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ex solo ad solem, वसुधैव कुटुम्बकम्
ex solo ad solem, Vasudhaiva Kutumbakam
from the earth to the sun, the world is one family

Charnockites of the Archean domain of Man (western Côte d'Ivoire): origin and role in the geodynamic evolution of the West African craton

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1 INTRODUCTION

Charnockites are orthopyroxene-bearing granitoids whose origin has long been debated:

- Magmatic origin: direct crystallization from a high-temperature, H_2O-poor magma (Frost and Frost, 2008)
- Metamorphic origin: dehydration under CO_2-rich fluid conditions (Newton, 1992; Santosh, 1992)
- Hybrid origin: interaction between magma and a dry country rock (Grantham *et al.*, 2012)

Central research question: Are the charnockites of the Man region of magmatic, metamorphic, or hybrid origin? What do they reveal about the geodynamic evolution of the craton?

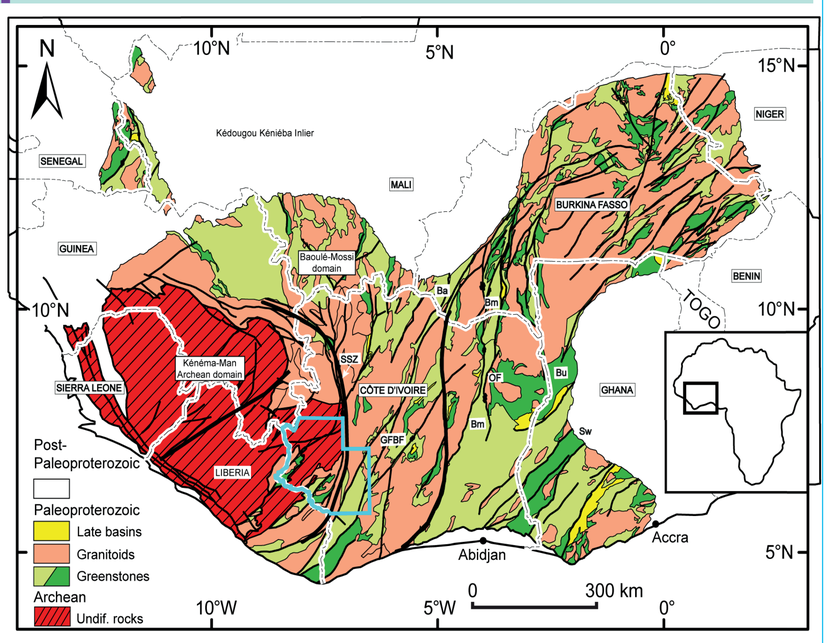


Fig. 1: Simplified map of the Man–Leo Shield (modified after Milési *et al.*, 2004; Thiéblémont *et al.*, 2016).

2 GEOLOGICAL SETTING

- West African Craton (~4.5 million km²): Reguibat Shield (N), Man–Leo Shield (S), and the Kayes–Kédougou–Kéniéba inliers
- Archean Kenema–Man Domain vs. Paleoproterozoic Baoulé–Mossi Domain, separated by the Sassandra Shear Zone (SSZ)
- Archean terranes (3.3–2.7 Ga): TTG complexes, grey gneisses, metabasites, and charnockites
- Eburnean Orogeny (2.10–2.07 Ga): crustal reworking along the margin of the Man Domain (Gasquet *et al.*, 2003)

3 STUDY AREA & SAMPLING

The study area covers the Man–Danané region (Tonkpi), a mountainous area:

- Crosscut by the SSZ, separating the Archean and Paleoproterozoic domains and controlling the emplacement/deformation of the units
- Volcano-sedimentary formations, metabasites, TTG, metasediments of oceanic origin (Cabu *et al.*, 2000; Koné *et al.*, 2025)
- Regional amphibolite-facies metamorphism (500–550°C); subvertical foliation, NW-SE syn-metamorphic lineation, ductile shearing

4 METHODOLOGY

- Geological field work and sampling
- Petrographical study (thin sections confection and description)
- Crytal chemistry: CAMECA SXFive electron microprobe (15 kV, 10-20 nA)
- Whole-rock geochemistry: major elements and trace elements by LA-ICP-MS
- The petrographic study focused on eight representative samples, four of which were subjected to geochemical analyses:

