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3 **Logging and lithostratigraphic study of the Cenomanian-Santonian**  
4 **reservoirs of four oil wells MSP1, MSP2, MSP3 and MSP4 of the margin of**  
5 **San Pedro (Côte d'Ivoire)**  
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8 **ABSTRACT**

9 The logging and petrophysical study of four oil wells, MSP1, MSP2, MSP3 and MSP4 from  
10 the San Pedro margin of the ivorian sedimentary basin has made it possible to evaluate the  
11 reservoir characteristics of the Cenomanian-Santonian age formations. On the  
12 lithostratigraphic plane, this study has shown that this interval consists of clay and sandstone  
13 deposits interspersed with frequent past carbonate.

14 At the logging plane, ten (10) sandstone reservoirs are highlighted with effective porosities  
15 ranging from 16% to 21% and permeabilities from 100 mD to 1100 mD (millidarcy).

16 These reservoirs have very good petrophysical characteristics however their high water  
17 saturation show that they are rather aquifers. The various log gamma ray profiles of the  
18 intervals considered highlight a fluvial and marine deposition environment. Sedimentation  
19 would have started in a Cenomanian-type fluvial environment and would have continued in a  
20 marine environment marked by the accumulation of sandstone and clay under the influence of  
21 transgression and regression phases in the Turonian and Lower Senonian.

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24 **Keywords :** *Logging; Reservoirs; lithostratigraphy; petrophysics; Ivorian basin;*  
*Cenomanian; Santonian; depositing environment*

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26 **1. INTRODUCTION**

27 Located in the southern part of the country, the ivorian sedimentary basin grows along the  
28 West Atlantic coast from Liberia (Sassandra) to Ghana. It extends between 3 ° 05 W and 7 °  
29 30 W and develops south of the latitude 5 ° 20 N. It results from the opening of the South  
30 Atlantic to the Jurassic and is part of the chain of sedimentary basins bordering the west  
31 Atlantic coast from southern Morocco to southern Africa [1].

32 This basin is of Meso-Cenozoic age [2] and includes a terrestrial part (onshore) or coastal  
33 basin and a submerged part (offshore) object of this study.

34 The submerged basin or offshore basin represents the largest part of the basin and develops on  
35 the continental shelf area, 750 km wide [3]. This offshore basin is studied only by oil drilling.

36 It presents a structure in horsts and grabens, in response to the action of transtension  
37 phenomena that surround it. These are the transforming faults of Saint-Paul in the North-West  
38 and Romanche in the South-East [4, 5, 6].

39 This offshore basin is subdivided into a margin of Abidjan and a margin of San Pedro.

40 The Abidjan margin is the area of the main hydrocarbon discoveries in Côte d'Ivoire. It  
41 contains all the oil fields (Baobab, Lion, Hope, Foxtrot ...) known to date.

42 The oil exploration campaigns conducted so far at the San Pedro margin have not yet revealed  
43 sufficient commercial hydrocarbon accumulations to justify exploitation.

44 These less favorable oil results from recent wells drilled in this western part of the  
45 sedimentary basin of Côte d'Ivoire are prompting new geological studies to better understand  
46 the oil system of this margin. It is in this context that this study is initiated.

47 The main objective sought in this study is to characterize the Cenomanian-Santonian  
48 reservoirs of this zone at logging and lithostratigraphic and petrophysical levels. The choice  
49 of this interval obeys the fact that most deposits in the Abidjan margin have ages in this range.  
50 This study also aims to identify the reservoir zones from their lithological and petrophysical  
51 characteristic

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## 54 2. PRESENTATION OF THE STUDY AREA

55 The study area is located in the ivorian offshore sedimentary basin. This basin covers an area  
56 of about 22000 km<sup>2</sup> and a width of 80 km to 150 km from east to west from the coast to  
57 depths of water above 3000 m. It constitutes the bulk of the Ivorian sedimentary basin. It  
58 presents a structure in horsts and grabens, in response to the action of transtension phenomena  
59 that surround it.

60 These are the transforming faults of Saint-Paul in the North-West and Romanche in the  
61 South-East [4, 5, 6]. This deep basin is subdivided into a margin of San Pedro in the west and  
62 a margin of Abidjan in the east which are two geologically distinct margins (**Fig. 1**):

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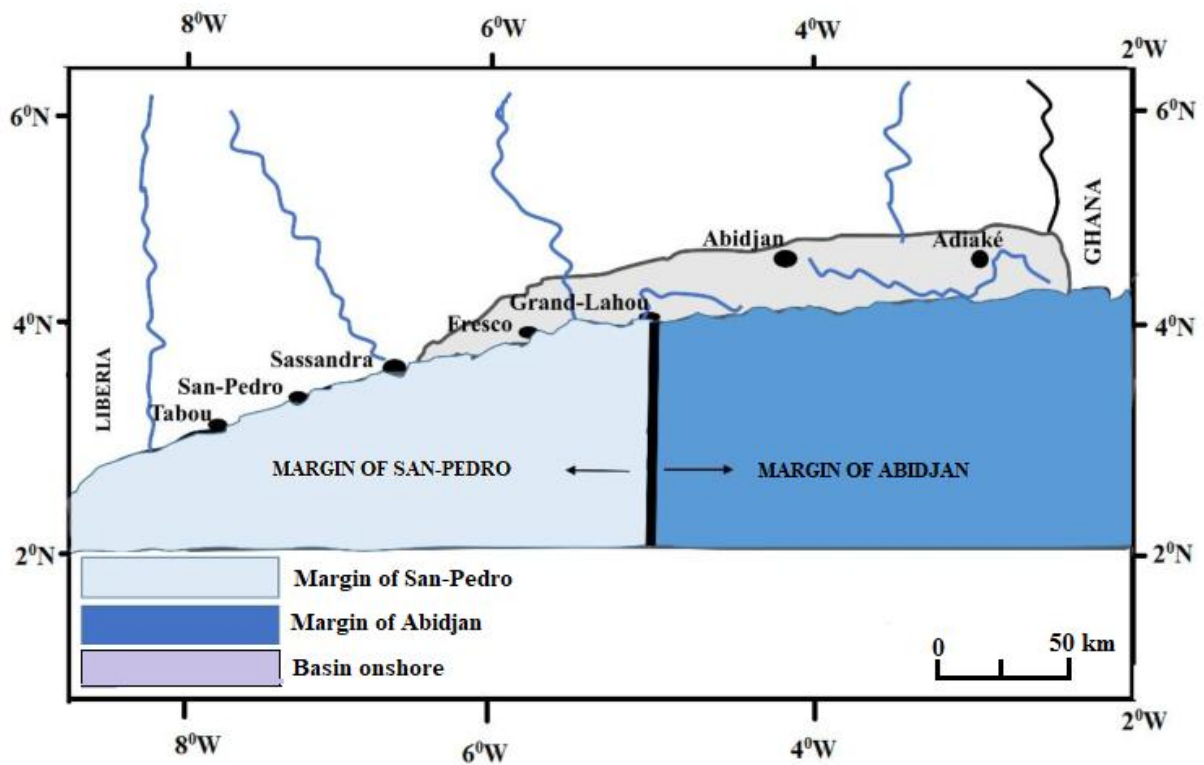
64 - The margin of San Pedro extends from the Liberian border to the city of Grand-Lahou. She  
65 is characterized by a deep basement, about 8 km according to the magnetic data of [7]. This  
66 Socle on which is located a steep continental shelf characteristic of the West margin, is part of  
67 the offshore extension of the West African craton. The sediments thicken from north to south  
68 where they reach about 700 to 800m at the top of the slope.

69

70 - The margin of Abidjan extends from Grand Lahou to the Ghanaian border. She is  
71 characterized by a deep basement where sediment thickness increases from west to east  
72 (towards the Ghanaian basin) [8].

73 This thickness was estimated by [7] between 6 and 10 Km by magnetic methods, but the  
74 seismic overestimated it between 12 and 13 Km. South of Abidjan, the plateau is cut by the  
75 bottom hole.

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**Fig. 1. Margins of the sedimentary basin of Côte d'Ivoire**

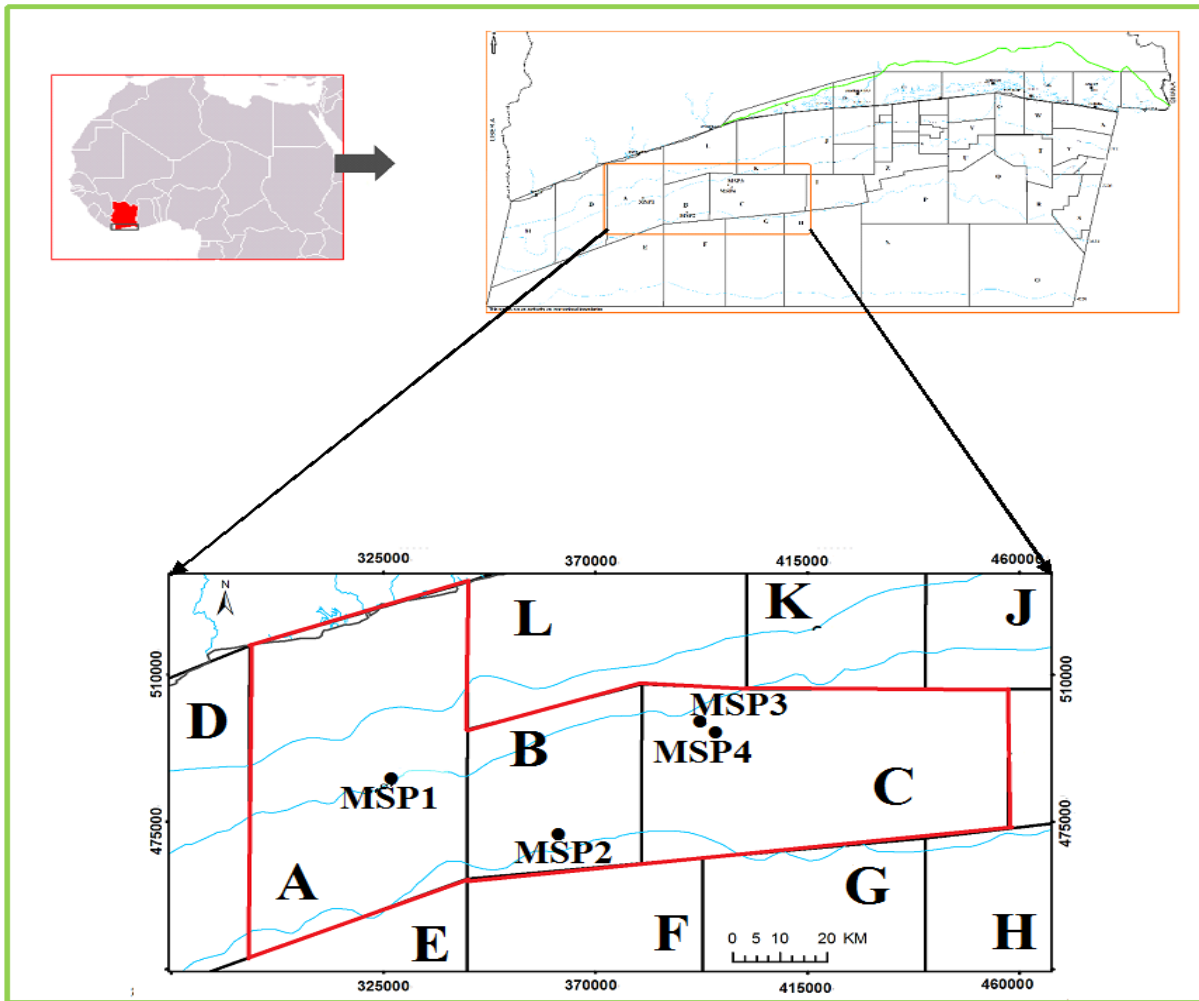
80 The whole Ivorian sedimentary basin is divided into forty-eight (48) petroleum blocks today.  
 81 This study area has fifteen (15) and nine (9) exploratory wells of which four (4) are studied in  
 82 this work. These wells are located in blocks A, B and C of the San Pedro Margin (**Fig. 2**). The  
 83 coordinates of these wells are shown in **Table 1** below.

84

85

**Table 1. Wells coordinates**

Block	Wells	Latitude	Longitude	Depth (m)
A	MSP-1	4°23'27,9098''N	6°34'02,2528''W	1838,5
B	MSP-2	4°16'29,841'' N	6°14'43,912'' W	2864
C	MSP-3	4°30'58,249'' N	5°57'31,953'' W	2162
	MSP4	4° 29' 51,756'' N	5°56'44,100'' W	2303



86

87 **Fig. 2. Location of the wells**

88

89 **3. MATERIALS AND METHODS**

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91 The material used for the realization of this work consists of technical data of end of drilling  
 92 reports, digital logging data (L.A.S files), composite logs and computer equipment.

93 L.A.S (Log Ascii Standard) files are digital files that contain the log data from records made  
 94 during Wireline or LWD operation.

95 End of drilling reports provide information on the lithology and petrophysical properties of  
 96 the soil layers traversed by the different wells studied.

