The Pan-African Fayalite Quartz-monzonite from North-central Basement of Nigeria

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Introduction

Figure 1. Field view of Bauchite (NE of the study area)

The fayalite- and orthopyroxene-bearing quartz monzonite, locally named bauchite (Figure 1), is identified at the lowest exposed structural level of the Pan-African basement in Nigeria. This rock is very iron-rich challenging the typical Bowen's reaction series, which suggests that olivine and quartz should not coexist. Earlier studies[1,2] attributed bauchite formation to the impregnation of granites by iron-rich fluids and argued that the coexistence of ortho- and clinopyroxenes with fayalite and quartz suggests deep-crustal magmatic emplacement (≈30 km depth). In this study, we used field, textural, and whole rock geochemical approach in order to unravel the mystery surrounding this fascinating rock type.

Geological context

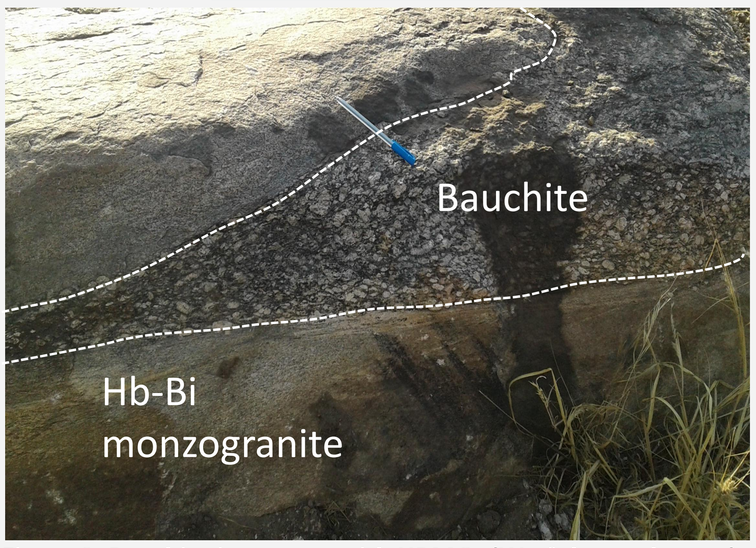


Figure 2. Bauchite in contact with HBMGr (W of the study area)

Our field investigations indicate that bauchite and surrounding granite, crosscuts the regional scale NW-SE trending foliation of the host migmatites, which is consistent with intrusive plutonic bodies (Figure 2). The preferred orientation of feldspar phenocrysts in bauchite but also in granites, delineates a shallow-dipping magmatic foliation and a regional-scale domal structure (Figure 3). The lowest structural level of this complex consists, from bottom to top, of bauchite, hornblende-biotite granite and biotite granite, which is in contact with granulite facies migmatites (Figure 4).

