Rb–Sr Isotope systematics of muscovite from Pan-African granitic pegmatites of Western and Northeastern Africa

D. Küster

SFB 69, Fachbereich Bergbau und Geowissenschaften, Technische Universität Berlin, Federal Republic of Germany

With 6 Figures

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Summary

Rb–Sr investigations have been carried out on early-formed muscovite from three pegmatite fields of the late Proterozoic to early Phanerozoic Pan-African Belt. The individual mineral ages obtained are highly discordant for each pegmatite field. Using Best Isochron Diagrams, isochron construction of selected muscovite samples yielded geologically realistic ages of pegmatite formation: around 670 Ma for the Bayuda Desert pegmatites of northern Sudan, around 550 Ma for the Wamba pegmatites of central Nigeria, and around 465 Ma for the Majayahan pegmatites of northeastern Somalia. Initial Sr ratios obtained from isochron calculations have unrealistic values and cannot be used for petrogenetic interpretations.

The geologically unrealistic young model ages of some of the muscovite samples are most probably attributed to open-system behaviour and post-crystallization loss of $^{87}\text{Sr}^\ast$ from the respective minerals. The amounts of $^{87}\text{Sr}^\ast$ losses have been approximated from the discrepancies between isotopically measured and theoretically calculated (from decay of Rb) $^{87}\text{Sr}^\ast$ concentrations. The loss of $^{87}\text{Sr}^\ast$ from the micas is variable in each pegmatite field. In none of the three cases can this unsystematic, post-emplacement, open-system behaviour be directly related to a particular, temporally confined, geologic event.

Zusammenfassung

Rb–Sr Isotopen-Systematik von Muskovit aus panafrikanischen Granit-Pegmatiten West- und Nordost-Africas

Rb–Sr Isotopen-Untersuchungen wurden an frühgebildetem Muskovit dreier Pegmatitfelder der spätproterozoischen bis frühphanerozoischen, panafrikanischen Mobilzone...
Introduction

Several associations of granitic pegmatites of differing chemical and mineralogical composition occur in the late Proterozoic to early Phanerozoic Pan-African Belt of western and northeastern Africa. The Pan-African orogeny (900–500 Ma) led to the formation of Gondwana and was the last major crust-forming event which affected the present African Continent as a whole. Due to the multistage history and the vast regional extent of the Pan-African orogen, granitic pegmatites can be expected to have formed at different periods and in different provinces of the Pan-African Belt. Küster and Matheis (1990) have addressed the relationships between pegmatite formation, rare element enrichment, granitoid magmatism and the regional history of Pan-African crustal evolution; precise age determinations of the pegmatites are needed for the deciphering of these relationships. This paper presents Rb–Sr age determinations on Pan-African pegmatites from central Nigeria, northern Sudan and northeastern Somalia (Fig. 1). The only reliable age determinations on Pan-African pegmatites from western and northeastern Africa have so far been carried out by Matheis and Caen-Vachette (1983). These authors used Rb–Sr whole rock isochron and Rb–Sr mineral dating (feldspars and micas), and obtained ages between 562 and 534 Ma for pegmatites from southwestern and central Nigeria.

The coarse grain size of pegmatites usually makes their whole rock sampling for Rb–Sr dating a laborious if not impossible attempt. The Rb–Sr age determinations of the three pegmatite fields were thus carried out on muscovite. This mineral has also been used to assess the geochemical evolution of each of the pegmatite fields in general and their rare metal potentials in particular (Matheis and Küster, 1989; Küster et al., 1990a). The muscovite model ages obtained turned out to be unsatisfactory due to frequent occurrence of discordant ages. A closer look into the Rb–Sr isotope systematics of muscovite from the three Pan-African pegmatite occurrences was therefore felt to be necessary.

Previous studies on Rb–Sr isotope systematics in granitic pegmatite systems elsewhere, (e.g. Brookins et al., 1969; Riley, 1970; Clark, 1982; Clark and Černý, 1987) have all highlighted the open-system behaviour of $^{87}\text{Sr}^*$. This study addresses again