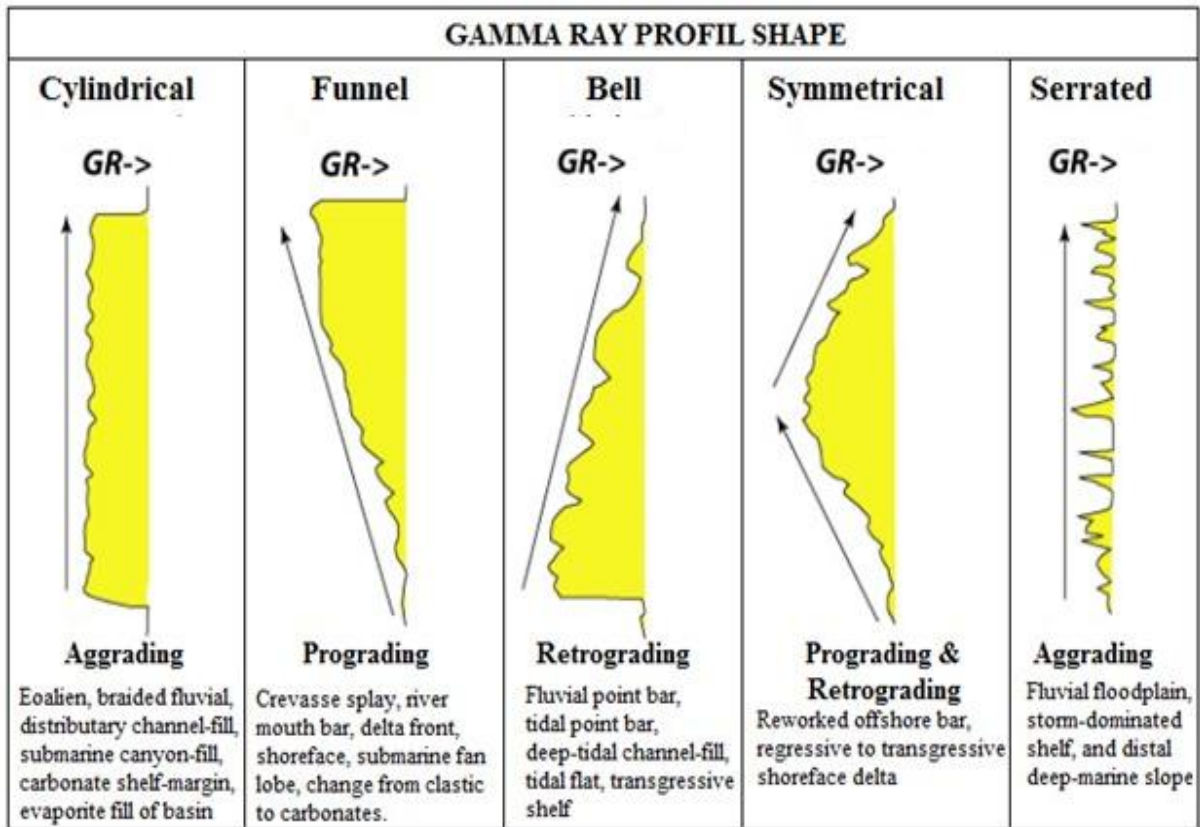
97 Composite logs are a set of logging signatures consisting of Gamma ray, Sonic, Resistivity,  
 98 Density and Neutron logs derived from digital logging data.

99 Computer hardware is made up of high-capacity computers and software, the Decision Space  
 100 Geosciences (DSG) software. It is a multifunction software, which has applications in  
 101 geology, geophysics and petrophysics. It allows, among other things, log analysis, loading,  
 102 processing and logging data interpretation.

103 The methodological approach used is based exclusively on log analysis and interpretation.

104 Logging digital data recorded in L.A.S (Log Ascii Standard) format during acquisition is  
 105 loaded into a database and processed using Decision Space Geosciences (DSG) software.

106 Once the files are loaded, we proceed to the assignment of the curves to each logging family,  
 107 the positioning of the roofs of the floors and the development of the lithological logs.  
 108 The assignment consists of matching the curves to each type of log log (Gamma Ray, Sonic,  
 109 Resistivity, Density, Neutron).  
 110 Once log logs have been constructed, the different lithological formations and stages traversed  
 111 by the borehole are characterized, along with their limits, on the basis of the signatures of the  
 112 gamma ray and density-neutron logs and verified by the drill cuttings descriptions and by the  
 113 biostratigraphic analysis.  
 114 The potential reservoir zones correspond to the low values of gamma ray and whose thickness  
 115 is greater than or equal to 10m.  
 116 The gamma ray profile analysis also makes it possible to define the training implementation  
 117 environments. This analysis is based on the comparison of the morphology of the gamma ray  
 118 profile of the potential reservoirs identified with the standard model (**Fig. 3**) established by  
 119 [9].  
 120 As for the petrophysical characterization of potential reservoirs, its purpose is to determine  
 121 their oil potential. The desired characteristics are: porosity ( $\Phi$ ), permeability (K), clay volume  
 122 (Vsh), water saturation (Sw) and Net / Gross (N / G).  
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124  
 125 **Fig. 3. Standard gamma ray (GR) response model based on variation in grain size and**  
 126 **deposit environments [9]**

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 128 These parameters are calculated from formulas integrating log data. These formulas having  
 129 been automated, they are directly processed by computer from specialized software such as  
 130 Techlog.  
 131  
 132

## 4. RESULTS

### 4.1 Identification of floors and potential reservoirs

The log log signatures analysis coupled with the biostratigraphy data allowed to identify the roofs of the different floors of the studied wells. The results are shown in Table 2 below.

It is noted that the layers are thicker in wells further south such as MSP-2 and MSP-4 than those located in the north (MSP-1 and MSP-3). Sediment thickness increases from north to south.

**Table 2.** Roofs of the stage of studied wells

Wells	MSP-1	MSP-2	MSP-3	MSP-4
Roof of Santonian	2960	5068	3821	3976
Roof of Coniacian	Eroded	Eroded	3878	4098
Roof of Turonian	3080	5162.5	3980	4219
Roof of Cénomianian	3260	5370	4090	4315
Cenomanian base	3430	Not reached	4228	4529

These stages are confirmed by recent biostratigraphy data. Recent palynological data distinguish a lower Cenomanian characterized by the presence of pollen species *Triporopollenites sp.*; *Classopolis echinatus*, *Classopolis spinosus*, *Afropollis gardenus* and *Stevesipollenites binodosus*.

As for the Cenomanian superior, it is characterized by the association composed of spores and pollen *Triorites africaensis*, *Classopollis sp.*; *Pemphixipollenites inequixinus*, *Galeocornea causea*, *Ephedripites sp.*; *Classopollis echinatus*, *Classopollis spinosus*, *Gnetaceapollenites diversus*, *Triorites africaensis* and *Classopollis classoids*.

The microfauna is dominated by the planktonic foraminifera *Herdbergella planispira*, *Herdbergella delrioensis*, *Herdbergella sp.* and *Globigerinoides bentonensis* [10].

#### ➤ Turonian

The highlight of Turonian is mainly planktonic foraminifera: *Whiteinella baltica*, *Whiteinella paradubia* *Herdbergella delrioensis*, *Herdbergella simplex*, *Heterohelix moremani*, *Whiteinella archaeocretacea* [11, 12].

Palynologically, no species has been clearly described as a good stratigraphic marker. However, Turonian is characterized from pollen grains *Tricolpites sp.*, *Tricolpites microstriatus*, *Tricolpites giganteus*, *Multiporopollenites sp.*, *Multiporopollenites aff. Maculosus* and *Tricolporopollenites sp.* [11].

