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Unpacking the origin of dolerites from the external zones of the Betic Cordillera

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The sedimentary rocks corresponding to the Permian-Triassic Iberian margin of the Betic Cordillera host abundant hypabyssal mafic bodies distributed along 1,000 km in south Spain[1]. These bodies known in the local literature as “ofites” exhibit a holocrystalline fabric consisting of fine- to medium-grain-sized clinopyroxene and plagioclase with minor amounts of orthopyroxene and/or olivine and accessory ilmenite and apatite. Paleontologic dating of sedimentary rocks intercalated with these subvolcanic rocks suggest magmatic activity from the Upper Triassic to Middle Jurassic, although widespread radiometric ages[2] (based on whole-rock, biotite and plagioclase K/Ar) indicate 187-155 Ma. New whole rock-data collected from a selected group of bodies (>25) across the Betic Cordillera yield chemistry typical of intermediate rocks with SiO_2 =48.16–56.12 wt% but variable alkalis ($Na_2O + K_2O$= 2.36 to 6.75 wt%), suggesting bodies with varying subalkaline (gabbro-diorite) to alkaline (syeno-diorite) nature. Overall, all the analyzed bodies exhibit negative-sloped chondrite-normalized rare earth element (REE) patterns characterized by strong enrichment in light rare earth elements (LREE) and depletion in heavy rare earth elements (HREE). Besides, most of them show enrichment in large-ion lithophile elements (LILE) relative to high field strength elements (HFSE), as well as strong positive anomalies in Pb and Sr. Counterparts whole-rock Nd and Sr isotopes suggest a uniform mantle source for the parental magmas but with variable degree of crustal contamination (i.e., $\varepsilon Nd_{t=180\ Ma}$ = -1.28 to +13.85). Our new data suggest an origin related to the emplacement of basaltic magmas in an extensional basin opened during the continental rifting associated with the Triassic to Jurassic rupture of Pangea in the western Tethyan realm.

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