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LATE DEVONIAN REGRESSION AND EARLY CARBONIFEROUS TRANSGRESSION ON THE NORTHERN AFRICAN PLATFORM

by

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(4 figures and 1 table)

ABSTRACT.- The Northern African Platform, south to the Maghreb, is subdivided in three large domains around respectively the Reguibat, Targui and Tibesti Shields. Event stratigraphy at the end of the Devonian and early Carboniferous is reviewed in each domain. The data point to an overall latest-Devonian regression followed by an early Carboniferous transgression in these areas. (Abstracted by the editors).

RESUME. - La plateforme nord-africaine, au sud du Maghreb est subdivisée en trois grands domaines respectivement autour des boucliers Reguibat, Targui et Tibesti. Les événements stratigraphiques à la fin du Dévonien et au début du Carbonifère sont revus dans chacun de ces domaines. Ces données conduisent à admettre, dans ces régions, une régression au sommet du Dévonien suivie d'une transgression au début du Carbonifère.

1. - GEOLOGICAL SETTING

In Northern Africa the South-Atlas Flexure forms the boundary between the Northern African Platform *sensu stricto* to the South and the Maghreb to the North (Fig. 1). The Maghreb is an Alpine orogenic belt and is superimposed on pre-existing (Hercynian or even older) structures. Within the Maghreb, the Devono-Carboniferous outcrops are rare in Algeria where these are poorly dated and extremely fragmentary because of the intensive tectonism. The sedimentary facies in that area (flysch, kulm and volcanogenic deposits) are not the most appropriate for biostratigraphic investigations (Conrad *et al.*, 1985).

The outcrops of Hercynian rocks are more widely distributed in Morocco. However these occur as isolated, intensively fractured blocks which have been displaced by post-Hercynian orogenes. The late Famennian is marked by sandy and arkosic fan deposits usually ranging up into the Strunian. Important orogenic movements along with volcanic intrusions and (still poorly dated) folding characterize this period. The rather limited Tournaisian transgression is represented in some very rare outcrops. This Tournaisian transgression is often confounded with the widespread Visean transgression that leveled all pre-existing relief (Michard, 1976; Jeannette & Piqué, 1981; Bensaïd, Termier, H. & G., 1985). Devono-Carboniferous deposits are absent in Tunesia.

The South-Atlas Flexure forms not only a structural boundary between the Maghreb and the Northern African Platform, it also separates two completely different paleogeographic domains.

The African continent to the South of this flexure consists of large shields and sedimentary basins or syneclises with tabular and only weakly folded deposits, which are separated by strongly folded anteclises. This structural configuration is easily recognized on the geological maps, and was formed during the Hercynian and Alpine orogenes. However, it does not reflect the sedimentary realms in Paleozoic times. The so-called "basins" were no separate Devono-Carboniferous seas hich occurred along the Northern African margin, showing a general deepening of the environment from the South to the North. At most we may state that some of the structural axes separating these basins were formed on old lineaments. Eventually, a transverse ridge was formed since the late Devonian along the margin of the Tethys Ocean, parallel to the South-

