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Geochemistry of the Neogene-Quaternary Middle Atlas basaltic province (Morocco)

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In Northwest Africa, a huge mafic intraplate cenozoic volcanism extends along a NE-SW strip, through the Middle- and Anti- Atlas mountains (Morocco). The Middle Atlas basaltic province is the largest and youngest volcanic field in Morocco. A hundred well-preserved strombolian cones and maars emitted numerous mafic lava flows which cover a surface of ca. 960 km2 and range in composition from nephelinites to subalkaline basalts through basanites and alkali basalts. This alkaline volcanism, associated to an abnormally shallow lithosphere-asthenosphere boundary (around 70km thick), expands from Middle and Late Miocene to Plio-Quaternary. Previous works demonstrated that nephelinites, basanites and alkali basalts derive from partial degree of spinel- and garnet-bearing peridotites from the base of the lithospheric mantle (El Azzouzi & al., 2011). Trace elements and Sr, Nd, Pb and Hf isotopic compositions have been done on thirty samples selected in order to cover the variability of differentiation degree and age. Nephelinites represent only 1.2 % of the total surface of volcanic units; they form small monogenic volcanoes built during the Middle and Late Miocene (16.25 – 5.87 Ma) and the Plio-Quaternary (3.92 - 0.67 Ma). The three other types are exclusively Plio-Quaternary (3.77 – 0.60 Ma). Basanites cover 22.5 % of the volcanic field area, and generally overlie the more widespread alkali basaltic flows (68.5 % of the plateau surface). Finally, subalkaline basalts form the El Koudiate cone and associated flows (7.8 % of the surface of the volcanic units) and their petrographic, trace element and isotopic features suggest that they derive from the contamination of alkali basaltic magmas by the upper continental crust. Nephelinites, basanites and alkali basalts have a distinct HIMU flavour. Most nephelinites have rather unradiogenic 87Sr/86Sr ratios close to 0.7032, which do not change through time. Those of the other types are slightly higher (up to 0.7037) and tend to increase temporally, and also from basanites to alkali basalts. The Nd isotopes range from 0.51292 to 0.51275. These geochemical features allow us to discuss the relative contributions of the African continental crust and lithospheric mantle and that of the underlying asthenosphere to the genesis of the Middle Atlas magmas.