International Journal of Science and Research Methodology (IJSRM)
Volume 29, Issue 4, April 2026 **ijsrm.humanjournals.com** ISSN: 2454-2008

Macroscopic and Mineralogical Characterization of the Gelomorphic Bauxite Facies from the Sangaredi Deposit, Boké, Republic of Guinea

Aly SOUMAH[1, 2 *], Prof. Gbélé OUATTARA[2], Dr Mohamed Samuel Moriah CONTE[1]; Mohamed Lamine SYLLA[3], Abdoulaye Kadiatou DIALLO[1, 2], Mohamed CISSE[1], Dr Boubacar BAH[1]

[1] Institut Supérieur des Mines et Géologie de Boké (ISMGB), Laboratoire de Recherche Appliquée en Géosciences et Environnement (LRA), Boké, République de Guinée.
[2] Institut National Polytechnique Félix Houphouët-Boigny (INP-HB), Laboratoire des Sciences Géographiques, du Génie Civil et des Géosciences (LASCIG3), Yamoussoukro, République de Côte d'Ivoire.
[3]State Power Investment Corporation - Guinea (SPIC-Guinea), Centre Technologique d'Analyse XRF (CTA), Boffa, République de Guinée.

Received: 21 February 2026 Revised: 10 March 2026 Accepted: 25 March 2026

ABSTRACT :

The Sangarédi bauxite deposit, in the Bowé Basin, is one of the world's largest lateritic systems. Developed over a Devonian basement, intruded by Mesozoic magmatic bodies, and overlain by the Miocene Sangarédi Formation, it exhibits a wide diversity of bauxitic facies resulting from supergene weathering in a tropical environment. However, industrial mining still relies on a bulk approach without detailed facies differentiation, limiting optimization of mining and metallurgical processes. In this context, the gelomorphic facies, associated with advanced weathering and potentially enriched in alumina, remains insufficiently characterized. This study characterizes the gelomorphic facies through integrated macroscopic and mineralogical analyses. Samples were collected during a field campaign at Sangarédi within the concession of the Compagnie des Bauxites de Guinée (CBG) between June 2023 and January 2024. Macroscopic descriptions were complemented by X-ray diffraction (XRD) using a Rigaku Miniflex diffractometer, with data processed using HighScore Plus software. Macroscopic observations reveal massive structures with granular textures, including oolitic to pisolitic grains, and color variations linked to ferruginization and gelification. Mineralogical results indicate gibbsite as the dominant phase (28.9–95.3%), while boehmite ranges from 0 to 65.5%. Accessory minerals, mainly quartz and orthoclase, occur in minor amounts (1–5%). This distribution reflects progressive lateritic evolution from mixed gibbsite–boehmite facies to gibbsite-dominated facies, indicating advanced desilicification and high alumina potential. These results contribute to optimizing mining and processing strategies at CBG, supporting sustainable valorization of bauxite resources and improving understanding of supergene weathering and gelomorphic bauxite facies genesis in tropical environments.

Keywords: Sangaredi; bauxite; gelomorphic facies; mineralogy; X-ray diffraction (XRD).

1. INTRODUCTION

Bauxite is a strategic mineral resource and the primary source of aluminum worldwide. It forms through supergene weathering of aluminosilicate rocks in tropical and subtropical environments, where hot and humid conditions promote intense lateritization [1], [2], [3]. This process leads to progressive desilicification and residual enrichment in aluminum hydroxides, resulting in lateritic bauxites, which constitute the main type exploited globally. These bauxites are typically indurated and composed of aluminum hydroxides and oxyhydroxides (gibbsite, boehmite), iron oxyhydroxides (goethite, hematite), as well as neoformed minerals and relics of the parent rock [4], [5], [6], [7], [8]. Macroscopically, bauxites display a wide range of textures and structures, including massive, oolitic, pisolitic, and conglomeratic forms, with colors varying from red to brown, gray, or yellowish, depending on iron content and weathering conditions [1], [9], [10], [11], [12]. Numerous geological and mining studies have documented major bauxite deposits worldwide, particularly in tropical regions, contributing to improved understanding of their formation processes and supporting the optimization of their exploitation [10], [13], [14], [15].

From an economic perspective, global bauxite reserves were estimated at 29 billion tonnes in 2025 [16], with total resources ranging between 55 and 75 billion tonnes. These resources are unevenly distributed, with Africa accounting for 32%, followed by Oceania (23%), South America and the Caribbean (21%), and Asia (18 %) [3], [17], [18].

Guinea holds the world's largest proven bauxite reserves, estimated at approximately 7.4 billion tonnes [16], while total resources exceed 40 billion tonnes. Nearly 23 billion tonnes are concentrated in the Boké region, one of the country's main bauxite provinces

[19], [20], [21]. This region (**Figure 1**) hosts the Sangarédi deposit, one of the world's largest lateritic systems, located within the Bowé sedimentary basin [19], [22], [23], [24]. The deposit rests on a Devonian basement (Faro Suite) composed of sandstones, siltstones, and micaceous claystones, intruded by Mesozoic basic magmatic rocks (dolerites and gabbro-dolerites). These intensely lateritized formations host bauxite mineralization of variable intensity.

The overlying Sangarédi Formation (Middle Miocene) consists of alluvial-lacustrine deposits (pebbles, gravels, sands, silts, and clays) that also contain bauxite, with a diversity of facies including conglomeratic, gravelly, sandstone-like, pelitomorphic, and oolitic types [19], [25], [26]. Previous studies have addressed various aspects of this deposit, including formation processes, regional comparisons, and mineralogical and geochemical characteristics [3], [19], [25].

However, no in-depth study has specifically addressed the macroscopic and mineralogical characterization of the different facies of this deposit. Their differentiation remains a major challenge for optimizing mining operations and improving understanding of supergene weathering processes in tropical environments. Despite previous advances, the internal variability and mineralogical evolution of these facies remain poorly constrained, particularly in the Sangarédi deposit.

Among the identified facies, the gelomorphic facies is commonly associated with advanced stages of weathering and reflects processes of neoformation and remobilization of aluminum hydroxides. Its characterization is therefore essential for identifying high-alumina zones and for reconstructing the geochemical evolution of the deposit.

The objective of this study is to characterize the gelomorphic facies of the Sangarédi bauxite deposit based on macroscopic observations and mineralogical analyses using X-ray diffraction (XRD), in order to better understand its role in the geochemical evolution of the lateritic profile.

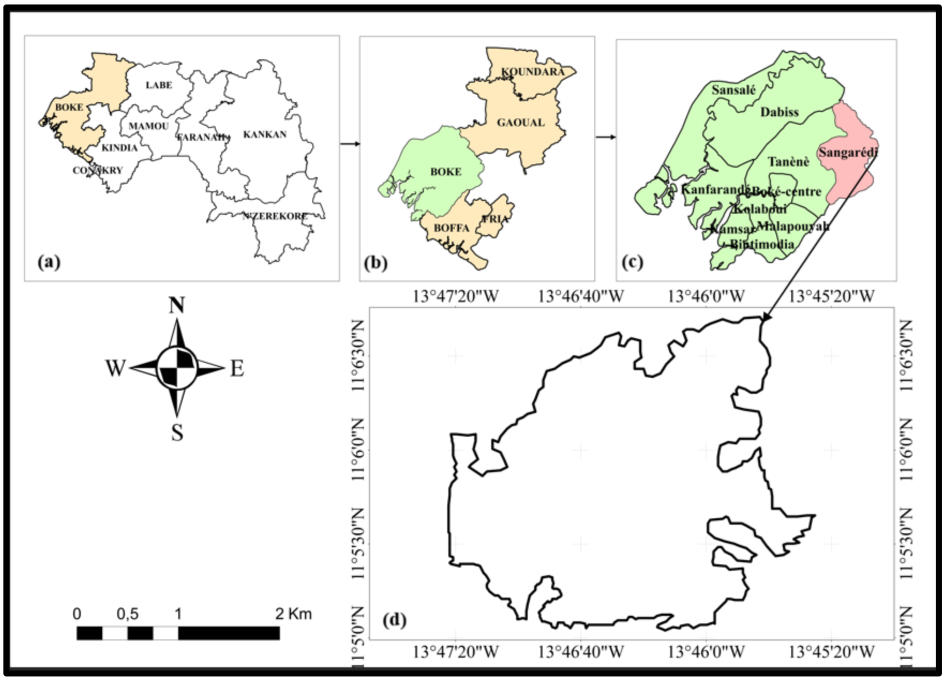

Figure 1: Location map of (a) the Boké region in Guinea; (b) the Boké prefecture; (c) the Sangarédi sub-prefecture; and (d) the Sangarédi bauxite deposit in the eastern part of the sub-prefecture.

2. Geological Setting

2.1 Geology of the Study Area

The Boké Prefecture, located in northwestern Guinea, lies within the sedimentary cover of the Guinean platform, along the southwestern margin of the West African Craton [27], [28], [29]. It is characterized by a geological succession ranging from the Paleozoic to the Cenozoic.

The Paleozoic formations include sandstones, quartzites, and quartzitic sandstones of Ordovician age (Pita Suite); finely bedded black claystones (argillites), shales, and micro-oolitic iron lenses of Silurian age (Télimélé Suite); and siltstones, claystones (argillites), and fine-grained sandstones of Devonian age (Faro Suite) [10], [19]. These formations are locally intruded and crosscut by Mesozoic magmatic bodies, dominated by dolerites and gabbro-dolerites [30], [31].

The Cenozoic formations consist of lateritic crusts and recent alluvial deposits, including sands, silts, clays, gravels, and pebbles. In areas of intense weathering, these deposits have given rise to conglomeratic, oolitic, and pelitomorphic bauxites [32], [33].

Regional tectonic structures are controlled by major faults and secondary fractures, predominantly oriented NE–SW, reflecting the complex tectonic history of the West African margin [19], [30] **(Figure 2).**

This diverse geological framework constitutes the foundation of the bauxite deposits, where supergene weathering processes have led to the development of heterogeneous lateritic facies enriched in alumina [34], [35].

2.2 Geology of the Sangarédi Bauxite Deposit

The Sangarédi bauxite deposit is developed over a Devonian detrital formation (Faro Suite), composed of fine-grained quartzitic sandstones, siltstones, and micaceous claystones. This formation is organized into two members: (i) a lower member consisting of sandstones with clayey-silty interbeds and lenses, and (ii) an upper member dominated by siltstones and claystones interspersed with discontinuous sandstone layers [19], [30], [32].

These formations are locally intruded and crosscut by Mesozoic basic magmatic bodies (dolerites, gabbro-dolerites, and diabases), which have induced localized contact metamorphism under hornfels facies conditions. The entire sequence is affected by major brittle faults, generally oriented NE–SW, controlling both fracturing and fluid circulation. The strata exhibit an overall gentle to subhorizontal dip [19], [30].

The Sangarédi Formation (Middle Miocene) conformably overlies this basement and consists of alluvial to alluvial-lacustrine deposits, including pebbles, gravels, sands, silts, and clays. This formation has undergone intense lateritization, leading to the development of a wide range of bauxitic facies, including conglomeratic, gravelly, sandstone-like, pelitomorphic, and oolitic types. The Sangarédi deposit, investigated in this study, results from the combined influence of the underlying Devonian formation, Mesozoic magmatic intrusions, tectonic deformation, and Cenozoic lateritic weathering processes, which together have controlled its geological evolution [19], [30], [36].