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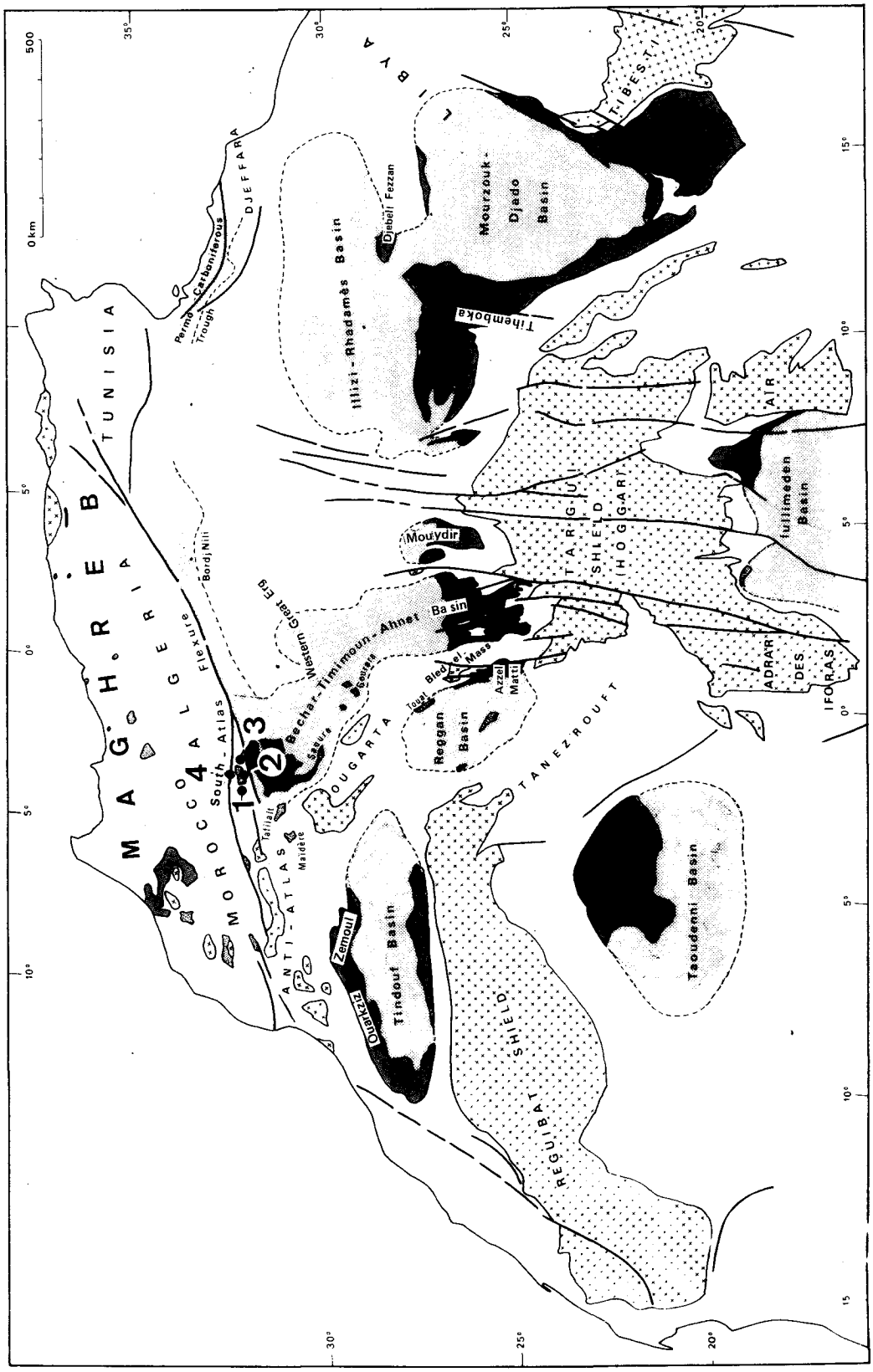

Figure 1. - Geology of Northern Africa. — 1. Djebel Horreit; 2. Djebel Antar; 3. Ben Zireg; 4. Djebel Grouz.

Atlas Flexure. This is the so-called South-Atlas Ridge (Conrad & Lemosquet, 1984).

Three large domains of the platform will be discussed here :

- the western domain around the Reguibat Shield that was stabilized some 1800 Ma ago,
- the central domain around the Targui (Hoggar) Shield, much more heterogeneous and instable, and separated from the western domain by the Ougarta aulacogen and the Tanezrouft lineament; and
- the eastern domain around the Tibesti Shield, separated from the central domain by the Tihemboka High, and displaying a more marked continental Gondwana character.

2. - WESTERN DOMAIN

The Reguibat Shield is bounded on the West by the Caledonian/Hercynian Mauretanides where the youngest deposits seem to be of Frasnian age (Lécorché & Sougy, 1978).

To the North of this shield the asymmetrical Tindouf Basin occurs with a rather thick pile of pericratonic deposits. The East-West running axial part of this basin is displaced northwards. The Zemoul Anticline separates the Tindouf Basin from the Moroccan Anti-Atlas to the North. The Reggan Basin to the East of this shield is also a strongly dissymetrical structure with its axis running from South-East to North-West. Late Devonian and early Carboniferous strata outcrop mainly at the steeply dipping eastern flank along the Bled-el-Mass Anteclise. This flank forms the transition to the central domain and will be dealt with in the following chapter.

The cratonic Taoudenni Basin to the South is marked by a relatively thin, incompletely studied rock sequence.

2.1. - ANTI-ATLAS AND NORTHERN BORDER OF TINDOUF BASIN

The Devono-Carboniferous transition has been studied by Hollard (1956, 1967, 1970, 1981a-b). The sandy-argillaceous deposits of this age belong to the Djebel Tazout Formation (Fig. 2) with outcrops in the Anti-Atlas at Maïdère and Tafilalt, in the Zemoul Anticline and along the northern border of the Tindouf Basin.

2.2. - SOUTHERN BORDER OF TINDOUF BASIN

This region has been studied by Menchikoff (1930), Gevin (1960) and some oil compagnies. The data have been reviewed later on by Hollard (1967). Although there is little biostratigraphic information (absence of goniatites and microfauna, few poorly preserved brachiopods), the following Famennian-Tournaisian succession has been recognized (Fig. 2).

- Famennian shales, upwards passing into Famennian sandy shales, are capped by a ferruginous conglomerate that might be dated as to IV to toV;
- "Strunian" fine-grained sandstones and siltstones with calcareous sandstone intercalations containing *"Leiorhynchus" laticosta;*
- shaly-sandy deposits of presumably Tournaisian age, with brachiopods, and capped by a ferruginous conglomerate with fish remains.

