INTRACONTINENTAL ALKALINE MAGMATISM: GEOLOGY, PETROGRAPHY, MINERALOGY AND GEOCHEMISTRY OF THE GABBRO-SYENITIC JEBEL HAYIM MASSIF (CENTRAL HIGH ATLAS, MOROCCO)

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Jebel Hayim Massif belongs to a suite of alkaline to transitional intrusive massifs scattered in the axial zone of the Moroccan Central High Atlas and formed during a Middle to Upper Jurassic transtensional phase. Country rock is locally strongly deformed and the style of deformation is consistent with a sinistral strike-slip regime contemporaneous to magma emplacement. During the Oxfordian, magma ascended to the upper crust where it solidified in Triassic to Early Jurassic sedimentary sequences at the base of the High Atlas sedimentary cover. Present position of magmatic rocks is within Bajocian to Bathonian sediments and is the result of a post-magmatic tectonic extrusion. Jebel Hayim Massif is made of two gabbroic layered complexes (JH1 and JH2) overlain by pneumatolytic gabbros and cross-cut by monzonitic to syenitic dikes. Both complexes consist of a lower troctolite series and of an upper oxide-rich gabbros and ol-gabbros series, respectively. The contacts between lower and upper series are horizontal and have a primary magmatic origin. Troctolites and ol-gabbros are cumulates with olivine, plagioclase and augite as early cumulus phases, and ilmenite, biotite and kaersutite as late interstitial phases. Both cumulates display modal and cryptic layering with a decrease of the olivine content and of the MgO content of all mineral phases from bottom to top. Oxide-rich gabbros are characterized by abundant magnetite (10%), scarce olivine, low MgO content, and flow texture, and they do not display modal or cryptic layering. Compositions was calculated for representative rock types using the trace element content in olivine, plagioclase and clinopyroxene, and selected sets of partition coefficients. On the basis of the calculations, it is clear that the evolution of the gabbros was not continuous nor linear, and that different parental magmas were responsible for the different series. Different degrees of partial melting are invoked to explain the variations of incompatible elements (Hf, Ta, REE and Th) abundances. A early differentiation stage, at depth, is invoked to explain the relatively low MgO calculated contents (<9%) and the large variations of Ni and Cr abundances. Oxide-rich gabbros are depleted in both compatible elements and incompatible elements which is attributed to a larger degree of partial melting (2.5%) and to more fractionation of olivine and chromite at depth (11% of crystal fractionation) than for generating troctolites and ol-gabbros melts (<7%). Troctolites and ol-gabbros parental magmas resulted from a degree of partial melting ranging from 0.8% for JH2 troctolites to 1.8% for JH2 ol-gabbros to 3% for JH1 troctolites.