Growth of monazite during prograde metamorphism

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

Brendon John Liley

November 2014

THE UNIVERSITY of ADELAIDE

GROWTH OF MONAZITE DURING PROGRADE METAMORPHISM

RUNNING TITLE: PROGRADE MONAZITE GROWTH

ABSTRACT

The reactions leading to monazite growth during progressive metamorphism are still not completely understood. This has a flow-on effect of not being able to completely and reliably link monazite U–Pb age data to specific parts of the P–T evolution of rocks. A suite of progressively contact-metamorphosed metapelites and metapsammites from Mt Stafford in central Australia were used to constrain metamorphic monazite growth mechanisms. U–Pb monazite geochronology is used to distinguish detrital (>1800 Ma) from metamorphic (<1800 Ma) monazite, and in granulite facies samples indicates that >50% of monazite is detrital. Differences in grain-separate yields are interpreted to reflect detrital and metamorphic monazite in greenschist facies samples being considerably finer-grained (<70 μm) than in granulite facies samples, since the sum of REE + Y + Th + U in samples is relatively uniform regardless of metamorphic grade. Comparatively low-Th rims on higher-Th monazite 'cores' in granulite facies samples are interpreted to reflect metamorphic monazite overgrowths on either detrital or (slightly) older metamorphic cores. Therefore, pre-existing monazite is interpreted as a major contributor to metamorphic monazite growth. Apatite—observed as inclusions in monazite—and xenotime, and possibly major silicate minerals such as plagioclase, biotite, muscovite and andalusite/sillimanite, are also interpreted to be contributors on the basis of their presence, their composition and, in the case of silicates, their vast abundance relative to monazite even if they only contain a minor amount of REEs. This study argues that pre-existing monazite is a major contributor to metamorphic monazite growth and therefore that the link between monazite growth and changes to P–T (as monitored by changes to silicate mineral assemblage) is not straightforward.

KEYWORDS

Metamorphism, Monazite, REEs, Mt Stafford, Metapelite, Psammite

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES