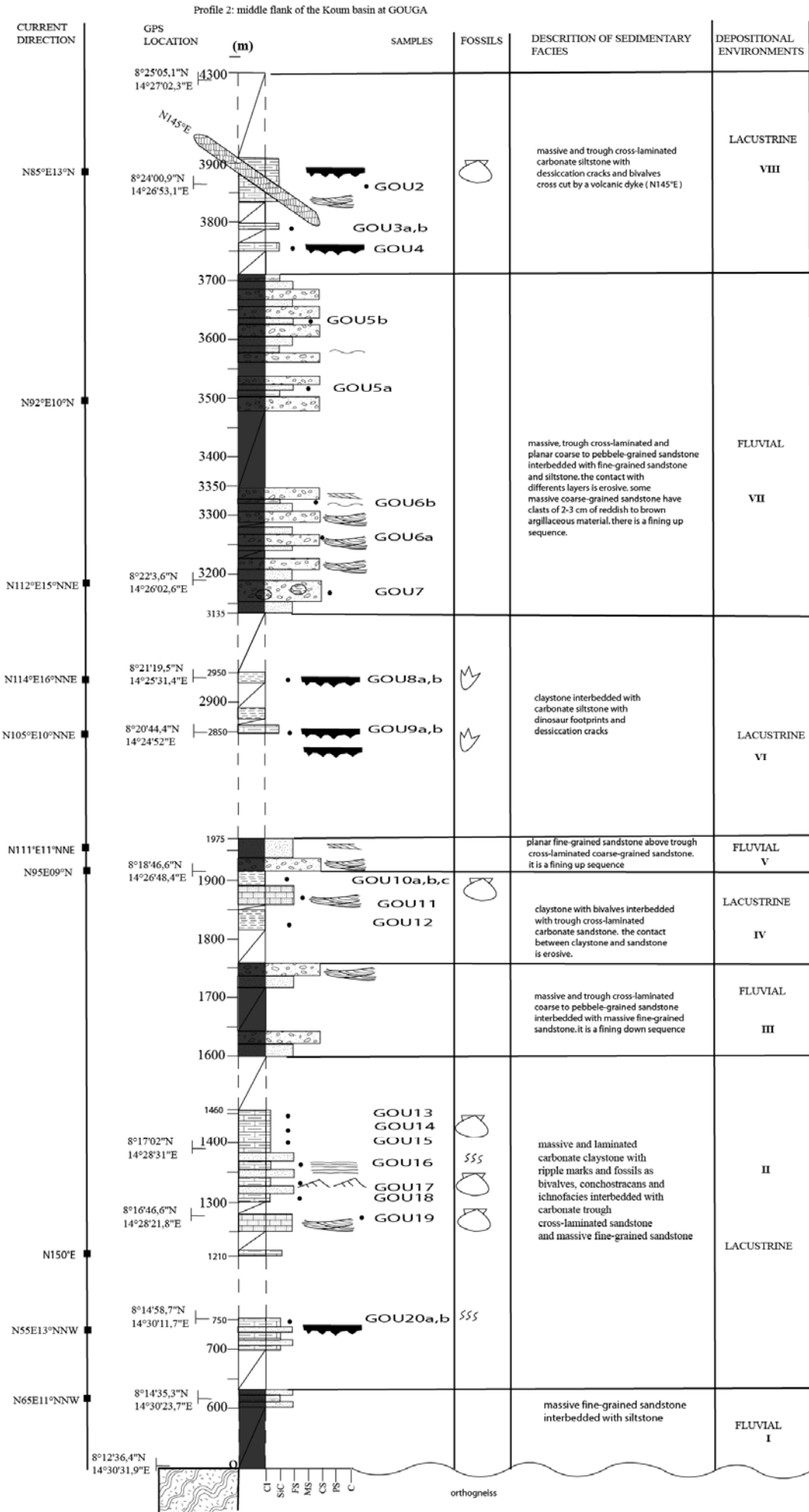


Fig 7: Lithostratigraphic log of the Gouga profile.

