Geophysical Research Abstracts
Vol. 21, EGU2019-5485, 2019
EGU General Assembly 2019

Lithium isotope composition as tracer of crust/mantle interaction at subduction zones: a pilot study to understand the magma genesis of the Plio-Quaternary volcanic areas of Central Italy

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In the framework of the FISR 2015-2016 "Centro di studio e monitoraggio dei rischi naturali dell'Italia Centrale" project, we carried out a pilot study on the application of the lithium-isotope systematics to selected igneous rocks, in order to shed new light on the nature of subduction components involved in the genesis of magmas feeding the Roman Magmatic Province (Central Italy).
On the Earth, the two lithium isotopes (6Li and 7Li) are susceptible to separation due to their relatively large difference in mass (i.e. fractionation) as natural processes occur. These include mineral formation (chemical precipitation), ion exchange (Li substitutes for Mg and Fe in octahedral sites in clay minerals, with 6Li preferentially substituted over 7Li), and rock alteration. Among the available techniques, Thermal Ionization Mass Spectrometry (TIMS) is inherently the most precise method for determination of the Li isotope composition. In the last two decades, considerable progress has been made to minimize mass fractionation during TIMS analysis. To date, no Li investigations have been performed on groundwater and volcanic products from the Italian volcanoes to study water-rock interaction and/or magmatic processes, except for Stromboli. This study acts as a driving factor towards the utilization of the Li-isotope systematics for future studies, and can be considered as a first step towards the realization of a geochemical database including Li isotopes, integrated with the available Sr, Nd, Pb, Hf, B and O isotopes on Italian Plio-Quaternary volcanic rocks.
The activities carried out include: 1. Set up of the procedures to be adopted in clean chemistry laboratory for extracting Li from natural samples; 2. chromatographic separation of Li in the NIST L-SVEC, in a 600m deep sea water aliquot, sampled several km far from the gulf of Napoli, and in the USGS BHVO-2 (batch #0759) standard sample, after acid dissolution; 3. Set up of the procedures for measuring Li isotope ratios by TIMS. The final aim of this pilot study is to test the application of the Li-isotope systematics to shed new light on the geochemical features of the subduction components involved in the genesis of magmas that fed the activity of Colli Albani Volcanic District (Central Italy). This goal will be achieved by analyzing the Li isotope ratios on well-characterized (chemically and isotopically) samples representative of the main eruptive phases of the District, in the 600- 40 ka time window.