



## CALCIUM PHOSPHATE OF KOLDA

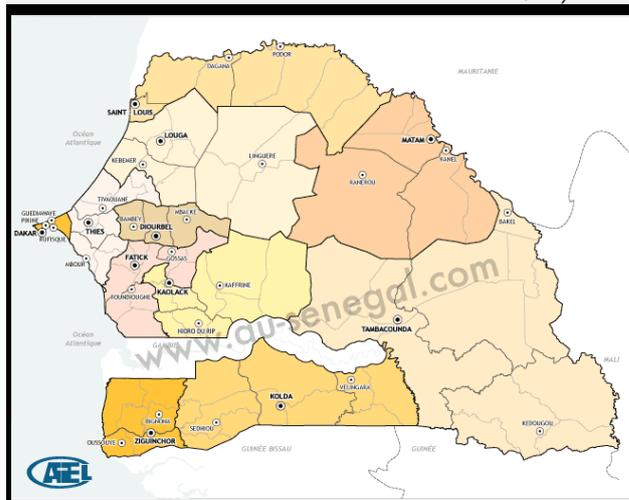
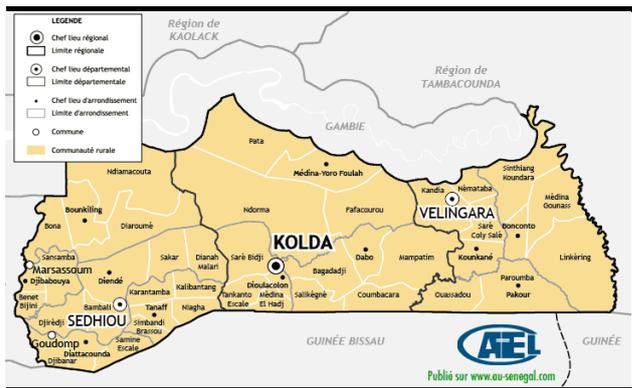
### REASONS TO INVEST?

Phosphates have been the main mineral used in Senegal with a good contribution to the country's GDP. For example, the use of phosphates began in 1949 for aluminum Thiès. Besides this western part, there is a deposit in Matam in the north, some indices in the central region (Kaolack, Fatick, Diourbel, Louga, Kaffrine) and southern (Kolda and Ziguinchor). This paper aims to study the host country, its legal framework and geological order to justify the exploitation and utilization of calcium phosphate in Kolda.

# CALCIUM PHOSPHATE OF KOLDA

## OVERVIEW OF SENEGAL

Situated in the extreme west of the African continent, Senegal is located between 12 ° 8:16 ° 41 north latitude and 11 ° 21 and 17 ° 32 west longitude. The country is bordered by the Atlantic Ocean to the west, Mauritania to the north, Mali to the east, Guinea Bissau Guinea to the south and the southeast. The Gambia is an enclave in southern Senegal in length within which penetrates deeply. With an area of 196,722 km<sup>2</sup>, Senegal, with Dakar as capital, has 12 million inhabitants distributed evenly so the 14 administrative regions (density of 61.1 <sup>2</sup> hab / km and the population growth rate: 2.34 %).



## The region of Kolda

The Kolda region has 3 departments, 9 districts and 31 rural communities. With an area of 21011 km<sup>2</sup>, Kolda has 847,243 inhabitants with a density of 40 inhabitants / km<sup>2</sup>. Kolda is about the poorest region of the country with an illiteracy rate of 98%.

## GEOLOGY OF SENEGAL

Geology of Senegal consists of old formations representing  $\frac{1}{4}$  of the national territory and sedimentary formations that occupy the remaining  $\frac{3}{4}$  territory. The sedimentary basin contains the most evidence and phosphate deposits. They can be distinguished by:

- group anticline dome of Ndiass-lac Guiers, which extends roughly along the western sedimentary basin where land essentially Eocene are covered by a relatively small thickness of the Continental Terminal. The central part of this area contains all currently exploited phosphate deposits in Senegal;
- The Kolda-Vélingara area is a second area of mining phosphates in Senegal. So far, previous research are negative from the economic point of view.
- During the 60s, more precisely in recent years, exploration efforts were largely focused on the Senegal River area and led to the discovery of the deposit-Ouali Diala (Matam) whose potential is promising.

