Isotopic and geochemical characteristics of the British Empire Granite as indicators of magma provenance and processes of melt generation in the Mount Painter Inlier, South Australia.

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ABSTRACT

The production of granitic magmas at shallow to midcrustal depths by anatexis of crustal material requires a significant thermal perturbation of the normal crustal geothermal regime. Thermal perturbations leading to anatexis may be initiated by crustal thickening associated with deformation, intrusion and/or upwelling of heat sources from lower crust or mantle regions or by anomalous concentrations of heat-producing elements, U, Th and K. This thesis explores the origin of shallow to mid-crustal peraluminous granites within the Mount Painter Inlier, together with their relationship to older granite suites, as indicators of magmatic processes during crustal deformation of the Delamerian Orogeny.

The geochemical and isotopic characteristics of granites and gneisses of the Mount Painter Inlier indicate two distinct periods of granitic evolution involving different source regions and magmatic processes. Proterozoic granites and gneisses reflect magmatic sources and processes similar to those involved in the evolution of other Australian anorogenic Proterozoic terrains, although extreme concentrations of U, Th and K suggest an important role for element concentration within accessory minerals during granite genesis. Field relationships, together with geochemical and isotopic characteristics of the Palaeozoic(?) British Empire Granite indicate evolution from a complex mixture of surrounding metasediments and granites in a number of possible scenarios. The additional thermal energy required to produce the British Empire Granite from partial melting of this package at depths of approximately 12 to 15 km is consistent with perturbed thermal regimes resulting from anomalous internal heat production due to the extreme concentration of U, Th and K within the Proterozoic units.

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TERMINOLOGY AND ABBREVIATIONS

Below is listed a list of abbreviations used throughout this document

BEG	British Empire Granite
bt	biotite
CHUR	Chondritic Uniform Reservoir
DM	Depleted Mantle
$_{\varepsilon}$Nd	Epsilon Nd
Ma	Mega-anna, = Million years before present
Ga	Giga-anna, = Billion Years before present
GRV	Gawler Range Volcanics
FHQ	Freeling Heights Quartzite
fspar	feldspar
HREE	Heavy Rare Earth Elements
k-feldspar	potassium feldspar
LFB	Lachlan Fold Belt
LREE	Light Rare Earth Elements
MBI	Mount Babbage Inlier
MPI	Mount Painter Inlier
MPB	Mount Painter Block
mu	muscovite
PCM	Paralana Creek Metasediments
Peg G	Pegmatitic Granite
PG	Paralana Granodiorite
plag	plagioclase
ppm	parts per million
qtz	quartz
REE	Rare Earth Elements
T_{CHUR}	Model age from CHUR
T_{Model}	Model age from Depleted Mantle