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# Lithostratigraphic Characterisation of Senonian Deposits on the Abidjan Margin

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

The sedimentary basin of Côte d'Ivoire has generated numerous geophysical, sedimentological and biostratigraphic research. However, the lithostratigraphic characteristics for revealing seismic processes are very little known. This study was carried out with the aim of understanding the relationship between sea level variations and seismic terminations. the studies carried out relate to

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the lithostratigraphic analysis of two seismic profiles of Senonian age in the Abidjan margin. The seismic study of this work is based on the interpretation of the seismic profile. Recognizing reflector terminations and reflector geometries is arguably one of the most useful aspects of this approach. the seismic profiles show the Senonian formation is generally continuous and of approximately constant thickness overall. overall, the formation is affected by simple normal faults offshore, note the presence of structures that could constitute structural hydrocarbon traps.

*Keywords: Onlap; downlap; toplap; lithoseismics; oil potential; Ivory Coast.*

## 1. INTRODUCTION

The Ivorian continental margin is a passive margin that has been the subject of a number of research studies, most of which have focused on sedimentology, biostratigraphy, tectonics and stratigraphy [1,2] on the one hand, and on structural aspects [3,4,5,6] on the other. The few results obtained on the 'Bélier' deposit remain to be elucidated. The use of seismic data in terms of deposit processes can provide fundamental information on reservoir zones. It is in this context that the present study has been initiated with the theme: 'lithostratigraphic characterisation of the senonian deposits of the abidjan margin'. The général objective of this work is to understand the geological context of the Senonian deposits. Specifically, the aim is to match the various sequences derived from the drilling data to the reflector terminations and to describe the lithology according to the sedimentary processes. This study is based on data from five boreholes and seismic data from a single block located in the Abidjan margin (Fig. 1: study area).

