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A geochemical study of alkaline and tholeitic lavas from the Hyblean Plateau (Italy): inferences from noble gases, trace elements and Sr-Nd isotopes

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Eight Plio-Pleistocenic lavas from the Hyblean volcanic province, south-eastern Sicily (Italy), were investigated for the noble gas geochemistry, for the first time. Major element composition classified these products as tholeiite basalts, basanites and nephelinites. Noble gas content of fluid inclusions from their olivine and/or orthopyroxene phenocrysts was analyzed for He, Ne and Ar and ranges between 45×10^{-15}–3.78×10^{-11}, 2.12×10^{-16}–1.13×10^{-14} and 5.13×10^{-13}–4.48×10^{-11} mol/g, respectively. Most samples display $^{3}He/^{4}He$ ratios of about 7Ra (where Ra is the atmospheric $^{3}He/^{4}He$ ratio of 1.38×10^{-6}) except for two lavas characterized by low He abundance and showing $^{3}He/^{4}He$ = 3.53 and 8.35Ra, respectively. Such a wide deviation from the most recurrent value (7Ra) is attributed to external inputs of ^{4}He and ^{3}He by secondary phenomena (i.e. magma aging, crustal contamination and cosmogenic processes, respectively). The isotopic signature of He, together with Sr and Nd isotope data ($^{87}Sr/^{86}Sr$=0.70274-0.70331; $^{143}Nd/^{144}Nd$ =0,51293-0,513162) evidenced a strict relation with mantle harzburgite xenoliths found in Miocenic diatremes from the same volcanic province, suggesting that a depleted mantle source with an $^{3}He/^{4}He$ of about 7Ra fed the Plio-Pleistocenic volcanism.

In this respect, the wide compositional spectrum of the samples, ranging from nephelinite to tholeiite, could derive from the different P-T conditions during partial melting and/or different partial melting degrees of this common mantle source. Contrarily, trace elements did not highlight the close relation between the Plio-Pleistocenic lavas and mantle xenoliths from diatremes, as cryptic metasomatism seems to modify the primordial trace elements feature of xenoliths after their entrapment in the diatreme eruptive systems.