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The Paleoproterozoic Two-Mica Granites of the West African Craton: A Petrological and Geochemical Study of the Ferké Batholith and Associated Plutons, Ivory Coast

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Abstract

The Paleoproterozoic basement of Ivory Coast, a key component of the West African Craton (WAC), is intruded by numerous granitoid suites. Among these, the two-mica granites (leucogranites) form a significant component, predominantly represented by the North-South trending Ferké Batholith. This study synthesizes petrographic and geochemical data from the Ferké Batholith and other leucogranite plutons across Ivory Coast to constrain their petrogenesis and geodynamic setting. Petrographically, these leucogranites are characterized by a quartz + K-feldspar + plagioclase + biotite + muscovite ± garnet assemblage. Geochemically, they are high-silica (68.5 - 74.8 wt% SiO_2), potassic to shoshonitic, and range from metaluminous to strongly peraluminous. Multi-element spider diagrams show enrichment in Large-Ion Lithophile Elements (LILE: Rb, Ba, Th, U) and negative anomalies in Nb, Ta, Ti, and Eu. Chondrite-normalized REE patterns display LREE enrichment [$(La/Yb)_N$ = 11.6 – 51.5] and variable negative Eu anomalies (Eu/Eu^* = 0.54 – 1.05). The geochemical signatures indicate a dual origin: a crustal source (peraluminous granites of Ferké, Abidjan, Grand-Lahou) likely involving partial melting of Archean TTG-like protoliths, and a mantle-derived component with crustal assimilation (metaluminous granites of Katiola, Nassian, and some from Bouaké and Dabakala). Tectonic discrimination diagrams suggest emplacement in syn-collisional to volcanic arc settings during the Eburnean orogeny.

The enrichment in LILE is attributed to a combination of magmatic differentiation and crustal contamination. This study underscores the genetic link between these leucogranites and the Paleoproterozoic crustal evolution of the West African Craton.

Keywords

Two-Mica Granite, Leucogranite, Geochemistry, Petrogenesis, Eburnéen Orogeny, West African Craton, Ivory Coast

1. Introduction

The West African Craton (WAC), stabilized during the Paleoproterozoic Eburnean orogeny (~2.1 Ga), represents a fundamental unit of the Earth's continental crust. In Ivory Coast, the crystalline basement is a testament to a complex crustal evolution involving three major Precambrian orogenies (Leonian, Liberian, and Eburnéen) and constitutes over 97% of the national territory, with the remainder covered by a Mesozoic-Tertiary coastal basin [1]. This ancient basement, aged over 1.6 billion years, is predominantly composed of a diverse suite of granitoid rocks, which form its architectural backbone [2]. This suite includes granodiorites, alkaline granites, calc-alkaline granites, tonalites, trondhjemites, and two-mica granites (leucogranites). Their formation is intrinsically linked to the tectonic processes that shaped the craton, making them critical for understanding the geodynamic evolution of West Africa. Consequently, they have been the focus of numerous lithostratigraphic and geochemical studies aimed at deciphering their genesis [3]-[7].

Among these, the two-mica leucogranites hold particular significance. They are predominantly represented by the vast, N-S trending Ferké Batholith—a ~400 km long intrusive body—but are also recorded in numerous other plutons across the Paleoproterozoic domain of the country [8] [9]. Despite their widespread occurrence and importance, a comprehensive synthesis of their distribution, petrographic character, and geochemical signature has been lacking. Previous studies have often been localized, leaving a gap in the holistic understanding of this major granite group.

This study aims to address this gap by building upon foundational work to provide a unified analysis. The specific objectives are to: 1) systematically map and describe the petrographic units of the major two-mica granite plutons across Ivory Coast; 2) characterize their geochemical signatures using major, trace, and rare earth element data; 3) integrate petrographic and geochemical data to understand petrogenetic processes and source characteristics; and 4) propose a coherent geodynamic model for their emplacement within the Eburnean orogeny. By achieving these objectives, this work contributes to a more nuanced model for the formation of the Paleoproterozoic crust in the West African Craton.

2. Geological Setting

The West African Craton (WAC) records a long and complex Precambrian evolution marked by the Leonian, Liberian, and Eburnean orogenies. Its basement is composed of Archean and Paleoproterozoic granitoids that reflect different tectono-magmatic environments (**Figure 1**). The Archean granitoids, dated between 3.0 and 2.5 Ga, are mainly represented by tonalite-trondhjemite-granodiorite (TTG) associations, granodiorites, granites, and charnockites, locally reworked under granulite facies metamorphism [10] [11]. These TTG-type assemblages are typical of early cratonic crust and greenstone belt terranes.

During the Paleoproterozoic, the Eburnean orogeny (2.2 - 1.8 Ga) generated a wide range of granitoids with variable structural positions and geochemical signatures. Early classifications [6] [8] distinguished syntectonic heterogeneous batholiths (Baoulé-type, equivalent to Cape Coast granites in Ghana) from post-tectonic homogeneous plutons (Bondoukou-type, equivalent to Dixcove granites). Later refinements emphasized their emplacement in distinct tectonic domains: granitoids of folded eugeosynclinal zones (Abronian granitoids, Eburnean I) and granitoids of folded miogeosynclinal zones and activated intermediate massifs (Baoulé granitoids, Eburnean II) [3]. Geochemical studies further revealed that Ivorian Eburnean granitoids are generally leucocratic, sodic, and feldspathic, but poorer in ferromagnesian and calcic components compared to global analogues [12].

Two major Paleoproterozoic granitoid generations are recognized. The first (2200 - 2150 Ma) is closely associated with greenstone belts and dominated by TTG-type suites (granodiorites, tonalites, trondhjemites). The second (2150 - 1800 Ma) is related to volcanic-sedimentary ridges and includes monzogranites, granodiorites, tonalites, and leucogranites [4] [13]-[16]. Together, these granitoids reflect the transition from Archean TTG-dominated crustal growth to Paleoproterozoic syn- to post-orogenic magmatism during the Eburnean cycle, which played a major role in the stabilization and evolution of the southern WAC.