Profile 3: eastern flank of the Koum basin at MBISSIRI

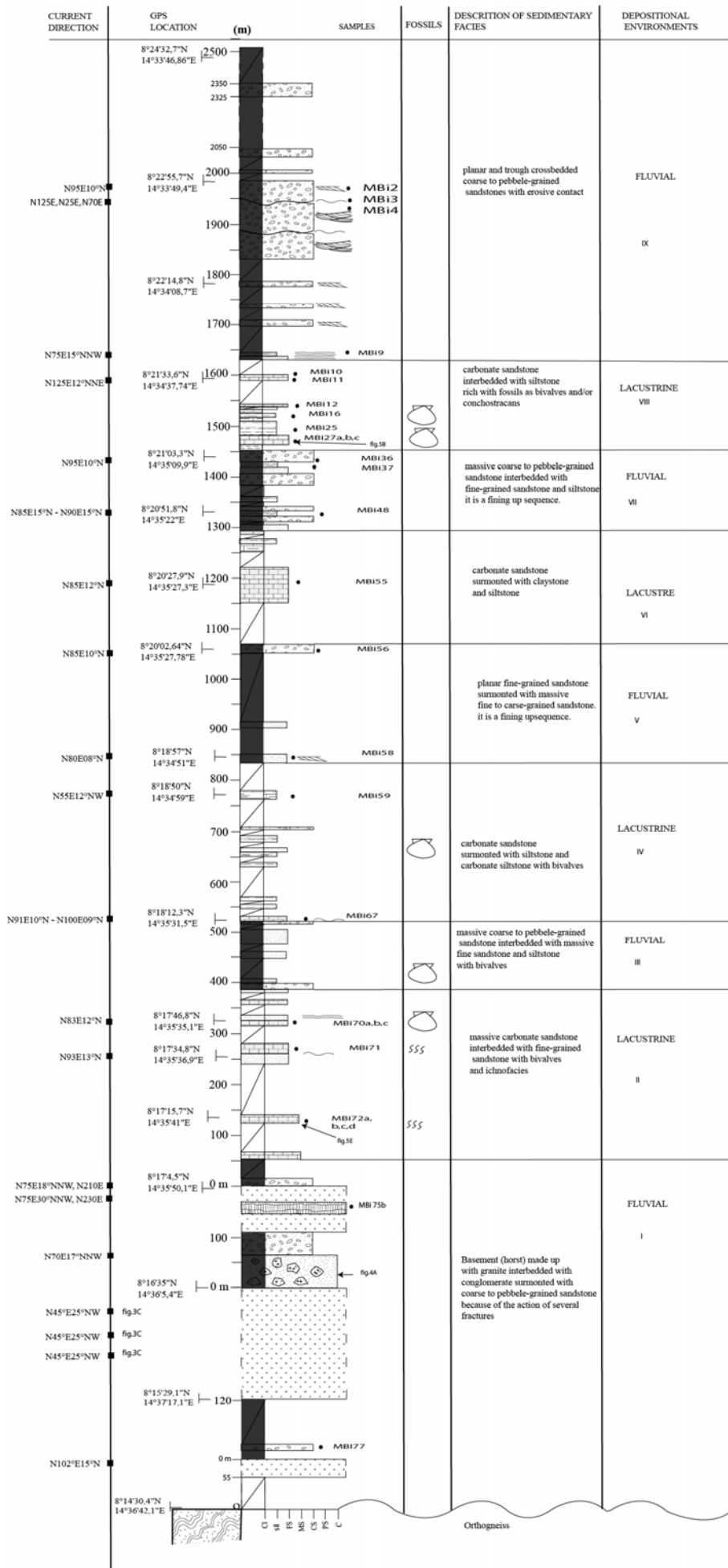
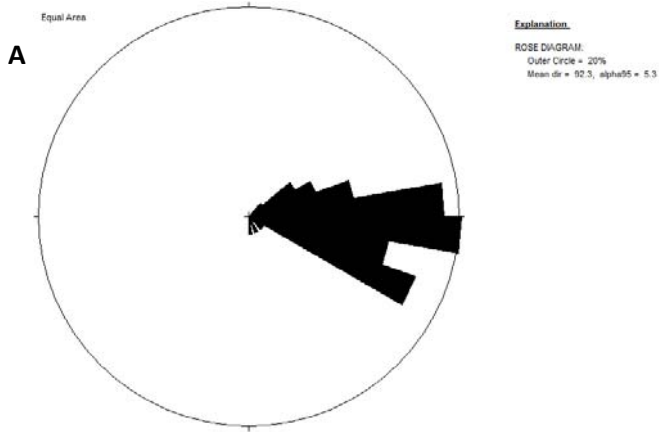
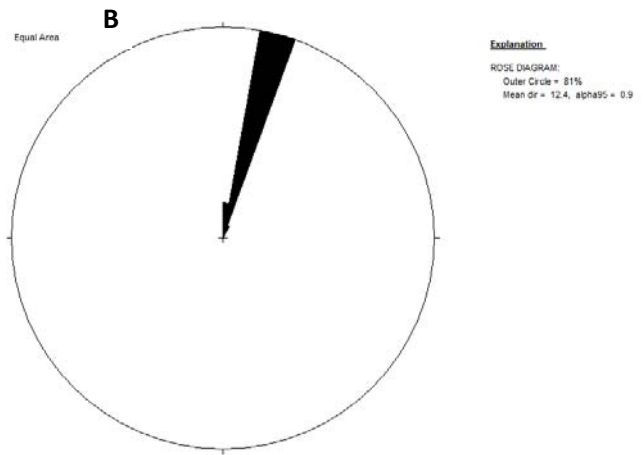


