Post-Collisional Leucite Alnoite in South Tibet and its Significance

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Geological background

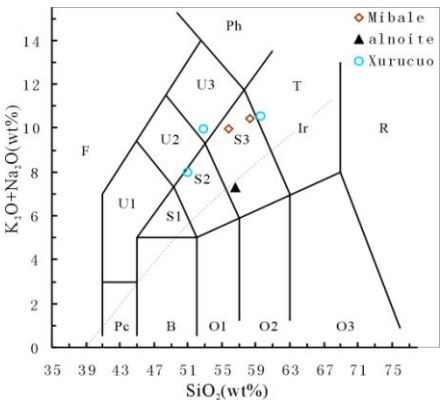
We report a preliminary study of newly recognized leucite alnoite dykes in the Lhasa Terrane in southern Tibet. The Lhasa terrane is the southernmost terrane of the Tibetan Plateau amalgamation immediately north of the India-Asia suture. Zhao and others (2009) have recently conducted a rather comprehensive petrological and geochemical study of the post-collisional ultrapotassic rocks throughout the Lhasa Terrane. The location (N 29°55'12", E 86°41'20") of our leucite alnoite samples is close to an outcrop of ultrapotassic rocks within the Dangreyougcuo-Xurucuo graben, one of the N-S-trending grabens.

Petrography and geochemistry

The specimens are dense and massive with yellowish-greenish ochreous colour and porphyritic texture. The phenocrysts include leucite, biotite, melilite and pyroxene with a microlitic matrix of the same mineralogy. Leucite is the major phenocryst and varies in size (~ 0.05 to 0.1mm) with apparent alteration and unidentified mineral inclusions. Small amounts of biotite occur as thin plates (up to 0.2 by 1 mm in size), mellilite appears as prisms (up to 0.02 by 0.3mm), and minor pyroxene (up to 0.02 by 0.3mm) as euhedral crystals.

The leucite alnoite is characterized by low SiO_2 (~52.86%) and high K_2O (~4.70%), P_2O_5 (~1.25%), MnO (~0.14%), CaO (~5.36%), and LiO (~6.22%), whereas TiO_2 (~1.56%), Al_2O_3 (~13.23%), Na_2O (~2.09%), MgO (~4.36%) and total Fe_2O_3 (~7.95%) are similar to high-K latites in the area (Zhao and others, 2009). The ultrapotassic nature of the leucite alnoite dykes are also manifested by high K_2O/Na_2O and $K_2O/A1_2O_3$ ratios as well illustrated in (Figures 1 and 2).

The samples are highly enriched in incompatible elements, e.g. very high Ba (3332 ppm), Rb (409 ppm), Sr (862 ppm), Th (233 ppm) and Zr (742 ppm) with high La_N/Yb_N (24.41), similar to the ultrapotassic volcanic rocks nearby. In comparison, leucite alnoite documents the weakest Eu anomaly (Eu/Eu^*=0.94).



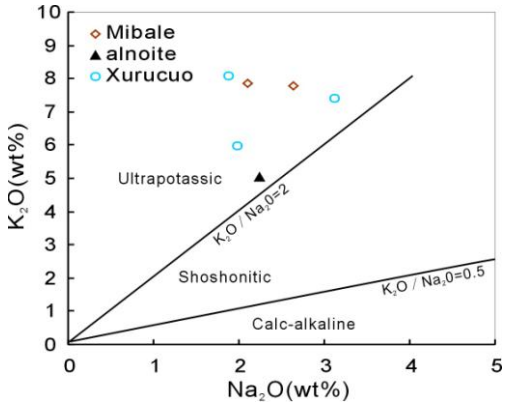


Figure 2. K2) vs. Na2O plots. Date for Mibale and Xurucuo are from Zhao and others (2009).

Figure 1 (above). K_2O+Na_2O vs. SiO_2 plot. Classification boundaries are from Le Bas and others (1986) and Le Maitre and others (1989). Mibale and Xurucuo are representative of adjacent post-collisional ultrapotassic rocks (Zhao and others, 2009). All data plotted have been recalculated to 100 wt.% on a volatile-free basis. Symbols are: Pc picrobasalt; B basalt; O1 basaltic andesite; O2 andesite; O3 dacite; R rhyolite; S1 trachybasalt; S2 basaltic trachyandesite; S3 trachy-andesite; T trachyte; U1 tephrite/basanite; U2 phono-tephrite; U3 tephri-phonolite; Ph phonolite; F foidite.

