

Abstract

With the aim of understanding the formation processes and paragenetic evolution of episyenites, which are granitic rocks hydrothermally deprived of quartz, some newly discovered occurrences in the Neoproterozoic Bohus granite, Sweden, were investigated in terms of petrography, geochemistry, fluid inclusions and isotope systematics of O, H, C, Sr and U–Pb. Each occurrence consists of some more or less separate episyenite bodies, all less than ten metres in diameter, and of irregular or roughly ovoid geometry. Although the exact mineral assemblage varies from one locality to another, all episyenites reveal a common paragenetic succession: an initial loss of quartz, accompanied by albitization of plagioclase, followed by sporadic precipitation of apatite in the vugs left after the dissolved quartz, and later a resumed infilling and replacement of igneous Fe–Ti-phases by various micaceous \pm hematite assemblages, quartz, carbonates and anatase.

Low and variable $\delta^{18}\text{O}$ values for albite suggest disturbed O-isotope systematics during superimposed vug-filling events. Information regarding the nature of the fluid(s) responsible for the actual episyenite formation is limited to two key localities where what optically appears to be igneous quartz *post-dates* the albitization. Oxygen-isotope systematics of this quartz indeed indicate high-temperature crystallization from a fluid in isotopic equilibrium with the granite magma. This clearly indicates that the initial dissolution and albitization was a late-magmatic, deuteritic process. On the basis of field arguments it is moreover proposed that the quartz-dissolving fluid was generated in-situ from the residual melt of the almost consolidated granite, and was thus highly quartz-undersaturated already at exsolution. Consequently, the *P–T* conditions during this stage were close to the water-saturated granite solidus, which is estimated at ~ 4 kbar and 670°C .

Turning to the vug-filling assemblage, apatite crystallized at temperatures below 300°C from heterogeneous, ^{18}O -depleted fluids of principal meteoric origin. Judging from its low $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, this incipient infilling was probably related to the cooling and uplift history of the granite. The subsequent, micaceous infilling stage, on the other hand, was dated at 252 ± 8 Ma (2σ) by ion microprobe U–Pb analysis of xenotime. This coincides with the final development of the nearby Oslo Rift, and a genetic relationship is thus proposed. Quartz from this stage registers the alternate presence of low- and high-salinity, aqueous fluids at 185 – 235°C and fluctuating pressure. The preferred interpretation is that the episyenite structures mostly were occupied by high-salinity fluids, but during intervening periods of fault-induced pressure release the draining systems were invaded by a low-salinity end-member of meteoric origin. The calculated H- and O-isotopic compositions of the high-salinity end-members are highly reminiscent of modern Shield brines, and although the kinship is not proven it is suggested that they underwent a similar isotopic evolution. The presence of an additional fluid component in some occurrences towards the end of this stage is recorded by ankerite.

A reassessment of available data on episyenites in the literature gives a picture similar to that presented above, with initial deuteritic quartz dissolution, and later, often separate, influx of various surface-derived fluids. However, the pressure conditions inferred from a deuteritic origin are generally well beyond the physical limitations of the prevailing view for episyenite genesis, which envisages a temperature-driven dissolution of quartz. The only model which is fully satisfactory in all instances is that the quartz-dissolving fluids were highly quartz-undersaturated already at exsolution from the crystallizing magma, as proposed for the episyenites of the Bohus granite.

Keywords: episyenite, granites, hydrothermal processes, volatiles, deuteritic, Bohus granite, paragenesis