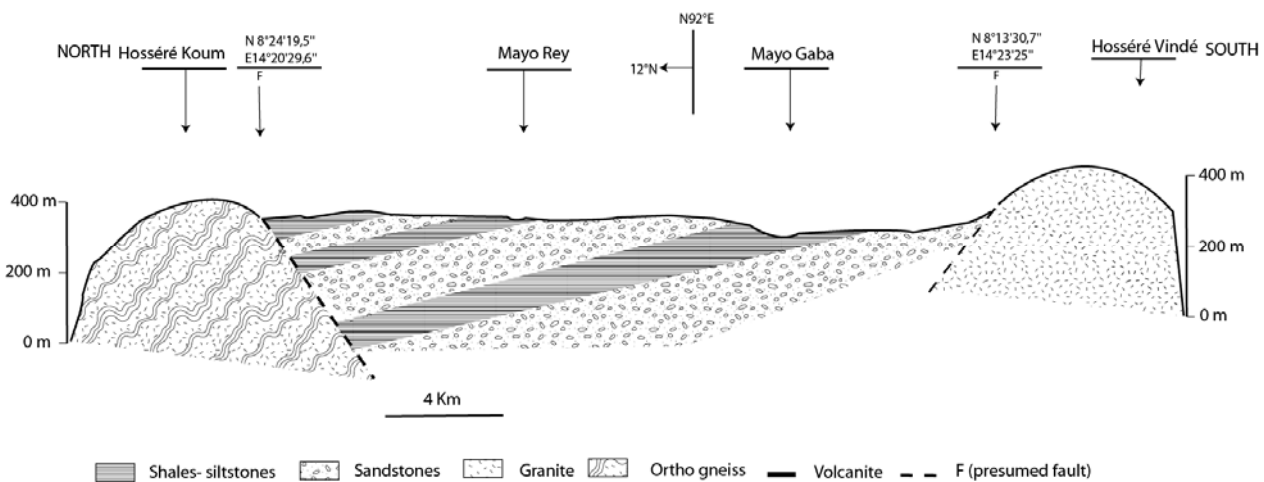
Figure 8: Lithographic log along the Mbissiri profile.



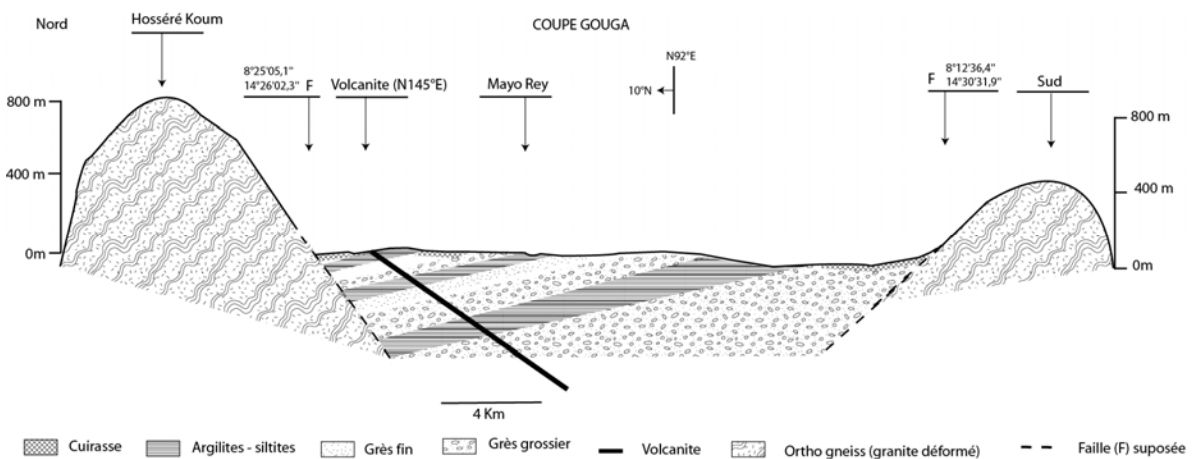
**Fig.9A:** Rose diagram plot to show the general strike direction of lithologies in Koum basin. The results of this plot in the Koum basin show a general east-west trend at N92°E.