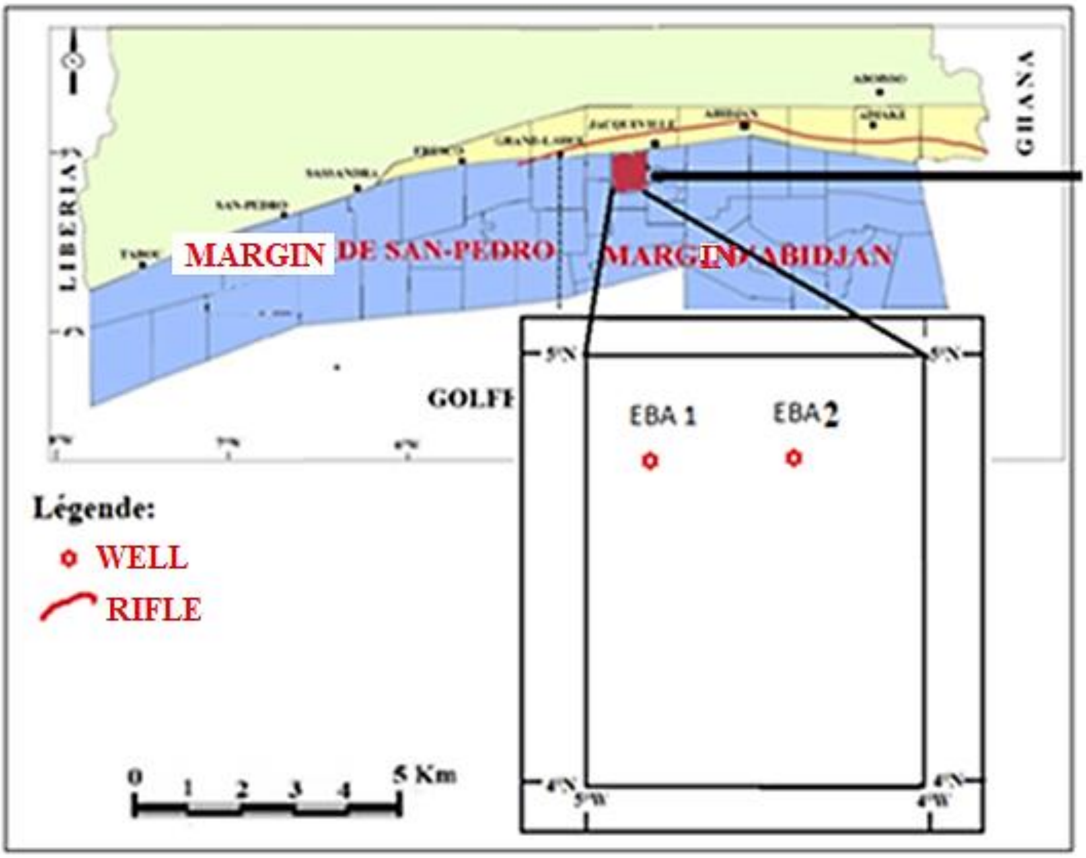


**Fig. 1. Geographical location of boreholes studied in the Abidjan margin**

## 2. MATERIALS AND METHODS

The seismic study in this work is based on the interpretation of borehole data and seismic profiles. A number of seismic stratigraphic concepts, such as onlap, downlap and toplap, were used as a guide. A depositional sequence is therefore limited at its top and bottom by discontinuity surfaces underlined by reflection terminations. The seismic reflection-sequence boundary relationships were defined by [7] as a function of the termination of these reflectors on adjacent boundaries. Recognition of reflector terminations and reflector geometries is undoubtedly one of the most useful aspects of this approach. These terminations describe the contacts between reflectors. There are two boundaries for each sequence, the lower boundary and the upper boundary. These sequence boundaries are defined by their relationship to the sequence. These relationships are based on the parallelism or lack thereof between the strata and their boundary surfaces.

- The ‘onlap’ or aggradation bevel corresponds to the termination of horizontal strata. on a sloping base surface or sloping strata on a base surface with a steeper slope. This arrangement marks a migration of deposits towards the coast in the case of a rise in sea level. In the case of a rapid fall in sea level, the onlap marks a migration of deposits towards the basin.

- The ‘downlap’ or progradation wedge is the termination of more inclined strata on a less inclined base surface. It corresponds to a lateral increase in deposits in the direction of the slope. Onlap’ and “downlap” are indicators of a non-depositional hiatus rather than an erosional hiatus [7].

Once defined, the discontinuities that limit the sequence identify the constituent units in terms of seismic facies. These are first studied globally on the basis of the internal configuration of the reflections. Then, the characteristics of the reflections analysed are the internal parameters of the reflections. The seismic sections are used to identify seismic sequences, which often correspond to second- and third-order stratigraphic sequences. When the resolving power of seismic allows it, it is possible to identify sequences. Seismic drilling is used to match seismic sequences with stratigraphic sequences. Sequence boundaries are defined on the basis of the geometric relationships of the markers truncation by erosion, then Onlap for the limits of regressive sequences, downlap for transgressive sequence boundaries.

## 3. RESULTS AND DISCUSSION

### 3.1 Correspondence of the Geological Sequences to the Reflector Terminations of the EBA 1 Borehole

Following the fundamental principles of seismic stratigraphy defined by [9,7,10], the superimposed seismic units can be distinguished in the stratigraphic series [11].

Following the North-South direction of the profiles, the reflectors are not parallel but diverge over the whole section with an irregular, heavily eroded surface. In Unit 1 (U1), within the Maastrichtian sequences (U1), the reflectors are generally undulating. To the north, the reflectors are of the aggradation bevel type. This configuration indicates clastic coastal sediments transported by a watercourse or by waves or low-energy turbidity currents [10]. In Unit 1, these less pronounced reflectors have very low amplitudes to the point of resembling a white facies with low to medium frequencies (Fig. 2). Unit 2 (U2), the Campanian sequences present discontinuous reflectors throughout the profiles, with high and low amplitudes to the north and south respectively. The frequency is variable. Unit 1 is deposited in Onlap on unit 2. This is a fundamental indication of a relative rise in sea level, thus justifying the first marine transgression [12-14].

### 3.2 Mapping of Geological Sequences to Reflector Terminations in Borehole EBA 2

The North-South seismic line of borehole EBA2 (Fig. 3) was interpreted to see the evolution of the Senonian formations (Coniacian-Maastrichtian). The reflectors are discontinuous.

From north to south, the thickness of the formations decreases. The seismic reflector is prograding These reflectors are discontinuous, discordant, of variable amplitude and average frequency. The transition to the Campanian shows low amplitude reflectors. The Campanian sequences have high to low amplitude reflectors. The characteristics of the reflectors are almost similar to those of the Maastrichtian (units U1 and U2) are characterised by the sigmoidal-progressive shape of their internal reflectors, which are limited at the base by a downlap surface and at the top by an onlap surface. Between these 2 limits is a well-marked reflector that separates and announces the Lower Senonian (Coniacian-Santonian) sequences. The seismic reflectors are generally discontinuous throughout the section. They are discordant, of variable amplitude and high to low frequency from north to south. This suggests a mixture of fine and coarse deposits. All the reflectors begin in onlap in the proximal part and in downlap towards the open sea.