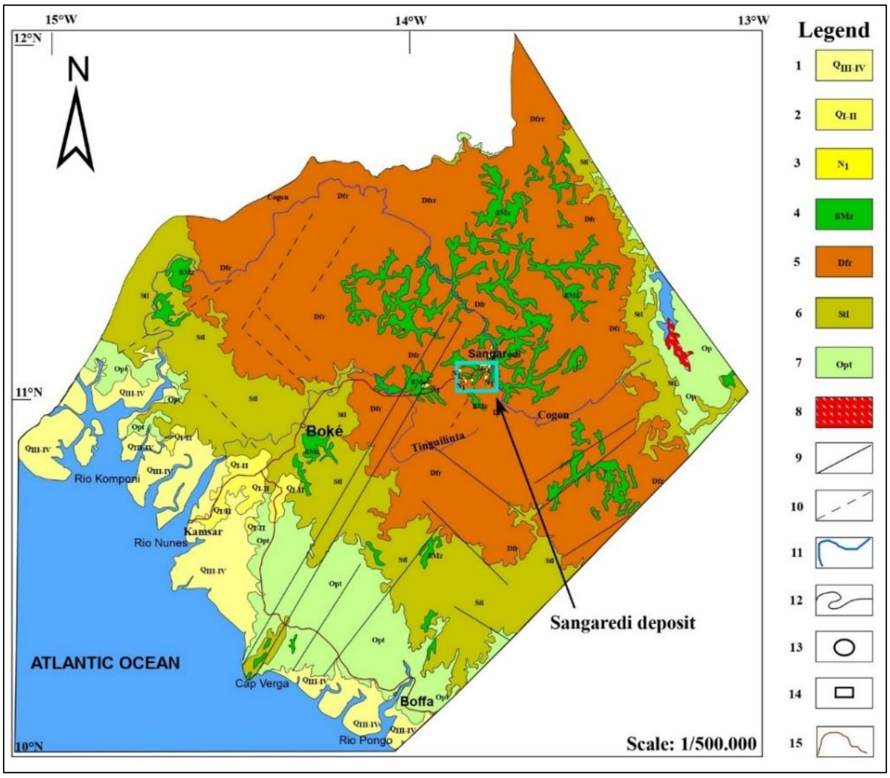

Figure 2: Geological map of the study area [10], [37]

The map illustrates the following units: 1. Undifferentiated deposits (alluvial and delusional): sands and calcareous sands with gravel, deluvial-proluvian pebbles. 2. Undifferentiated deposits (recent alluvial deposits): clayey sands, clayey silts, gravel, alluvial sands. 3. Lateritic rocks: lateritized sands, sandy silt, conglomerates. 4. Mesozoic magmatic rocks: dolerites. 5. Faro Devonian Suite: Upper member: micaceous aleurolites and argillites. Lower limb: fine-grained quartz sandstone, sometimes micaceous, with interbeds and lenses of aleurolites and argillites. 6. Silurian suite Télimélé: black and compact pélites, aleurolites and ferruginous microlenses. 7. Pita Ordovician suite: fine-grained quartzite sandstone, sometimes feldspathic, interspersed with aleurolites. 8. Granitic and granodioritic rocks with biotite. 9. Well-identified major brittle accidents. 10. Major brittle accidents masked under the recent deposits. 11. Watercourse. 12. Established geological boundaries. 13. Cities. 14. Sub-prefectures. 15. Roads.

3. Materials and Methods

This study is based on a combination of analysis with field work., including sample description and mineralogical investigations based on X-ray diffraction (XRD) data interpretation.

3.1. Field Campaign

The field campaign was conducted from June 13, 2023 to January 15, 2024 within the concession area of the Compagnie des Bauxites de Guinée (CBG) on the Sangarédi bauxite plateau. A total of 65 samples were collected from surface horizons using an Estwing geological hammer, and the geographic coordinates of sampling points were recorded using a Garmin GPSMAP 64s device. These points were plotted onto the geological map of the study area (Figure 3) to assess the spatial distribution of facies within the Sangarédi deposit. Sampling was carried out using a combined purposive and random approach to ensure representative coverage of facies spatial variability.

The collected samples were subsequently selected for X-ray diffraction (XRD) analyses, among which five samples correspond to the gelomorphic bauxitic facies.

3.2. Macroscopic Description and Sample Preparation

Macroscopic description was based on color, texture, structure, and grain size. Following field identification, the samples underwent mechanical preparation at CBG facilities, including crushing, homogenization, sieving, and reduction, to obtain powdered material suitable for laboratory analyses.

3.3. X-ray Diffraction (XRD) Analysis

Mineralogical analyses were performed at the National Geosciences Research Laboratories (Kaduna, Nigeria) using a Rigaku Miniflex XRD diffractometer operating in Bragg–Brentano geometry (CuKα radiation, $\lambda = 1.5418$ Å; 2θ range: 4–75°; 30 kV, 15 mA). Samples were ground to a grain size below 150 µm, compacted, and analyzed to acquire diffraction patterns. Phase identification and diffractogram processing were performed using SMART LAB II and HighScore Plus software, coupled with the ICDD PDF-4 database, enabling both automatic and manual peak matching procedures.

4. Results and Discussion

4.1. Macroscopic Characterization of Gelomorphic Bauxites

The gelomorphic bauxitic facies samples from the Sangarédi deposit **(Figure 3)** generally exhibit massive structures with granular textures dominated by fine ooids (< 1 mm), reflecting a high degree of chemogenic-sedimentary consolidation.

Sample S1-S004 corresponds to a gravelly-type gelomorphic bauxite, characterized by a massive structure and a cohesive granular texture, with millimetric to centimetric grain sizes. Sample S9-S007 displays a pisolitic to oolitic facies, with a compact massive structure and ovoid grains with concentric organization, also showing millimetric to centimetric granulometry. Sample S14-S051 is a gravelly bauxite undergoing ferruginization, with a massive structure and weakly granular texture, with grain sizes ranging from millimetric to submillimetric scale. Sample S23-S052 corresponds to a consolidated oolitic facies, characterized by a compact massive structure and fine ooids (< 1 mm). Finally, sample S51-S036 also presents a consolidated oolitic facies with a concretionary granular texture, locally affected by the presence of a vein.

Field observations are supported by macroscopic photographs of the samples **(Figure 4),** which illustrate the main morphological and textural characteristics described **(Table 1),** particularly the high degree of chemogenic-sedimentary consolidation and local variations in ferruginization and gelification within the gelomorphic facies.

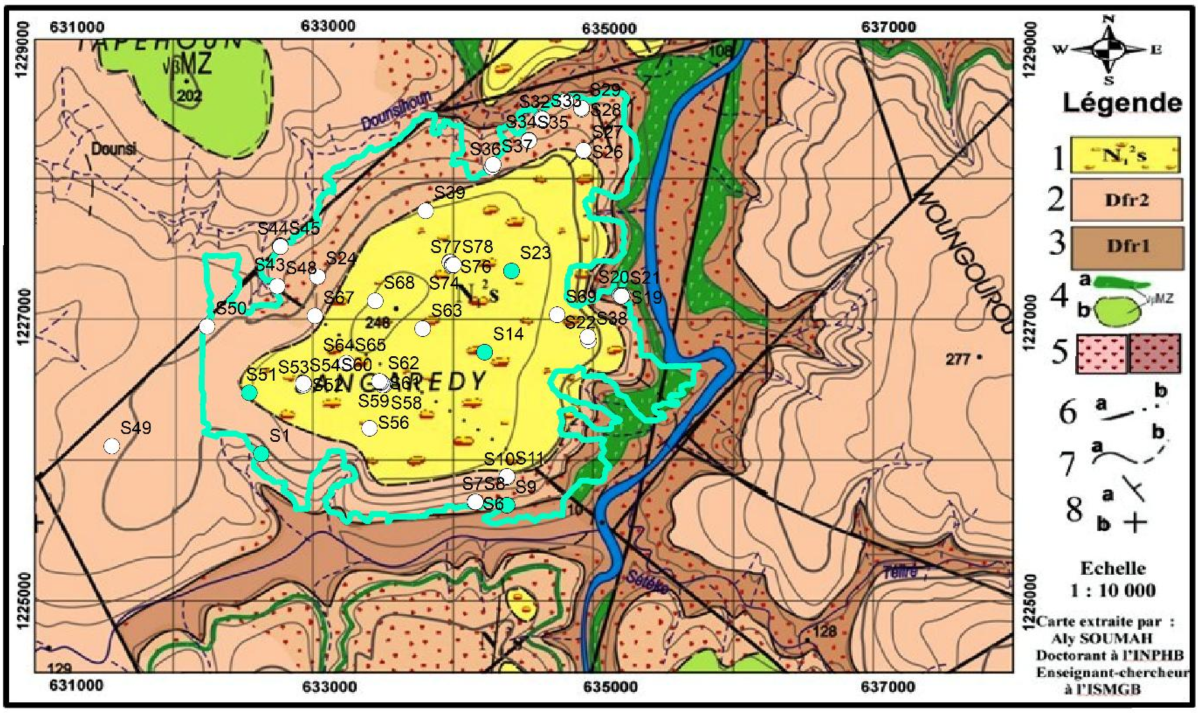

Figure 3: Location of samples from the field campaign [38]; modified by Soumah et al., 2026.

The white circles correspond to all the samples collected, and the green circles to the samples of the gelomorphic range. (1) The Middle Miocene Sangarédi Series consists of alluvial and alluvial–lacustrine deposits, including pebbles, gravels, sands, silts, and clays, which have been lateritized and transformed into various bauxitic facies such as conglomeratic, gravelly, sandstone-like, pelitomorphic, and oolitic types; (2) the Devonian Faro Suite includes an upper member composed of micaceous siltstones and claystones, interbedded with isolated layers (0.3–1.5 m) of fine-grained quartzose sandstones; (3) the lower member consists of fine-grained quartzose sandstones, locally micaceous, with interbeds and lenses (1–3 m, occasionally up to 25 m thick) of siltstones and claystones; (4) the Mesozoic formations correspond to magmatic rocks of a trap series, including dolerites, gabbro-dolerites, and congo-diabases, as well as equivalent lithologies strongly affected by lateritization; (5) hornfels rocks are also present; (6) major brittle faults are either (a) clearly identifiable and partially confirmed during field traverses or (b) concealed beneath younger sedimentary cover; (7) geological boundaries are either (a) identified in the field and/or interpreted from aerial imagery or (b) inferred; and (8) rock attitude is characterized by (a) gentle dips and (b) subhorizontal bedding.

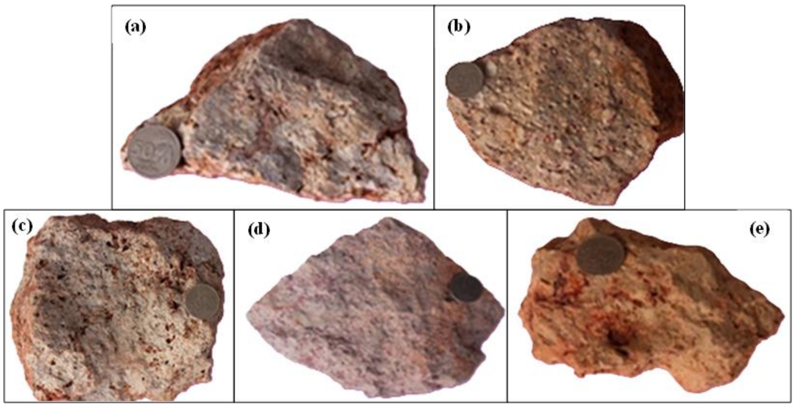

Figure 4: Samples of the different gelomorphic facies from the Sangarédi bauxite deposit.

(a) Gravelly gelomorphic bauxite (S1-S004); (b) Pisolitic-oolitic gelomorphic bauxite (S9-S007); (c) Gravelly gelomorphic bauxite with ferritization (S14-S051); (d) Consolidated oolitic gelomorphic bauxite (S23-S052); (e) Consolidated oolitic gelomorphic bauxite (S51-S036).

International Journal of Science and Research Methodology (IJSRM)
Volume 29, Issue 4, April 2026 ijsrm.humanjournals.com ISSN: 2454-2008

Table 1: Macroscopic description of gelomorphic bauxite samples from the Sangarédi deposit.

