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In-situ Ar isotope, ^{40}Ar/^{39}Ar analysis and mineral chemistry of nosean in the phonolite from Olbrück volcano, East Eifel volcanic field, Germany: Implication for the source of excess ^{40}Ar

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Since the report by Lippolt et al. (1990), hauyne and nosean phenocrysts in certain phonolites from the northwest in the Quaternary East Eifel volcanic field in Germany were known to contain significant amounts of excess ^{40}Ar, thus, show apparent older ages than the other minerals. However, its petrographic meaning have not been well known. Meanwhile, Sumino et al. (2008) has identified the source of the excess ^{40}Ar in the plagioclase phenocrysts from the historic Unzen dacite lava as the melt inclusions in the zones parallely developed to the plagioclase rim by in-situ laser Ar isotope analysis. In order to obtain eruption ages of very young volcanoes as like Quaternary Eifel volcanic field by the K-Ar system, it is quite essential to know about the location of excess ^{40}Ar in volcanic rocks.

We have collected phonolites from the Olbrück volcano in East Eifel and investigated its petrography and mineral chemistry and also performed in-situ Ar isotope analyses of unirradiated rock section sample and also in-situ ^{40}Ar/^{39}Ar analysis of neutron irradiated section sample with the UV pulse laser (wavelength 266 nm) and ^{40}Ar/^{39}Ar analytical system of the University of Potsdam.

Petrographically, nosean contained fine melt and/or gas inclusions of less than 5 micrometer, which mostly distribute linearly and are relatively enriched in chlorine than the areas without inclusions. Solid inclusions of similar sizes contain CaO and fluorine. In nosean, typically around 5 wt% of sulfur is contained.

The ^{40}Ar/^{39}Ar dating was also performed to leucite, sanidine and groundmass in the same section for comparison of those ages with that of nosean. In each analysis, 200 micrometer of beam size was used for making a pit with depth of up to 300 micrometer by laser ablation. As our ^{40}Ar/^{39}Ar analyses were conducted one and half year after the neutron irradiation, thus, short lived ^{37}Ar derived from Ca had decayed very much, we measured Ca and K contents in nosean by SEM-EDS then applied their Ca/K ratios to the Ar analytical results. The in-situ Ar isotopic analysis of nosean and leucite show clearly the different slope of isochron and implied apparent older age for the nosean. The in-situ ^{40}Ar/^{39}Ar analysis of nosean yields three various ages, from 6.86 ± 2.77 Ma to 41.57 ± 11.58 Ma, but clearly older than those of the other minerals and groundmass. However, it was difficult to analyze and compare the ^{40}Ar/^{39}Ar ages between different areas with or without inclusions by the UV-laser because of its less spatial resolution, therefore, was difficult to understand the correlation between ages and the presence of inclusions. Considering the enriched contents of S and Cl in nosean, the excess ^{40}Ar could be derived from the common volatile component separated from the magma which provided S and Cl then be trapped in nosean during or after the formation of nosean.

References:

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