$^{40}Ar/^{39}Ar$ analysis and results

Incremental step-heating $^{40}Ar/^{39}Ar$ analysis of biotite separates was performed at the Geochronology Laboratory at China University of Geosciences (Beijing) using Macromass 5400 static vacuum mass spectrometry. The fluence monitor, ZBH-25, was an interlaboratory standard biotite with an age of 133.2 Ma and is typically used in Chinese argon-dating laboratories, calibrated by international standards (Standard analyses methods for isotopic samples, 1997). Twelve heating-increments were applied and the apparent age spectrums and isotope correlation (isochron) diagrams for $^{40}Ar/^{36}Ar$ versus $^{39}Ar/^{36}Ar$ are drawn through the results for plateau gas fractions (Figure 3). Both are calculated and displayed with 1σ uncertainties using the ISOPLOT software version 2.31 (Ludwig, 1993). Biotite separates yield $^{40}Ar/^{39}Ar$ released age spectra and isochron ages of 11.78±0.10 Ma. The plateau ages are essentially identical to the isochron ages with the intercept of the isochron giving an initial $^{40}Ar/^{36}Ar$ ratio not significantly different from 295.5, suggesting that the data are credible (Figure 3).

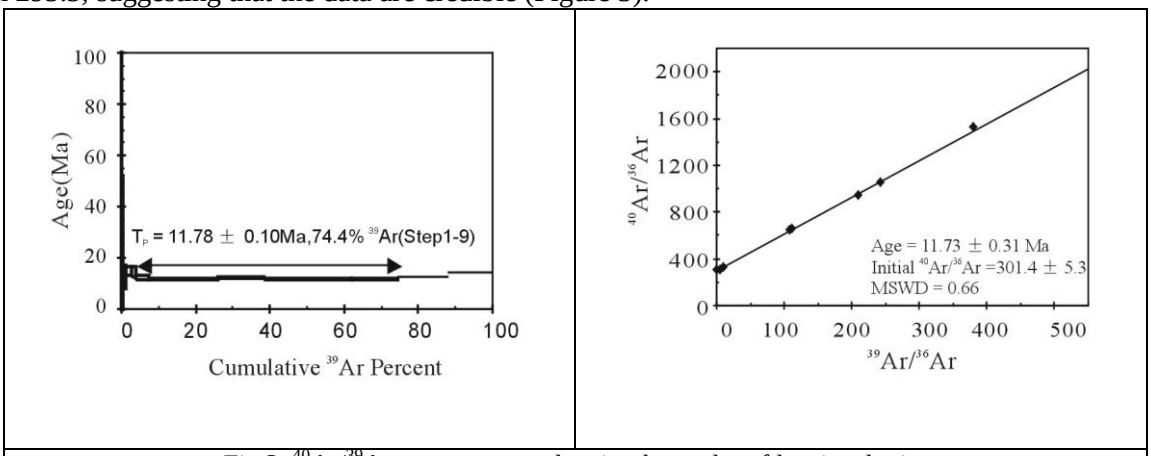


Fig 3. $^{40}Ar/^{39}Ar$ age spectra and an isochron plot of leucite alnoite

Significance

Lamprophyres occur widely on all of the continents in the form of dykes in extensional tectonic settings (Rock, 1987). Except for our study, a recent 1:250,000-scale regional geological survey has reported some N- or NW-trending minette dykes around the area, with a supposed Neogene formation age (XZBGMR, 2002). The radiometric dating of ultrapotassic volcanic rocks obtained in Dangreyougcuo-Xurucuo graben range from 11.5 Ma to 14.2 Ma (Zhao and others, 2009). Therefore, we infer that the latest magmatic episode in the study area is about 11 Ma and the Tibetan plateau may have reached its elevation by this time. Neal and Davidson (1989) proposed that the original alnoite magmas formed by decompression melting in a rising diapir of asthenospheric mantle, which could be the tectonic setting of our samples and also of ultrapotassic volcanic rocks in Dangreyougcuo-Xurucuo graben.

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