Precambrian Research 169 (2009) 80–99

Contents lists available at ScienceDirect

Precambrian Research

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

Paleomagnetism of a Neoarchean-Paleoproterozoic carbonate ramp and carbonate platform succession (Transvaal Supergroup) from surface outcrop and drill core, Griqualand West region, South Africa

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ARTICLE INFO

Article history:
Received 24 December 2007
Received in revised form 12 May 2008
Accepted 23 October 2008

Keywords:
Paleomagnetism
Paleoproterozoic
South Africa
Apparent polar wander path
Remagnetization
Epigenetic mineralization

ABSTRACT

Detailed paleomagnetic study across the Archean-Paleoproterozoic boundary interval preserved in the Ghaap Group, Transvaal Supergroup, of the Kaapvaal craton reveals a complex series of viscous and thermo-chemical magnetic overprints. Despite this complex history, a potential primary single-polarity remanence direction was revealed at high-temperature demagnetization steps in about 10% of orientated drill core samples only. This component (declination = 132°, inclination = 69°) was not identified in any of the outcrop sites. Overprint directions include a present geomagnetic field remanence and a very well developed thermo-chemical overprint (declination = 359°, inclination = 54°), which is believed to be associated with a ~2.0 Ga regional thermal event and the development of extensive epigenetic Pb–Zn deposits. At higher levels of demagnetization, two shallow west-directed components appear to be related to the extrusion of the Ongeluk Formation lava at 2.22 Ga (declination = 268°, inclination = −20°; eastern parts of the studied region) and to the post-1.92 Ga Kheis orogeny (declination = 272°, inclination = 16°; exclusive to the western margin of the study area), respectively.

1. Introduction

The Agouron-Griqualand Paleoproterozoic Drilling Project was initiated to study the Archean-Paleoproterozoic transition recorded within the Transvaal Supergroup, western South Africa (Fig. 1). Drilling initially focussed on deepwater and slope facies (boreholes GKP1 and GKF1) of the lower Transvaal Supergroup, to further understanding of the paleoenvironmental changes across the shelf to basin transition. Even though the Neoarchean-Paleoproterozoic interval is well studied in South Africa, and a sound understanding exists of the sequence stratigraphic framework in which the lower Transvaal Supergroup developed (e.g., Sumner and Beukes, 2006), the first two Agouron cores fill a gap that is not well represented in outcrop (Fig. 1).

The goals of this paper are threefold. First, we aim to provide paleolatitude constraints on this key stratigraphic record by determining reliable Archean-Paleoproterozoic paleopoles from core and outcrop sampling. Secondly, we aim to construct a magnetostratigraphy to aid correlation between drill core and outcrop. Finally, this study can help to assess the degree of thermochemical alteration within these rocks, and constrain the nature and timing of hydrothermal fluids potentially responsible for resetting geochemical and isotopic records.

2. Geological setting

The lower Transvaal Supergroup represents a well-preserved ~2.67 to ~2.46 Ga continental-ocean record. It was accommodated in space created via thermal subsidence following the crustal heating and thinning events captured by the Ventersdorp Supergroup (Schmitz and Bowring, 2003). The sequence is preserved in areas historically known as the Transvaal Basin in the central Kaapvaal craton, and the Griqualand West Basin in the western part of the craton (Fig. 1). The base of the Transvaal Supergroup is defined by the unconformity at the base of the 2642 ± 3 Ma (unpublished age listed by Nelson et al., 1999) Vryburg Formation in Griqualand West. Here the Vryburg Formation overlies the Ventersdorp Supergroup, and the generally siliciclastic Vryburg Formation is overlain by a ca 1.5 km thick succession of chemical sediments (carbonate and banded-iron formation), collectively known as the Ghaap Group.