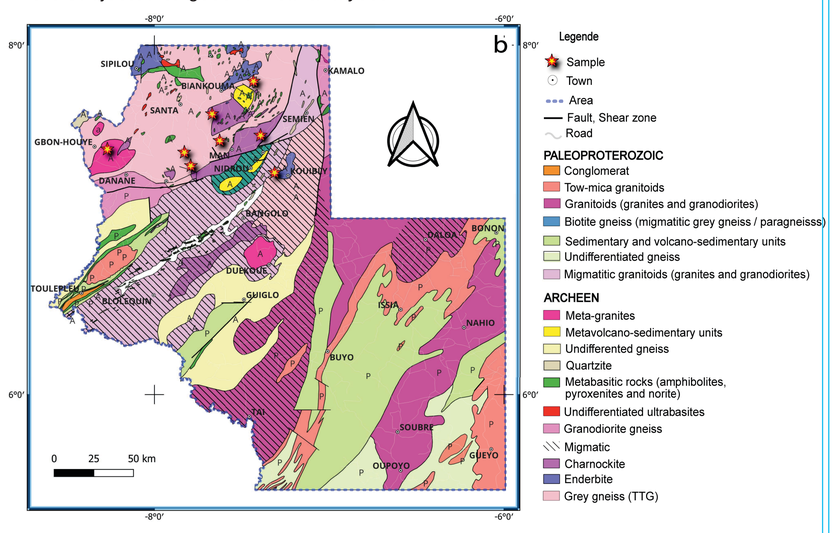


Fig. 2: Simplified geological map of Côte d'Ivoire and location of the study area (modified after Tagini, 1971).

5 PETROGRAPHY

- Granite wiith microcline, plagioclase, relict orthopyroxene and clinopyroxene (HT granulite-facies assemblage), and retrograde biotite and hornblende.
- Granodiorite: plagioclase, K-fsp, myrmekite; opx rimmed by biotite/chlorite
- Q-monzodiorite/Q-monzogabbro: plagioclase-dominanate rock with a band texture; early orthopyroxene and clinopyroxene are partially replaced by amphibole and biotite

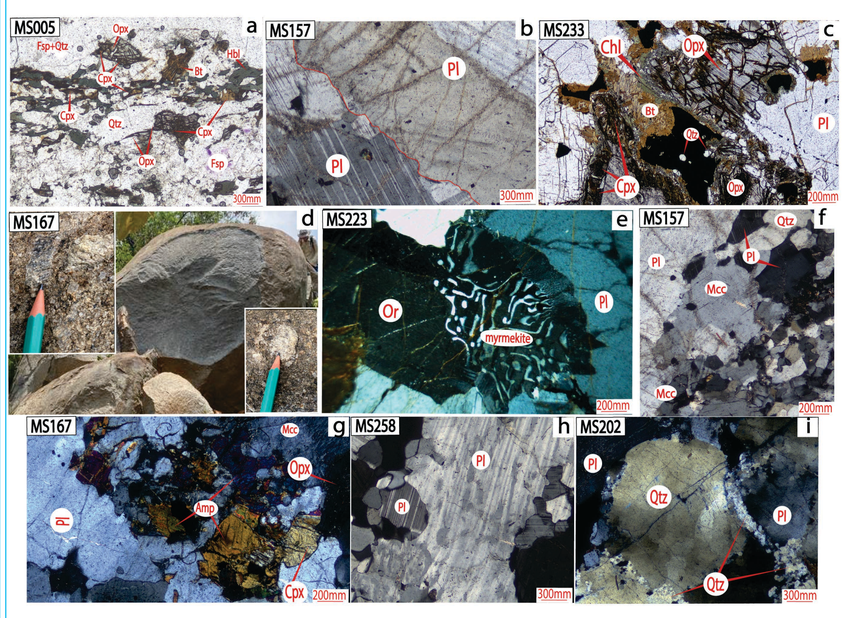


Fig. 3: Macro- and microscopic aspects of charnockites with granitic composition. Mc: microcline, Fsp: feldspar, Qz: quartz, Hbl: hornblende, Bt: biotite, Pl: plagioclase, Opx: orthopyroxene, Cpx: clinopyroxene

