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Diatexite Deformation and Magma Extraction on Kangaroo Island, South Australia

Pavlina Hasalova (1,2), Roberto Weinberg (2), Lindsay Ward (2), and Mark Fanning (3)

(1) Centre for Lithospheric Research, Czech Geological Survey, Klarov 3, Prague, 11821, Czech Republic Cheers,, (2) School of Geosciences, Monash University, Australia, (3) Research School of Earth Sciences, The Australian National University, Canberra, Australia

Migmatite terranes are structurally complex because of strong rheological contrast between layers with different melt contents and because of magma migration leading to volume changes. Migmatite deformation is intimately linked with magma extraction and the origin of granitoids. We investigate here the relationships between an evolving deformation and magma extraction in migmatites formed during the ca. 500Ma Delamerian orogeny, exposed on Kangaroo Island, South Australia. Here, several phases of deformation occurred in the presence of melt. During an early upright, non-cylindrical folding event, magma was channeled towards the hinge zones of antiforms. Funnel-shaped networks of leucosomes form a root zone that link up towards a central axial planar channel, forming the main magma extraction paths during folding. Extraction was associated with fold limb collapse, and antiformal hinge disruption by magma accumulation and transfer. During a later deformation phase, melt-rich diatexites were deformed, and schollen were disaggregated into smaller blocks and schlieren, and deformed into asymmetric, sigmoidal shapes indicative of dextral shearing flow. During flow, magma accumulated preferentially along shear planes, indicating a dilatational component during shearing (transtension) and in strain shadows of schollen. As deformation waned, magma extraction from these diatexites gave rise to N-trending, steeply dipping, funnel-shaped channels not associated to any deformational feature. The funnel-shape of these structures indicates the direction of magma flow. Structures developed during this phase are comparable with those formed during dewatering of soft sediments. Despite a high degree of complexity, magma migration and extraction features record distinct responses to the evolving deformation which can be used to understand deformation, and nature and direction of melt extraction. The oldest and youngest magmatic rocks from migmatites were dated (U-Pb monazite, SHRIMP). Both reveal continuous age spread of ca. 490−470Ma with two dominant age groups of ca. 485Ma and ca. 470Ma corresponding to monazite rims and cores, respectively. The age range is interpreted to indicate the duration of anatexis (order of 20Ma) with the two peaks marking individual magma batch crystallization during D1 and D4 deformation event.