

Did Bushmanland extensionally unroof Namaqualand?

John F. Dewey^{a,b,c,d,*}, Laurence Robb^{d,e}, Louw Van Schalkwyk^f

^a Department of Geology, UC Davis, Davis, CA 95616, USA

^b University College, Oxford OX1 4HH, UK

^c Department of Earth Sciences, Imperial College, London, UK

^d Economic Geology Research Institute, University of the Witwatersrand, Johannesburg, South Africa

^e Department of Earth Sciences, Parks Road, Oxford OX1 3PR, UK

^f Anglo-American Mining Corporation, Aggeneys, Northern Cape, South Africa

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This paper is dedicated to the memory of Richard (Dick) Armstrong and Vaclav Vajner, clever and inceptive geologists whose early deaths were a profound tragedy for our understanding of metamorphic core complexes and the geology of Namaqualand.

Abstract

The Namaqua-Natal Orogen evolved between about 2000 and 1000 Ma as part of an orogenic system that assembled the Rodinian supercontinent, and “wraps” the Archaean Kaapvaal Craton to the south and west. The Orogen includes the western ultra-high-temperature sapphirine/hercynite-granulite-facies Namaqualand Terrane, structurally overlain, to the north, by the low-grade, high-level igneous, Richtersveld Terrane (1900–1700 Ma) and, to the east, by the amphibolite-facies granite gneiss/Pb-Zn-rich supracrustal Bushmanland Terrane, which is overthrust, from the north along the Groothoek Thrust, by the high-pressure Hom Terrane. West of the dextral Tantalite Valley/Pofadder Shear Zone, the gently-dipping contacts among these terranes have been considered to be thrusts. With the exception of the Groothoek Thrust, the contacts are low-angle, top-down-to-the-east or northeast, folded extensional detachments with displacements of up to at least 100 km. The Namaqualand part of the Namaqua-Natal Orogen comprises two distinct event sequences, a Kibaran phase of crustal shortening and thickening, and voluminous granitic sheets at about 1200 Ma, then a Namaquan phase of mafic underplating, ultra-high-temperature metamorphism, granitic sheets, dextral transtension, constrictional fabrics, and crustal thinning from about 1060 to 1030 Ma. A dominant constrictional LS fabric was developed in regionally sub-horizontal layered pink granite gneisses and metasediments deformed by ENE-trending folds. Extensional detachments developed late in the Namaquan phase when the ultra-high-temperature rocks were exhumed. In the Bushmanland Terrane, Aggeneys metasediments have mainly constrictional fabrics and are deformed by giant upward-facing, downward-closing sheath folds, developed during transtension, in which lie 1700 Ma Pb/Zn SedEx deposits like those of Broken Hill and Flin Flon. The Namaqualand Terrane may be the largest and oldest extensional core complex on Earth. The Proterozoic Era was characterized by transtensional ultra-high-temperature, horizontally-layered, lineated, pink gneiss terrains with corrugating fold hinges roughly parallel with the finite stretching direction.

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1. Introduction

The Mesoproterozoic Namaqua-Natal Orogen wraps the Archaean Kaapvaal Craton to the south and west, and is truncated by the Neoproterozoic (Pan-African)

* Corresponding author. Tel.: +1 530 754 7472;
fax: +1 530 752 0951.

E-mail address: dewey@geology.ucdavis.edu (J.F. Dewey).