The thickness of the Strunian-Tournaisian deposits increases from some 80 m in the West to some 160m in the East.

2.3. - TAOUDENNI SYNECLISE (Fig. 2)

Devono-Carboniferous outcrops only occur along the northern border. Southwards these are covered by Cretaceous sediments. The southern border of this basin has been identified by geophysical methods. The northern border has been studied by Villemur (1967) and by the Bureau de Recherches des Pétroles (BRP). Lys (1964) recognized some micropaleontological markers. Legrand-Blain (1985) studied the brachiopods.

3. - CENTRAL DOMAIN

On the West the central domain is bounded by the Ougarta aulacogen and the Tanezrouft lineament, to the North-West by the South-Atlas Flexure, and on the East by the Tihemboka High. This central domain is marked by the Targui (Hoggar) Shield surrounded by several (partly composite) basins to the South (Iullimeden) and North (South-Atlas Ridge, Bechar-Timimoun-Ahnet Basin, eastern Reggan Basin, Mouydir Basin and Illizi Basin).

3.1.- TETHYS BORDER : THE SOUTH-ATLAS RIDGE

Remnants of this old high outcrop around Djebel Grouz at the extreme northern border of the Sahara Platform, near the South-Atlas Flexure, where an ultra-condensed succession of pelagic deposits, ranging from the late Famennian into the Serpukhovian, has been dated by means of conodonts (Weyant *in* Weyant & Pareyn, 1975). The only few meters thick succession consists of griotte limestones at the base (*Spathognathodus costatus* conodont zone indicating top Famennian or base of Strunian), succeeded by discoloured shales, a bed with phosphatic nodules and a 1 m thick crinoidal limestone bed (*Scaliognathus anchoralis* zone or "Tn3c" to *Paragnathodus homopunctatus* zone or Lower Visean, Lemosquet & Pareyn, 1985). The southern portion of this South-Atlas Ridge must have been the source area for the olistolites-bearing flysch deposits of Ben Zireg.

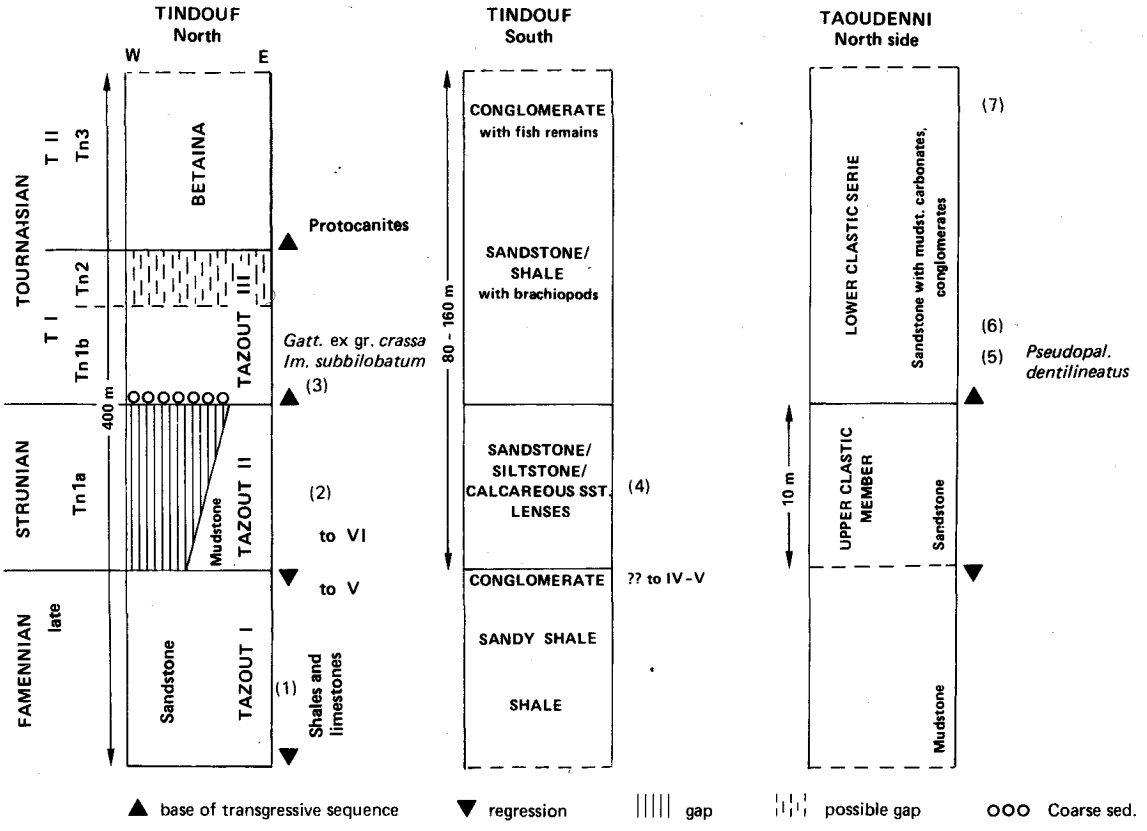

Figure 2. - Famennian-Tournaisian litho- and biostratigraphy in the western domain.