6 GEOCHIMICAL CLASSIFICATION

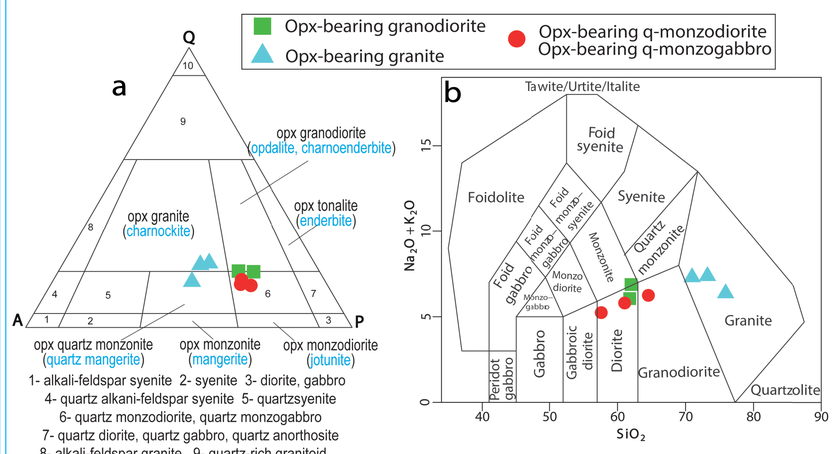
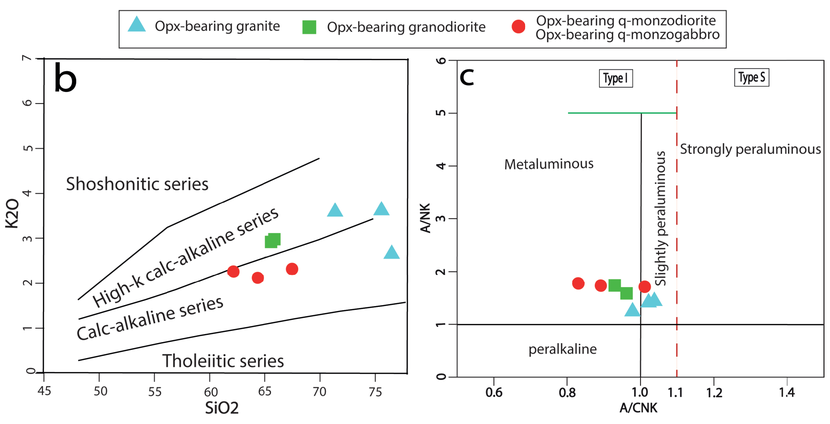


Fig. 4: QAP (Strekeisen,1974) and TAS (Middlemost, 1991, 1997) diagrams: continuum q-monzondiorite/q-monzogabbro to granite to OPX-bearing granite



- Calc-alkaline to high-K series; slight initial tholeiitic trend (early Fe enrichment)
- Metaluminous to strongly peraluminous composition, I-type granitoids (A/CNK 0.89–1.05)

7 Trace Elements, REE & Geodynamic Setting

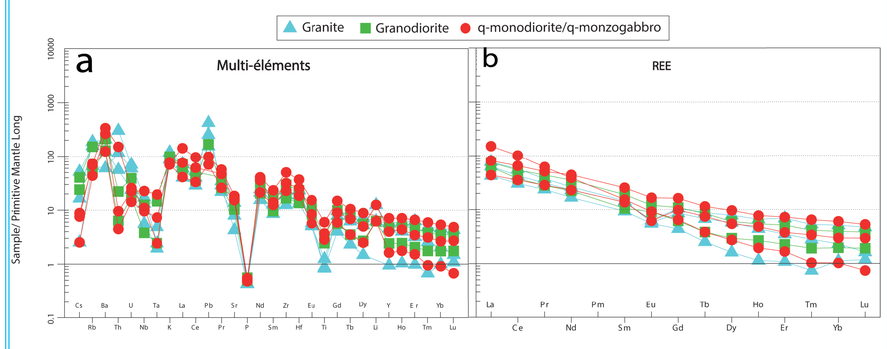


Fig. 6: Multi-element and rare earth element spectra (normalized to primitive mantle/chondrite).

- LILE enrichment (Ba, Rb, Th, K); negative Nb-Ta, Sr, P, Ti anomalies -> crustal source + subduction componen
- LREE/HREE fractionation; negative Eu anomaly increasing with differentiation (plagioclase fractionation)

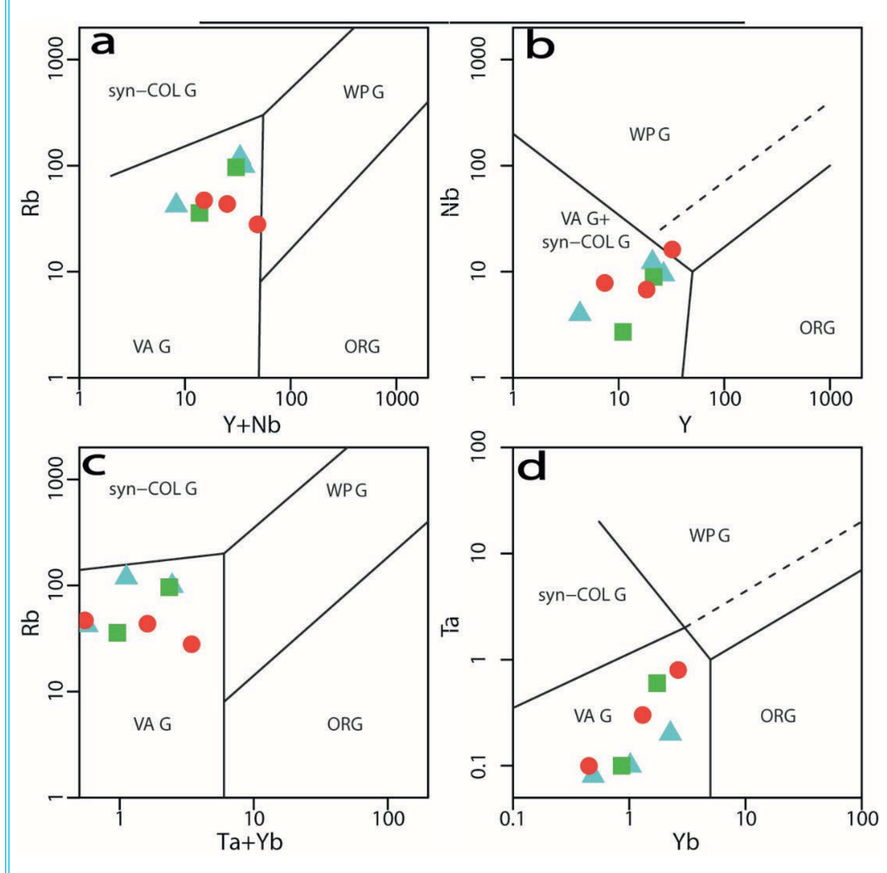


Fig. 7: Tectonic discrimination diagrams (Pearce et al., 1984): Volcanic Arc Granite (VAG) affinity, with evolved sample trending toward the syn-collisional field

8 Conclusion

Orthopyroxene is a primary magmatic phase (HT crystallization, >800°C, anhydrous), rather than solely metamorphic

- Continuous mafic-felsic suite derived from a single parent magma through fractional crystallization
- Partial melting of mafic lower crust + probable mantle input, followed by post-magmatic granulite-facies metamorphism and polyphase retrograde rehydration. Consistent with a lithospheric convergence setting, in line with the Eburnean orogeny and remobilization of the Archean Man basement
- **The Man charnockites: evolutionary stages of a single deep magmatic system are key markers of the thermo-tectonic history of the West African Craton**

- Réf. clés : Frost & Frost (2008) Gondwana Res.
- Grantham et al. (2012) Precambrian Res.
- Caby *et al.* (2000) J. Afr. Earth Sci. • Pearce *et al.* (1984) J. Petrol.
- • Kouamelan (1996) PhD Thesis

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Structural Geology in a Changing World: Tectonics, Resources and Sustainable Transitions