1 Introduction

In this presentation, we report the results of our work on the ferrocarbonatites and the associated ironstone veins that constitute the Gifford Creek Ferrocarbonatite Complex (GFC), Gascoyne Province, Western Australia. Our study was carried out on the basis of field observations and the integration of petrography (by conventional optical microscopy, SEM and XRD), and whole-rock geochemistry. Furthermore, we discuss age data obtained from primary apatites contained in ferrocarbonatite and from monazites contained in fenitic rocks associated with the ironstone veins (Pirajno and González-Álvarez, 2013; Pirajno et al. 2014). The apatites yielded an age of ~1075 Ma, whereas the monazites returned an age of ~1050 Ma, suggesting two distinct events. The former fits, within error, with the age of Warakurna large igneous province (WLIP; Wingate et al., 2004), which covers an area of at least 1.5x10^6 km^2, extending from western-central Australia across to the Capricorn Orogen and the Gascoyne Province. This makes the GFC the first recorded carbonatite system associated with the WLIP.

2 The Gifford Creek Ferrocarbonatite Complex

The GFC comprises sills, dykes, and veins of ferrocarbonatite intruding the Pimbyana Granite and Yangibana Granite of the Durlacher Supersuite and metasedimentary rocks of the Pooranoo Metamorphics. The ferrocarbonatites are associated with complex and irregularly distributed zones of fenitic alteration. Also associated with the carbonatites and fenites are veins of Fe oxides (magnetite, hematite and goethite) and quartz that were likely formed during post-magmatic alteration processes, by dissolution of Fe carbonates. The ferrocarbonatite sills and dykes form a NW-trending belt in the south-western sector of the GFC, parallel to, and to the north of the Lyons River Fault. On the northern side of this NW-trending belt are swarms of carbonatite and ironstone veins, distributed in a series of sinuous trends, terminating along a WNW-trending belt of carbonatite-ironstone veins. This WNW-trending belt is along a poorly defined lineament, which Pearson et al. (1996) called the Bald Hill Lineament, and which may represent one side of a pull-apart structure. The granitic country rocks north of the Bald Hill Lineament are extensively hydrothermally altered, as indicated by nearly pervasive replacement of the primary igneous minerals by green biotite, epidote and calcite. However, it is not clear if this alteration is related to the fenitic alteration associated with the carbonatites.

3 A genetic Model Based on Age Data

The GFC was emplaced along the Lyons River Fault, a major NW-trending structure in the region. The GFC rocks occur as dyke and sill-like intrusions and are surrounded by or associated with Na-K fenitic aureoles.
Fenitisation is dominated by K-feldspar and albite, and varying amounts of aegirine, arvedsonite, pyrochlore, monazite, bastnaesite and magnetite. In places, K-feldspar and/or albite are dominant and the rock becomes an orthoclase or an albite. The predominance of one or the other may be related to depth profiles. The carbonatite-ironstone veins and their associated fenitic haloes have a similar mineralogy as those directly associated with the ferrocarbonatites sills and dykes. The apatite and monazite ages, although with error bars showing a substantial overlap and statistically indistinguishable, suggest the possibility of two magmatic phase, as in fact recorded in the Warakurna Supersuite (Giles Event; 1085-1040 Ma) of the West Musgrave Province, the hotspot centre of the related WLIP. The first phase at ~1075 Ma was responsible for the emplacement of dykes and sills along the Lyons River fault for which seismic profiling indicate that, joining with the sub-parallel Ti Tree Shear Zone, cuts through the crust and reaches into the sub-continental lithospheric mantle. Carbonatite melts will have formed in a metasomatised lithospheric mantle, perhaps due to the heat induced by the lateral flow of the Warakurna mantle plume, resulting in the emplacement of the NW-trending ferrocarbonatites dykes and sills. The Lyons River fault system was activated time and again during tectonic events in the Gascoyne Province. We suggest that in one of these events, at about 1050 Ma, a small pull-apart structure, possibly defined by the Lyons River Fault and the Bald Hill Lineament, referred to above, was formed on the sites, where the ferrocarbonatites had been previously intruded at ~1075 Ma. This may have stimulated the re-activation of the carbonatite system, widening the fenitic halo in the country rocks and producing a sinuous carbonatite veins system, which eventually was altered to the ironstone veins.

References