The geology of Côte d'Ivoire is part of the West African Craton (WAC), which includes Archean and Paleoproterozoic terranes stabilized between 3450 and 1600 Ma [17]-[19] (**Figure 1**). The country lies within the Man Shield, one of the major exposures of the craton, and is composed of ~97.5% Precambrian basement rocks and ~2.5% of a narrow Cretaceous-Tertiary coastal sedimentary basin. The Precambrian basement is divided into two main structural domains separated by the Sassandra fault: 1) the Kenema-Man Archean domain to the west, shaped by the Leonian (3300 - 2900 Ma) and Liberian (2900 - 2700 Ma) orogenies, and 2) the Baoulé-Mossi Paleoproterozoic domain to the east, structured during the Eburnean orogeny (2500 - 1600 Ma), sometimes subdivided into a Burkinian event (2400 - 2150 Ma) and the Eburnean sensu stricto (2120 - 1800 Ma) cycle [20]. The Archean domain is dominated by gneissic granitoids, greenstone relics, and high-grade metamorphic rocks, whereas the Paleoproterozoic domain is characterized by predominantly felsic lithologies metamorphosed under greenschist to amphibolite facies conditions. The latter includes two structural zones [9] [21]: the SASCA zone in the southwest, where Archean and Birimian units coexist, and a broader geosynclinal-type zone dominated by Birimian volcano-sedimentary sequences and granitoid intrusions oriented NE-SW. Structurally, the Eburnean evolution is marked by three major defor

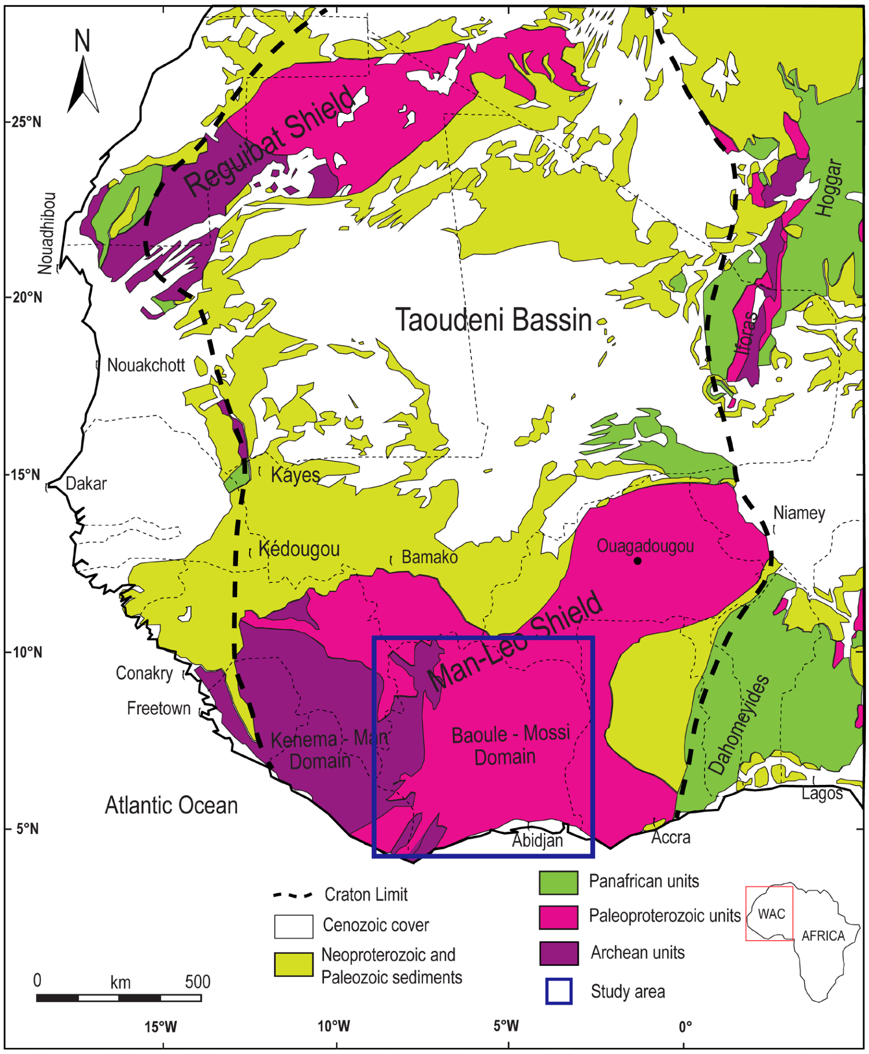

Figure 1. Geological map of the West African Craton showing the location of the study area (modified after [22]).

Mation phases: an early brittle deformation (D1) responsible for the formation of Eburnean troughs and the Sassandra fault system; a ductile phase (D2) associated with regional folding and metamorphism; and a late Eburnean phase (D3, 1800 - 1550 Ma) that localized shear zones and was partly coeval with Tarkwaian sedimentation. A distinctive feature of the Ivorian basement is the widespread development of two-mica granites, particularly the Ferkessédougou Batholith (syntectonic muscovite-rich leucogranite). This body extends over ~400 km in length and up to 50 km in width, cutting across the country from NE to SW and separating the Archean and Paleoproterozoic domains [4] [12] (**Figure 2**). These granites are aligned parallel to the tectonic fabric of the surrounding metasedimentary units and are mostly restricted to the Paleoproterozoic domain, being virtually absent in the Archean terranes. Overall, the geological framework of Côte d'Ivoire reflects the juxtaposition of Archean and Paleoproterozoic crustal blocks, later intruded by granitoids and affected by successive deformation and metamorphism during the Eburnean cycle, followed by post-orogenic brittle faulting and dolerite-kimberlite intrusions.