#### ➤ Lower Senonian (Santonian-Coniacian)

The lower Senonian is characterized by the planktonic foraminifera *Dicarinella concavata*, *Marginotruncana renzi*, *Hastigerinoides alexanderi*, *Herdbergella sp.* and *Heterohelix globulosa* [13].

168 Palynologically, this stage is characterized by marker dinocysts such as *Canningia sp.*,  
169 *Oligosphaeridium complex*, *Dinogymnium acuminatum*, *Dinogymnium sp.*, *Xenascus sp.*,  
170 *Oligosphaeridium pulcherrinum* and *Circulodinium distinctum* [14].  
171

#### 172 **4.2 Reservoirs oil potentials**

173  
174 Analysis of Gamma Ray (GR) data from the wells revealed potential reservoirs. Classically,  
175 gamma-ray is used for the determination of clay and sand formations. The highest values of  
176 gamma ray correspond to the clay formations and the lowest values to the sandy formations.

177 In principle, gamma ray measures the clayiness of the formation [15]. This study revealed ten  
178 (10) reservoir levels of variable thickness in the four wells studied. **Table 3** below gives  
179 details of these reservoirs and their lithostratigraphic characteristics. Some reservoirs have  
180 small discontinuity intervals which are in fact clay beds of high gamma Ray value  
181 interspersed in a zone of low values (**Fig. 4 and 5**). These intercalations are encountered in  
182 the tanks R3 and R1 compartmentalized in tanks R3a, R3b and in tanks R1a and R1b at the  
183 wells MSP-3 and MSP-4.

184 The reservoir levels encountered in this study mainly consist of calcareous, clay or silty  
185 cement sandstone. These reservoirs are interposed by places of clay and silts. They are  
186 surmounted by thick layers of clay or silts (**Fig. 6**).  
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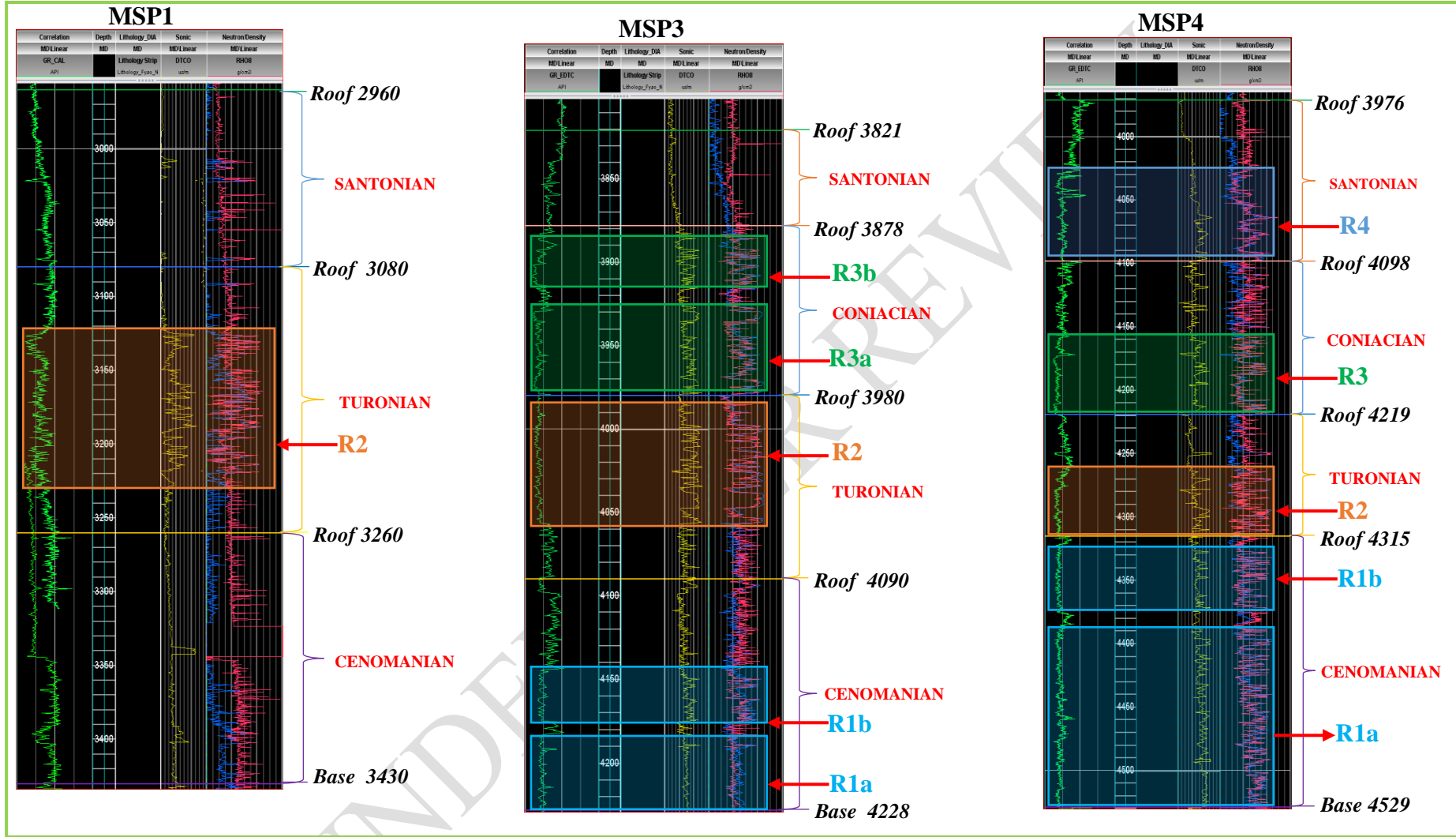
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**Table 3. Potential reservoirs and their lithostratigraphic characteristics**

Reservoirs of stage	Wells			
	MSP-1	MSP-2	MSP-3	MSP-4
<b>Santonian (R4)</b>	No reservoir R4	<b>R4 (95m)</b> Sandstone white to gray with fine to very coarse grains	No reservoir	<b>R4 (70m)</b> Fine to coarse sandstone poorly cemented with a clay-limestone cement
<b>Coniacian (R3)</b>	No reservoir R3	No reservoir R3	<b>R3b (50m)</b> Fine to coarse sandstone, compacted or not, with limestone cement	<b>R3 (50,5m)</b> Very fine to medium sandstone with limestone cement,
			<b>R3a (60m)</b> Fine to coarse sandstone, compacted or not, with limestone cement	
<b>Turonian (R2)</b>	<b>R2 (110m)</b> Coarse sandstone, with limestone cement	<b>R2 (90m)</b> Gray sandstone, fine to medium, with limestone cement and clay interlayers	<b>R2 (70m)</b> Fine to coarse sandstone with limestone cement	<b>R2 (55m)</b> Gray sandstone, very fine to medium, with limestone cement
<b>Cenomanian (R1)</b>	No reservoir R1	No reservoir R1	<b>R1b (23m)</b> Fine to coarse sandstone, compacted or not, white to gray, calcareous cement	<b>R1b (54m)</b> Very thin to medium gray to light gray to calcareous cement
			<b>R1a (38m)</b> Fine to coarse sandstone, compacted or not, white to gray, calcareous cement	<b>R1a (146m)</b> Very thin to medium gray to light gray to calcareous cement