Sample	Coordinates (E, N, Z)	Color	Structure	Texture	Grain size	Interpretation / Type
S1-S004	632632; 1226046; 195 m	Grey with whitish and brownish shades	Massive	Cohesive granular	mm to ~3 cm	Gravelly gelomorphic bauxite (chemogenic-sedimentary)
S9-S007	634387; 1225681; 156 m	Grey with brownish tones	Compact massive	Ovoid grains, concentric structures	mm to ~2 cm	Pisolitic–oolitic gelomorphic bauxite (chemogenic-sedimentary)
S14-S051	634228; 1226771; 208 m	Grey with brown in pores	Massive	Weakly granular	mm to ~4 mm	Gravelly gelomorphic bauxite undergoing ferruginization (chemogenic-sedimentary)
S23-S052	634420; 1227351; 201 m	Grey and brown (grey dominant)	Compact massive	Granular, spherical grains (ooids)	< 1 mm	Consolidated oolitic gelomorphic bauxite (chemogenic-sedimentary)
S51-S036	632547; 1226483; 218 m	Grey with red and black shades	Massive	Concretionary granular, rough	< 1 mm	Consolidated oolitic gelomorphic bauxite (chemogenic-sedimentary)

4.2 Mineralogical Characterization by X-ray Diffraction (XRD)

Mineralogical analysis of the gelomorphic facies samples from the Sangarédi deposit reveals a mineral assemblage composed of gibbsite ($Al(OH)_3$), boehmite (AlO(OH)), quartz (SiO_2), and orthoclase ($KAlSi_3O_8$), with variable proportions and degrees of crystallinity. The diffractograms **(Figures 5)** show characteristic peaks of gibbsite at approximately 18–20° (2θ), boehmite at approximately 14–15° and 28–30° (2θ), and quartz at approximately 26.6° (2θ), while orthoclase, present in low abundance, is identified by low-intensity reflections mainly around 21°, 27–28°, 30–31°, and 32° (2θ). The presence of quartz and orthoclase reflects an incomplete desilicification of the parent material.

Quantitative results and corresponding weathering stages are summarized in **Table 2**. Samples S1-S004 and S9-S007 exhibit a mixed gibbsite–boehmite mineralogy, characteristic of an intermediate weathering stage. This trend is confirmed by quantitative data, with 67% and 28.9% gibbsite associated with 23% and 65.5% boehmite, respectively. The presence of quartz (≈ 3.5–5%) and orthoclase (≈ 2–5%) indicates a residual or detrital siliceous fraction and incomplete alteration of the feldspathic material.

International Journal of Science and Research Methodology (IJSRM)
Volume 29, Issue 4, April 2026 **ijsrm.humanjournals.com** ISSN: 2454-2008

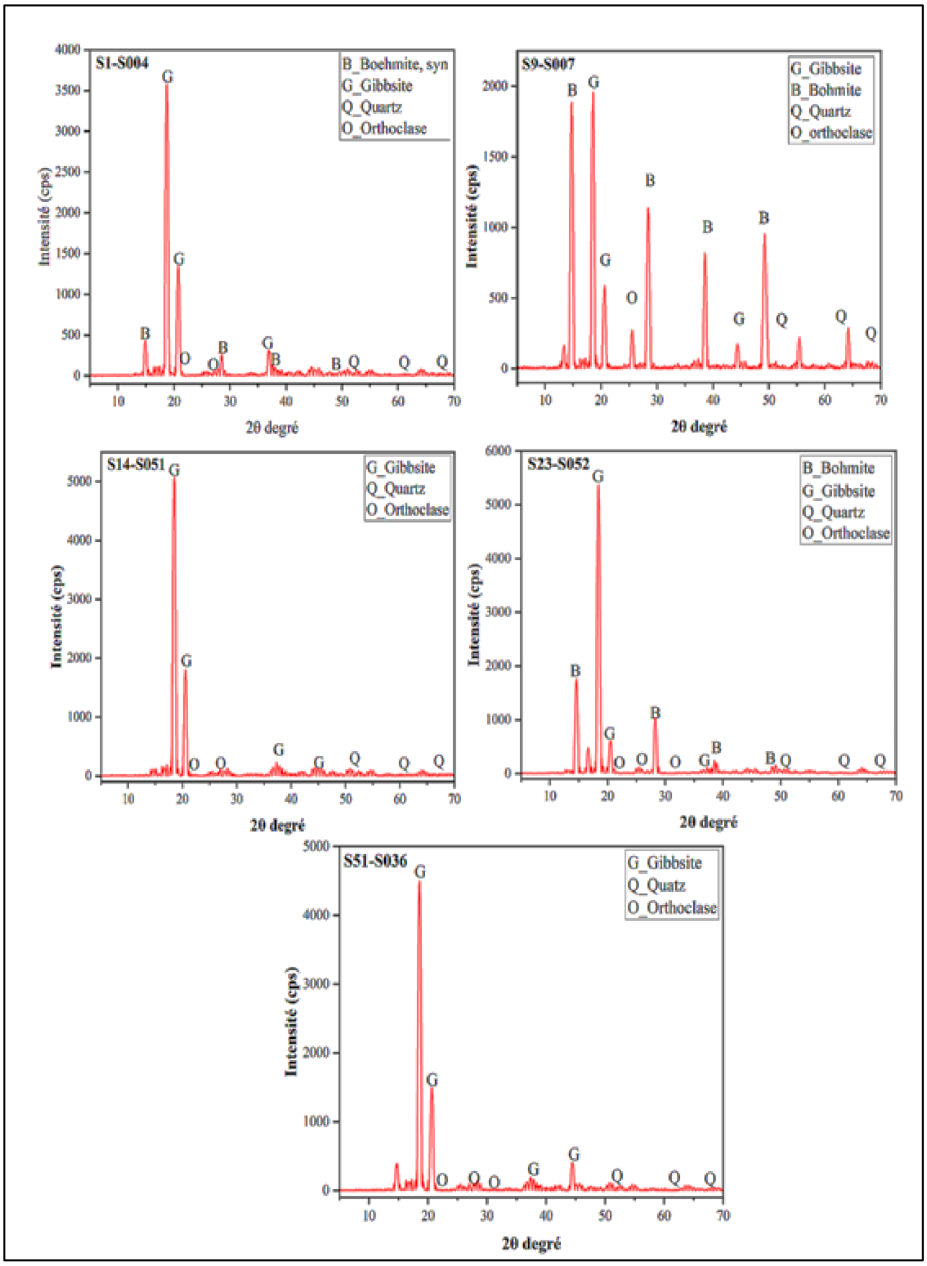

Figure 5: Diffractograms of the different gelomorphic facies from the Sangarédi bauxite deposit.