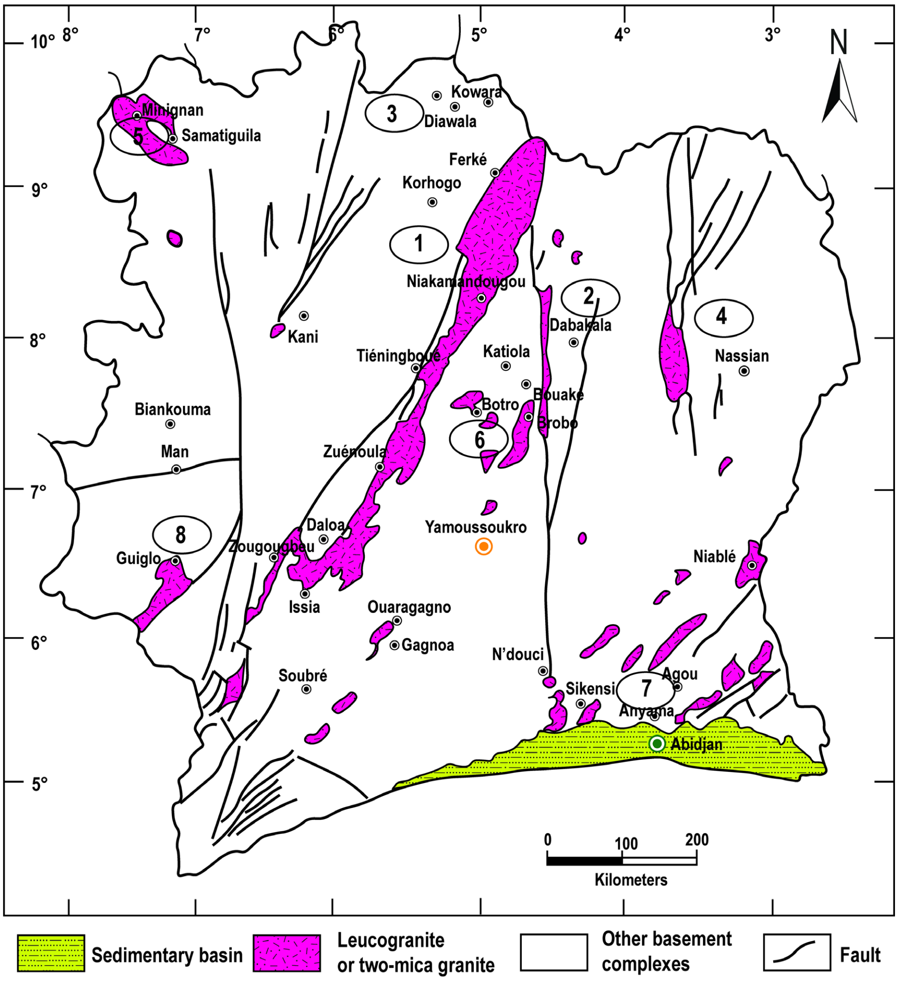

Figure 2. Simplified map of two-mica granites in Côte d'Ivoire (modified after [23]). 1-Ferke batholith; 2-Dabakala batholith; 3-Kowara batholith; 4-Nassian batholith; 5-Minignan batholith; 6-Bouake batholith; 7-Batholiths of the N'Douci, Skensi, and Anyama regions.

3. Methodology

The data used in this study are derived from the doctoral theses of Casanova, Yobou, and Doumbia [4] [7] [12], which were based on extensive field campaigns and laboratory analyses. Petrographic analyses were carried out on thin sections to determine the lithology and mineral parageneses, allowing for detailed characterization of the constituent minerals and their textures.

Geochemical analyses employed multiple techniques. Major and minor elements were quantified using ICP-ES, while trace elements were measured by ICP-MS at the CRPG in Nancy [4] [7]. Casanova's earlier work also utilized emission spectrography, atomic absorption spectrophotometry, and colorimetry, depending on the element analyzed. To ensure consistency and comparability across the entire geochemical dataset, all data were normalized to common reference standards and reprocessed using contemporary calibration methods. This integrated approach provides precise information on rock chemical composition and offers a reliable basis for tectono-geochemical interpretation of the Precambrian basement of Côte d'Ivoire. The data were processed using standard petrological software and plotted on discriminant diagrams (TAS, R1-R2, Pearce diagrams, multi-element spidergrams, REE patterns) to classify the rocks and infer their petrogenesis and tectonic setting.

4. Results

4.1. Petrography

The granites and leucogranites of Côte d'Ivoire display significant textural and mineralogical variability, reflecting diverse magmatic and tectonic conditions. The Ferké-Niakaramandougou leucogranites are syntectonic, muscovite-dominated, with well-developed foliation and lineation. Two facies are recognized: a medium- to coarse-grained facies, granitic to porphyrogranular, and a fine-grained border facies, microgranular to micro-porphyritic. Quartz ranges from subhedral to euhedral, alkali feldspar is xenomorphic or perthitic, and plagioclase commonly exhibits twinning and sillimanite inclusions. Biotite is automorphic and elongate, often interlayered with muscovite, which occurs in multiple generations.

The Katiola-Marabadiassa massifs (Kowara and N'Zi) contain mesocratic porphyrogranites, enriched in biotite and plagioclase. Intense mylonitization is observed in the N'Zi massif, associated with mineral lineation and injection of pegmatites with muscovite ± tourmaline ± garnet. Two-mica granites from Bouaké, Zuénoula, Dabakala-Nassian, and Abidjan are granitic to porphyrogranular, composed mainly of quartz, microcline, plagioclase, chloritized biotite, and muscovite. Accessory minerals include garnet, apatite, zircon, epidote, and magnetite.

Korhogo and Kong granites exhibit granoblastic to porphyrogranular textures, with biotite, muscovite, quartz, and feldspars, and accessories such as tourmaline and spodumene. In the SASCA domain, six petrographic types were identified, ranging from foliated granites with large muscovite lamellae to weakly oriented, leucocratic granites. Tectonic structures, including foliation, lineation, and mortar-like textures, are frequent, especially in deformed massifs.