## PHOSPHATES OF KOLDA

The Kolda phosphates were studied in the eighties, as part of research programs by core drilling medium and high in Casamance.

The area of Kolda is characterized by a series of condensation Eocene and is comparable to deposits of phosphates and Bofal CIVE (Mauritania) and Kanel and Semme (Senegal region of Matam). Furthermore, the existence of a zone movable in edge area Casamance is a factor structurally favorable compared with forming means Western phosphate from Senegal (Taiba Tobéne), which led C. MONCIARDINI to recommend research to prospect for phosphate in this area. This research is oriented south axis-Kounkané Kolda where the recovery Eocene is + - 40m and east where the mineralization appears to be related to a major structure paleo-directed ENE-WNW. Phosphates Kolda been studied in the eighties within the framework of research programs polls core of middle and high Casamance.

In Kolda, recovery varies between 30 and 40m. The work of C. MONCIARDINI (1966), also showed indications of the presence of phosphates in polls Kolda (between 59.69 and 85-87m in depth) and Dianah Mlari (a 140m deep).

The mineralogy is defined according to the type of formation where we:

- reworked phosphates on interface Eocene / Continental terminal which is a sporadic level with a thickness of 1.5 is composed of: 23, 47% P<sub>2</sub>O<sub>5</sub>, 24, 58% SiO<sub>2</sub>; 6.35 feral and a CaO / P<sub>2</sub>O<sub>5</sub> 1.43
- The phosphates that are interposed in the upper calcareous soft clay 1m thick and having a composition of 28% P<sub>2</sub>O<sub>5</sub>, 1.8% feral 1.63% and the ratio of CaO/PO<sub>5</sub>.

- Lower phosphates, representing a set marl and phosphated Glauconitic often a great thickness (more than 40 m in CP1) and which are individualized levels phosphoarénite assaying between 15 and 25%. The survey CP1 intersects the 10 m phosphoarénites 15.75 P<sub>2</sub>O<sub>5</sub> content-rich carbonates. The exo-phosphate and carbonate gangue and silica with varying amounts of pyrite and glauconite. It is the same with the endo-matrix.

The mineralogical study of phospharénites Green probing CP1 made 60.8 and 70m gives the following results: 15.75% P<sub>2</sub>O<sub>5</sub>, 1.22% and 21.22% CO<sub>2</sub> feral and record CaO/P<sub>2</sub>O<sub>5</sub> is high (2 to 3). Tests for enrichment CP1 to show that sclamms represent 32% of the initial mass of 15% phosphorus.

Surveys conducted during campaigns revealed that samples were analyzed in the laboratory and the results helped to define a lithology and concreting.

From top to bottom, the lithology is as follows:

- Marly mostly a set up. 15 to 30m which correspond to the upper and calcareous minerals poor FFB said deposits of Farim phosphates in Guinea Bissau
- green laminitos (approx. 10m depth) that are irregularly carbonaceous clays papery, locally rich in dolomite;
- crystalline limestone;
- glauconite sands and clays.

The study of foraminifera allows bionização to propose the following secession lithological :

- crystalline limestone : zone A ;
- green laminitor : zone B ;
- a portion of the upper assembly predominantly loamy;
- end of the field to set up Marly: zone C e D

### SENEGALESE LEGAL FRAMEWORK

Aware of its proximity to the America and Europe Continente, in the framework of the promotion of investment and in particular in mining, proceeded to implement a declaration of a mining policy and a code extraction mining law known as nr. 2003-36 of November 24, 2003, but the law on major investments.

Among the innovations introduced by the declaration of mining policy and the Mining Code, we have:

- disengagement of the state and strengthening its role as regulator;
- rationalization and simplification of administrative procedures;
- improving the system of mining investment incentives;
- recovery and local processing of mining products;
- Environmental Protection;
- The possibility of retaining a discovery considered marginal in the research phase when the current economic conditions are deemed unfavorable to the economic viability of the project;
- the opportunity for mining companies to build joint ventures without administrative requirements;
- The establishment of an Equalization Fund and Support for Local Government: it is a redistribution of mining revenues which contributes to the good governance of the mining sector and social justice;
- the establishment of a Fund for the Rehabilitation of Mining Sites: This fund provides a performance guarantee for compliance by mining their obligations rehabilitation of mining sites operated;

## TAXES

The Mining Code provides tax, customs and economic advantages in order to make the mining sector more attractive.