(a) Gravelly gelomorphic bauxite (S1-S004); (b) Pisolitic-oolitic gelomorphic bauxite (S9-S007); (c) Gravelly gelomorphic bauxite with ferritization (S14-S051); (d) Consolidated oolitic gelomorphic bauxite (S23-S052); (e) Consolidated oolitic gelomorphic bauxite (S51-S036).

Table 2: Mineralogical composition and weathering stage of gelomorphic samples (XRD).

Sample	Gibbsite (wt%)	Boehmite (wt%)	Quartz (wt%)	Orthoclase (wt%)	Total (wt%)	Weathering stage
S1-S004	67 ± 4	23 ± 3	5 ± 4	4.9 ± 0.6	99.9	Intermediate
S9-S007	28.9 ± 0.7	65.5 ± 0.7	3.54 ± 0.6	2.06 ± 0.3	100.0	Intermediate
S14-S051	95.3 ± 0.7	0	4.4 ± 0.5	0.3 ± 0.5	100.0	Advanced
S23-S052	52.0 ± 1.2	45.6 ± 1.1	1.0 ± 1.1	1.3 ± 1.4	99.9	Intermediate
S51-S036	94.8 ± 1.2	0	4.7 ± 0.8	0.6 ± 0.8	100.1	Advanced

It should be noted that the weathering stages are defined on the basis of the relative proportions of gibbsite and boehmite.

4.3. Discussion

The integrated approach combining macroscopic observations and X-ray diffraction (XRD) mineralogical analyses applied to the gelomorphic facies of the Sangarédi deposit allows the identification of several lateritic evolutionary stages and reveals unexpected decoupling between texture and mineralogy.

The XRD results reveal a well-structured mineralogical evolution within the studied samples **(Table 2; Figure 5a–5e).** Samples S14-S051 and S51-S036 are strongly dominated by gibbsite (>94%), as shown by their diffractograms **(Figure 5c and 5e)**, whereas sample S9-S007 exhibits a clear predominance of boehmite (65.5%) **(Figure 5b)**. In contrast, samples S1-S004 and S23-S052 display mixed assemblages, reflecting intermediate stages of alteration **(Figure 5a and 5d).** Overall, these data indicate a progressive transition from boehmite to gibbsite, consistent with an increasing degree of alteration along the profile. This trend aligns with observations from tropical bauxite systems, where gibbsite dominates at advanced stages of supergene alteration [30], [39]. It is primarily driven by progressive silica leaching, leading to relative aluminum enrichment and stabilization of gibbsite, in agreement with [8] geochemical models. This interpretation is also consistent with field-based observations reported by [11], although local variations in texture–mineralogy relationships may occur. The mineralogical variations observed **(Table 2; Figure 5a–5e)** thus reflect a leaching-controlled evolution under specific hydrogeochemical conditions. However, the persistence of mixed boehmite–gibbsite assemblages in samples S1-S004 and S23-S052 highlights local heterogeneities, likely related to variations in drainage efficiency, pH, or micro-environmental conditions, suggesting that the transformation is not strictly uniform across the profile.

Sample S23-S052 **(Table 2; Figure 5d)** shows an anomaly: despite a massive and homogeneous texture, its mineralogy remains mixed (52% gibbsite, 45.6% boehmite). This decoupling suggests that textural homogenization may precede the complete transformation of boehmite into gibbsite in near-surface environments. This observation is consistent with several studies indicating that the transformation from boehmite to gibbsite is progressive and strongly dependent on local conditions (depth, drainage, and leaching intensity), which may favor the coexistence of massive textures and mixed mineralogy [9], [30], [40]. In addition, trace elements may locally inhibit gibbsite formation [41]. Thus, in supergene settings, textural evolution and mineralogical transformation may be partially decoupled. However, this interpretation appears to differ from the hypothesis of [42], who suggested that massive textures are systematically associated with complete gibbsitization. Field observations from bauxites and lateritic profiles do not consistently support such a coupling. Moreover, experimental results [43], [44], [45], obtained under controlled conditions, are not easily transferable to supergene environments. Overall, these results rather suggest a decoupling between textural evolution and mineralogical transformation in the studied sample.

All samples contain small proportions (0.6–5%) of quartz and orthoclase (Table 2). Their presence suggests advanced but incomplete desilication of the parent material, with persistence of inherited silicate minerals even at advanced stages of alteration. These residual phases may originate either from the Devonian detrital basement or from Miocene alluvial–lacustrine deposits, although the available data do not allow a definitive distinction. Nevertheless, they can be considered indirect indicators of leaching intensity and supergene weathering dynamics. This interpretation is broadly consistent with [31], [46], who show that residual silicate phases (quartz, feldspars) may persist in mature lateritic profiles despite strong gibbsite enrichment (>94%). These studies therefore suggest that the presence of inherited minerals can be compatible with a high degree of bauxitization. In contrast, [47], [48] propose a more restrictive view, according to which advanced weathering stages should correspond to an almost complete removal of inherited silicates, with negligible residual quartz and feldspar contents. The occurrence of 0.6–5% of these phases in our samples therefore challenges a model of supergene leaching assumed to be complete.

Overall, the integrated macroscopic and XRD-based approach proves essential for interpreting the lateritic evolution of the Sangarédi gelomorphic facies and for guiding mining exploitation strategies. This confirms the view of [19] regarding the strategic value of this methodology.

5. Conclusion

This study highlights a well-defined mineralogical evolution within gelomorphic bauxite facies, dominated by gibbsite and boehmite. High gibbsite contents (>90%) reflect advanced stages of supergene weathering, whereas mixed assemblages correspond to intermediate stages of evolution, as confirmed by the XRD data (Table 2; Figure 5a–5e).

An important result is the identification of a recurrent decoupling between texture and mineralogy. Sample S23-S052 illustrates this behavior, showing a massive and homogeneous texture associated with a mixed boehmite–gibbsite assemblage. Other samples, such as S1-S004, display similar characteristics, suggesting that textural homogenization may, in some cases, precede complete mineralogical transformation. This result highlights the complexity of lateritic weathering processes, where mineralogical evolution is strongly controlled by local conditions and does not always directly follow textural development.