(1) *Mesoplica praelonga* and *Cyrtospirifer verneuilli;*
(2) *Eobrachythyris strunianus*
(3) *Marginatia vaughani* in sandstone
(4) "*Leiorhynchus*" *laticosta*
} Legrand-Blain 1979

(5) Lys 1964.

(6) *Syringothyris ahnetensis* and *Unispirifer*
(7) *Marginatia betainensis* and *Syringothyris folloti*
} Legrand-Blain 1985

3.2. - BECHAR BASIN AND SAOURA GRABEN

Strunian-Tournaisian strata outcrop in the northern portion of this basin in the Ben Zireg region and North of Djebel Antar. These have also been recognized in some boreholes in the Western Great Erg (or "Northern Hoggar") below the Hercynian unconformity. And finally, there are outcrops at the eastern flanks of the Ougarta Mountains and in the Saoura Valley.

3.2.1. - Djebel Antar and Djebel Horreit region

This northern part of the Béchar Basin has been studied by Lemosquet, Pareyn & Weyant (1980) and Lemosquet & Pareyn (1985). Relevant outcrops are the Soltane el Betoum Anticline (North of Djebel Antar) and the Mader el Majib Anticline (North of Djebel Horreit). In this area a condensed Devonian-Tournaisian succession occurs which is practically complete in the East and becomes more and more truncated towards the West (Fig. 3). This sequence is capped by a Lower Viséan limestone with the coral *Siphonophylla.*

3.2.2. - Ben Zireg region

The base of the olistolite-bearing Ben Zireg Flysch (Pareyn, 1961) is of Lower Visean age (*Gn. homopunctatus* conodont zone). The age of the olistolite blocks ranges from Cambro-Ordovician to Upper Tournaisian. Alberti (1972) recognized in some of these latest Devonian fossils of the toVI (*Phacops (Ph.) accipitrinus, Bispathodus spinulicostatus, B. costatus*) and Lower Tournaisian conodonts (*Protognathodus meischneri, P. collinsoni, P. kockeli, Siphonodella quadruplicata,* etc.). Lemosquet, Pareyn & Weyant (1980) also described Upper Tournaisian conodonts (*Sc. anchoralis* zone). Presumably, all these blocks have been transported southwards from the South-Atlas Ridge to the North.

3.2.3. - Western Great Erg

Palynological data from boreholes to the South-East of Béchar (a.o. Lanzoni & Magloire, 1969 and unpublished data) suggest uplift and erosion of the