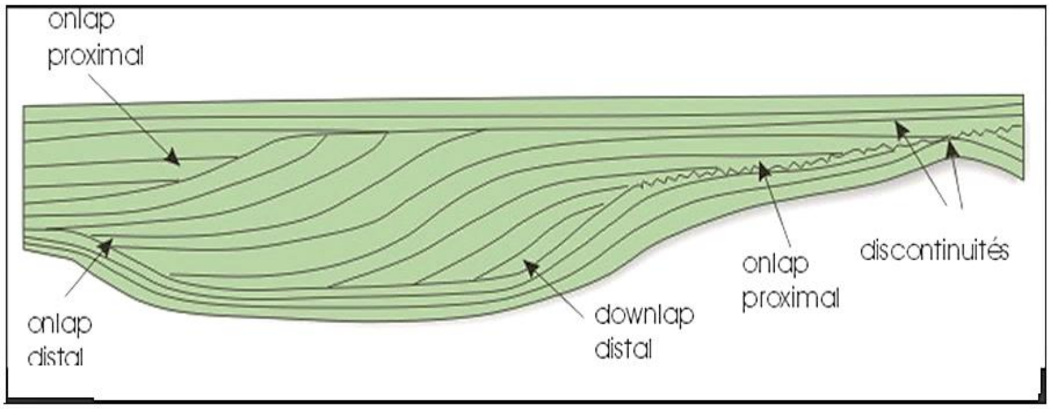


**Fig. 2. Geometry of contact surfaces between sedimentary bodies during the filling of a basin [8].**

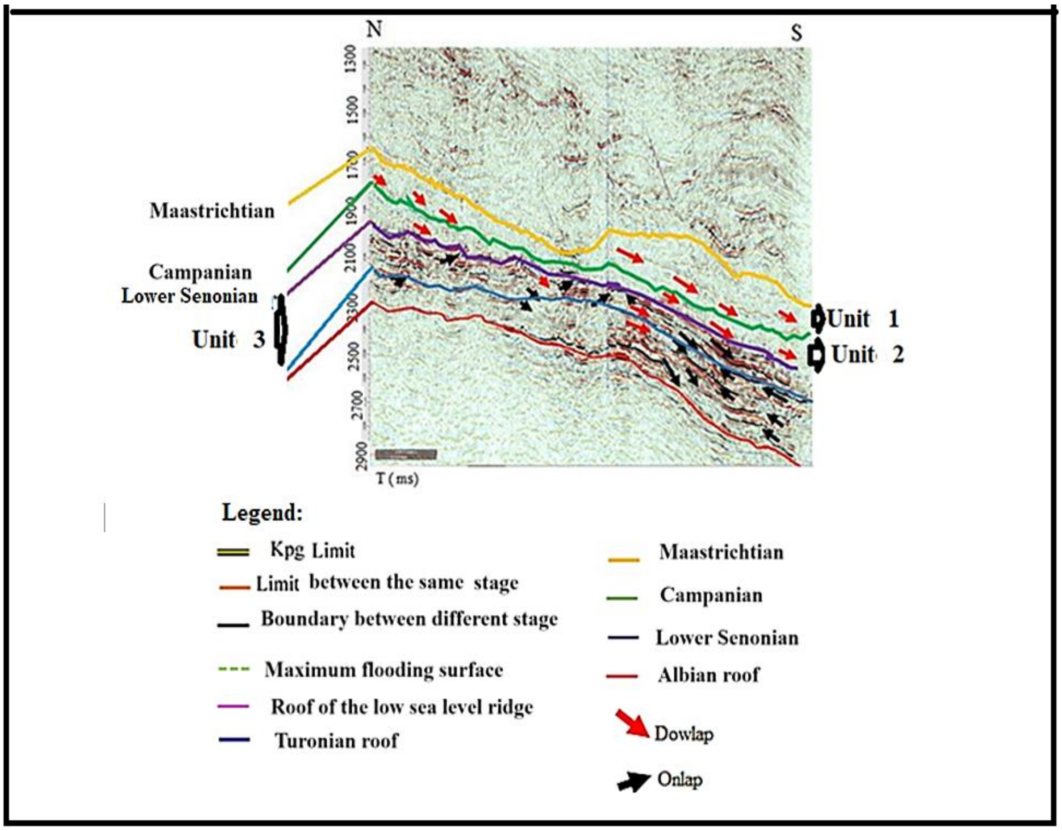


**Fig. 3. Seismic section of borehole EBA 1**

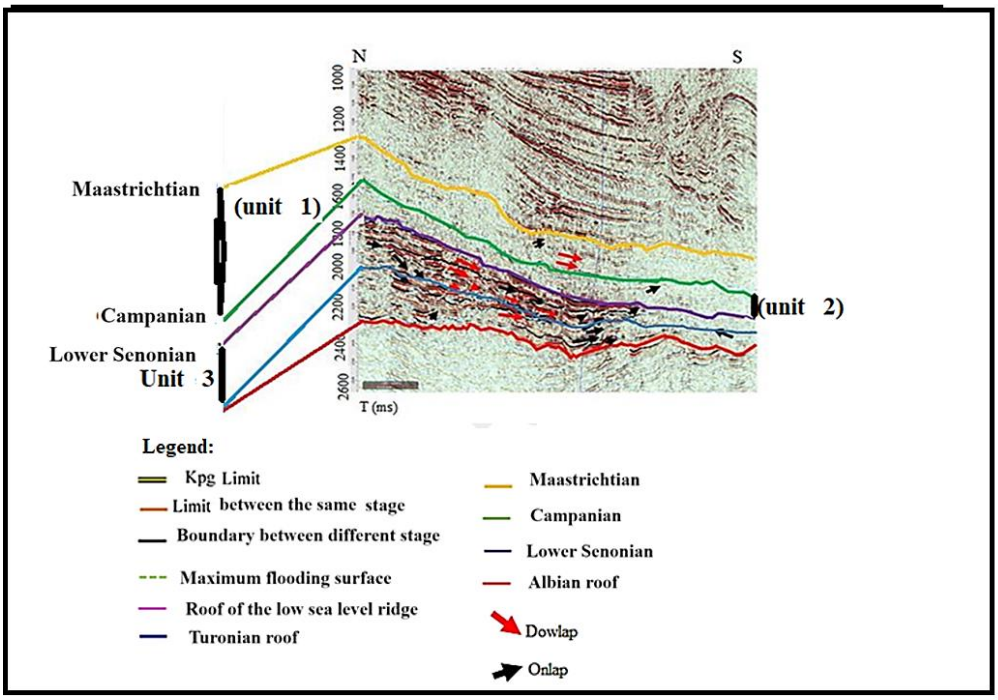


**Fig. 4. Seismic section of borehole EBA 2**

### 3.3 Lithological Description by Sedimentary Sequence

The sedimentary formation studied in this study revealed a succession of deposits ranging from Coniacian to Maastrichtian. The depositional sequences were determined on the basis of lithological and seismic studies. This study enabled us to identify in the different sequences low-level marine processes, transgressive processes and high-level marine processes. Sequences that are identical throughout a complete cycle are made up of genetically linked strata [15]. The identification of facies also enabled us to determine the periods of advancement of the depositional profile (progradation) or retreat (retrogradation) [16]. By superimposing these different depositional environments over time, we can define 10 depositional sequences. These sequences are made up of three depositional processes: the transgressive procession and the high marine level procession are clayey and the low marine level procession is sandy with an intercalation.

