Chemical Geology
Volume 109, Issues 1-4 , 25 October 1993, Pages 341-354

doi:10.1016/0009-2541(93)90079-X Cite or Link Using DOI

Research paper

Sm---Nd mineral isochron ages of Late Proterozoic dyke swarms in Australia: evidence for two distinctive events of mafic magmatism and crustal extension*1

Jian-xin Zhao and Malcolm T. McCulloch

Research School of Earth Sciences, Australian National University, G.P.O. Box 4, Canberra, A.C.T. 2601, Australia

Received 4 August 1992; accepted 3 March 1993. ; Available online 1 April 2003.

Abstract

Two distinctive events of widespread dyke intrusion have been identified in central-southern Australia. Crystallization ages of the dykes were determined using Sm---Nd mineral isochrons obtained by splitting clinopyroxene and plagioclase into different magnetic and density fractions, respectively. The Stuart Dyke Swarm in the southern Arunta Inlier and the Kulgera Dyke Swarm in the eastern Musgrave Inlier define essentially identical crystallization ages of 1076 ± 33 and 1090 ± 32 Ma, respectively, marking the first episode of post-orogenic mafic magmatism in the region. Two samples from the Gairdner Dyke Swarm in the Stuart Shelf yield Sm---Nd mineral isochron ages of 867 ± 47 and 802 ± 35 Ma, respectively, whilst two samples from the Amata suite in the central Musgrave Inlier, 790 ± 40 and 797 ± 49 Ma. These four ages represent the second episode of mafic magmatism in central-southern Australia. These ages allow new constraints to be placed on the timing of large-scale crustal extension and formation of intracratic depositional basins in the region.

Initial ϵ_{Nd}-values of – 7.8 to – 6.6 for the Stuart dykes and + 0.7 for the Kulgera dykes suggest they were derived from different mantle sources with the Stuart dykes being produced from strongly enriched sources. In contrast, positive and relatively uniform initial ϵ_{Nd}-values of + 2.5 to + 4.1 for the younger Amata Suite and Gairdner dykes indicate that they were derived from relatively depleted and homogeneous mantle sources.

The 1076 ± 33-Ma Sm---Nd age of the Stuart Dyke Swarm is significantly older than its Rb-Sr mineral

isochron age of 897 ± 9 Ma previously reported, suggesting mobility of Rb and/or Sr and partial resetting of Rb-Sr isotopic systematics.

This study demonstrates that reliable and relatively precise Sm---Nd ages can be obtained for Precambrian dykes, despite the limited number of mineral phases available in the dykes.

*1 The project was undertaken while J.X.Z. was holding and ANU scholarship.

Chemical Geology
Volume 109, Issues 1-4 , 25 October 1993, Pages 341-354