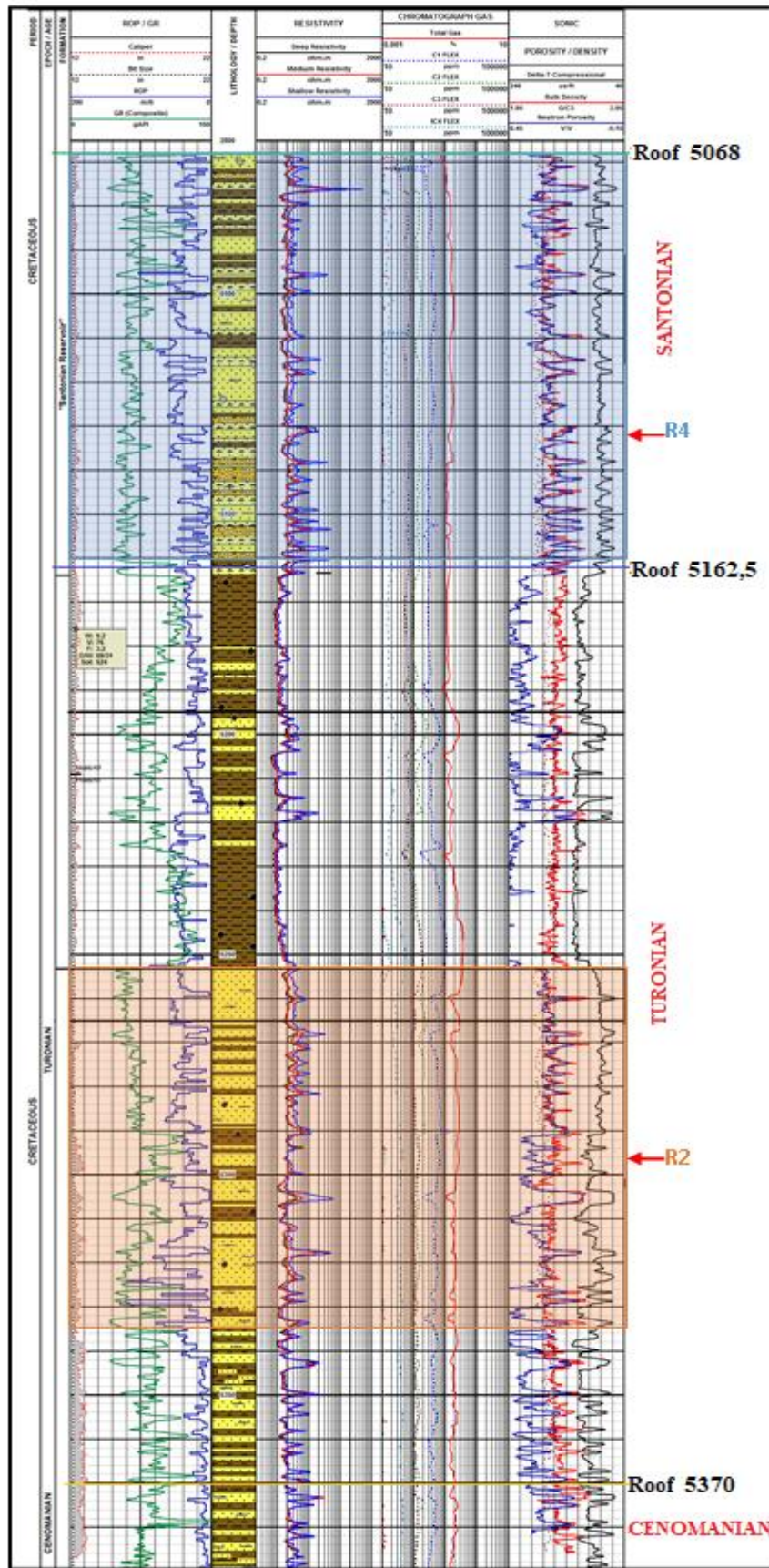




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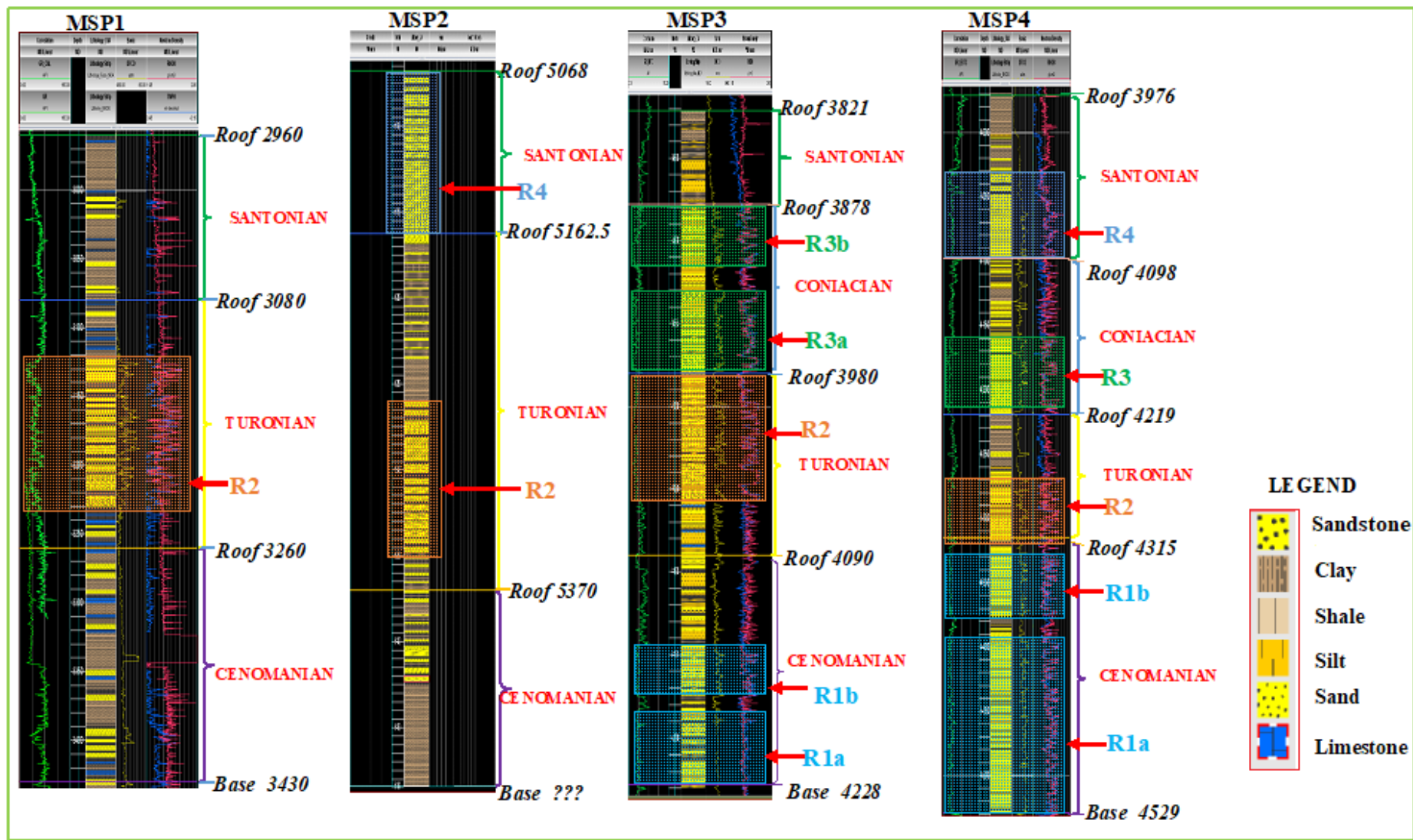
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212 Fig. 4. Potential reservoir levels of MSP1, MSP3 and MSP4 wells