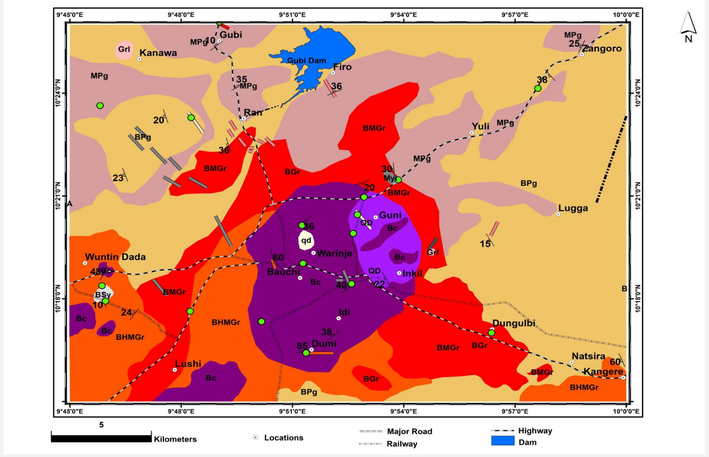


Figure 3. Geologic map of Bauchi complex

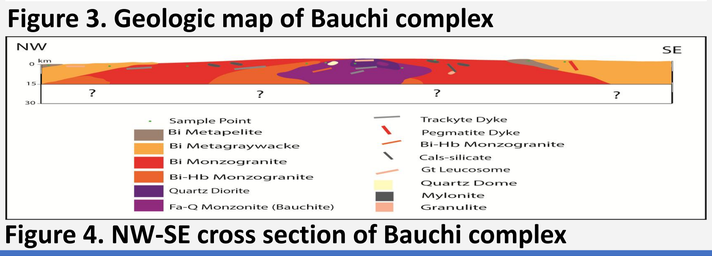
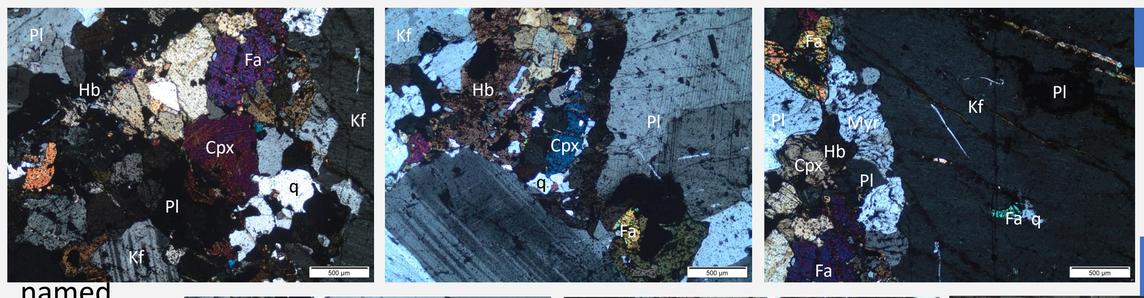


Figure 4. NW-SE cross section of Bauchi complex

Petrological analysis

Bauchite, exposed in the core of the dome (Figure 3), has a granular texture, with microcline and albite phenocrysts in a matrix of fayalite, ortho- and clinopyroxenes, hornblende, biotite, and quartz (Figure 5). The accessory minerals present are zircon, apatite, magnetite, ilmenite, and titanite. At the lowest structural level (Figure 4), green bauchite dominated by fayalite and pyroxenes grades into brown bauchite characterized by a larger amount of hornblende and biotite. Textural analysis indicates a magmatic layering delineated by the alternation of fayalite-pyroxenes and microcline-albite layers. Interstitial quartz shows no signs of intracrystalline deformation, consistent with late crystallization from a melt. Hornblende shows lobate contacts with feldspars and forms a corona around fayalite and pyroxenes, which points to reaction between these minerals. Biotite euhedral crystals are in contact with hornblende. Microcline is typically bordered by myrmekite (Figure 5).



Green bauchite

Pl – Plagioclase, Hb – Hornblende, Fa – Fayalite, Cpx – Clinopyroxene, Kf – K-feldspar, q – Quartz, Myr - Myrmekite

Brown bauchite

Pl, Hb, Fa, Kf, q, Myr – same as above, Opx – Orthopyroxene, Bi – Biotite

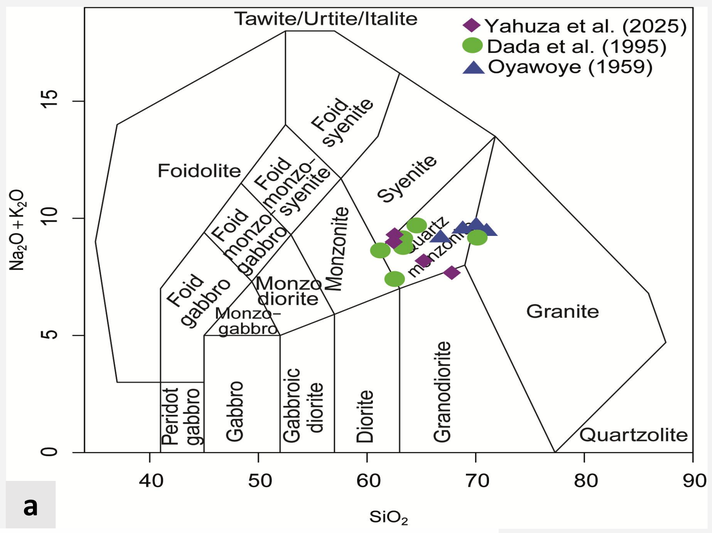
Figure 5. Bauchite texture: green to brown