The lithological units relevant to this study (i.e., the Ghaap Group, with its triplet subdivision into the Schmidtsdrif, Camp-

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doi:10.1016/j.precamres.2008.10.015

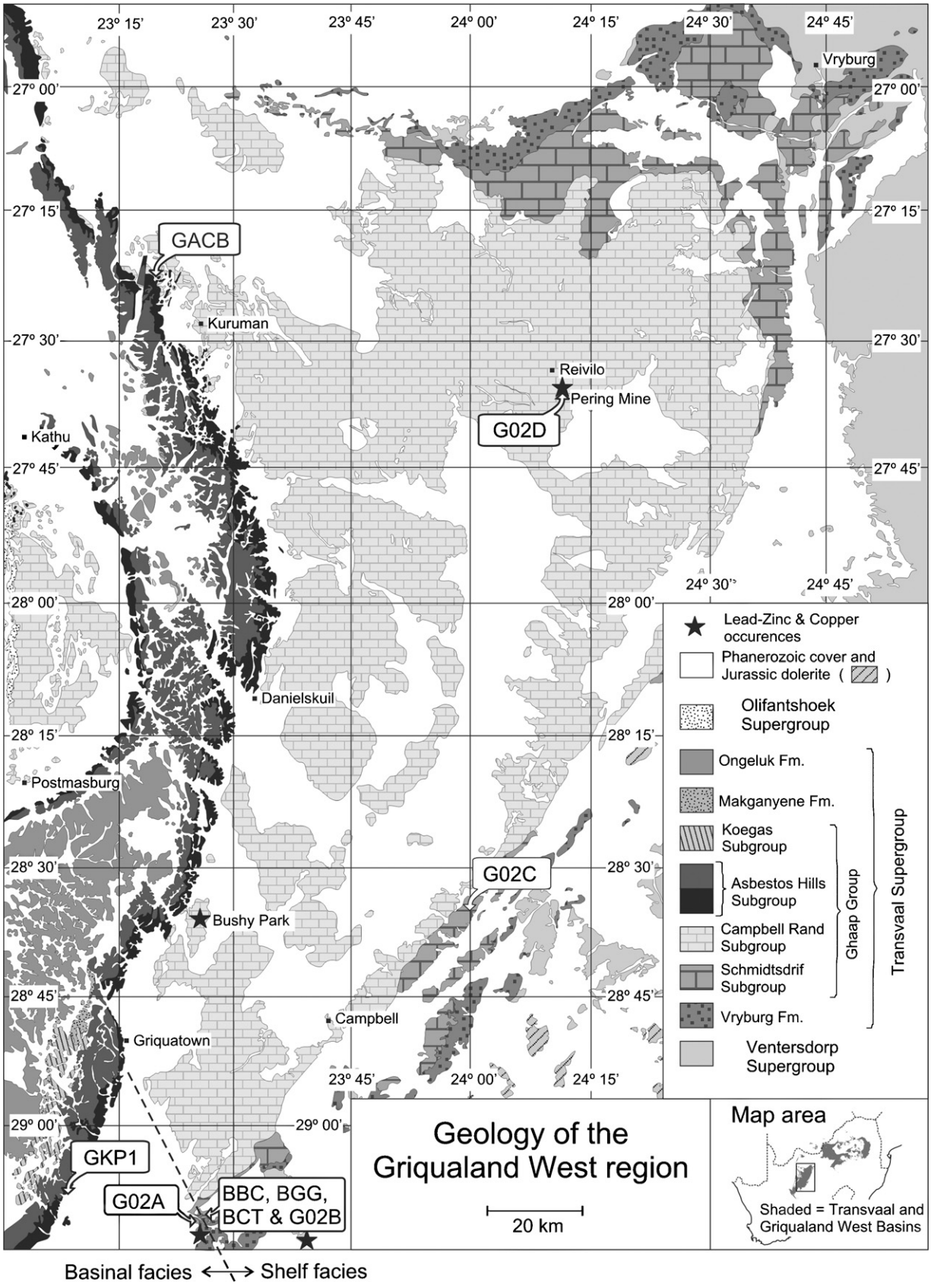

Fig. 1. Geology of the Griqualand West region displaying the location of paleomagnetic sampling sites for this study as well as the location of drill core GKP1.