

Abstract New geochemical, isotopic, and geochronological data and interpretations are presented for late Neoproterozoic intrusive carbonates and related rocks of southern Sinai, Egypt (northernmost Arabian–Nubian Shield). The Tarr carbonates are coarsely crystalline and related to explosive emplacement of hypabyssal and volcanic albitite at 605 ± 13 Ma. The carbonates associated with the albitites are divisible into two types: primary dolomitite and secondary breunneritite (Fe-rich magnesite). The dolomitite was clearly intrusive but differs from classic igneous carbonatites, containing much lower abundances of incompatible elements, such as REE, U, Th, Rb, Nb, Y, P, Sr, Zr, Ba, and total alkalis. The breunneritite is a secondary replacement of dolomitite, probably marking the roots of a vigorous hydrothermal system. Albitites show pristine abundances of major and trace elements and were not subjected to a major metamorphic overprint. They are relatively more fractionated, alkaline and related to within-plate A-type magmas, were emplaced in an extensional or non-compressive tectonic regime in the cupola of high-level A-type granite. Tarr albitites may represent residual magma remaining after near-total crystallization of an A-type granite pluton at depth, forcibly emplaced into the roof above the cooling pluton. The intrusive dolomitite exsolved from highly differentiated albitite melt, in the apical regions of a still-buried alkaline “A-type” granite pluton that was rich in CO_2 ; these volatiles migrated upwards and towards the cooler margins of the magma body. Late NNE–SSW extension allowed a shallow-level cupola to form, into which albitite melts and carbonate fluids migrated, culminating in explosive emplacement of albitite breccia and intrusive carbonate. Isotopic compositions of Tarr dolomitite and albitite indicate these are consanguineous and ultimately of mantle origin. Magmatic volatiles fenitized the wall rock, while submarine hydrothermal activity transformed some of the dolomitite into breunneritite. Recognition of Tarr-type should encourage similar hypabyssal complex intrusions to be sought for in association with A-type granitic plutons elsewhere.

Keywords Albitite · Magmatic cupola · Intrusive dolomitite · Sr, Nd isotopes · Geochronology