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REVIEWER'S REPORT

Manuscript No.: IJAR-57756

Title: CARACTÉRISATION PÉTROGRAPHIQUE ET MINÉRALOGIQUE DES GRANITOÏDES ET PEGMATITES DANS LE MASSIF PANAFRICAIN DE HARAZE DJOMBO (BATHA, TCHAD CENTRAL),

Recommendation:

Accept after minor revision

Rating	Excel.	Good	Fair	Poor
Originality		✓,		
Techn. Quality		✓,		
Clarity	✓,			
Significance	✓,			

Reviewer Name: Abdul Haseeb Mir

Detailed Reviewer's Report

The manuscript titled "**Petrographic and Mineralogical Characterization of Granitoids and Pegmatites in the Pan-African Haraze Djombo Massif (Batha, Central Chad)**" provides an essential geological and mineralogical investigation of an understudied region. Positioned at the structural transition zone between the Saharan Metacraton and the Pan-African Central African Fold Belt (CAFB), the Batha Massif represents a critical area for understanding late-Neoproterozoic crustal evolution. The scope of the paper is well-defined, addressing a significant literature gap through an integrated baseline analysis of the post-collisional felsic magmatism that occurred during regional crustal relaxation (~570–560 Ma). By mapping these specific igneous and hydrothermal systems, the study aims to clarify both the local petrogenetic history and the structural framework that governs regional mineralization patterns.

The study uses a practical multi-analytical approach that combines geological mapping, macro-scale structural fieldwork, optical trans-illumination microscopy, and high-resolution powder X-ray diffraction (XRD). Field data collection targeted two primary resource sectors within the Haraze Djombo department: the Djombo and Gleb sectors.

The key empirical findings clearly identify distinct magmatic facies and hydrothermal overprints within the massif:

- **Facies Differentiation:** The fieldwork distinguishes two distinct granitic variants: a peraluminous biotite-muscovite granite dominating the Djombo sector and a highly altered amphibole-biotite granite found within the Gleb sector.

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- **Mineralogical Fingerprinting:** High-resolution powder XRD analysis of the Djombo granite confirms a crystalline mineral assemblage composed of quartz, microcline, albite, biotite, and tremolite.
- **Hydrothermal Deformations:** Samples from the Gleb pegmatitic and veining systems reveal a distinct monophasic composition of highly crystalline, pure quartz. This mineralogy is paired with a prominent cataclastic texture, indicating late- to post-orogenic deformation.
- **Metallogenic Potential:** The structural association of massive, sheared quartz veins points to extensive circulation of hydrothermal fluids along localized shear zones, supporting the area's potential for orogenic gold mineralization.

The manuscript demonstrates good analytical potential by linking basic mineralogical identification to broader regional geodynamic processes. Using high-resolution XRD data provides solid support for the optical mineral assignments. The authors successfully interpret the cataclastic microstructures and pure quartz veins within a post-collisional framework, showing how fracturing during the final cooling phases of the Pan-African orogeny created pathways for hydrothermal fluids. This provides a useful baseline dataset for central Chad, which has traditionally lacked high-resolution laboratory analysis compared to neighboring Cameroon or Nigeria.

Suggestions for Improvement

- **Provide an Explicit Quantitative Modal Composition Table:** While the text lists the primary mineral phases identified via XRD (quartz, microcline, albite, biotite, tremolite), it should include a structured table presenting the quantitative or semi-quantitative modal percentages of these minerals. This detail is necessary to accurately classify the rocks using standard IUGS QAPF diagrams.
- **Integrate Representative Photomicrographs:** The petrographic narrative would be much stronger if it included high-resolution optical microscopy images. Add figures showing the samples under both Plane-Polarized Light (PPL) and Cross-Polarized Light (XPL) to visually demonstrate key features like the cataclastic textures, plagioclase twinning, and muscovite-biotite relationships.
- **Incorporate a Geological and Sample Location Map:** Introduce a clear multi-scale figure containing a regional tectonic map of Central Africa alongside a localized geological map of the Haraze Djombo massif. Clearly plot the exact GPS coordinates where the Djombo and Gleb samples were collected to ensure reproducibility.

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- **Present Raw XRD Diffractograms:** To back up the mineralogical claims, include the raw, indexed X-ray diffraction patterns as figures in the main text or appendix. Show the characteristic intensity peaks for microcline, albite, and tremolite, along with their matching 2θ angles.
- **Clarify the Petrogenetic Significance of Tremolite:** The presence of tremolite within a peraluminous biotite-muscovite granite is unusual. Expand the discussion section to explain this occurrence. Clarify whether the tremolite formed through secondary hydrothermal alteration of earlier ferromagnesian minerals or if it points to local contamination from calcareous country rocks.
- **Add Geochemical Context to Support the "Peraluminous" Label:** The abstract describes the Djombo granite as "peraluminous". Since this classification depends on specific chemical ratios (i.e., A/CNK > 1.1), the authors should either provide whole-rock major element geochemical data or clarify that this label is based on petrographic observations, such as the presence of primary muscovite.
- **Expand the Comparative Structural Analysis:** Deepen the regional comparison by explicitly contrasting the Haraze Djombo massif with similar post-collisional structures in the region, such as the Guéra Massif in southern Chad or the western Adamawa-Yadé domain. Discuss whether their shear zones share similar orientations and deformation styles.
- **Elaborate on the Economic and Metallogenic Indicators:** The paper notes a strong potential for gold mineralization within the sheared quartz veins. To make this argument more robust, describe any visible macroscopic indicators of mineralization observed during fieldwork, such as sulfide boxworks, iron oxide staining, or wall-rock alteration zones (like sericitization or silicification).
- **Refine Mechanical and Structural Terminology:** Ensure a clear distinction is maintained between the "pegmatite samples" and "massive quartz veins" mentioned in the text. Clarify whether the pure quartz zones represent highly differentiated, feldspar-depleted zones of pegmatite cores or if they are entirely separate hydrothermal veins that cut across the older granitoids.
- **Standardize and Update Bibliographic References:** Ensure the reference list is uniformly formatted according to an established style guide, such as APA 7th edition or Vancouver. Check that all in-text citations match the final bibliography perfectly, and verify that newer regional entries include complete volume numbers, page ranges, and active DOIs.

Recommendation for Publication

I recommend this manuscript for **publication with major revision**. The article addresses a genuinely understudied and important segment of the Pan-African orogenic belt, and the combination of field

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mapping with XRD mineral assignment provides a good foundation for further work. However, to meet the standards of international international geological journals, the authors must include clear sample location maps, representative optical photomicrographs, and raw indexed XRD diffractograms. Additionally, resolving the geochemical classification and explaining the presence of tremolite will significantly improve the paper's scientific value and impact.