### 3.4 Discussion

Two more or less continuous seismic lines, confirm the transgressive and regressive. The Lower Senonian (Coniacian-Santonian), this set of stages is characterized by discordant reflectors with continuous facies. The range of reflections is strong. From North to South, these reflectors are not present in the deposits of the EBA 1 and EBA 2 boreholes. This configuration may correspond to sandy sedimentation with clayey intercalation and marl, deposited under more or less agitated hydrodynamic conditions, these strong, discontinuous reflectors correspond to the chaotic facies. [17] a, interpreted this type of facies as a chaotic set of heterogeneous offshore material of Jijel (Eastern Algeria). These coarse deposits are very frequently linked to fillings at the level of the submarine fans as indicated by [18]. As for the Upper Senonian (Maastrichtian – Campanian), Over the entire seismic profile (Fig. 6), the reflectors have porous rock facies that cause little reflection and can characterize deposits gravitational (turbidites) or disorganized sands [15]. This superior Senonian presents the same facies as the sedimentary series described by [19]. This facies semi-transparent, is also found in the recent sedimentary series, which are not very compacted, muddy and homogeneous, characteristic of surveys of distal zones or submarine deltas In a north-south direction, the Upper Senonian gradually thickens towards the large where the proportion of clay becomes more important before reducing considerably in very deep water. From east to west, the thick of lithological composition.