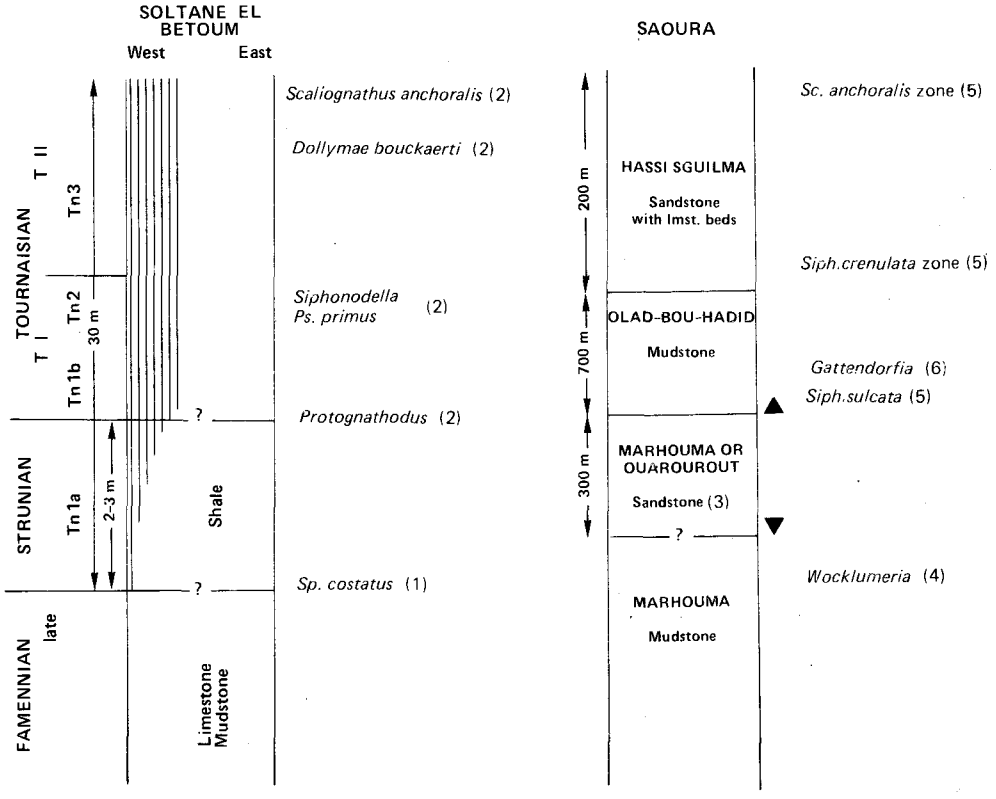

Figure 3. - Famennian-Tournaisian litho- and biostratigraphy in the central domain, western part.
(1) Weyant 1976.
(2) Lemosquet, Pareyn & Weyant 1980 (p. 201).
(3) Regressive sediments of estuary env. (Pareyn 1961).
(4) Petter 1959.
(5) Weyant 1985.
(6) Conrad, Pareyn & Weyant 1970.

Upper Famennian to Strunian (*R. lepidophyta* spore zone) sandstones, followed by early and late Tournaisian transgressions characterized by shaly sediments.

3.2.4. - Saoura Graben

Uppermost Devonian and Tournaisian strata outcrop on the eastern flanks of the Ougarta Mountains and in the Saoura Valley. This was an area with high rates of subsidence (Ougarta aulacogen and Saoura Graben). The stratigraphic sequence is shown in Fig. 3.

3.3. - TIMIMOUN REGION

The Gourara outcrops to the East of Ougarta display an intermediate sedimentary facies (with intricately interrelated marine and deltaic deposits) between the northern Béchar area and the proximal platform facies on the margin of the Targui (Hoggar) Shield. This region has been studied by Meyendorff (1939), several oil companies, and Conrad (1984). Legrand-Blain (1979) described the brachiopod assemblages. The lithostratigraphic succession (Fig. 4) starts with the Kahla Shales (Upper Famennian, toV) which may be the lateral equivalent of part of the Marhouma Shales in Saoura Valley (Fig. 3). These are overlain by the argillaceous Kahla Sandstones, a more or less regressive sequence with some marine intercalations, ranging from the uppermost Famennian into the Upper Tournaisian.

3.4. - REGGAN, AHNET AND MOUYDIR BASINS

Apart from the work by Follot (1952) and several oil companies, this area has been analyzed in detail by Conrad (1984). The sedimentological characteristics around the entire border of the Targui (Hoggar) Shield (including the Illizi and Iullimeden Basins) display the influence of this relatively young, quasi-craton that is an unstable, rather heterogeneous mass split into smaller units by important North-South running faults. This instability is noticed in particular in the western part of the shield that belongs to the Panafrican Rift Belt (550 Ma), and where two large blocks can be distinguished during the late Devonian and early Carboniferous :

- To the West the rate of subsidence was low around the Bled-el-Mass High (a stable outlier of the Ougarta) in the eastern Reggan Basin and western Ahnet Basin. There the deposits are rather condensed and

