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Petrogenetic implications from Triassic rift and subduction-related volcanics in Greece

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Oceanic Triassic volcanic rocks are widespread over mainland Greece. Triassic magmatism has been interpreted of having occurred during the rifting and development of a Tethyan oceanic basin, as the Apulia and Pangea continents spread apart[1]. It comprises of rift-related volcanics (OIB and E-MORB basalts) and of arc volcanics (IAT or calc-alkaline)[e.g. 2-14].

The geochemistry of the OIB alkaline basalts indicates that they originated from the same mantle source but were affected in many cases by differentiation. They range from undersaturated alkaline basalts (Saturation Index SI[15] from -22.0 to -8.0) to differentiated trachybasalts and basaltic trachyandesites (SI values from -6.0 to 1.5). Differentiation is also noticed by their highly variable Mg# values (e.g. Koziakas 46.0-71.5; Evia 46.2-69.0; Othris 36.5-61.5). These rocks can be regarded as sodic ($K_2O/Na_2O \approx 0.3$) and are enriched in LREE [$(La/Yb)_{PM} \approx 6.0\text{-}17.0$], displaying moderate to steep HREE patterns [$(Dy/Yb)_{PM} \approx 1.1\text{-}1.7$]. They exhibit rather low La/Nb (Avg.≈0.7) and similar to the average HIMU-OIB Zr/Nb ratios (Avg.≈3.5). E-MORB volcanics include both alkaline and subalkaline tholeiitic basalts. Many of the E-MORB basalts were also affected by differentiation processes, ranging from undersaturated basalts (SI values from -15.0 to -6.0) to differentiated trachybasalts and basaltic trachyandesites (SI values from -4.0 to 14.5). The extent of differentiation is noticed by their highly variable Mg# values (e.g. Koziakas 33.0-66.5; Evia 58.0-65.0; Pindos 59.0-67.0; Attica 47.0-66.0; Othris 54.0-80.0; Argolis 50.5-70.0; SW & Central Peloponnese 50.5-65.0; Samos 41.5-61.5). They are sodic ($K_2O/Na_2O \approx 0.2$) and compared to OIB basalts are less enriched in LREE [$(La/Yb)_{PM} \approx 1.5\text{-}7.5$], but present highly comparable HREE patterns [$(Dy/Yb)_{PM} \approx 1.1\text{-}1.6$]. They exhibit higher La/Nb (Avg.≈0.9) and Zr/Nb ratios (Avg.≈8.0). Subduction-related high-Mg mafic IAT lavas are enriched in LREE [$(La/Yb)_{PM} \approx 2.0\text{-}5.5$] similar to the E-MORB lavas, and display highly comparable HREE patterns [$(Dy/Yb)_{PM} \approx 1.0\text{-}1.6$] with the OIB and E-MORB lavas. However, their La/Nb (Avg.≈4.5) and Zr/Nb ratios (Avg.≈30.0) clearly associate these rocks with subduction processes.

Various geothermobarometers[16-20] were applied upon the least differentiated OIB and E-MORB alkaline basalts. Mantle potential temperature results are estimated at ∼1450 ˚C and ∼1410 ˚C respectively (melt fraction of ∼5% from a garnet peridotite source). The hydrous primary magma of the IAT basalts is roughly estimated to have been formed at high temperature (>1300 ˚C) melting conditions for arc settings, which can possibly be attributed to subduction of an infant and presumably hot oceanic lithospheric slab[5,18].

References [1] Robertson & Mountrakis 2006 [2] Capedri et al 1997 [3] Chiari et al. 2012 [4] Danelian & Robertson 2001 [5] Koutsovitis et al. 2012 [6] Magganas et al. 1997 [7] Magganas, Kyriakopoulos 2005 [8] Monjoie et al. 2008 [9] Pe-Piper & Piper 2002 [10] Pomonis et al. 2004 [11] Saccani & Photiades 2005 [12] Saccani et al 2003 [13] Saccani et al. 2015 [14] Tsikouras et al. 2008 [15] Fitton et al. 1991 [16] Albarede 1992 [17] Herzberg & Asimow 2015 [18] Lee et al. 2009 [19] Putirka 2005 [20] Scarrow & Cox 1995.