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Fig. 5. Potential reservoir levels of the MSP2 well



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217 Fig. 6. Lithostratigraphic log of the different wells studied



218 **4.3 Correlation of reservoir levels of studied wells**

219 The West-East correlation profile between the different reservoirs (**Fig. 7**) shows that only the  
 220 turonian reservoir (R2) is continuous over the entire profile and that its thickness decreases  
 221 progressively from west to east. As for the other tanks, they are discontinuous. The  
 222 Cenomanian (R1) and Coniacian (R3) reservoirs are present only in the East. We also note  
 223 that the Santonian reservoir (R4) is absent in the center of the profile that is to say in the block  
 224 B and that its thickness decreases from West to East. This can be explained by erosion caused  
 225 by eustatic variations in the Ivorian sedimentary basin. The absence of R1 and R3 in the rest  
 226 of the zone may be due to a no deposit phase or erosion. If the thickness of the tank R3  
 227 decreases towards the East, the thickness of R4 increases.  
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229 **4.4 Petrophysical characteristics of reservoirs**

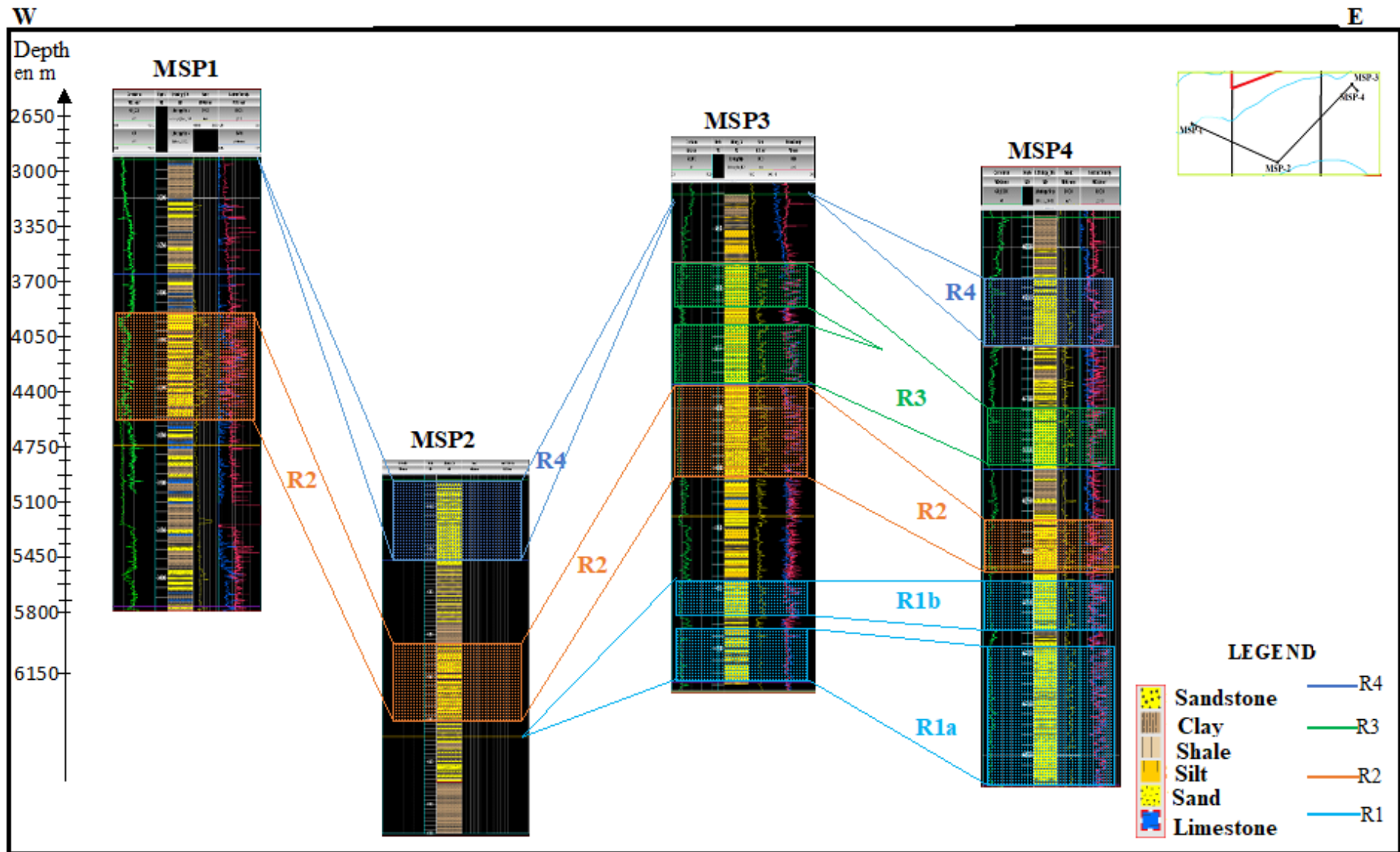
230 The results of the petrophysical evaluation are recorded in the table 4 below.  
 231

232 **Table 4. Results of the petrophysical study**

BLOCK	WELLS	FORMATIONS	INTERVAL					RESERVOIRS					
			EXTENSION (m)	Gross (m)	GR (API)	Net (m)	N/G (%)	VSH (%)	PHIE (%)	PERM (mD)	SWE (%)	FLUID	
A	MSP1	TURONIAN	3120-3230	110	37	30	29	21	21	155	98	water	
B	MSP2	SANTONIAN	5068 - 5162.5	95	45-60	80	83	19	20.1	NA	100	water	
		TURONIAN	5260 - 5350	90	45-60	60	67	25	19.6	NA	99	water	
	MSP3	CONIACIAN	3878-3980	102	15-30	53	52	11	18	NA	94	water	
		TURONIAN	3980-4060	80	25-37	31	39	12	19	NA	86	water	
C	MSP3	CENOMANIAN	4153-4228	75	30-37	40	53	15	16	NA	95	water	
		SANTONIAN	4028-4098	70	30-45	46	66	13	18	100-1100	81	water	
	MSP4	CONIACIAN	4155-4219	64	25-30	56	88	14	18	100-300	94	water	
		TURONIAN	4260-4315	55	25-30	47	86	17	18	NA	95	water	
		CENOMANIAN	4315-4529	214	30-45	193	90	8	20	400-700	91	water	

233  
 234 The analysis of the petrophysical parameters reveals generally for the different wells studied  
 235 that:

- 236 ➤ Porosity ( $\Phi$ ) varies from 16% to 21% in all tanks. This result indicates that the  
 237 reservoirs have medium to good porosities.