Overall, the Precambrian granites exhibit substantial variability in texture, mica proportions, and accessory minerals, reflecting a strong syn- and post-emplacement tectonomagmatic influence. This mineralogical and textural diversity allows clear differentiation between leucocratic, mesocratic, and highly deformed to migmatitic facies.

4.2. Geochemistry

4.2.1. Major Elements

The two-mica granites from the studied massifs display a remarkable chemical homogeneity. They are consistently silica-rich (SiO_2 = 68.5 - 74.8 wt.%) and aluminum-rich (Al_2O_3 = 13.3 - 17.2 wt.%, average 14.9 wt.%), with alumina saturation indices generally above 1.13 (**Table S1** in Supplementary material). Total alkalis ($Na_2O + K_2O$) range from 6.8 wt.% to 10.2 wt.%, although four Kowara samples yield slightly lower values (5.5 - 6.8 wt.%). K_2O dominates over Na_2O, with an average K_2O/Na_2O ratio of 1.18, indicating the predominance of alkali feldspar over sodic plagioclase, which is mainly albite-oligoclase with CaO < 3.5 wt.%. The $Na_2O + K_2O/CaO$ ratio reaches up to 16.3. Mafic constituents are scarce, as shown by the sum of TiO_2 + FeOt + MnO + MgO rarely exceeding 7% (mean 2.1%).

In the TAS diagram [24], the samples (SiO_2 = 58.2 - 74.8 wt.%; $Na_2O + K_2O$ = 5.8 - 10.2 wt.%) plot within the granite field, extending toward alkaline granites (**Figure 3(a)**). Most samples fall in the acidic domain, ranging from subalkaline to alkaline compositions, whereas Kowara rocks are the least siliceous and lie at the granite-quartz diorite boundary. The R1-R2 diagram of De la Roche [25] indicates limited compositional variation, from quartz syenite to granodiorite (**Figure 3(b)**). Granites from Ferkéssédougou, Abidjan, and Bouaké cluster within the granite field, while Grand-Lahou samples lie at the granite-alkaline granite boundary. Dabakala samples fall between granite and granodiorite, and Kowara leucogranites show granodioritic affinities. These classifications confirm the granitic affinity of the Abidjan, Bouaké, Katiola, Ferkéssédougou, Grand-Lahou, and Nassian intrusions, and the granodioritic to tonalitic character of Kowara and part of Dabakala.

The two-mica granites follow the calc-alkaline trend close to the A pole, consistent with their evolved nature. In the K_2O vs. SiO_2 diagram of Peccerillo and Taylor [26] (**Figure 3(c)**), samples from Abidjan, Bouaké, Grand-Lahou, Katiola, and Ferké plot between the high-K calc-alkaline and shoshonitic series, with one Ferké sample in the calc-alkaline field. Dabakala rocks are more scattered, ranging from tholeiitic to shoshonitic affinities, likely due to alkali mobility. Kowara and Nassian samples fall within the calc-alkaline series. In the alumina saturation diagram of Barton and Young [27], the granites are mostly peraluminous (**Figure 3(d)**). Abidjan and Ferké range from weakly to strongly peraluminous, Kowara rocks are strongly peraluminous (ASI > 1.1), and Grand-Lahou is weakly peraluminous. Bouaké and Dabakala vary from metaluminous to strongly peraluminous, while Katiola and Nassian are generally metaluminous (ASI < 1). **Figure 3(d)** reveals the granite types for the two-mica granites studied. The Nassian, Katiola, and Grand-Lahou granites are I-type, while those from Kowara are S-type. Those from Abidjan, Bouaké, Dabakala, and Ferké straddle I- and S-types.

Overall, the two-mica granites from Côte d'Ivoire are predominantly peraluminous, silica-rich, and K-rich, with compositions ranging from syenogranite to granodiorite. Their calc-alkaline to shoshonitic affinities and evolved geochemical features highlight their magmatic differentiation and the influence of source composition.