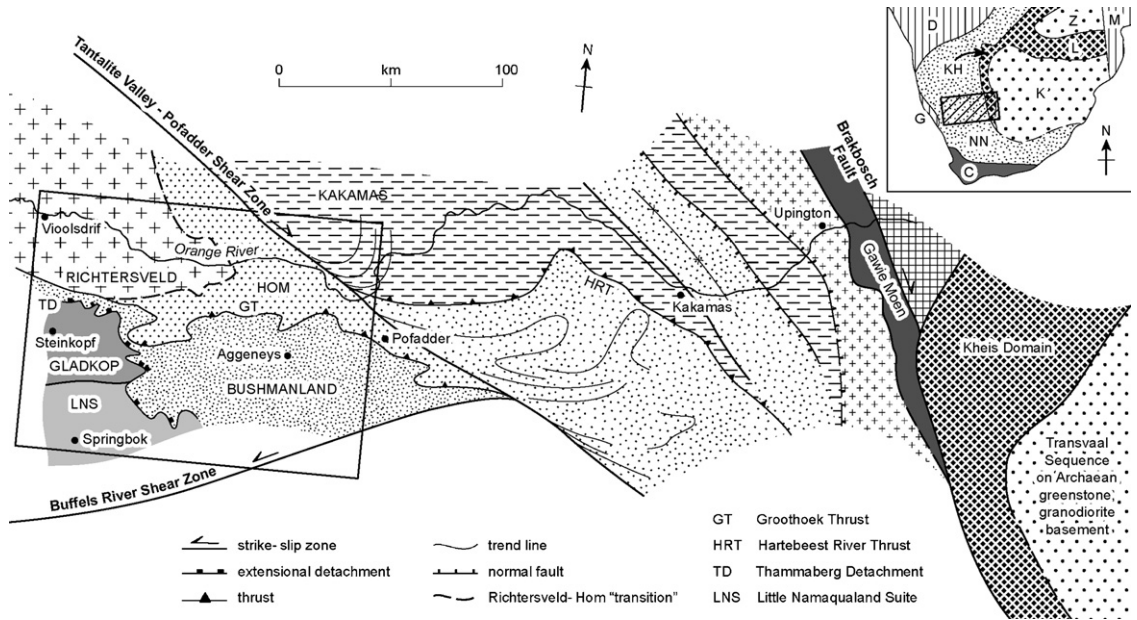


Fig. 1. Outline geological map of Namaqualand/Bushmanland. Area of Fig. 2 outlined. Ornament as in Fig. 2. Small inset map shows position in southern Africa. C—Cape Fold Belt (Triassic), D/G/M—Damaran/Gariep/Mozambique (late Neoproterozoic), KH/L—Kheis/Limpopo (Palaeoproterozoic), K/Z—Kapaavaal/Zimbabwe (Archaean), and NN—Namaqua/Natal (late Mesoproterozoic).

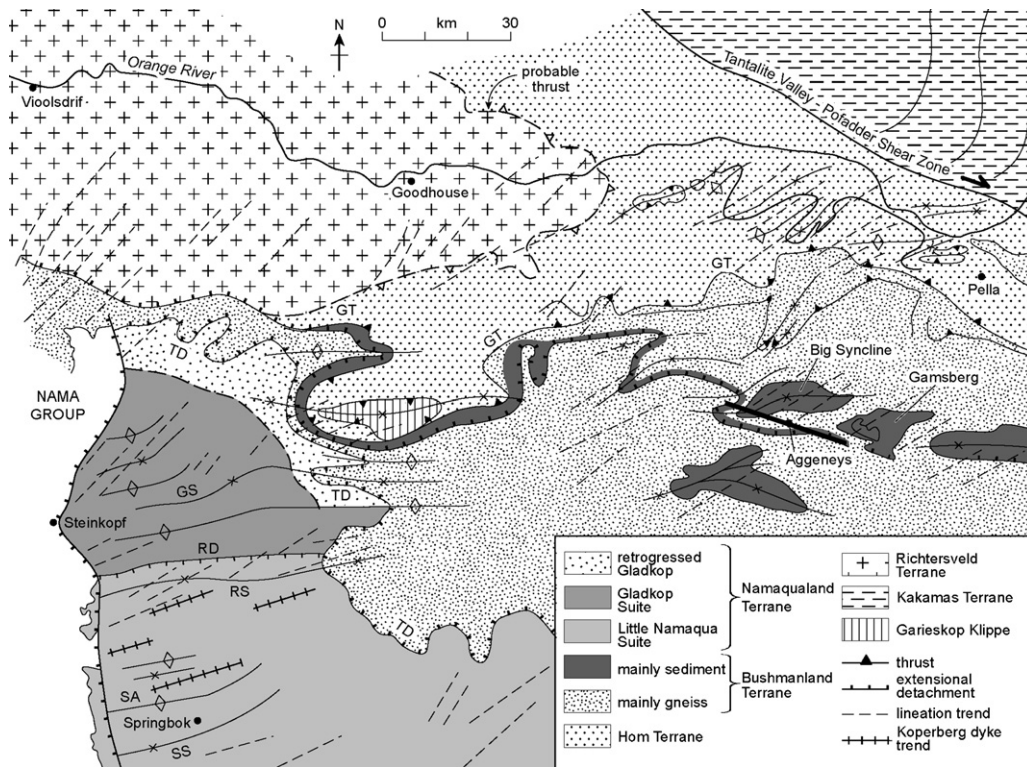


Fig. 2. Geological map of Namaqualand/western Bushmanland (area outlined in Fig. 1). GT—Groothoek Thrust, RD—Rappaport Detachment, RS—Rappaport Synform, SA—Springbok Antiform, SS—Springbok Synform, and TD—Thammaberg Detachment.

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