### *Tax exemptions*

The licensee search of minerals benefits throughout the period of validity of research permits and renewals thereof, in the context of its research operations, a system of total exemption from taxes, and taxes any kind.

Throughout the duration of the operation, the licensee or operating mining concession or authorization beneficiary's small-scale mining are exempt from export tax products from their operations on the perimeter of the mining exploitation title granted.

For a period of three (03) years for licensees operating and seven (07) years for holders of mining concession from the date of issuance of the mining operations and subject to the provisions of Article 64, these holders receive a full tax exemption, including:

- tax exemption on the value of goods and services purchased from local suppliers or contractors domiciled outside of Senegal;
- Exemption from duties and taxes output;
- Exemption from minimum tax;
- Exemption from land taxes and patent properties and undeveloped except for buildings for residential use;
- Exemption from the sum payable by the employer;
- Exemption from duties and taxes on deeds evidencing the incorporation of companies and capital increases.

However, major mining projects subject to mining concession and requiring the mobilization of heavy investment, benefit for tax and customs benefits mentioned above, for a period of exemption at least equal to the period of loan repayment which may not exceed fifteen (15) years from the date of issuance of the mining concession.

### *Customs exemptions*

The licensee or research as mineral substances is exempt from all customs duties and taxes, including value added tax (VAT), and the removal of Senegalese Shippers Council (COSEC) for:

- Equipment, materials, supplies, machinery, vehicles and equipment, vehicles included in the approved program, as well as spare parts and consumable materials and goods or products, or manufactured in Senegal, for a specific and definitive operations mining Research and the import is essential to the achievement of the research program;

- Parts and spare parts for machinery and equipment recognized specifically designed to carry out the approved research program.

During the research, production investment and production start of a new operation or expansion of the production capacity of an existing operation, equipment, materials, supplies, machinery, plant, equipment and vehicles for mining operations directly imported into Senegal by the holder of an operating license or mining lease or permit recipients small-scale mining and companies working on their behalf and may be re-exported or transferred after use, be reported to the temporary admission regime suspended from all duties and import taxes including value added tax (VAT) and COSEC levy.

### **INFRASTRUCTURE EVACUATION**

Si le la zone de Kolda présente un intérêt certes pour la recherche des phosphates, le seul problème auquel une éventuelle exploitation pourrait être confrontée est celui de l'évacuation du minerai. Il s'agit surtout d'analyser la rentabilité d'une telle exploitation en envisageant la création d'un chemin de fer qui permettra l'évacuation du minerai vers un port minéralier.

Toutefois des solutions existent notamment en développement des synergies avec les grands projets miniers du Sénégal tel que les phosphates de Matam et le fer de la Falémé mais aussi avec la Guinée Bissau (phosphates de Farim), la Mauritanie (phosphates de Bofal et Civé) et le Mali pour son fer. Ces solutions permettent d'amoindrir le coût de construction d'un chemin de fer par un seul projet afin d'améliorer la rentabilité de celui-ci.

## **Conclusion**

Kolda phosphates can today, given the development of technology, in the interest of global phosphate and acceptable recovery in some areas, to be an exploration that may lead to a deposit economically viable and whose exploitation could find a solution within the framework of sub-regional mining policy. Thus we recommend a global recognition of the area in order to better prepare the annual work program to be submitted to the discretion of the Administration mines.

