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Major and trace element variations in amphibole and clinopyroxene of Birimian greenstones and tonalites (western Burkina Faso)

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Amphibole is a common constituent mineral of mafic rocks, yet it's complex mineral structure often makes it difficult to distinguish unambiguously if it is of magmatic, metamorphic, hydrothermal or metasomatic origin. Besides primary magmatic amphibole, in studied basalts and gabbros, green amphibole often replaces original clinopyroxene due to metasomatism (autometamorphism) of oceaning floor (uralitisation). Moreover, actinolite and/or hornblende can form in the same lithologies during regional metamorphism under greeschist to amphibolites facies conditions. In contrast with clinopyroxene, which shows only minor compositional zoning, amphibole composition is extremely variable. Magmatic, metasomatic and metamorphic compositional clusters significantly overlap due to continuous reactions, with Al-and Ti-tschermakite, edenite, Fe-Mg and plagioclase-type substitution vectors being the most common.
In order to establish supplementary criteria allowing us to better determine the amphibole origin, we have analysed trace elements in amphibole and/or clinopyroxene in 15 samples from Birimian mafic to intermediate volcanic and intrusive rocks. Method of in-situ ICP-MS laser ablation was used to determine the trace element contents in minerals. Three types of bulk-rock compositions were studied: tholeiitic metabasalts and associated metagabbros, calc-alkaline mafic and intermediate metavolcanites and intrusive tonalites. Samples containing 1) magmatic pargasite, 2) metasomatic amphibole corresponding to actinolite, hornblende, tschermakite and edenite, 3) regional metamorphic actinolite and hornblende and 4) hydrothermal hornblende occurring in veinlets and vesicles were selected. Clinopyroxene of magmatic origin is present in some of the samples. First results for amphibole and clinopyroxene trace element analyses allow us to clearly distinguish the different types defined by the petrographic study. The whole rock trace element data point out that the investigated samples are crystallization products from two different types of magmas: tholeiitic magmas and calc-alkaline magmas.