Geoscience Frontiers 13 (2022) 101408

HOSTED BY

Contents lists available at ScienceDirect

Geoscience Frontiers

journal homepage: www.elsevier.com/locate/gsf

Research Paper

A continental back-arc setting for the Namaqua belt: Evidence from the Kakamas Domain

P.H. Macey [a], R.J. Thomas [a,*], A.F.M. Kisters [b], J.F.A. Diener [c], M. Angombe [d], S. Doggart [a], C.A. Groenewald [a], C.W. Lambert [a], J.A. Miller [b], H. Minnaar [a,e], H. Smith [a], H.F.G. Moen [a], E. Muvangua [d], A. Nguno [d], G. Shifotoka [d,f], J. Indongo [d], D. Frei [b,f], C. Spencer [g,h,i], P. le Roux [c], R.A. Armstrong [j], C. Tinguely [c]

[a] Council for Geoscience, P.O. Box 572, Bellville, South Africa
[b] Department of Geology, University of Stellenbosch, South Africa
[c] Department of Geological Sciences, University of Cape Town, South Africa
[d] Geological Survey of Namibia, Windhoek, Namibia
[e] Department of Geology, University of Free State, South Africa
[f] Department of Earth Sciences, University of the Western Cape, South Africa
[g] The Institute of Geoscience Research, Dept. Applied Geology, Curtin University, Perth, Australia
[h] Department of Geological Sciences and Geological Engineering, Queen's University, Kingston, Canada
[i] Geochronology and Tracers Facility, British Geological Survey, Nottingham NG12 5GG, UK
[j] RSES, Australian National, University, Canberra, ACT, Australia

ARTICLE INFO

Article history:
Received 21 February 2022
Revised 9 May 2022
Accepted 18 May 2022
Available online 21 May 2022
Handling Editor: N.M.W. Roberts

Keywords:
Kakamas
Namaqua
Geodynamics
Geochronology
Hot orogeny
Mesoproterozoic

ABSTRACT

A study of the NW Kakamas Domain in South Africa/Namibia provides a new, unified lithostratigraphy and evolutionary history applicable to the whole Namaqua Sector. The Mesoproterozoic history ranges from ~1350 Ma to 960 Ma, but isotopic evidence suggests it was built upon pre-existing Paleoproterozoic continental crust that extended west from the Archaean Craton. In eastern Namaqualand, early rift-related magmatism and sedimentation at ~1350 Ma occurred in a confined ocean basin. Subsequent tectonic reversal and subduction at ~1290–1240 Ma led to establishment of the Areachap, Konkiep and Kaaien Domains. In the Kakamas Domain, widespread deposition of pelitic sediments occurred at ~1220 Ma (Narries Group). These contain detrital zircons derived from proximal crust with ages between ~2020 Ma and 1800 Ma (western Palaeoproterozoic domains) and 1350–1240 Ma (eastern early Namaqua domains), suggesting pre-sedimentation juxtaposition. The pelites underwent granulite grade metamorphism at ~1210 Ma (peak conditions: 4.5–6 kbar and 770–850 °C), associated with voluminous, predominantly S-type granitoid orthogneisses between ~1210 Ma and 1190 Ma (Eendoorn and Ham River Suites) and low-angle ductile (D_2) deformation which continued until ~1110 Ma, interspersed with periods of sedimentation. This enduring P-T regime is inconsistent with the expected crustal over-thickening associated with the generally-accepted collision-accretion Namaqualand model. Rather, we propose the Namaqua Sector is a 'hot orogen' developed in a wide continental back-arc with subduction west of the present-day outcrop. The observed high geotherm resulted from thinned back-arc lithosphere accompanied by an influx of mantle-derived melts. Ductile D_2 deformation resulted from "bottom-driven" tectonics and viscous drag within the crust by convective flow in the underlying asthenospheric mantle. This extended tectonothermal regime ceased at ~1110 Ma when SW-directed thrusting stacked the Namaqua Domains into their current positions, constrained in the Kakamas Domain by late- to post-tectonic I-type granitoids intruded between ~1125 Ma and 1100 Ma (Komsberg Suite). The thermal peak then shifted west to the Bushmanland and Aus Domains, where voluminous granites (1080–1025 Ma) were associated with high-T/low-P granulite facies thermal metamorphism and mega-scale open folding (D_3). Unroofing of the Namaqua Sector is marked by large-scale, NW-trending, sub-vertical transcurrent dextral shear zones and associated pegmatites and leucogranites at ~990 Ma.

* Corresponding author.
E-mail address: bthomas@geoscience.org.za (R.J. Thomas).

https://doi.org/10.1016/j.gsf.2022.101408
1674-9871/