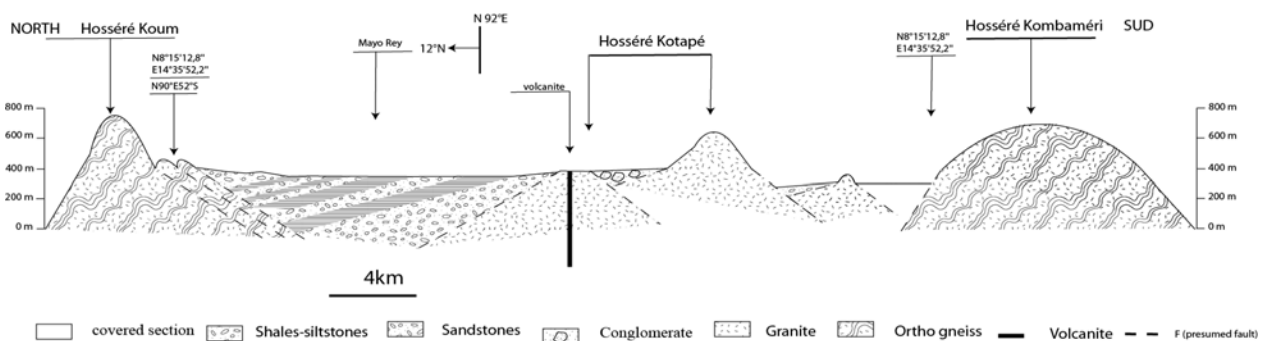
**Fig.9B:** Rose diagram plot to show the regional dip of lithofacies in Koum basin. The results of this plot in the Koum basin show an average dip of 12° towards the north.



**Fig.10A :** Schematic geological section of the Kali profile as located on Figure 1 modified from Schwoerer (1965).



**Fig.10B :** Schematic geological section of the Gouga profile.



**Fig.10C :** Schematic geological section of the Mbissiri profile.

## Conclusion

The facies of Koum basin consist of conglomerates, sandstones, shales and marlstones. The fossils found in this basin include dinosaur footprints, bivalves, conchostracans, ostracods, insects, ichnofacies, silicified wood and other plants fossils. The facies association of the Koum basin indicates deposition in alternation of fluvio-lacustrine paleoenvironment. The shale facies of the Koum basin has various color (brown, green, grey and black) and thought to be deposited under aerobic and anaerobic conditions. The Koum basin measures about 4300 m thick and has regionally been deformed into a monoclinical structure with the occurrence of localized syn-sedimentary deformational structures. The strike of beds trends at N92°E, with an average dip of 12° towards the north. The facies association of the Koum basin indicates deposition in a fluvio-lacustrine paleoenvironment and intertidal zone. The formation is cross-cut by volcanic rocks.

## Acknowledgement

The authors are indebted to the Cameroon Institute for Geological and mining Research (I.R.G.M), the Laboratory of Sedimentary and Petroleum Geology of the University of Maroua and the Earth Sciences Department of the University of Yaoundé I. We would like to thank the research team of sedimentary Basins in Cameroon and anonymous reviewers for their constructive comments. This work was supported financially by I.R.G.M.