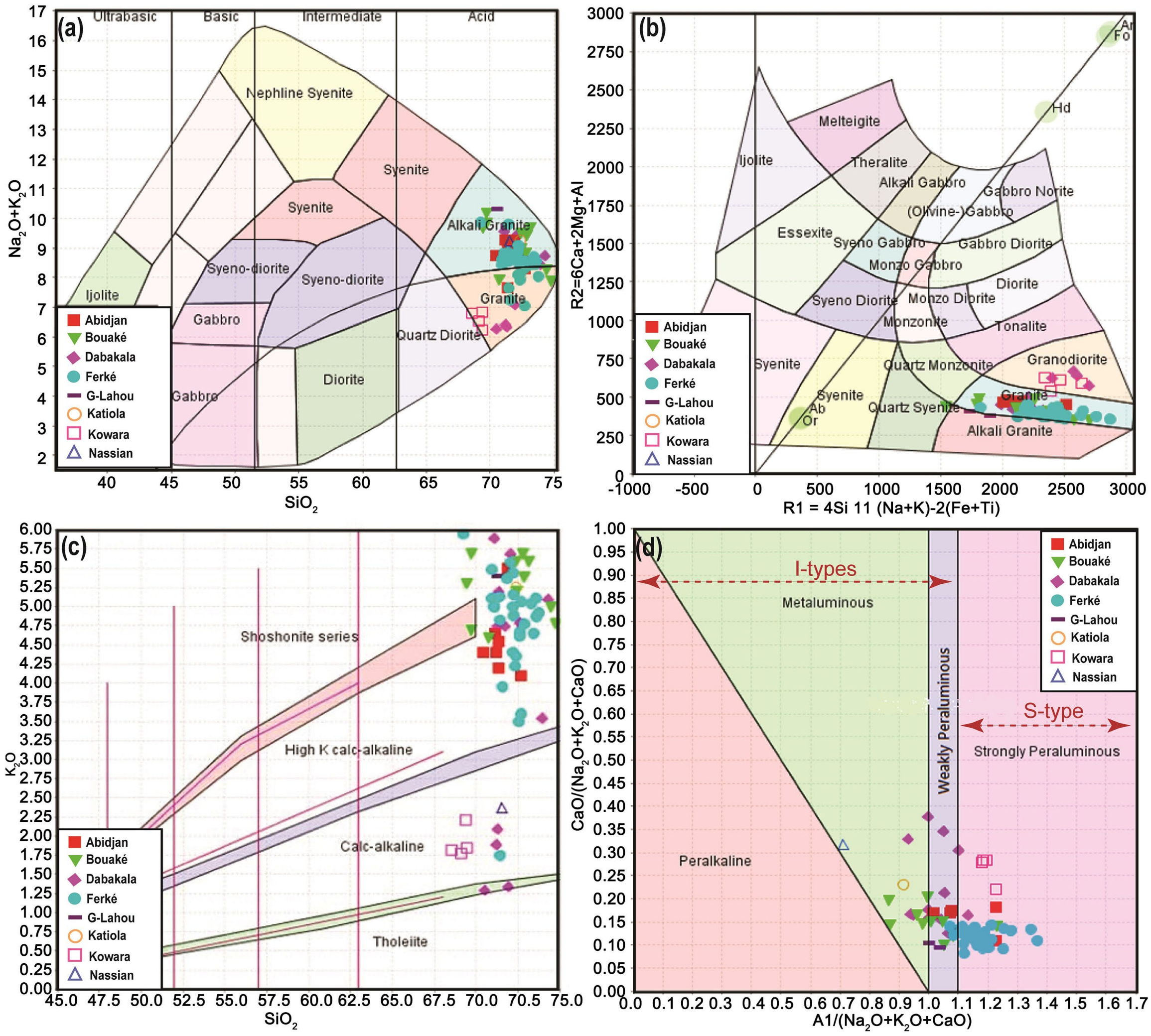

Figure 3. Chemical variation diagrams for the two-mica granites illustrate the geochemical features that distinguish the studied rocks. (a) Plot of $Na_2O + K_2O$ vs. SiO_2 (after [24]; adapted from [28]); (b) Plot of R_1 vs. R_2 ([25]); (c) Plot of K_2O vs. Na_2O ([26]), as modified by [29]); (d) Plot of alumina saturation ([27]).

4.2.2. Trace Elements

The trace element compositions of the two-mica granite massifs are illustrated in primitive mantle-normalized diagrams (**Figure 4**). The multi-element spectra display broadly similar patterns, characterized by enrichment in incompatible LILE (Cs, Rb, Ba, Sr) and HFSE (Th, U, Ta, Nb, Zr). The rocks also show a pronounced positive Pb anomaly and negative K and Ti anomalies. The Ba enrichment indicates a lack of significant fractionation of K-feldspar, while the positive Sr anomaly is attributed to plagioclase melting, as Sr readily substitutes for Ca in its crystal structure. Negative Ti anomalies reflect the fractionation of accessory phases such as Fe-Ti oxides and sphene, typical of intermediate to acidic magmas [30] (**Figure 4**). The enrichment in HFSE may be related to the separation of accessory minerals such as zircon, which is known to host Zr, Y, Hf, and Yb [31].

A total of eleven whole-rock analyses from the Ferkéssédougou (7 samples) and Kowara (4 samples) massifs were used to characterize REE distribution (**Table S1** in Supplementary material). The Ferké granites show variable total REE contents ranging from 28 to 489 ppm, with the lowest and highest concentrations recorded in samples T9N2 and T-14, respectively. The Ferké leucogranites display parallel REE spectra with low to moderate slopes (**Figure 5(a)**, indicating a moderate enrichment in light REE (LREE) (LaN = 17.58 - 350 × chondrite) and moderate to strong fractionation [(La/Yb)N = 11.58 - 51.50]. Sample T-14 is distinguished by its strong REE enrichment, interpreted as reflecting a low degree of partial melting of garnet-bearing crustal sources. Europium anomalies are generally weak to absent (Eu/Eu* = 0.54 - 0.97). The lack of Eu anomaly in T-14 may be explained by oxidizing conditions, under which Eu^{3+} cannot be incorporated into feldspars [7].

The Kowara granites show more homogeneous REE contents, ranging from 65.6 to 100 ppm, with spectra broadly parallel and comparable to those of Ferké (**Figure 5(b)**. These rocks are enriched in LREE with weak to moderate fractionation [(La/Yb)N = 11.48 - 21.79], except for sample SEP-1, which displays stronger fractionation [(La/Yb) N = 51.50]. No significant europium anomaly is observed in this massif (Eu/Eu* = 0.93 - 1.05).