# ANNEXES

Table 1: Main results of the surveys in 1980-1981 campaign

N° sondage	Profondeur (m)	Epaisseur du Continental terminal (m)	Caractéristiques de l'Eocène
CP 0	88	51	Eocène moyen à pellets phosphatés et nummulites ; grès et marnes phosphatés entre 51 et 56,5 m (biozone D).
CP 1	92	46	1 m de phosphates remaniés de 46 à 47 m ; niveaux phosphatés, notamment de 52 à 53 m et de 60 à 70 m (marne phosphatée) (biozone D).
CP 2	81,8	45	Argiles et sables phosphatés de 45 à 47 m (biozone D), 50,5 à 53 m et 60 à 63 m (biozones B et C).
CP 3	123	33	0,5 m de phosphate remanié à la base du Continental terminal ; phosphate disséminé à différents niveaux au-dessous (biozones A et B).
CP 4	102	31,5	Calcaires et marnes de l'Eocène inférieur ; pas d'indices phosphatés (biozone B).
CP 7	82	39,5	Marnes et calcaires à nummulites de l'Eocène ; horizons phosphatés à divers niveaux dont de 65 à 70 m (biozone D).
CP 8	77,5	44	Marno-calcaires à nummulites du Lutétien ; phosphates disséminés ; niveau phosphaté de 45 à 46,5 m (biozone D).
CP 9	75,5	48,5	Calcaires marneux à nummulites du Lutétien supérieur ; marnes et calcaires plus ou moins phosphatés de 57,5 à 72,5 m (biozone D).
CP 10	79	29	Un peu de phosphate remanié à la base du Continental terminal ; marnes et calcaires du Lutétien inférieur ; indices phosphatés de 34 à 34,5 m et au-dessous de 54 m (biozone B).

Table 2: 1981 and 1982 campaigns - Analyses of chemical phosphate rocks.

N° sondages	N° échant	Prof.	Nature de l'échantillon	Perte au feu %	SiO <sub>2</sub> %	Fe <sub>2</sub> O <sub>3</sub> %	Al <sub>2</sub> O <sub>3</sub> %	CaO %	MgO %	CO <sub>2</sub> %	P <sub>2</sub> O <sub>5</sub> %	CaO/F <sub>2</sub> O <sub>5</sub>
CP1	6a		Roches phosphatées	11,43	24,68	2,46	3,89	33,60	0,53	1,31	23,47	1,43
	9a			12,00	8,50	0,72	1,11	45,36	0,50	5,95	27,82	1,63
	15a			21,85	13,22	0,46	0,44	45,36	0,28	16,80	16,11	2,81
	17a			19,73	10,60	0,80	0,93	46,20	0,31	15,40	16,19	2,85
	20a			15,63	10,65	0,66	0,11	47,60	0,12	11,73	22,09	2,15
	21a			19,83	10,30	0,76	0,57	46,20	0,21	14,96	18,13	2,64
	27a			14,95	1,90	0,78	0,05	48,16	0,43	8,75	27,63	1,74
CP2	4			23,95	10,34	3,60	1,06	36,68	2,84	16,89	15,41	2,38
	6			20,90	22,30	1,52	1,63	37,80	0,67	16,63	14,77	2,55
	7			8,80	26,10	1,12	0,58	38,64	0,44	5,51	21,42	1,80
	11			17,21	9,01	2,32	0,27	45,92	1,34	12,60	19,46	2,35
	12			19,73	7,05	1,44	1,23	48,16	0,62	15,84	18,81	2,56
	16			13,10	7,72	4,40	0,70	42,28	0,94	8,23	22,18	1,90
CP3	7			10,72	25,98	9,40	7,31	24,92	1,04	1,75	15,85	1,57
	27A		20,56	8,73	1,60	0,89	42,28	1,62	14,88	16,27		
CP7	5a		15,08	4,16	0,50	0,87	45,92	0,72	9,01	25,50	1,80	
CP9	n°5		28,02	7,53	1,44	0,86	44,80	1,13	21,70	11,06	4,05	
	6		19,91	11,23	1,84	2,45	40,60	1,25	11,81	17,42	2,33	
	8		24,95	4,54	1,04	0,87	48,44	0,38	21,18	14,32	3,38	
	10		17,12	7,26	1,20	1,02	45,36	0,58	12,78	21,08	2,15	
CS1	C	42,7		16,50	1,38	2,85	39,20	1,52	-	14,66	2,67	
	D	45,0		21,34	1,72	4,31	37,24	0,94	-	14,33	2,59	
	3	64,5		3,67	0,58	0,93	51,80	1,00	-	11,67	4,43	
CS3	6	61,5		15,75	0,96	3,38	39,48	0,96	-	20,84	1,89	
	B	76,4		26,57	0,64	1,16	36,68	1,13	-	17,06	2,15	
CS2	2	47,0		11,08	0,58	1,35	46,70	0,80	-	13,86	3,36	

