

Paleozoic alkaline volcanism: geochemistry and petrogenesis of Um Khors and Um Shaghir trachytes of the central Eastern Desert, Egypt

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Abstract The Um Khors and Um Shaghir trachyte (UKT and UST) plugs and sheets represent two conspicuous outcrops of Paleozoic alkaline volcanism in the central Eastern Desert of Egypt. The trachyte magmatism erupted along the Pan-African NW-trending shear zone (302 ± 15 and 273 ± 15 Ma, respectively) and intruded the Late Proterozoic rocks of the studied area. The trachyte rocks consist mainly of sanidine, anorthoclase, albite, and quartz with a noticeable amount of aegirine-augite, aegirine, hedenbergite, and arvedsonite. The studied trachytes are moderately evolved in composition (with 62–67.5 wt.% SiO_2) and exhibit a limited compositional range in most of the major elements. They are alkaline in nature and considered as silica-oversaturated rocks. The rare earth elements (REE) patterns are somewhat uniform and highly fractionated, being enriched in light REE over heavy REE and show prominent negative Eu anomalies. The UKT and UST are enriched in high field strength elements Nb, Zr, and Y, consistent with typical within-plate alkaline magmatism of extensional tectonic regimes. They were generated through the fractional crystallization of mantle-derived magmas. Although the UST is younger than the UKT, they show approximately similar chemical compositional ranges of the most major and trace elements, with somewhat higher MgO, Cr, Ni, and Ba contents in the former. This may argue against the evolution of the UST via a continuous fractional crystallization of the

residual magmatic melt of the UKT. Thus, the UKT and UST are genetically related but could be emplaced through two various magmatic pulses of the same parent source (i.e., asthenospheric mantle source) at different times. The ascending magmatism was subjected to variable significant degrees of crustal contamination during their generation.

Keywords Paleozoic alkaline volcanism · Um Khors · Um Shaghir · Trachyte · Asthenospheric mantle · Eastern Desert · Egypt

Introduction

The Arabian–Nubian Shield (ANS) extends over most of NE Africa and the Arabian Peninsula, covering an area of about 3×10^6 km². The ANS crust is considered to have developed during the Pan-African event (950–550 Ma; Kröner 1985) by rapid subduction along a series of island arcs (Stoeser 1986). It was stabilized by accretion and subsequent sweeping together of this arc system. Toward the end of the Pan-African event (650–550 Ma), the calc-alkaline arc-related magmatism was replaced by calc-alkaline to alkaline post-orogenic magmatism (Stern 1981; Abdel-Rahman 1995). From the end of the Pan-African orogeny until the Tertiary, the ANS was extensively intruded by alkaline to peralkaline, basic to acidic, plutonic to volcanic rocks (ca. 600–30 Ma; Harris 1982). These igneous rocks represent the surface manifestations of within-plate or A-type magmatism during the anorogenic tectonic–magmatic phase of the Arabian–Nubian Shield.

Most of the Egyptian alkaline rocks are located in the Eastern Desert and considered part of its basement complex. They comprise a wide variety of alkaline granites,

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