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From Large Igneous Province to Arc Magmatism in Bou Azzer–El Graara Inlier (Morocco) : The Neoproterozoïc Geodynamic Evolution of the NW edge of the WAC

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The Tachdamt and Bleida formations of the Bou Azzer–El Graara inlier (Central Anti-Atlas, Morocco) represent two temporally and geochemically distinct Neoproterozoic magmatic episodes that were previously considered as a single lithostratigraphic unit. This study presents new whole-rock major and trace element data combined with Sm–Nd isotopic analyses for volcanic and volcano-sedimentary rocks from both formations. Previously published U–Pb zircon ages constrain emplacement at ~883 Ma for the Tachdamt Formation and ~700 Ma for the Bleida Formation, confirming a significant temporal gap between the two events.

Geochemical and isotopic signatures further highlight their contrasting origins. The ~883 Ma Tachdamt basalts display tholeiitic characteristics, elevated Fe–Ti contents, enrichment in large-ion lithophile elements (LILE), and positive εNd(t) values (+3.2 to +4.5), supporting derivation from a plume-related mantle source associated with Tonian large igneous province (LIP) magmatism. This event broadly coincides with the ~880–860 Ma Munali magmatism of the Greater Congo Craton, suggesting development during a widespread Neoproterozoic extensional regime. In contrast, the ~700 Ma Bleida basalts are marked by negative Nb anomalies, greater compositional variability, and older depleted mantle model ages (TDM = 1.1–1.3 Ga), indicating partial melting of a subduction-modified lithospheric mantle source in a foreland basin context.

These data collectively document a major geodynamic shift along the northwestern margin of the West African Craton, from plume-driven extensional magmatism during the Tonian to arc-influenced magmatism during the Cryogenian. Doleritic dykes cutting both formations represent a later magmatic phase and show structural similarities with the ~860 Ma Manso dyke swarm, although further U–Pb geochronology is needed to better constrain their origin. Overall, the new geochemical and isotopic dataset refines the Neoproterozoic tectono-magmatic evolution of the Anti-Atlas and provides important insights into the magmatic processes associated with the fragmentation of Rodinia.