



Kolumbo submarine volcano (Greece): An active window into the Aegean subduction system

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Submarine volcanism represents ~80% of the volcanic activity on Earth and is an important source of mantle-derived gases. These gases are fundamental for the comprehension of mantle characteristics in key sectors where subaerial volcanism is missing or strongly modified by mixing with crustal and atmospheric components. Though, the study of submarine volcanic areas remains a challenge due to their hazardousness and sea depth. Here, we report $3\text{He}/4\text{He}$ measurements in CO_2 -dominated gases discharged at 500 m below the sea level from the high-temperature (~220°C) hydrothermal system of Kolumbo submarine volcano, located 7 km northeast off Santorini Island in the central part of Hellenic Volcanic Arc (HVA). For the first time, we demonstrate that the mantle below Kolumbo and Santorini has a $3\text{He}/4\text{He}$ signature of at least 7.1 Ra (being Ra the $3\text{He}/4\text{He}$ ratio of atmospheric He equal to 1.39×10^{-6}), 3 Ra units higher than actually known for Santorini gases-rocks. This isotopic ratio is also the highest measured across HVA and is indicative of the direct degassing of a MORB-like mantle through lithospheric faults or a possible slab tear. We finally highlight that the $3\text{He}/4\text{He}$ ratio has been increasing since 2010 ($\Delta\text{Ra}=0.3$), which implies an enhanced magmatic activity beneath Kolumbo.