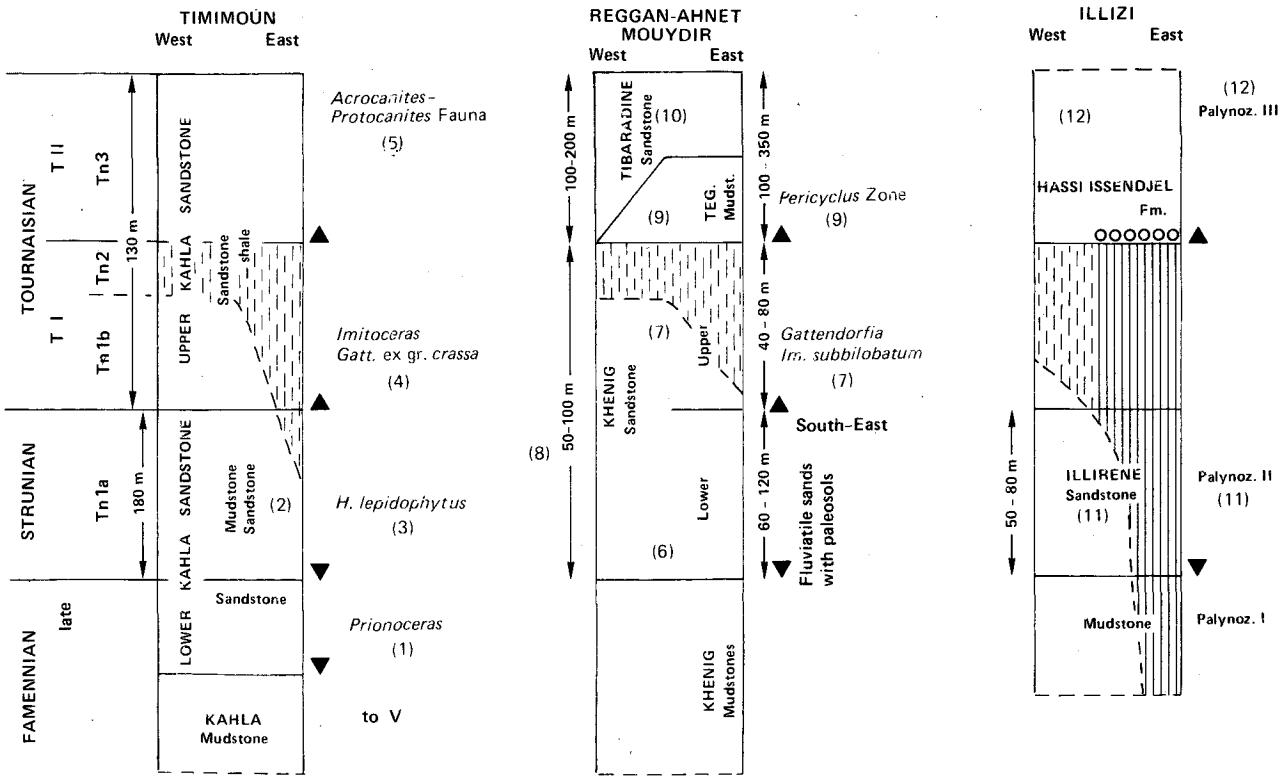

Figure 4. - Famennian-Tournaisian litho-and biostratigraphy in the central domain, eastern part.

(1) Rhynchonelles, *Mesoplica praelonga, Cyrtospirifer, Paleospirifer* (Legrand-Blain, 1979)
(2) Fluvio-deltaic facies dominant.
(3) Lanzoni & Magloire 1969.
(4) Faune à *Cyathaxonia* et brachiopodes : *Eobrachythyris strunianus, Eochoristites,, Syringothyris ahnetensis, Unispirifer* (Legrand-Blain, 1979).
(5) *Pustula interrupta* and *Spirifer subcinctus* (Legrand-Blain, 1979).
(6) Deltaic environment with bioturbations. Lamellibranchs and Rhynchonellids.
(7) Transgressive environment (deltaic to micritic) in North Ahnet and Mouydir. Brachiopods : *Syringothyris ahnetensis, Verkhotomia, Unispirifer* ex. gr. *pesasica.*
(8) Littoral facies.
(9) Transgressive environment with Goniatites, Conodonts and some Brachiopods.
(10) *Syringothyris folloti, S. sefiatensis, Histosyrinx vautrini, Marginatia betainensis, M. vaughani.*
(11) Abundant bioturbations; Strunian Brachiopods (Chanut & Simandoux, 1958).
(12) Limy sandstone and silty mudstone with Brachiopods (Dubois, 1960).

display less well marked transgressive tendencies.

- To the East, in the central and eastern Ahnet Basin and in the Mouydir Basin (outliers of the North Sahara basins) an intricate horst-and-graben system existed with high rates of subsidence. Here the sedimentary sequence is relatively thick for a cratonic domain.

Three formations are distinguished within the Famennian-Tournaisian succession : the Khenig Sandstones, the Teguentour Shales and the Tibaradine Sandstones (Fig. 4).

3.5. - IULLIMEDEN BASIN

This basin to the South of the Targui (Hoggar) Shield is also subdivided by North-South running faults. The Tamesna Subbasin in the West is separated from the Tim Mersoi Subbasin in the East by the In Guezzam High. Relevant Devono-Carboniferous outcrops occur in the Tim Mersoi Subbasin on the western flank of the Aïr Shield, where the strata dip southwards and disappear below the Cretaceous. This large syneclise has been studied by Joulia (1959), Lessard (1962), Claret & Tempère (1968), Valsardieu (1971) and Sempéré (1981).

The Upper Devonian to Tournaisian Térada series is subdivided in three formations of which only two are briefly described here below. The Térada series rests in the North on marine Middle Devonian to Frasnian rocks. South of the 19° latitude it lies unconformably on the Precambrian basement with presumably a glacially modelled paleotopography. The Térada series is up to 500 m thick in the North and strongly thins southwards.

The Teragh Formation at the base of this sequence consists of sandstones and conglomerates suggesting a glacial or fluvio-glacial environment. These have yielded Spirophyton and abundant plant remains *(Lepidodendron, Ulodendron, Archaeosigillaria, Calamites).* The flora is known elsewhere on the craton from the Upper Devonian and basal Carboniferous deposits.

