Moving the heat around: the impact of metamorphism on the distribution of crustal heat production

Thesis submitted in accordance with the requirements of the University of Adelaide for an Honours Degree in Geology

Christopher Wilde Kemp

November 2014

THE UNIVERSITY of ADELAIDE

MOVING THE HEAT AROUND: THE IMPACT OF METAMORPHISM ON THE DISTRIBUTION OF CRUSTAL HEAT PRODUCTION

RUNNING TITLE: METAMORPHIC IMPACT ON CRUSTAL HEAT PRODUCTION

ABSTRACT

Crustal differentiation has resulted in the concentration of heat producing elements (HPEs) in the upper crust due to partial melting processes. Recent studies into the mineral hosts of HPEs have shown that it may be possible to enrich a rock in HPEs via partial melting rather than depleting it. This paper details transects that were performed across metamorphic grade at Mt Stafford, the Reynolds Ranges and Broken Hill using portable Gamma Ray Spectrometer (GRS) devices. The paper found that there is a small, but significant rise in heat production with an increase in metamorphic grade from greenschist to granulite facies rocks exposed at the surface at those locations driven by thorium concentration. A definite non-linear trend pattern was also found in the distribution of heat production with increasing grade, predominantly at Mt Stafford. The methods and findings were compared to contemporary airborne radiometry scans and geochemical assay studies at Mt Stafford in order to compare the newer largely untested GRS method to these modern standards. Findings indicate that the HPE bearing rocks at these locations are enriched enough in HPEs that they can further self-enrich in open partial melting systems, increasing heat production and leading to structurally weaker crust.

KEYWORDS

Metamorphism, Crustal heat production, Radiogenic heat production, Distribution of heat production, Portable gamma ray spectrometry, Field sampling, Mt Stafford, Reynolds Ranges, Broken Hill.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES