Toward a more complete database of regional dyke swarms of the West African Craton

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Regional dyke swarms are considered to represent periods of repeated crustal extension wherein enormous amounts of mantle-derived magmas ascend through the crust. Their distribution, palaeomagnetism, petrology, geochemistry and emplacement ages are of intense geodynamic interest since they provide invaluable clues to our understanding of the nature of the sub-continental lithospheric mantle. There is also an increasing global recognition of their utility in delineating the existence and extent of Large Igneous Provinces (LIPs) and, especially, to use their exact emplacement ages and dyke directions to reconstruct formerly adjacent crustal blocks. Thus, the study of dyke rocks is extremely important in order to reveal the configuration of ancient supercontinents. In this contribution we present a preliminary survey of mafic dyke swarms of the West African craton (WAC). The synthesis demonstrates the complexity in the dyke record, suggesting that geochronological, petrological, geochemical and paleomagnetic characteristics of many dyke sets remain to be established before WAC and its shield areas can be put into a global plate tectonic framework. The WAC, stable since 2 Ga, constitutes the basement of northwestern Africa. The WAC is composed of three Archean and Paleoproterozoic shields: the Reguibat Shield, the Anti-Atlas and the Leo-Man shield, separated by two cratonic sedimentary basins. The basement of the WAC was built through several major orogenic cycles: the Paleoarchean–Leonian cycle (multiple episodes between 3.5 and 3.0 Ga) related to continental accretion and volcano-sedimentary activity whose chronology remains uncertain, the Liberian cycle (2.95–2.75 Ga), the Eburnian–Birimian cycle (2.2–1.75 Ga) and the Pan-African orogenic event (760–660 Ma). One of the main characteristics of the WAC is that no Mesoproterozoic events or rocks are known, suggesting a quiescent period between 1.7 and 1.0 Ga. The exposed parts of the craton outcrop in two main uplifts: the Reguibat Shield in the north (Mauritania, Morocco and Algeria) and the Leo-Man Shield in the south, and in smaller inliers of the Anti-Atlas belt. The dykes and sills of the WAC display remarkably uniform textural, mineralogical and geochemical features throughout the area in which they occur. They all consist essentially of tholeiitic basalts and are typically composed of plagioclase + clinopyroxene (augite) ± orthopyroxene (enstatite) ± olivine displaying doleritic texture and variable grain size. From the geochemical point of view, they are all characterized by a clear negative Nb anomaly, indicating a plausible subduction fingerprint and/or crustal contamination. The similarities of all their trace element patterns play in favor of a single geodynamic environment or a common influence of contamination from sub-lithospheric mantle. These conditions should have been consistent for a long period of time, according to the large range of available ages.

The compilation of geochronological data on mafic dyke swarms in the WAC is dominated by the identification of the so-called Central Atlantic Magmatic Province (CAMP), although it has become increasingly apparent that not all mafic dyke swarms fall into this category. In addition to the mafic dyke and sill swarms that are linked to the CAMP LIP, a number of mafic units can be linked to the Ediacaran-Cambrian Central Iapetus Magmatic Province (CIMP) and the Permo-Carboniferous European North West African Magmatic Province (EUNWA) LIP groups (each representing a clustering of related LIPs emplaced over a more extended time).