Figure 1: Map of mineral deposits from Senegal

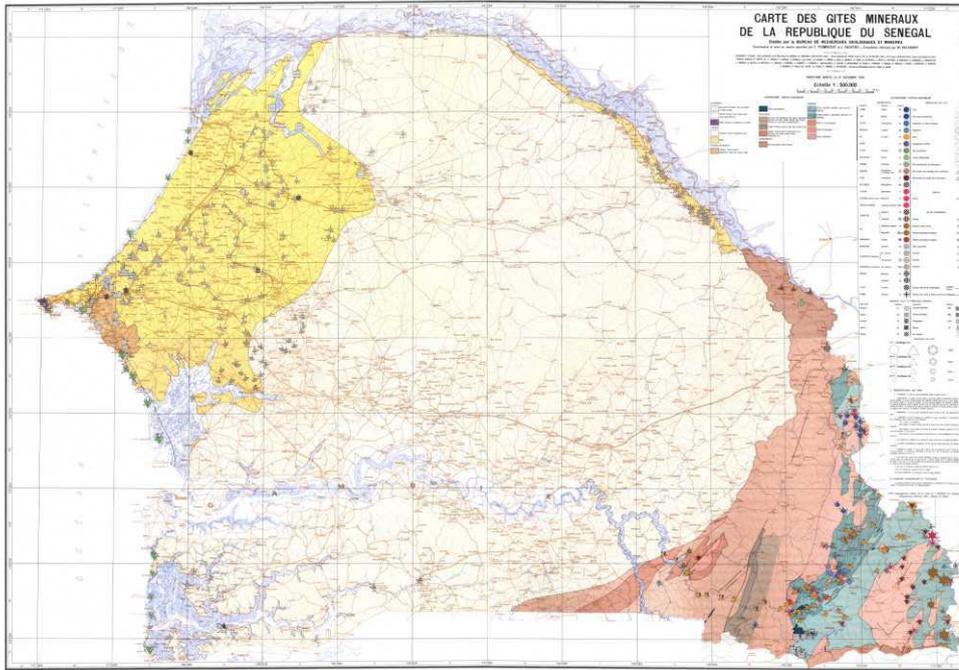
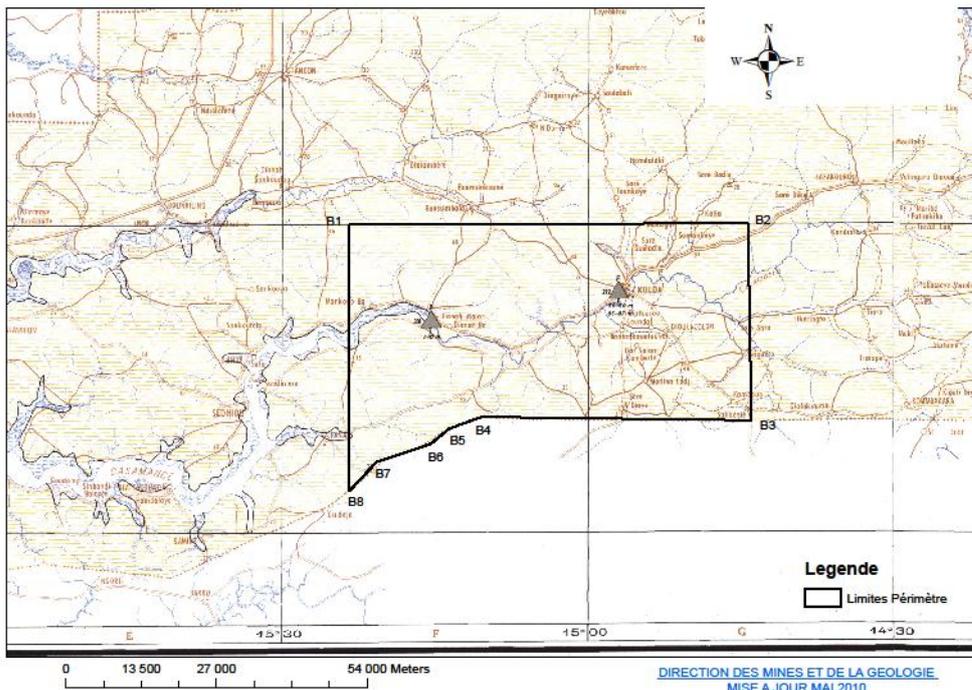