The Talach Shales onlap either the Teragh Sandstones or the basement. In the North these yield marine faunas, and in the South a rich flora, thus giving a clue how far the marine transgression extended southwards. The brachiopod assemblages had been interpreted by all authors (including Valsardieu, 1971 and Sempéré, 1981) as Lower to Upper Viséan. However, Legrand-Blain (1974) dated these as Upper Tournaisian. These assemblages include *Histosyrinx vautrini* and *Antiquatonia (Marginatia) betainensis* (species also known from the Teguentour Shales in the Reggan-Ahnet-Mouydir Basins. This emphasizes that the Tournaisian transgression (which often has been confounded with the Viséan transgression) may have drowned an important portion of the Targui (Hoggar) Shield.

3.6. - ILLIZI BASIN

This basin is situated North of the eastern portion of the Targui (Hoggar) Shield at the foot of a shield fragment with North-South running faults. It is bounded on the West by the Amguid-el-Biod High and on the East by the Tihemboka High. The latter separates this basin from the Rhamadès Basin in the East. Devono-Dinantian outcrops are limited to the southern flank of the basin. But elsewhere the Devono-Dinantian has been explored by numerous boreholes since a large number of hydrocarbon reservoirs is known to occur in the Paleozoic of this area. Actual exploration is being carried out by SONOTRACH (studies realized by S. Latrèche on the Strunian F2 reservoir). The outcropping rocks have been dealt with in numerous publications (see bibliography in Latrèche, 1982). The boreholes have permitted to establish a detailed palynozonation which cannot be recognized in the weathered surface (Attar *et al.,* 1980). The lithostratigraphy and palynozonation are shown in Fig. 4.

4. - EASTERN DOMAIN

Four Paleozoic basins are distinguished in Libya, of which only the western ones (Rhadamès and Mourzouk-Djado) are dealt with here below. To the East the Cirenaica Platform and the Koufra Basin occur. In the Koufra Basin (Al Kufrah Basin) the subcontinental sandy deposits of the Binem Formation have been dated as Middle to Upper Devonian (Bellini & Massa, 1980). It is impossible to distinguish Famennian or Strunian strata in that area. The late Famennian and Strunian have been recognized on the Cirenaica Platform (Thusu & Owens, 1985).

Eight formations and their respective ages (Massa & Moreau-Benoît, 1976) are distinguished in the Rhadamès Basin and northern part of the Mourzouk-Djado Basin (Table 1) :

Table 1.- Formations and correlative ages in the Rhadames Basin

MRAR FORMATION		UPPER TOURNAISIAN
TAHARA FORMATION		FAMENNIAN to STRUNIAN
AOUINET OUENINE GROUP	AO IV Formation	FAMENNIAN
	AO III Formation	FRASNIAN
	AO II Formation	GIVETIAN
	AO I Formation	COUVINIAN
OUAN-KASA FORMATION		EMSIAN
TADRART FORMATION		LOWER DEVONIAN l.s.

Further to the South in the Mourzouk-Djado Basin the Famennian-"Strunian" has not been recognized. On the one hand because the Upper Devonian strata consist of continental sandstones with Lycophytes. And on the other because the upper portion of the Upper Devonian has been truncated progressively by erosion in southwestern Libya and in Djado (Plauchut & Faure, 1959). The presumably incomplete Upper Devonian rocks are capped by the ferruginous and oolitic sandstones with *Histosyrinx* and *Septacamera* of the Upper Tournaisian (Massa, Termier & Termier, 1974).

4.1. - RHADAMES (GHADAMIS) BASIN

The Aouinet Ouenine (Awaynat Wanin) outcrop in the South-East of this basin displays the reference section for the Devonian subdivision. The Famennian AOIV Formation in this section is 42 m thick. This formation is easily distinguished in numerous boreholes where a maximum thickness of 180 m is observed. Macrofossils are rare, but it has been possible to date this sequence by means of conodonts and microfloras (Palynozones 9 and 10).

The AOIV Formation and the overlying Tahara Formation are well-distinguished by their respective lithologies. The AOIV Formation consists mainly of clayey shales with thin siltstone intercalations, whereas the (in the type location some 50 m thick) Tahara Formation is composed of two sandy units separated by clayey-silty sequences. The sandy units form an important hydrocarbon reservoir ("F2") in eastern Algeria

(Echikh, 1976) and in Libya. The age of the Tahara Formation has been determined by means of spores (palynozone 11) (Massa & Moreau-Benoît, 1976, 1985, Massa *et al.*, 1979). Acritarchs are frequent.
Within the Tahara Formation hematite beds and ferruginous oolites occur along with paleosols and Lycophyte remnants. Marine faunas are rare. The sedimentary facies shows a regressive tendency in all boreholes.

The sediments of the AOIV Formation and the Tahara Formation have been deposited during one single "Famennian-Strunian" megacycle.

4.2. - MOURZOUK BASIN

Several outcrops of Devono-Carboniferous sediments occur in the northern part of the basin, to the South of Djebel Fezzan (= Jabal Fazzan) in the Ouadi Chatti (Wadi ash Shati) region. The Famennian-Strunian rocks have been studied in detail because of the presence of their rich iron ore reserves (for bibliography, see Turk *et al.*, 1980; Seidl & Röhlich, 1984).