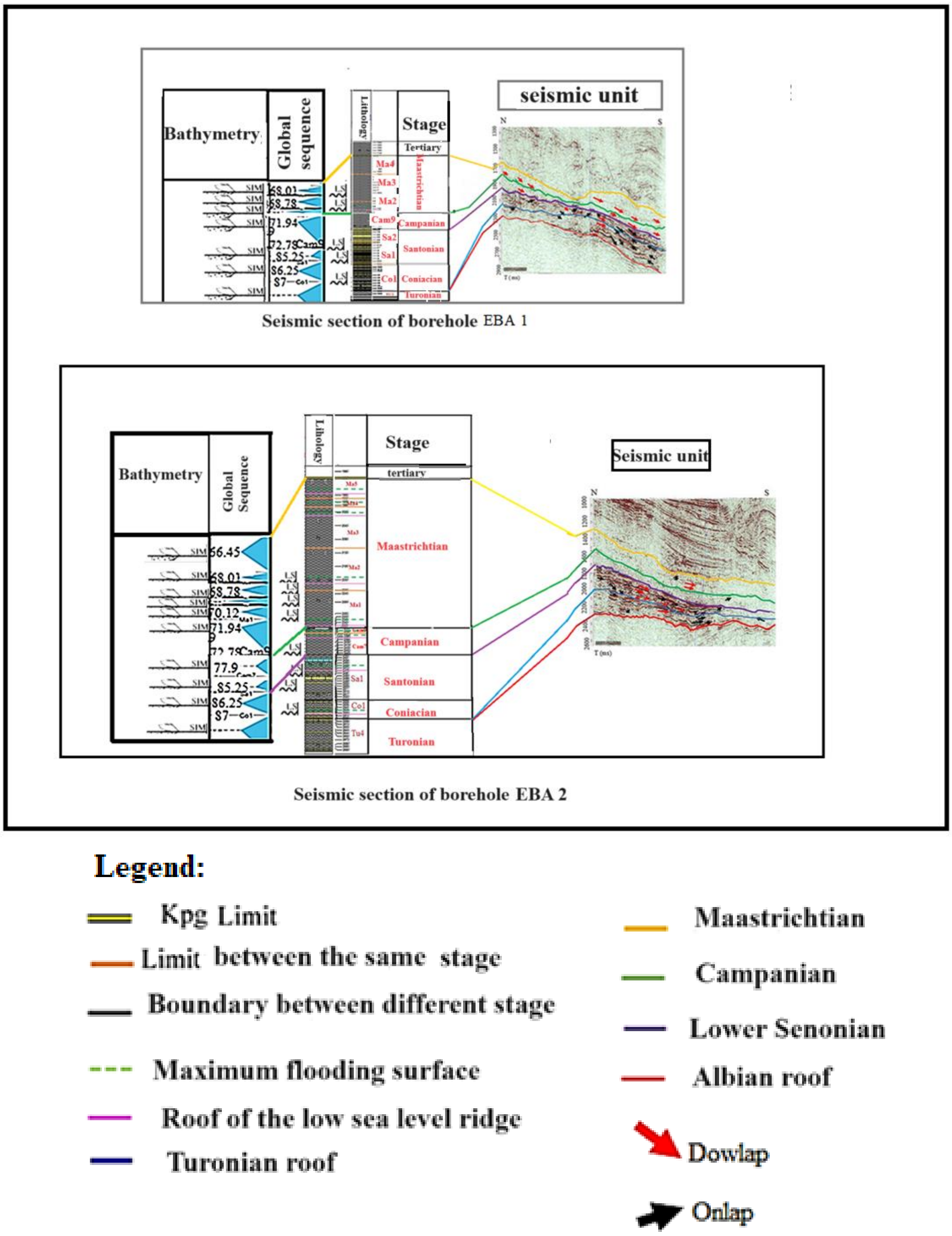


**Fig. 5. Seismic section of borehole EBA**

The very discontinuous reflectors which correspond to the coarse elements, comparable to the chaotic facies. In a sedimentary body, the presence of strong reflectors shows coarse sands or marine carbonates at the margin, probably sedimented under hydrodynamic conditions Variables. Overall, a semi-transparent facies that appears very often in the series sedimentary flows are the result of gravity flow phenomena at the level of the slopes continental according to [19]. Good opportunities therefore exist in the sedimentary basin of Côte d'Ivoire and further work on stratigraphic traps should be encouraged [20].