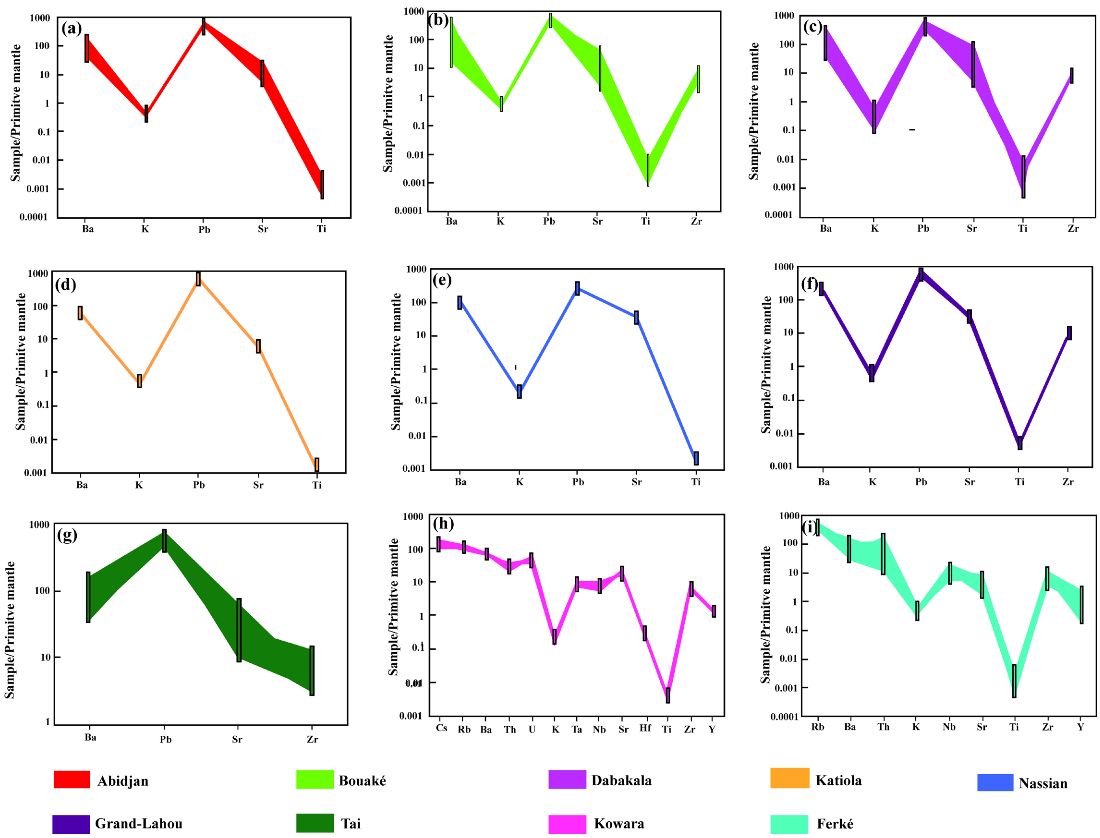

Figure 4. Primitive mantle-normalized multi-element spider diagrams for the studied Cote d'Ivoire two-mica granite suites. (a) Abidjan; (b) Bouaké; (c) Dabakala; (d) Katiola; (e) Nassian; (f) Grand-Bassam; (g) Tai; (h) Kowara; and (i) Ferké (chondrite values from [32]).

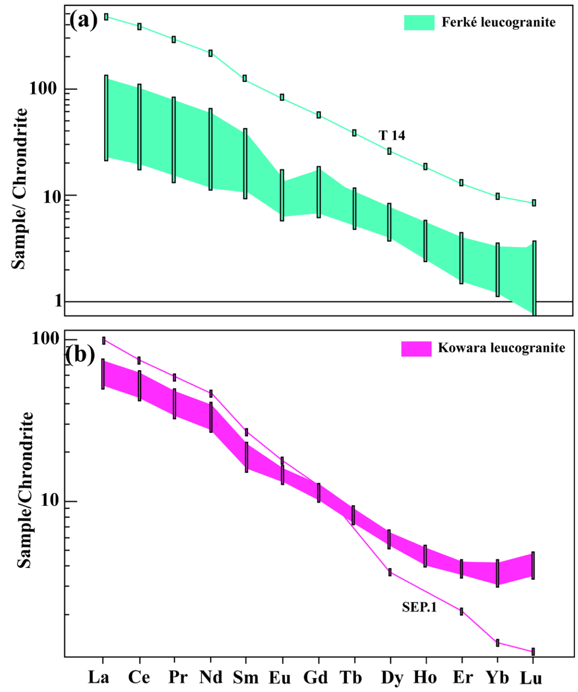

Figure 5. Chondrite-normalized rare earth element (REE) patterns for the studied Cote d'Ivoire two-mica granite suites. (a) Kowara and (b) Ferké (chondrite values from [32]).

5. Discussion

5.1. Nomenclature

The classification of two-mica granites, long based solely on field observations and petrography, appears more complex when examined through geochemical data. The use of various discrimination diagrams highlights greater lithological diversity within the studied plutons. Most samples belong to the two-mica granite group, identified in the Abidjan, Bouaké, Dabakala, Ferké, Grand-Lahou, Nassian, and Katiola plutons, consistent with the Casanova and Yobou findings [7] [12]. However, some samples show distinct compositions. These rocks had previously been described as leucogranites by [4] and as (meso)granites with two micas by [12]. Similarly, two Dabakala samples (N˚ 72 and 86) correspond to leucogranitic tonalites, although [12] classified them as granites with two micas. Finally, sample N˚ 185 from Bouaké, interpreted by Casanova as a leucogranite with two micas, is more accurately a syenite. These comparisons indicate that, depending on the diagram used, some samples may shift between classification fields, while remaining within closely related petrographic categories. Overall, despite these variations, all the studied rocks clearly fall within the broader granitoid suite.

5.2. Geodynamic Context

Geochemical data reveal close relationships between the chemical composition of the granites and their geodynamic settings, in the Nb vs. Y diagram (**Figure 6(a)**, the Ferké granites plot within the syn-collisional granite field, whereas the Kowara granites fall in the volcanic-arc granite field. The Rb vs. (Y + Nb) diagram confirms these trends (**Figure 6(b)**: the two-mica granites from Ferké are mainly syn-collisional, while those from Kowara plot in the volcanic-arc field, reflecting subduction-related influences [7]. In the R1-R2 diagram [25] (**Figure 6(c)**, most Ferké granites lie in the syn-collisional field. The two-mica granites from Abidjan and Bouaké fall into both the late-orogenic and syn-collisional fields, whereas the Grand-Lahou granites are restricted to the late-orogenic field. Finally, the Kowara granites plot along the boundary between the pre-collisional and syn-collisional fields, suggesting emplacement in a transitional setting between active convergence and collisional stages.

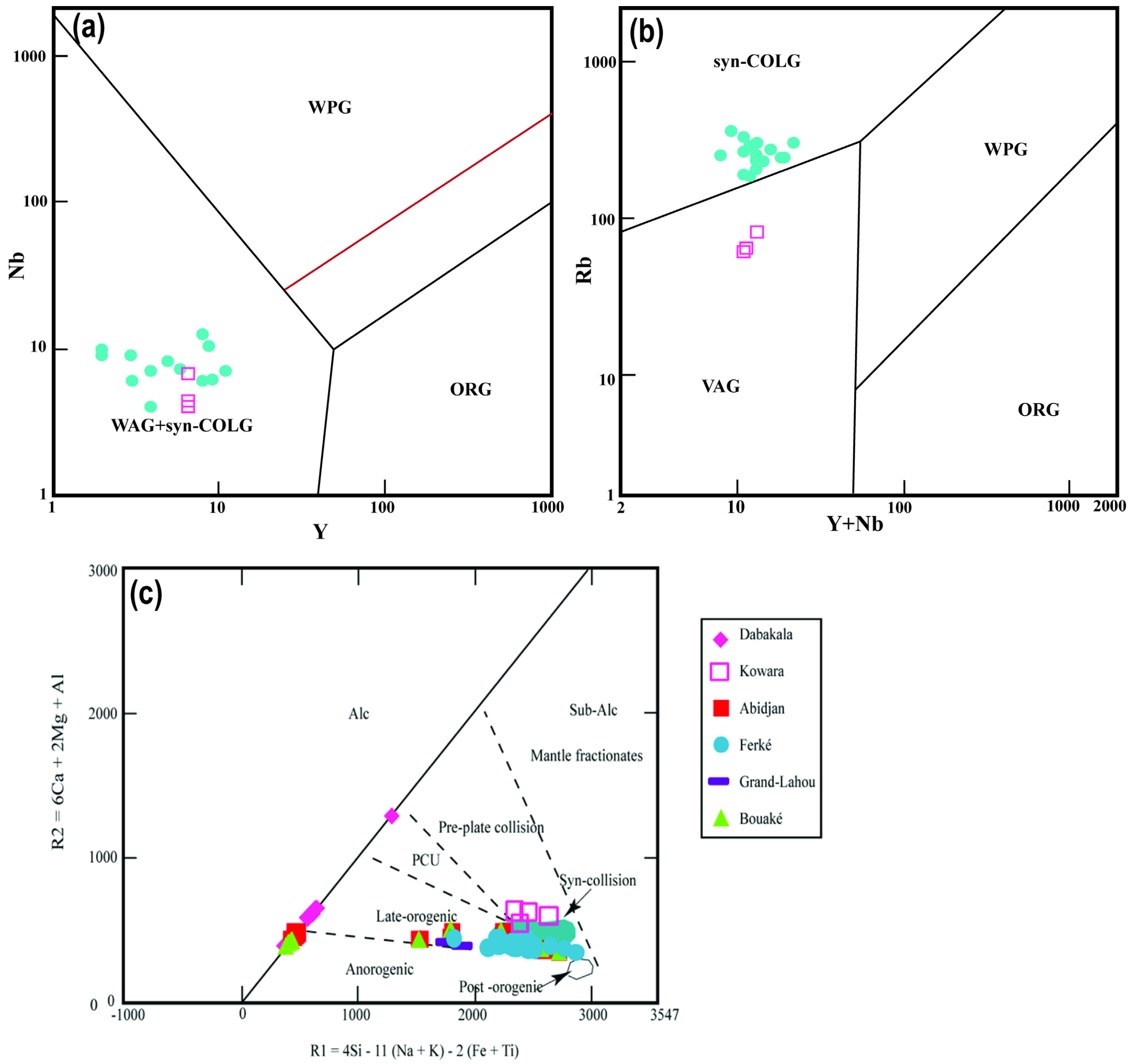

Figure 6. Tectonic discrimination diagrams for the Côte d'Ivoire two-mica granite suites. (a) Nb vs. Y plot; (b) Rb vs. (Yb + Nb) plot (Pearce *et al.*, 1984); (c) R1 vs. R2 plot (De La Roche *et al.*, 1980), modified by Batchelor and Bowden (1985).

5.3. Petrogenesis and Geotectonic Implications

Geochemical data indicate that the two-mica granites of Côte d'Ivoire are predominantly meta- to strongly peraluminous and show a calc-alkaline to high-K calc-alkaline trend. Based only on geochemical characteristics, clear compositional differences are observed between massifs. The Ferké, Abidjan, and Grand-Lahou massifs display strongly peraluminous signatures, consistent with a crustal affinity [33]. The Kowara granites share similar features with Ferké, also suggesting a crustal source. In contrast, the Katiola and Nassian granites are meta-aluminous, pointing to a mantle contribution [33]. The Bouaké and Dabakala massifs range from meta- to peraluminous, implying a dual origin that combines both crustal and mantle sources. These results corroborate earlier studies [4] [34] [35], which emphasized the mixed origin of Ivorian granitoids. However, Doumbia *et al.* (1998) reported that all the granitoids (Ferké, Kowara, Katiola) exhibit juvenile characteristics, evidenced by mantle-like low initial Sr isotopic compositions (0.700 - 0.702) and positive ε_{Nd} values (+1.5 to +2.7). The potassic enrichment of these granites is consistent with advanced magmatic differentiation [3]. Gamsonré [36], studying granitoids in Burkina Faso, attributed K enrichment to the progressive destruction of biotite during granitization, releasing potassium that accumulates in more evolved rocks. Rare earth element (REE) patterns and multi-element diagrams reveal negative Eu anomalies in the Ferké granites, reflecting feldspar fractionation. The fractionation of heavy REE further suggests residual garnet and, to a lesser extent, zircon in the source [7]. Elevated concentrations of Rb, Ba, Th, and U in the Ferké, Abidjan, Bouaké, Dabakala, Grand-Lahou, and Kowara granitoids cannot be explained solely by magmatic differentiation and likely result from crustal contamination, as highlighted by Sr isotopic composition and positive epsilon Nd values [7]. On the Martin tectonic discrimination diagrams [37], Ferké and Kowara leucogranites fall mainly within the Archean granitoid field, with some Kowara samples straddling the Archean-post-Archean boundary (**Figure 7(a)**. Their position indicates that the protoliths of these leucogranites are TTG-type sources. Geotectonically, the two-mica granites of Ferké, Abidjan, Bouaké, Dabakala, and Grand-Lahou are linked to a collisional setting, whereas the granodioritic two-mica granites of Kowara are more consistent with a subduction-related context. The evidence indicates that the granites of Ferké, Abidjan, Bouaké, Dabakala, and Grand-Lahou were formed from magma generated by a collisional event, whereas those from Kowara originated from the fusion of sediments and/or crustal anatexis. This interpretation aligns with broader geodynamic models proposed for Archean cratons [11] [37]-[39]. These models suggest that TTG suites formed through partial melting of undepleted oceanic crust in Archean subduction zones. The REE-depleted signatures of TTG are explained by garnet ± amphibole retention in the melting residue. Interestingly, mechanisms first proposed for Archean crustal evolution may extend into the Paleoproterozoic, as illustrated by the Birimian granitoids of Côte d'Ivoire. Beyond horizontal subduction-related processes, vertical tectonic styles such as sagduction [40] may also have influenced the geodynamic evolution of these terranes, adding complexity to their petrogenetic history. The multi-element diagrams of the two-mica granites from Côte d'Ivoire, normalized to the primitive mantle [41], show a close similarity to those of the two-mica granites from Central Bretagne, France [42] (Figure 7(b). These features suggest that they may have formed under similar tectonic or magmatic conditions, such as crustal anatexis (partial melting of continental crust) in a collisional or post-collisional setting. This is confirmed by studies conducted by [43], who reveal that the Central Bretagne granite results from the Hercynian orogen formed by the collision of the Sud Gondwana plate, the Laurentia plate, and the Laurasia plate.

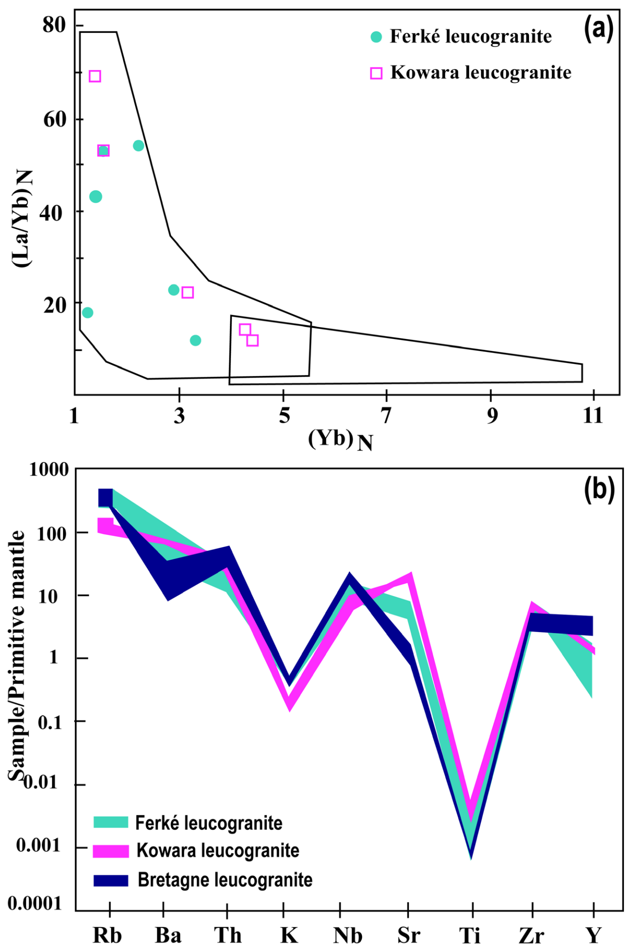

Figure 7. (a) Position of the Ferké and Kowara leucogranites on the (La/Yb) N vs. (Yb) N diagram [37]. (b) Comparison spider diagrams of the two-mica granites from Côte d'Ivoire with those from France.

6. Conclusions

The two-mica granites of the Ivory Coast, prominently represented by the extensive Ferké Batholith, constitute a petrogenetically significant component of the Paleoproterozoic crust within the West African Craton. This integrated petrographic and geochemical study demonstrates that these leucogranites, while sharing a common mineralogical signature, exhibit remarkable geochemical diversity that reveals a complex petrogenetic history. Their high-silica, potassic to shoshonitic, and predominantly peraluminous character, coupled with distinct enrichments in LILE and LREE with negative Nb-Ta-Ti-Eu anomalies, points to a dual origin. This involves both the anatexis of ancient, TTG-like Archean crustal protoliths, producing the strongly peraluminous varieties of Ferké, Abidjan, and Grand-Lahou, and the involvement of mantle-derived magmas with significant crustal assimilation, giving rise to the metaluminous granites of Katiola and Nassian and the hybrid compositions of Bouaké and Dabakala.

Tectonic discrimination analyses firmly place the emplacement of these granitoids within the dynamic framework of the Eburnean orogeny, transitioning from volcanic-arc settings to syn-collisional environments. This evolution reflects the progressive crustal thickening and convergence that culminated in the stabilization of the craton. The geochemical signatures are not merely a product of fractional crystallization but are profoundly shaped by source composition, partial melting conditions, and interaction with the continental crust.

In summary, this synthesis underscores that the two-mica granites of Ivory Coast are more than just a widespread lithological unit; they are critical archives of the Paleoproterozoic crustal evolution of the West African Craton. They record the intricate interplay between reworked ancient crust and juvenile mantle additions during a major orogenic cycle. To further refine this petrogenetic model, future research should prioritize high-precision geochronology (e.g., U-Pb on zircon) coupled with detailed isotopic studies (Nd-Sr-Hf) to precisely constrain the timing of magmatism and quantitatively assess the contributions of their diverse source components.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table S1. Geochemistry data in Supplementary material.
https://docs.google.com/spreadsheets/d/1HL0il8JIXORstdxj97Kbfr2eSucI-giWg/edit?usp=sharing&ouid=116111865943465123694&rtpof=true&sd=true