Overall, these results indicate that bauxitization in gelomorphic facies is best understood through a combined textural and mineralogical approach. An integrated approach is therefore required to characterize facies and to better understand ore quality distribution within lateritic profiles.

Acknowledgments

We extend our sincere gratitude to the General Directorate of the Higher Institute of Mines and Geology of Boké for its continuous support throughout the completion of this work. We also express our profound appreciation to the General Directorate of the Compagnie des Bauxites de Guinée (CBG), as well as to all its staff, particularly those of the Geology Department, for their availability, guidance, supervision, and valuable contributions during the field campaign. Finally, we wish to sincerely thank all individuals who, directly or indirectly, contributed significantly to the successful completion of this study.

6. References

[1] F. W. N. Dongmo, Y. Fouateu, R. F. D. Ntouala, Y. Lemdjou, D. C. Ledoux, et A. Bolarinwa, « Geochemical, mineralogical and macroscopic facies of the Fongo-Tongo bauxite deposit western Cameroon », *Applied Earth Science*. 2021; 130 :23-41.
[2] G. J. Retallack, « Lateritization and Bauxitization Events », *Economic Geology*. 2010; 105 :655-667.
[3] N. Zainudeen, L. Mohammed, A. Nyamful, D. Adotey, et S. Osae, « A comparative review of the mineralogical and chemical composition of African major bauxite deposits », *Heliyon*. 2023; 9 :1-22.
[4] B. Boulangé, J. P. Ambrosi, et D. Nahon, « Latérites et bauxites ». 1993; 41-53.
[5] D. Mildan, A. Subandrio, P. Bangun, et D. Sunjaya, « Contrasting Genesis of Lateritic Bauxite on Granodioritic and Andesitic Rocks of Mempawah Area, West Kalimantan », *Indonesian Association of Geologists Journal*. 2021; 1 :81-88.
[6] D. A. Monsels, « Bauxite deposits in Suriname: Geological context and resource development », *Netherlands Journal of Geosciences*. 2016; 95 :405-418.
[7] R. D. Nugraheni et D. Sunjaya, « Geochemical Approach to Reveal The Genetic Occurrence of Gibbsite, Relative to The Parent Rock Type in Lateritic Bauxites », *J. Phys.: Conf. Ser.* 2019; 1363 : 12-42.
[8] W. Schellmann, « Geochemical differentiation in laterite and bauxite formation », *Catena*. 1994; 21 :131-143.
[9] S. K. Balabantaray, S. Aravindan, et R. Ravi, « Morphological, microstructural and mineralogical dataset of bauxite over Mainpat plateau from a part of Deccan traps, Surguja district, Chhattisgarh », *SN Applied Sciences*. 2020; 2 :1-11.
[10] A. K. Diallo, M. S. M. Conte, O. B. Kaba, A. Soumah, et M. Camara, « Petrological and Statistical Studies of the Limbiko Bauxite Deposit, Republic of Guinea », *International Journal of Geosciences*. 2023; 14 :351-376.
[11] F. Oliveira, A. Varajão, C. Varajão, B. Boulangé, et C. Soares, « Mineralogical, micromorphological and geochemical evolution of the facies from the bauxite deposit of Barro Alto, Central Brazil », *Catena*. 2013; 105 :29-39.
[12] S. Sahoo, P. Mishra, et B. K. Mohapatra, « Morphological and microstructural characteristics of bauxite developed over a part of Precambrian Iron Ore Group of rocks, Sundergarh District, Eastern India », *Arabian Journal of Geosciences*. 2016; 1-11.
[13] A. M. Daya, A. Haruna, A. Maigari, et I. Yahuza, « Resource Assessment and Possible Industrial Applications of Bauxite Occurrences in Parts of the Mambila Plateau, NE Nigeria », *European Journal of Environment and Earth Sciences*. 2022; 3 :1-23.
[14] B. da R. Pereira, M. Rosset, J. D. de O. Lima, K. P. Gomes, D. C. R. Espinosa, et J. A. S. Tenório, « Characterization Study of some Bauxite Deposits in Northern Brazil », *Clays and Clay Minerals*. 2023; 71 :707-721.
[15] P. Zhang, X. Jing, R. Pu, A. Wang, et X. Huang, « Logging Identification and Distribution of Bauxite in the Southwest Ordos Basin », *Minerals*. 2023; 13 :1-19.
[16] USGS, « Mineral commodity summaries 2025. U.S. Geological Survey, Reston, Virginia. 2025; 1-216.
[17] A. O. Ali, A. S. Morshedy, A. A. El-Zahhar, M. M. Alghamdi, et A. M. A. El Naggar, « African continent: Rich land of minerals and energy sources », *Inorganic Chemistry Communications.* 2024; 169 :113-123.
[18] N. S. Ouedraogo et J. M. M. Kilolo, « Africa's critical minerals can power the global low-carbon transition », *Prog. Energy.* 2024; 6 :1-15.
[19] A. D. Barry, M. Cissé, M. M. Parfait, et M. M. Hallarou, « Mineralogical and Geochemical Characteristics of the Sangarédi Bauxite Deposit, Boké Region, Republic of Guinea », *Environmental and Earth Sciences Research Journal*. 2021; 8 :11-22.
[20] S. Souare, « An Analysis of Civil Society Organisations Advocating for Adequate Bauxite Mining in Boke Region (Western Guinea) », *Int. J. Environ. Prot. Policy*. 2022; 10 :39-47.
[21] S. Traoré, A. Diarra, O. Kourouma, et D. L. Traoré, « Survey of Bauxite Resources, Alumina Industry and the Prospects of the Production of Geopolymer Composites from the Resulting by-product », in *Geopolymers and Other Geosynthetics*, IntechOpen. 2019; 1-25.
[22] M. S. M. Conté, A. K. Diallo, S. Aly, M. L. Timité, M. Fofana, et D. M. Camara, « Petrographic and geochemical characterization of the Parawi bauxitic deposit, Republic of Guinea », *World Journal of Advanced Research and Reviews*. 2025; 28 :1181-1197.
[23] C. V. Traoré, M. S. M. Conté, D. Keita, A. K. Diallo, M. Diallo, et M. Conde, « Caractérisation pétrographique, minéralogique et géochimique du gisement de bauxite de Boundou-Waadé (Sangaredi, République de Guinée) », *Journal de géoscience et de protection de l'environnement*. 2024; 12 :28-45.

