# A PETROLOGICAL, GEOCHEMICAL AND ISOTOPIC INVESTIGATION OF GRANITOIDS FROM THE OLARY PROVINCE OF SOUTH AUSTRALIA - IMPLICATIONS FOR PROTEROZOIC CRUSTAL GROWTH

**By**

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# KEY TO ABBREVIATIONS

| | |
|---|---|
| **Al-Index** | aluminium index = molar $Al_2O_3/(CaO + Na_2O + K_2O)$ |
| **bt** | biotite |
| **CHUR** | Chondritic Uniform Reservoir |
| **DM** | depleted mantle |
| **fld** | feldspar |
| **Ga** | Giga-anna = billions of years before present |
| **gt** | garnet |
| **haem** | haematite |
| **hb** | hornblende |
| **HREE** | Heavy Rare Earth Elements |
| **kb** | kilobar |
| **K-fld** | potassium feldspar |
| **ky** | kyanite |
| **LREE** | Light Rare Earth Elements |
| **Ma** | Mega-anna = millions of years before present |
| **MORB** | Mid Ocean Ridge Basalt |
| **mu** | muscovite |
| **Na-plag** | sodium plagioclase |
| **Nd-Sm** | neodymium-samarium isotopic system |
| **ORG** | ocean ridge granites |
| **plag** | plagioclase |
| **px** | pyroxene |
| **qtz** | quartz |
| **Rb-Sr** | rubidium-strontium isotopic system |
| **REE** | Rare Earth Elements |
| **sill** | sillimanite |
| **syn-COLG** | syn-collisional granites |
| **tour** | tourmaline |
| **VAG** | volcanic arc granites |
| **WPG** | within plate granites |
| **wt%** | weight percent |

# ABSTRACT

Analysis of granitoids from the Olary Block of South Australia, gave rise to the identification of three genetically different granitoids. The Bimbowrie Granite, characterised by high $Al_2O_3$, CaO, $K_2O$, $P_2O_5$, Rb, Sr, Pb, Zn and low $Na_2O$, Nb, Zr, Ga and Y is an S-type granite, considered to be largely a product of partial anatexis and melt segregation from adjacent and underlying migmatitic metasediments during a high grade metamorphic event. The Basso Granodiorite with high $SiO_2$, Zr, Nb, Y and LREE and low CaO, $Al_2O_3$, MgO, V, Ba and Sr is a typical A-type granite that is, it formed from remelting of crust from which earlier granites had been extracted, or alternatively from fractionation of basaltic magma. It intrudes the host metasediments and is subsequently intruded by the Bimbowrie Granite. Thirdly, the Antro Tonalite exhibits I-type characteristics with high $Fe_2O_3$, $Na_2O$, CaO and $TiO_2$ levels and low LREE and $K_2O$.

Rb-Sr dating produced an isochron age of 1642 ± 5 Ma for the Basso Granodiorite and metasedimentary units. The Rb-Sr isotope system is easily reset, and generally registers significantly younger ages. Hence, 1642 ± 5 Ma may reflect the timing of a metamorphic/ deformational event.

Sm-Nd isotope investigations into the Olary Block, revealed a clustering of model ages. The Bimbowrie Granite has DM model ages of 2.6 - 2.67 Ga, recording the age of extraction from the mantle. One sample did however produce an age of 3.28 Ga, reflecting the granites source. That is, it may be sampling metasediment derived from older crust, present either as a basal sequence upon which the current stratigraphy is deposited or alternatively it may be sourcing a metasedimentary pile with a greater crustal residence time than the exposed metasediments. DM model age for the metasediment of 2.55 Ga further supports the notion that the Bimbowrie Granite formed as a result of *in situ* melting of the metasedimentary sequence.

2.12 - 2.13 Ga DM model ages were determined for the Basso Granodiorite. One sample did however have a TDM similar to the S-type granites of 2.61 Ga; this clearly indicates crustal contamination of this sample during emplacement, whereas the other samples reflect true mantle separation ages.

Regardless of the exact rates of crustal growth, it is clear that large volumes of continental crust were formed during the Palaeo- Mesoproterozoic. Identification of crustal production peaks for the Australian continent at ~3600 Ma, ~2600 Ma, ~2200 Ma and ~1800 Ma by McCulloch (1987), are reinforced by the data obtained herein. Two peaks were established, one at ~2600 Ma for the Bimbowrie Granite and the other at ~2200 for the Basso Granodiorite. Controversy still remains over whether these periods are discrete growth episodes or simply reflect a variation in the rate of recycling of continental crust into the mantle.