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Fig. 7. West-East Correlation Profile of Well Wells Studied

- 240 ➤ **Volume of clay (Vsh):** With the exception of the reservoir R2 of the MSP2 well,  
241 which can be qualified as a medium quality reservoir with a Vsh of 25%, the other  
242 reservoirs are good qualities because the volume of clay is less than 20%.  
243
- 244 ➤ **Water saturation (SW):** This study shows that the water saturation of the different  
245 tanks is greater than 80%. This result indicates that the identified reservoirs are  
246 aquifers.  
247
- 248 ➤ **Net to Gross (N / G):** The Net to Cross values are above 20% and indicate that the  
249 tanks are good qualities.  
250

251 In general, [20] estimates that an oil reservoir is of good quality if the cut-off values of the  
252 following parameters are respected:

- 253 - Porosity ( $\Phi$ ) > 10%  
254 - Volume of clay (Vsh) < 40%  
255 - Water saturation (Sw) < 60%  
256 - Net / Gross > 20%  
257

258 With the exception of water saturation, our results indicate that the potential reservoirs  
259 highlighted are of good quality. They have all the necessary characteristics to store  
260 hydrocarbons except that they are all aquifers.  
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#### 263 **4.5 Deposit environments of reservoir levels**

264 From the different form of the Gamma Ray profile of the identified reservoir levels, the  
265 associated depositing environments are determined. **Fig. 8, 9, 10 and 11** below indicate the  
266 deposition environments of the identified reservoirs.

267 At the Cenomanian, reservoir sediments deposited either in a fluvial environment because of  
268 the serrated form of the Gama Ray or marine with strong fluvial influence because of  
269 cylindrical shape that tends towards the serrated form of Gama Ray (**Fig. 8**).

270 In Turonian, reservoir sediments were deposited in environments ranging from marine to  
271 fluvial through deltaic environments due to the combination of cylindrical, serrated, funnel  
272 and bell-shaped Gama Ray (**Fig. 9**).

273 At the Conancian and Santonian tanks were set up in a marine environment (**Fig. 10 and 11**).

274 From this study, two dominant deposition environments emerge. Sedimentation would have  
275 started in a fluvial environment and would have continued in a marine environment marked  
276 by the accumulation of sandstone, clay, limestone. However, frequent variations of the  
277 deposition conditions in connection with the phenomena of transgressions and regressions are  
278 observed.  
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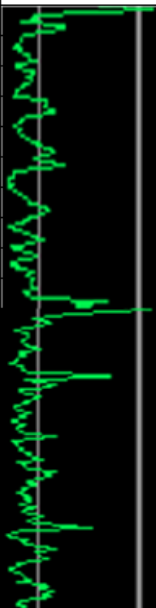
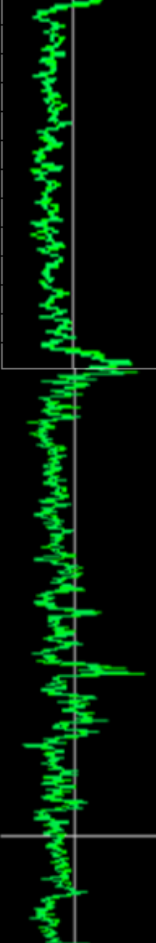
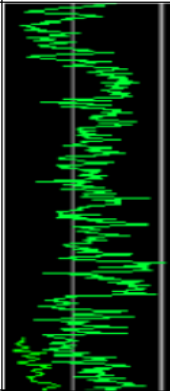
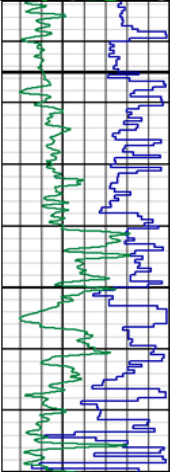
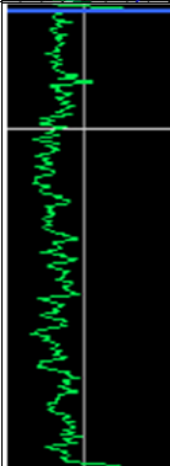
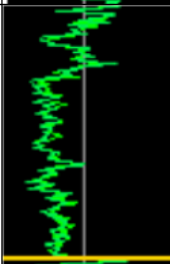
WELLS	STAGE	RESERVOIR	GAMA RAY	SHAPE	DEPOSIT ENVIRONMENT
MSP3	CENOMANIAN	R1b		CYLINDRICAL	MARINE DEPOSITION UNDER FLUVIAL INFLUENCE
		R1a		CYLINDRICAL	
MSP4	CENOMANIAN	R1b		CYLINDRICAL	MARINE DEPOSITION UNDER FLUVIAL INFLUENCE
		R1a		CYLINDRICAL	
		R1a		INDENTED	FLUVIAL

Fig. 8. Cenomanian reservoir deposit environments

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WELLS	STAGE	RESERVOIR	GAMA RAY	SHAPE	DEPOSIT ENVIRONMENT
MSP1	TURONIAN	R2		CYLINDRICAL	MARINE
				BELL	FLUVIAL
				INDENTED	
				FUNNEL	
MSP2	TURONIAN	R2		CYLINDRICAL	MARINE
				SYMMETRICAL	DELTAIC
				BELL	
MSP3	TURONIAN	R2		INDENTED	DELTAIC
MSP4	TURONIAN	R2		CYLINDRICAL	MARINE

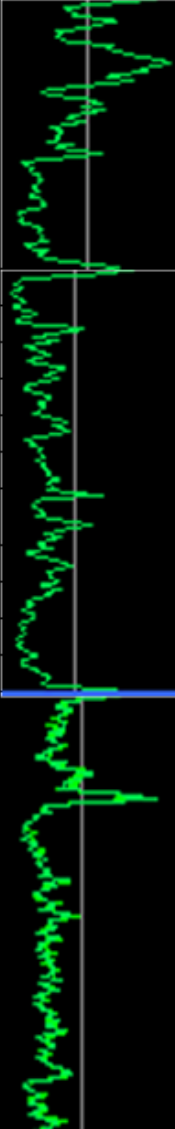
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**Fig. 9. Turonian reservoir deposit environments**



WELLS	STAGE	RESERVOIR	GAMA RAY	SHAPE	DEPOSIT ENVIRONMENT
MSP3	CONIACIAN	R3b		CYLINDRICAL	MARINE
		R3a		CYLINDRICAL	MARINE
				SYMMETRICAL	DELTA
MSP4	CONIACIAN	R3		CYLINDRICAL	SUBMARINE CHANNEL DEPOSIT
			CYLINDRICAL		