The some 30 m thick Tahara Formation is here named Ashkidah Formation. The "Upper Famennian-Strunian" age of the sequence is supported by an assemblage of miospores (a.o. *R. lepidophyta*), chitinozoaires and acritarchs characterizing the Palynozone 11 of Massa & Moreau-Benoît (1976). The Ashkidah Formation is overlain by very fossiliferous sandstones of the basal M'Rar Formation (Upper Tournaisian).

4.3. - INFLUENCE OF PALEOSTRUCTURES ON DEVONO-CARBONIFEROUS SEDIMENTATION

Usually, the Devonian succession in the Western Libyan basins does not display important gaps between the Lower Devonian and the Strunian. There is a clearly regressive tendency in the Famennian-Strunian sequence. Also there is evidence of an important late Tournaisian transgression, starting with extremely diversified marine faunas (including *Muensteroceras rotella, M. crassum*).

However, in some cases the Upper Tournaisian strata rest immediately on Lower Silurian rocks. This is observed for example on the Tihemboka High near the Algerian-Libyan frontier. This high separates the Illizi and Rhadamès Basins and is one of the proofs that Caledono-Hercynian highs have subdivided the intracratonic domain of the northern Sahara in several subbasins which extend from Morocco to Libya.

5. - CONCLUSIONS

The now available data on the regional stratigraphic successions in Northwestern Africa point to an overall latest-Devonian regression followed by an early Carboniferous transgression in this area. These events may be compared with similar phenomena elsewhere on the globe. Such a comparison had been made already by Fabre & Moussine-Pouchkine (1971). However, the biostratigraphic basis for such an attempt has been considerably improved since then.

5.1. - LATEST-DEVONIAN REGRESSION

Throughout the northern border of the African Platform a latest-Devonian regression can be observed, although its characteristics and exact timing may vary from one area to the other. Only at the northern border of the South-Atlas Ridge a more or less continuous, albeit very condensed, succession of marine pelagic sediments belonging to the Tethys domain has been observed.

Along the northernmost parts of the platform (northern margin of Tindouf Basin and Anti-Atlas) and in some rapidly subsiding areas (Saoura Graben and axis of Béchar-Timimoun-Ahnet Basin, both situated in the Pan-African Rift Belt) the marine influence continued during the latest Devonian. But there the regression is characterized by transitory influx of continental detritus during part of the Strunian period. Elsewhere in the more intern zones, the regression has affected the top of the Famennian, the entire Strunian and the Lower Tournaisian. This is the case in the southern part of the western domain and the central domain (except for the Pan-African Rift Belt); and also in the eastern domain, where the sequences show reduced thicknesses, where the top of the Tahara Formation has been truncated by erosion and where the Lower Tournaisian is missing.

We may thus conclude that this late Devonian regression in Northern Africa reached its acme somewhere during the Strunian.

Presumably, this event can be correlated with a late-Strunian regression that affected the margins of the Tethys from Western Europe to Turkey. This regression has not been noticed however in the southern Urals (Conil *in litt.*).

If this regression is restricted to the Tethys realm it may have been caused by tectono-eustatic phenomena following the Bretonic epeirogenesis rather than by a glacio-eustatic lowering of the world sea-level. In this context it should be noticed that the first important glaciation on Gondwana is of Visean age (Lemoigne, 1981), and that the fluvio-glacial deposits along the western flank of the Aïr Shield seem to have been derived from mountain glaciers of only regional importance and without influence on the eustatic sea-level.

5.2. - THE EARLY CARBONIFEROUS TRANSGRESSION

Everywhere around the Tethys Ocean we can distinguish two main phases in the early Carboniferous transgression. If we use the chronostratigraphic subdivision adopted for Belgium (Paproth *et al.*, 1983) as a reference, the first phase started at the base of the Hastarian (T I), whereas the second main phase is of Ivorian age (T II).

The same seems to have occurred along the southern margins of the Tethys in North Africa, where the epicontinental seas gradually extended over the borders of the African Platform. The first marine transgression is only noticed by the deposition of rather sandy detritus during the Hastarian and is limited to the northern border of the area and to some rapidly subsiding zones.

The main Ivorian transgression rapidly drowned the entire area during the Upper Tournaisian. This transgression is characterized by rather uniform, fine-grained detrital deposits with occasionally some carbonate. This second transgression is well-dated by a diverse fauna. These Upper Tournaisian strata may cover a substratum of quite varying ages on some of the active highs.

This Ivorian transgression seems to have an eustatic character. However, it is difficult to decide whether this is a tectono-eustatic or a glacio-eustatic event. We should not forget that this event is pre-Dwyka in age. Maybe, the data from other regions will help to solve this problem.

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