



# A Study of Kimberlitic Eclogites and Mafic Granulites from the Southern Adelaide Fold Belt

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Geology Honours

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## Abstract

A xenolith suite recovered from a Jurassic, diatreme facies kimberlite pipe located near Angaston is the subject of this thesis. This kimberlite is the southern-most occurrence in a province of xenolith-bearing kimberlites that intrudes the Adelaide Fold Belt (mainly as thin dykes), as far north as Port Augusta. The majority of the xenoliths, which range up to ~5 kgs, are mafic garnet-clinopyroxene granulites, kyanite bearing granulites, kyanite bearing eclogites and amphibole bearing eclogites. Mineral assemblages include; gar-cpx-ky-rutile, gar-hb-cpx-ky and gar-cpx-plag. The use of garnet-clinopyroxene Fe-Mg exchange geothermometers and clinopyroxene site occupancy (Ganguly *et al.* 1998), together with the use of *THERMOCALC* (Powell *et al.* 1998) suggests the xenoliths span a pressure range between ~10 and 30 kbar with temperatures in the range 800 – 1020 °C. These mafic granulites and eclogites are mildly silica under saturated mafic rocks with compositions dominated by normative olivine, plagioclase and clinopyroxene. They have SiO<sub>2</sub> contents between 40-50 wt% coupled with Mg# (calculated with total Fe) ranging from 0.4 up to 0.85. They display positive correlations between Mg# vs. MgO, Fe<sub>2</sub>O<sub>3</sub> (total), CaO, Al<sub>2</sub>O<sub>3</sub>, Cr, Sc and Ni and negative correlation between TiO<sub>2</sub>, V and potentially incompatible trace elements Zr, Nb, Y and REE. Their composition and trends are like those of Neoproterozoic basalts that were erupted at rifts in SE Gondwana (including the Gairdner dykes and Wooltana basalts). In detail they share the closest similarities with late Neoproterozoic basalts from NW Tasmania and King Island. The xenoliths apparent magmatic trend is defined by plagioclase-pyroxene crystallisation suggesting initial intrusion at or close to the Moho. The Angaston xenoliths also share MORB-like initial <sup>143</sup>Nd/<sup>144</sup>Nd isotopic compositions with the Tasmanian Basalts with an isochron-like array yielding a ~580 Ma age. Garnet-clinopyroxene pairs gave a well-defined Early Jurassic internal Sm-Nd isochron (~206Ma). This is interpreted as an eruption age. Two models are proposed for the formation of these eclogites. They may either be relicts of oceanic lithosphere subducted in the Cambrian, or they may be (perhaps more likely) the delaminated remains of Moho-depth mafic underplates intruded during Rodinian rift-drift and then delaminated at the end of the Delamerian Orogeny to become distributed amongst the mantle peridotite that subsequently cooled to form the present (and Jurassic) lithospheric mantle.

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