[24] R. Zhang, E. Gong, G. Wang, et W. Peng, « Mineralization Patterns and Conditions of Lateritic Gibbsite Bauxite in Guinea ». 2018; 2.
[25] V. Mamedov, M. Makarova, N. Boeva, A. Slukin, E. Shipilova, et N. Bortnikov, « The Main Processes and Stages in the Formation of the Unique Sangaredi Deposit of Bauxites (West Africa) », *Doklady Earth Sciences*. 2020; 492 :291-296.
[26] V. I. Mamedov, A. A. Chausov, et A. I. Kanishev, « Formation stages of the unique sangaredi bauxite-bearing group, Futa Jallon-Mandingo province, West Africa », *Geology of Ore Deposits*. 2011; 53 : 203-229.
[27] J. Bertrand-Sarfati, A. Moussine-Pouchkine, P. Affaton, R. Trompette, et Y. Bellion, « Cover Sequences of the West African Craton », in *The West African Orogens and Circum-Atlantic Correlatives*, R. D. Dallmeyer et J. P. Lécorché, Éd., Berlin, Heidelberg: Springer. 1991; 65-82.
[28] W. P. Dillon et J. M. A. Sougy, « Geology of West Africa and Canary and Cape Verde Islands », in *The Ocean Basins and Margins: The North Atlantic*, A. E. M. Nairn et F. G. Stehli, Éd., Boston, MA: Springer US. 1974; 315-390.
[29] M. Villeneuve et J. J. Cornée, « Structure, evolution and palaeogeography of the West African craton and bordering belts during the Neoproterozoic », *Precambrian Research*. 1994; 69 : 307-326.
[30] V. Mamedov, N. Boeva, M. Makarova, E. Shipilova, et P. Melnikov, « The Problem of the Formation of Boehmite and Gibbsite in Bauxite-Bearing Lateritic Profiles. », *Minerals (2075-163X)*. 2022; 12 : 1-18.
[31] G. Uehara, H. Ikawa, et G. Sherman, « Desilication of Halloysite and Its Relation to Gibbsite Formation », *Pacific Science*. 2025; 20 : 119-124.
[32] M. Abzalov et J. Bower, « Geology of bauxite deposits and their resource estimation practices », *Applied Earth Science*. 2014; 123 :118-134.
[33] J. Hem et C. Roberson, « Form and stability of aluminum hydroxide complexes in dilute solution ». 1967; 1-66.
[34] H. Kodama et M. Schnitzer, « Effect of fulvic acid on the crystallization of aluminum hydroxides », *Geoderma*. 1980; 24 :195-205.
[35] A. Singer et P. Huang, « Effects of Humic Acid on the Crystallization of Aluminum Hydroxides », *Clays and Clay Minerals*. 1990; 38 :47-52.
[36] G. Behera et B. Sarkar, « Geostatistical Modelling and Vertical Effect Analysis of a Ferruginous East Coast Bauxite Deposit, India », *Geology of Ore Deposits*. 2021; 63 : 269-285.
[37] V. I. Mamedov, Y. V. Bouféév, et Y. A. Nikitine, *Géologie de la République de Guinée*, vol. I. Conakry-Moscou. 2010; 1 : 1-327.
[38] D. V. Mamedov *et al.*, « Carte géologique de la concession Halco, Annexe No 2 », Compagne des Bauxites de Guinée (CBG) - Géoconsult Ltd., Guinée, 2000; 158.
[39] H. Zhang *et al.*, « Crystallization and Phase Transformations of Aluminum (Oxy)hydroxide Polymorphs in Caustic Aqueous Solution. », *Inorganic chemistry*. 2021; 60 : 1-12 (9820-9832).
[40] N. M. Boeva, Б. H. M, N. S. Bortnikov, et Б. H. C, « Dimensional effect and crystallomorphological features of gibbsite in the bauxite-bearing weathering crust. », *Doklady Earth Sciences*. 2023; 510 : 38-45.
[41] H. Qi *et al.*, « Formation mechanism of boehmite and diaspore in karstic bauxites: Trace element geochemistry in source materials using a large sample geochemical dataset and a random forest model », *American Mineralogist*. 2025; 110 :1269-1279.
[42] D. Monsels et M. Bergen, « Bauxite formation on Proterozoic bedrock of Suriname », *Journal of Geochemical Exploration*. 2017; 180 :71-90.
[43] T. C. Alex, R. Kumar, S. K. Roy, et S. P. Mehrotra, « Anomalous reduction in surface area during mechanical activation of boehmite synthesized by thermal decomposition of gibbsite », *Powder Technology*. 2011; 208 : 128–136.
[44] X. Gong *et al.*, « Gibbsite to Boehmite Transformation in Strongly Caustic and Nitrate Environments », *Ind. Eng. Chem. Res.* 2003; 42 :2163-2170.
[45] J. Rouquerol, F. Rouquerol, et M. Ganteaume, « Thermal decomposition of gibbsite under low pressures I. Formation of the boehmitic phase », *Journal of Catalysis*. 1975; 36 :99-110.
[46] V. T. Allen, « Petrographic Relations in Some Typical Bauxite and Diaspore deposits », *GSA Bulletin*. 1952; 63 :649-688.
[47] S. Iqbal, M. Bibi, et M. Wagreich, « Geochemistry of the Triassic–Jurassic lateritic bauxites of the Salt Range: implications for eastward extension of the Tethyan bauxite deposits into Pakistan », *International Journal of Earth Sciences*. 2023; 112 :1-26.
[48] A. D. Slukin, N. M. Boeva, E. A. Zhegallo, et N. S. Bortnikov, « Biogenic Dissolution of Quartz during Formation of Laterite Bauxites (According to the Results of Electron Microscopic Study) », *Doklady Earth Sciences*. 2019; 486 :441-544.

How to cite this article:
Aly SOUMAH et al. Ijsrm.Human, 2026; Vol. 29 (4): 34-43.

Conflict of Interest Statement: All authors have nothing else to disclose.