Unravelling polymetamorphism in east Antarctica using evidence from the Cape Denison Moraines, Terre Adélie Craton, and Gawler Craton, South Australia

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

Megan Alice Williams

November 2015

THE UNIVERSITY of ADELAIDE

UNRAVELLING POLYMETAMORPHISM IN EAST ANTARCTICA USING EVIDENCE FROM THE CAPE DENISON MORAINES, TERRE ADÉLIE CRATON, AND GAWLER CRATON, SOUTH AUSTRALIA

RUNNING TITLE: POLYMETAMORPHISM IN EAST ANTARCTICA

ABSTRACT

Polymetamorphic signatures in rocks can be difficult to deconvolve, especially where events have similar metamorphic grade. In situ and erratic samples from the Terre Adélie Craton, Antarctica, and in situ samples from the formerly contiguous Gawler Craton, South Australia, are examined to deconvolve microstructural, pressure–temperature and geochronological evidence of terrane-scale polymetamorphism. In situ monazite U–Pb geochronology shows that coastal and erratic samples record c. 1700 Ma and c. 2420 Ma ages, consistent with known ages of the Kimban and Sleafordian events, respectively. In situ samples from the Antarctic coast record exclusively c. 2420 Ma ages whereas most erratic samples from the glacial moraines at Cape Denison record only c. 1700 Ma ages. Phase equilibria forward modelling for the c. 2000 Ma Redbanks Charnockite uniquely constrains peak metamorphic conditions of the c. 1700 Ma Kimban Orogeny to 5.0–7.2 kbar and 700–860 ºC. Peak metamorphic conditions of the c. 2420 Ma event are ~5–8.7 kbar and 690–1000 ºC, as constrained by in situ samples from the Terre Adélie coast. As the peak pressure–temperature conditions for the two events are similar and the record of polymetamorphism is cryptic and spatially variable in the rock record, Antarctic samples that only record Kimban ages are interpreted as reflecting either a record of complete overprinting of the older (c. 2420 Ma) event, or that the rocks are younger than the c. 2420 Ma event. In such a situation polymetamorphism at a terrane scale may only be detected by differences in geochronological data. This study serves to highlight the careful approach required when investigating polymetamorphic terranes and argues that a spatially variable record of overprinting metamorphism is possibly related to locations of retrogression occurring either in the waning/exhumation stages of the earlier event or between events.

KEYWORDS

polymetamorphism; Antarctica; Mawson Craton; high-grade metamorphism; U–Pb geochronology; pseudosection; Cape Denison

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES