

Geochemical features of mantle source feeding Turrialba volcano (Costa Rica): insights on the ongoing unrest phase

A. DI PIAZZA^{1*}, A.L. RIZZO², F. BARBERI¹,
M.L. CARAPEZZA³, G. DE ASTIS³
AND C. ROMANO¹

¹Dip. Scienze, Univ. Roma Tre, Rome (Italy)

²Istituto Nazionale di Geofisica e Vulcanologia, sez. Palermo, Palermo, Italy

³Istituto Nazionale di Geofisica e Vulcanologia Roma-1, Rome, Italy

We performed a geochemical investigation on rocks and fluid inclusions (FIs) hosted in olivine crystals contained in Turrialba rocks from the last 7ka, as well as on fumarolic gases. The study was aimed to understand both the geochemical characteristic of the magmatic source below Turrialba volcano and the present state of unrest. The suite of analyzed rocks display a calc-alkaline affinity, ranging in composition from basaltic-andesite ($\text{SiO}_2=52.5$ wt % and $\text{MgO}=6$ wt %) to dacite. The pattern of trace elements is compatible with a subduction-related geodynamic context, but an OIB-like signature at the source was also recognized. Sr and Nd isotopes ($^{87}\text{Sr}/^{86}\text{Sr} = 0.703612-0.703678$; $^{143}\text{Nd}/^{144}\text{Nd} = 0.512960-0.512968$) indicated that Turrialba magmas derived from one of the less contaminated source feeding the entire Central America. The $^3\text{He}/^4\text{He}$ ratio of FIs from the most mafic eruptive products varies from 7.86 to 8.07 Ra, while that from andesite lavas ranges from 7.03 to 7.18 Ra. Olivine xenocrysts hosted in a dacitic rock display very high He isotopic values (7.95 Ra), similar to the basaltic ones. This signature of $^3\text{He}/^4\text{He}$ ratio is typical of arc volcanoes (7-8 Ra) in which the contamination of the mantle wedge by crustal fluids is small to negligible. Crater Fumaroles sampled during the unrest phase have an He isotope composition of 7.50-7.96 Ra, well in the range of that measured in FIs. Therefore, we assume that magma involved in the ongoing unrest (up to 2011) has petrological and geochemical features comparable to the basaltic-andesite rocks analyzed in this study. By comparing our data with previous investigations, we finally infer that the variations of $^3\text{He}/^4\text{He}$ ratio observed between 1998-2011 are reasonably related to a refill of the plumbing system by ^3He -rich magmas rising directly from the mantle.