A Coupled Thermo - Mechanical Model for Deformation in High Temperature-Low Pressure Metamorphic Terrains:implications for the Palmer region, Southern Adelaide Fold Belt.

by

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Abstract

Peak metamorphic growth in high temperature - low pressure terrains is commonly associated with crustal thickening strains reflected in syn - tectonic fabrics. Conductive heat transfer through the lithosphere for geologically plausible thermal and mechanical configurations is unable to produce such temperatures and thus an advective thermal perturbation is required, and is commonly in the form of granitic melts. Thermal weakening of the lithosphere as a consequence of this advective heat allows the potential for crustal thickening strain increments. In this thesis a coupled thermo - mechanical model is presented which allows quantification of this thermal weakening effect. Two granite generation models are investigated; firstly, lower crustal melting due to conductive heating of the lithosphere during orogenesis and secondly, segregation or roof rock melting from mafic sills located at the base of the crust. Results from the model indicate that, for granites produced by melting of the lower crust, crustal thickening strains increments are only in the order of 5 -10 %. However, for granites produced by segregation from a mafic sill crustal strain increments of up to 30% may occur during emplacement. Thus in order to produce peak metamorphic temperatures associated with significant crustal strain a system analogous to the second model is required. Structural and metamorphic studies of the Palmer region in the Southern Adelaide Fold Belt reveal the associated development of partial melting and peak metamorphism with the intrusion of the orthogneissic Rathjen Gneiss during the regional D_1 folding event. Thermal weakening triggered by the Rathjen Gneiss has produced a local D_2 folding event. Areas at some distance from the Rathjen Gneiss exhibit peak metamorphic growth during D_2 consistant with the delayed peak temperatures from the cooling body.