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Granitoid zircon forms the nucleus for minerals precipitated by carbonatite-derived metasomatic fluids at Chilwa Island, Malawi

Emma Dowman[a,b,c], Frances Wall[b,c], Teresa Jeffries[c*], Peter Treloar[a], Andrew Carter[d], Andrew Rankin[a]

[a]School of Geography, Geology & Environment, Kingston University, Penrhyn Road, Kingston upon Thames, KT1 2EE, UK

[b]Camborne School of Mines, University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9FE, UK

[c]Department of Mineralogy, Natural History Museum, Cromwell Road, London, SW7 5BD, UK

[d]Department of Earth and Planetary Sciences, Birkbeck College, Gower Street, London, WC1E 7HX, UK

Abstract

Mineralogical assemblages are fundamental to the interpretation of geological processes. Zircon is an integral petrographic component of the mineral assemblages present in fenites (rocks formed by alkaline metasomatism) associated with the 136 Ma-aged Chilwa Island carbonatite complex, Malawi. Zircon exhibits contrasting characteristics and properties across the fenite aureole that surrounds the carbonatite stock. It shows intense grain dissolution and subsequent replacement by pyrochlore in the more intensely metasomatised 'high-grade' fenite of the innermost part of the aureole. By contrast, relict zircon crystals form the nucleus for the development of apatite-ilmenite-REE mineral assemblages in less altered zones. These changes in zircon properties are considered to be evidence of the diverse nature of fluids that metasomatised the Chilwa Islands fenite aureole. Although zircon is a principal component of the fenite mineral assemblages, when dated by LA-ICP-MS techniques it was found to predate the other minerals present in the mineral assemblages and thus, the age of carbonatite intrusion, by over 380 Ma. Instead of co-crystallising with the assemblage, zircon is therefore interpreted as providing a focus around which the minerals in the fenite assemblage formed. This implies that caution is needed both in the interpretation of Zr mobility in metasomatic assemblages, and also in attributing a zircon age to the assemblage as a whole in such sequences.

Keywords: zircon; geochronology; fenite; metasomatism; carbonatite

1. Introduction

Zircon is the most commonly used, and therefore perhaps the most important, mineral in geochronology. Among the properties that make it useful for dating are its chemical durability and stability (Harley and Kelly, 2007; Siebel et al., 2012 and citations therein) and its low solubility in most geological fluids. However, it has been shown that zircon can be soluble in certain alkaline fluids (Rubin et al., 1993; Sheard et al., 2012). It is therefore possible that zircon breakdown and subsequent Zr mobility and reprecipitation might be expected in fenites developed by alkali metasomatism around carbonatite intrusions. These metasomatised rocks are created by the early expulsion of alkaline fluids associated with carbonatite or ijolite emplacement (Heinrich, 1966; Le Bas, 2008).