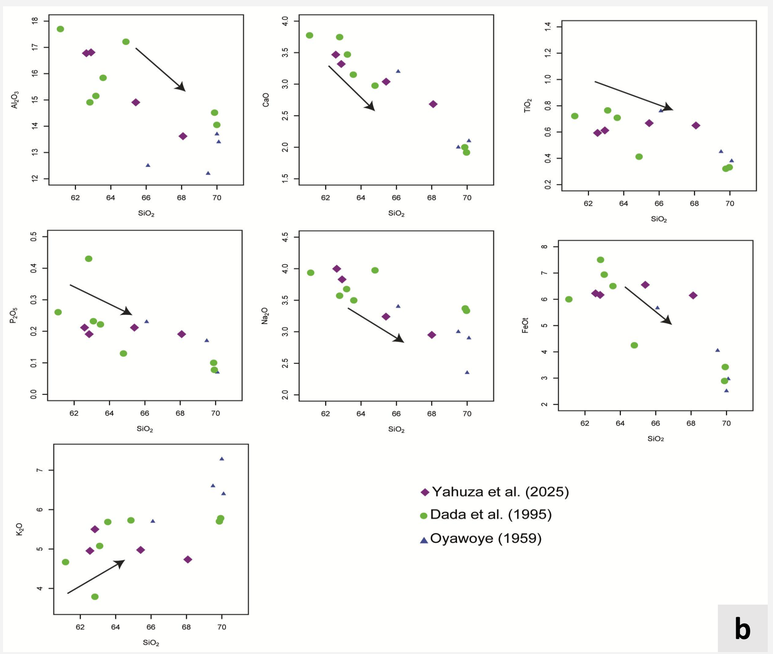
Green to brown bauchites mineral paragenesis

Pl + Kf + Fa + Cpx + Felsic melt ⟶ Hb + Opx + Pl + Kf + Bi + Qz

Whole rock geochemical data

Bauchite samples have an average SiO_2 content of 65%, a high FeO/MgO ratio (14-17), and low Mg/(Fe+Mg) ratios (0.09-0.12). Their average K/(Na+K) is 0.49, with K_2O exceeding 4%, making them highly potassic (Figure 6a). The SiO_2 content negatively correlates with most major oxides except K_2O, which shows positive correlation (Figure 6b). Trace elements data show high concentrations of Rb, Ba, K, and Zr, along with negative anomalies in Nb, Sr, P, Ti, and Y but positive anomalies in Zr (Figure 6c), pointing to an iron-rich alkaline magma more or less contaminated by granitic magma.





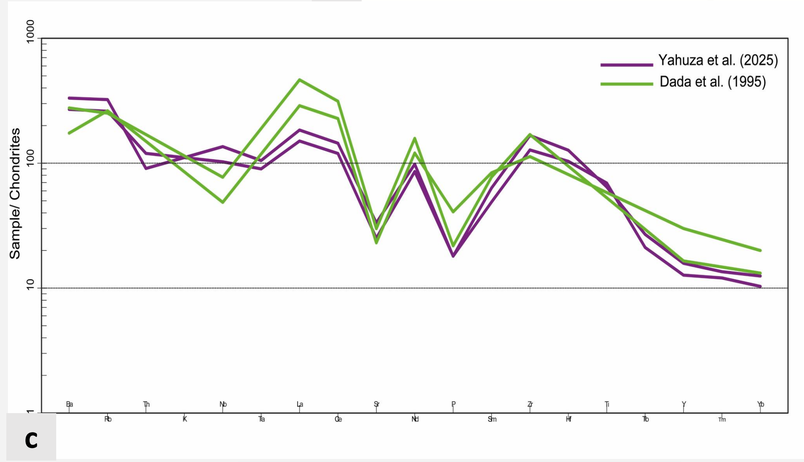


Figure 6. a) TAS diagram b) Harker diagram and c) Trace elements pattern of Bauchite

Conclusion and Perspectives

The features described herein are consistent with an origin of bauchite resulting from interaction between an exotic iron-rich mantle derived alkaline magma and a felsic hydrous crustal one. The next step is to test this hypothesis using Sr/Nd isotopes, U/Pb geochronology on Zr as well mineral trace elements data.

References

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