## References

1. Brabant P., Carte pédologique de reconnaissance. Feuille REI-BOUBA à 1/200000. 1976. 107p.
2. Brabant P et Gavaud M., Les sols et les ressources en Terre du nord- Cameroun. M.E.S.R.E.S, I.R.A, ORSTOM, Not. Exp. N°103. 1985. 285p.
3. Brunet M., Jacobs L., Congleton J., Coppens Y., Dejax J., Flynn L., et al. Première découverte d'un fragment de mandibule de mammifère dans le Crétacé inférieur d'Afrique (Cameroun, bassin de Koum). Comptes Rendus Académie de Sciences. Paris.307 (14), Série. II, 1988b. p. 1675-1680.
4. Brunet M., Coppens Y., Dejax J., Flynn L., Heintz E., Hell J. et al. Nouveaux mammifères du Crétacé inférieur du Cameroun, Afrique de l'Ouest. Comptes Rendus Académie de Sciences. Paris, t. 310, Série II, 1990. p.1139-1146.
5. Chamley H. Bases de sédimentologie. 1er et 2e cycles. DUNOD. 2000. 172p.
6. Colin J.P., Brunet M., Congleton J.D., Dejax J., Flynn J.L., Hell J.V., et al. "Ostracodes lacustres des bassins d'âge Crétacé inférieur du Nord Cameroun : Hamakoussou, Koum et Babouri-Figuil. Revue de paléontologie. 1992. 11(2):p. 357-372.
7. Deconinck J.F., Blanc-Valleron M.M., Rouchy J.M., Camoin G., Badaut-Trauth D. Palaeoenvironmental and diagenetic control of the mineralogy of Upper Cretaceous-Lower Tertiary deposits of the Central Palaeo-Andean basin of Bolivia (Potosi area). Sedimentary Geology. 2000. 132, 263-278.
8. Dupéron-laudoueneix M. Les flores lignieuses mésozoïques et cénozoïques d'Afrique nord - équatoriale (Tchad et Cameroun). Thèse doc- d'Etat, Univ Pierre et Marie Curie, Paris VI, France. 1991. 299p.
9. Ghibaudo G. Subaqueous sediment gravity flow deposits: practical criteria for their description and classification. Sedimentology. 1992. 39: 423-454.

10. Guiraud R., Bosworth W., Thierry J., Delphine A. Phanerozoic geologic evolution of Northern and Central Africa: an overview. Journal of African Earth Sciences. 2005. 43: 83-143.
11. Harms J.C., Southard J. B., Spearing D.R., Walker R.G. "Depositional environment interpreted from primary sedimentary and stratification sequences." Society of Economic Paleontologists and Mineralogists Short Course. 1995. 2: 161 pp.
12. Maurin J.C., Benkhelil J., and Robineau B. Fault rocks of the Kaltungo lineament, NE Nigeria, and their relationship with Benue trough tectonics. Journal of Geology Society, 143, 1986, p. 587 – 589.
13. Njel U.O., Paléogéographie d'un segment de l'orogène pan – africain : la ceinture volcano – sédimentaire de Poli (Nord – Cameroun). Comptes Rendus Académie de Sciences. t. 303, Série II, n°19, Paris, 1986, p. 1737-1742.
14. Njel U.O. Une série volcanique à albitophyres (Poli, Cameroun). Un exemple de volcanisme préorogénique non ophiolitique, ensialique, mais différent du modèle hercyno-type. Comptes Rendus Académie de Sciences. Paris, t. 304, Série II, n°10, 1987, p. 515-520.
15. Penaye J., Kroner A., Toteu S.T., Schmus V.W.S., Doumnang J-C. Evolution of the Mayo Kebbi region as revealed by zircon dating : an early (ca. 740Ma) Pan-african magmatic arc in southern Chad. Journal of African Earth Sciences, 44, 2006, p 530-542.
16. Prothero D.N., and Schwab F. An Introduction to Sedimentary Rocks and Stratigraphy. Sedimentary geology. W.H. Freeman and Company. 1996. 559p.
17. Schwoerer P. Carte géologique de reconnaissance à l'échelle du 1/500.000. Notice explicative sur la feuille Garoua Est. Direction des Mines et de la Géologie du Cameroun (éd.), Yaoundé, 1965, 49 p
18. Scolari G. et Lille R. Nomenclature et classification des roches sédimentaires (Roches détritiques terrigènes et roches carbonatées). BRGM, Série II. 1973. p 59-123.
19. Toteu S.T., Dumont J.F., Bassahak J., Penaye J., Complexe de base et série intermédiaires dans la zone mobile pan-africaine de la région de Poli, au Cameroun. Comptes Rendus Académie de Sciences. t. 299, Série II, n°9, Paris, 1984, p. 561-564.
20. William M. Trace fossils: concepts, problems, prospects. 2007.