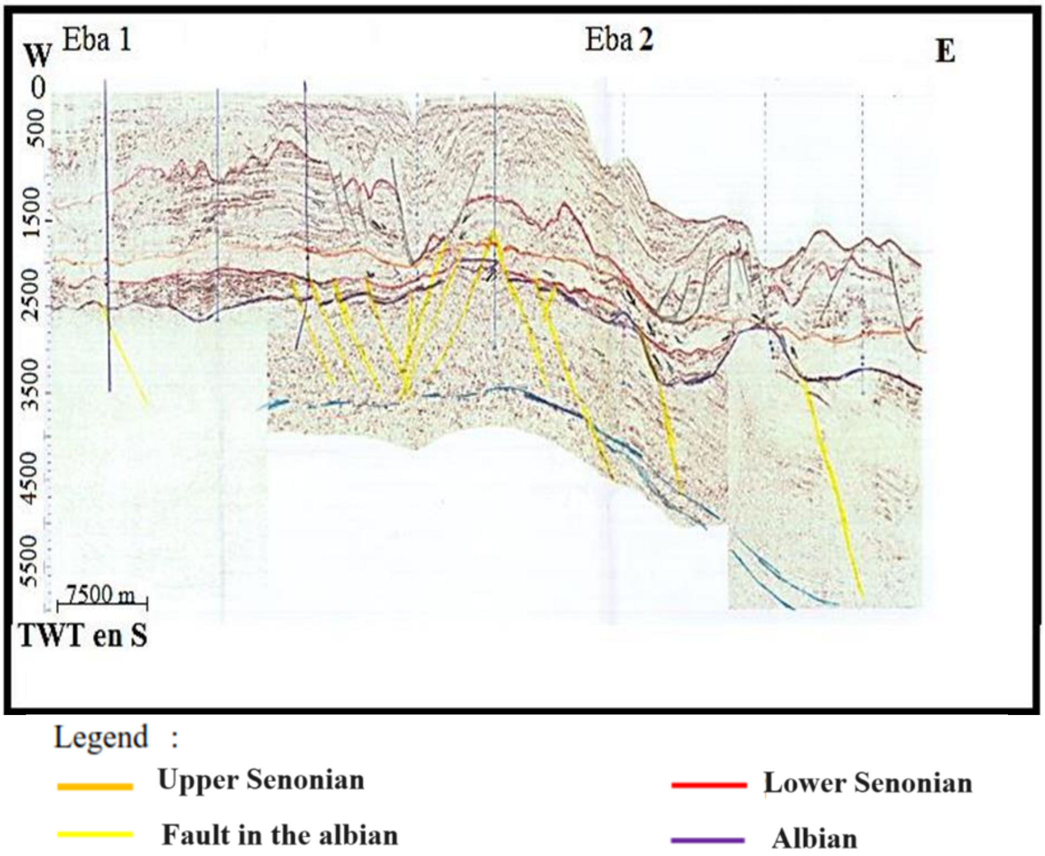


**Fig. 6. Correlation of seismic profiles from boreholes on the Abidjan margin**

## 4. CONCLUSION

This study has highlighted a Senonian (Coniacian – Maastrichtian) composed of 2 litho facies: a dominant clay facies and a sandy facies. the clay has layers interspersed with limestone pasts. the litho-acoustic characteristics show that the reflectors of the senonian are generally continuous, of almost constant thickness and of lithological composition constant in an east-west direction. in the direction of the north-south, the senonian gradually thickens towards the open sea where the clay content predominates before shrinking considerably to very deep water. overall, the training is affected by simple normal faults due to rifting accompanying oceanization, the tectonic pattern in this region of the basin plays a particularly important role in the definition of oil objectives. thus, the capture of hydrocarbons is favoured by phenomena of subsidence, erosion and fracture. Offshore, we note the presence of anticline structures that can constitute structural hydrocarbon traps while In the deep offshore, the configuration of the reflectors highlights the structures of the lenticulars which suggest the existence of stratigraphic hydrocarbon traps. To realize the petroleum potential of the Senonian formation in the basin Ivory Coast sedimentary area, it is important to determine the characteristics of the as well as the geochemical characteristics of sandy and clayey facies.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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