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Fig. 10. Conancian reservoir deposit environments

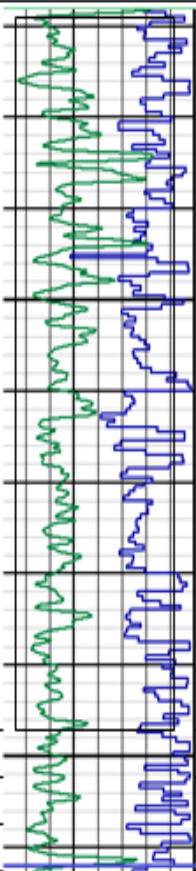
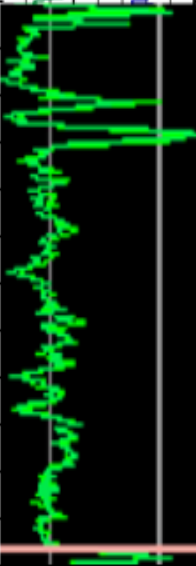
WELLS	STAGE	RESERVOIR	GAMA RAY	SHAPE	DEPOSIT ENVIRONMENT
MSP2	SANTONIAN	R4		CYLINDRICAL WITH INTERSPERSED CLAY LEVEL AT THE TOP	MARINE
MSP4	SANTONIAN	R4		CYLINDRICAL  CYLINDRICAL	MARINE

Fig. 11. Santonian reservoir deposit environments

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## 306 5. DISCUSSION

307 The identification of reservoir levels based on low gamma ray profiles was used by [16] in  
308 Benin to highlight Albian reservoirs in the deep offshore part of the Beninese coastal basin.  
309 These potential reservoirs are sandy with a variable percentage of clay that serves as cement.  
310 Thus, with this method, 10 silty reservoir levels presenting clay levels by location are  
311 highlighted and are consistent with those obtained by [17] which indicate that the reservoirs  
312 of the Ivory Coast basin are sandstone.

### 313 314 ➤ **Lithostratigraphy**

315  
316 This study reveals that sedimentation is mainly silico-clastic dominated by clays and  
317 sandstones (dominant facies) and incidentally silts, sands and limestones. [13] has shown that  
318 deposits in the Upper Albian-Lower Senonian interval of the Ivorian sedimentary basin are  
319 characterized by clay-sandstone deposits locally enriched with limestone. The results of  
320 Chierici were confirmed by those of [2] and recalled by [18].

321 The gritty nature of the reservoirs described in this work is confirmed by the work of [17].  
322 [7] demonstrated that the lithology of reservoir levels of the Abidjan margin in the  
323 Cenomanian-Santonian interval is identical to that described in this study on the margin of  
324 San-Pedro.

### 325 326 ➤ **Correlation**

327 The correlation established between the reservoir levels shows that the thickness of the  
328 Turonian reservoirs is gradually decreasing from west to east of our study area as described  
329 by the results of [19] recalled by [18], which showed that the Turonian is not visible  
330 throughout the basin because it is strongly eroded during the Turonian [13] or Senonian  
331 regression [2].

332 The effect of this erosion has been accentuated more in the East where the Turonian is no  
333 longer continuous and appears in tatters. However in the margin of San Pedro, the Turonian is  
334 not in flap but is continuous on the scale of the margin. The other identified reservoirs are not  
335 continuous either because they are eroded or have not been deposited.

### 336 337 ➤ **Petrophysical evaluation**

338 The petrophysical evaluation shows that the different reservoirs identified are of good quality  
339 because their petrophysical characteristics are in line with those of a quality reservoir  
340 according to [20]. However, the strong cementation of sandstone at some levels has  
341 contributed to the reduction of porosity and has influenced overall petrophysical properties  
342 that could have been better. [21] have shown that the porosity of rocks is related to the  
343 diagenesis and the dissolution of certain minerals, the low porosity of the reservoirs of the  
344 MSP2 well.

345 This study also shows that the study area was affected by transgressions and regressions that  
346 caused lateral and vertical facies variations. These phenomena could sensibly modify the  
347 petrophysical characteristics of the reservoirs.

### 348 349 ➤ **Deposit environment**

350  
351 Comparison of the Gamma Ray signatures of the reservoirs identified with the standard model  
352 established by [9] shows that sedimentation of the study area started in a fluvial environment  
353 and continued in a marine environment. The variations recorded in the different phases are  
354 mainly due to the numerous transgressions and regressions movements experienced by the

355 Ivorian sedimentary basin. Indeed, [22] and [23] showed that the deep oceanic domain of the  
356 Ivorian basin recorded three transgressive episodes.  
357 It begins with the transgression of the Upper Albian, which is not a generalized phenomenon  
358 at the scale of the whole basin [2]. At the end of the upper Albian, there is a generalized  
359 regression on the scale of the whole basin which marks the passage from the Albian to the  
360 Cenomanian.  
361 This regression, which marks the passage from the Albian to the Cenomanian, results in an  
362 important discordance of the Cenomanian on the Albian.  
363 The Cenomanian reservoirs (R1) would have deposited during this regression, or the littoral  
364 conditions favorable to the deposition of fluvial types prevailed in the basin.  
365 At the Cenomanian, there is a re-watering of the basin. This second transgressive episode  
366 generalized throughout the basin will continue until the end of the Lower Senonian.  
367 This marine transgression is highlighted in the MSP4 well where all the tanks have been  
368 highlighted and deposited in a marine environment.  
369 This marine transgression is interrupted at times by periods of regression, thus generating  
370 fluvial and deltaic deposits observed in the Turonian reservoirs of the MSP1 and MSP3  
371 wells.  
372 According to [2], in the Lower Senonian, there is another regressive phase which causes a  
373 strong erosion of the deposits of the Lower Senonian and in places those of the Turonian.  
374 This regression is highlighted in this study by the deposition of deltaic or fluvial sediments  
375 that cover the marine deposits in the MSP3 well.  
376 This period is characterized by clay-sandstone deposits enriched locally in limestone.  
377 The third transgressive episode occurs in the Upper Senonian.

## 378 379 380 **6. CONCLUSION**

381  
382 This study made it possible to characterize the Cenomanian, Turonian and Lower Senonian  
383 reservoirs of four oil wells located on the margin of San Pedro.  
384 On the lithostratigraphic level, the analysis of log log data and log gamma ray revealed a total  
385 of ten (10) reservoir levels in all four wells studied in the Cenomanian-Santonian interval.  
386 These reservoir levels identified, are mainly sandstone with fine grains and with limestone or  
387 clay cement. These reservoir are surmounted by clay or silts that serve as rock cover.  
388 Petrographic synthesis has shown that these sandstones come from the mainland and are  
389 deposited in a marine or deltaic environment with low to high energy.  
390 Petrophysically, petrophysical parameters have shown that reservoirs are of good quality; they  
391 have all the conditions necessary to store hydrocarbons. However, their high water saturation  
392 makes them aquifers.

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