Figure 2 : Map of the perimeter of Kolda



Coordinates in UTM WGS 84 (Zone 28)

Area 2645 km<sup>2</sup>

<b>Points</b>	<b>X</b>	<b>Y</b>
B1	447 749	1 444 371
B2	519 179	1 444 675
B3	519 787	1 409 111
B4	471 458	1 409 719
B5	465 682	1 407 592
B6	462 339	1 404 856
B7	452 612	1 401 512
B8	447 749	1 396 345

Table 3: Some documents relating to phosphates

TITLE	YEAR	AUTHOR[S]	DESCRIPTION
Etude de deux phosphates du Sénégal	1956	Saint-Chamant de H.	SENEGAL OCCIDENTAL ; PHOSPHATE ; PHOSPHATE DE CHAUX ; PHOSPHATE ALUMINE ; ANALYSE ; TENEUR ; RAYON X ; MOUILLAGE ; HUMIDITE ; ACIDITE ; ACIDE PHOSPHORIQUE
Contrôle tectonique et morphologique de la sédimentation phosphatée sur la bordure méridionale du bassin sénégalo-mauritanien-guinéen : exemple du gisement de phosphates de chaux éocène de Farim (Guinée Bissau)	1983	Prian J.-P.	CONTROLE TECTONIQUE ; MORPHOLOGIE ; SEDIMENTOLOGIE ; PHOSPHATE ; SEDIMENTATION PHOSPHATEE ; BASSIN SENEGALO-MAURITANIEN-GUINEEN ; GISEMENT ; CHAUX ; EOCENE ; FARIM ; SENEGAL ; GUINEE BISSAU
Recherche de phosphates au Sénégal - Campagnes de recherches 1980 - 1984 - Rapport final - Etude géologique et minière des nouveaux gisements de phosphates du département de Matam (secteurs de N'Diendouri et Ouali - Diala)	1984	Pascal M.	SENEGAL ; PHOSPHATE ; GISEMENT ; SONDAGE ; FORAGE
Recherche de Phosphates au Sénégal Seconde Campagne (1981 - 1982) - Reconnaissance géologique par sondages carottés en moyenne et haute Casamance (Département de Kolda et de Vélingara)	1982	Pascal M.	SENEGAL ; PHOSPHATE ; GISEMENT ; SONDAGE ; FORAGE
Préparation du Plan de développement géologique et minier, Note de présentation du secteur phosphates	1985	[Non précisé]	SENEGAL ; GEOLOGIE ; MINE ; PHOSPHATE ; POTENTIEL ; RECHERCHE ; GISEMENT ; RESERVE EXPLOITABLE ; BASSIN SEDIMENTAIRE ; TAIBA ; LAM-LAM ; NAMEL ; MATAM
Recherche de phosphates, Rapport complémentaire, Le phosphate de chaux au Sénégal, Synthèse des résultats acquis, étude paléogéographique et essai prévisionnel 1966	1966	Monciardini C.	SENEGAL ; PHOSPHATE ; STRATIGRAPHIE ; GEOLOGIE ; EOCENE ; LUTETIEN ; RECHERCHE ; PROSPECTION MINIERE
Quelques renseignements sur les phosphates naturels du Sénégal analogies avec les phosphates du Niger	1966	Poulain J.F.	PHOSPHATE ; VARIETE ; COMPOSITION MINERALOGIQUE ; GRANULOMETRIE ; ETUDE COMPARATIVE ; SENEGAL ; NIGER