

Mineralogy and petrogenesis of the precambrian basement rocks, around Ede, Southwestern Nigeria

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Basement rocks around Ede southwestern Nigeria consist of Banded migmatite-gneiss, pegmatites, Amphibolites and lenses of charnockites. Petrographic studies revealed that the gneisses are composed of 50% quartz, 20% plagioclase. The pegmatite is made up of 50% quartz, 25% microcline, 20% muscovite and 5% microperthite.

The study is aimed at showing the compositional features, petrogenesis and tectonic setting of the rocks mentioned above by analysing the whole rock and trace element chemistry of the various rock types present.

Ten representative samples of the pegmatites and banded gneisses in the study area were collected and analysed for major, trace and rare earth elements. Geochemical analyses reflected the highest average SiO₂ value (72.43%) for the pegmatites while the lowest average SiO₂ content (62.48%) was obtained for the banded migmatite-gneiss. Mean Al₂O₃, Fe₂O₃, MnO, CaO and MgO are higher in the banded migmatite-gneiss than in the pegmatites. However mean Na₂O and K₂O values are higher in the pegmatites than in the banded gneisses.

Average bivariate plots indicates that the precursors of the gneisses are sedimentary while that of the pegmatites are igneous. Mode of occurrences involving partial melting seems to be compatible with the high Zr contents from the result of the trace element analytical data.

Geochemical discriminant diagrams show the rocks to have originated in a continental environment whose tectonic setting is similar to an active continental margin and a continental island arc. Geochemical studies and plots also indicate trends comparable to those typical of the calc-alkaline plutonic suites. Abundances and variations of major and trace elements suggest that part of the protoliths of the rocks are of sedimentary origin with an evolution involving partial melting and subsequent contamination by the plutonic episodes of the Pan African orogeny.

Ferric iron and water incorporation in wadsleyite under hydrous and oxidizing conditions

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Wadsleyite is the most hydrous nominally anhydrous mineral of the mantle transition zone (410-510 km depth). It also has a high affinity for trivalent cations such as Fe³⁺. However the relationships between ferric iron and hydrogen incorporations in this mineral are unknown.

We conducted experiments at ~13 GPa and 1400°C, under oxidizing and hydrous conditions. The recovered samples were studied using micro-XANES (X-ray Absorption Near Edge Structure) to determine the ferric iron contents in polyphasic samples and SIMS (Secondary Ion Mass Spectrometry) to determine the water concentrations. XANES analyses show that ferric iron content increases with increasing total iron content, and reaches a maximum of 45 mol% of the total iron. The use of infrared spectroscopy highlights a new protonation scheme in wadsleyite, with most of the protons associated with the high frequency band near 3600 cm⁻¹. SIMS analyses show that water contents in wadsleyite vary from 0.5 to 0.7 wt% H₂O. Hydrogen content in wadsleyite is negatively correlated with ferric iron content. The divalent cations (i.e., Mg²⁺ + Fe²⁺) and the Si content in wadsleyite decrease with increasing Fe³⁺ content, evidencing an incorporation mechanism via substitution into the metal sites with charge compensation by metal and Si vacancies.

These results bring new constraints on the contents of Fe³⁺ and H⁺ defects in relation with the chemical environment. Such information is important in order to interpret electrical conductivity of wadsleyite in terms of hydrogen content.