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Lithos 71 (2003) ix–xi
LITHOS
www.elsevier.com/locate/lithos

Preface

The Slave–Kaapvaal workshop: a tale of two cratons

When academic curiosity and commercial interest intersect, there can be a tremendous growth in knowledge. Such was and is the case with the Kaapvaal craton in South Africa, and such is the case now with the Slave craton in northern Canada, where the diamond industry is catalysing, promoting and funding scientific research activities aimed at understanding Archean lithospheric processes.

As a direct consequence of the diamond wealth discovered in South Africa in 1867, the Kaapvaal craton has been studied scientifically for over a hundred years (Bonney, 1899). Much is known about the craton's lithospheric mantle, in part because of the abundance of mantle xenoliths made available by mining activities in the numerous kimberlites in southern Africa. The regional coverage of this information has been greatly expanded recently as a consequence of the National Science Foundation's Continental Dynamics funded Kaapvaal Project.

In stark contrast, diamond interest in the Slave craton dates only from the early 1980s, when Chuck Fipke, Stu Blusson and Hugo Dummett followed glacially dispersed indicator mineral trains from west of the craton, and eventually discovered the kimberlite pipes in the Lac de Gras area (Fipke et al., 1995). Knowledge of the Slave's cratonic mantle petrologic, geochemical and geophysical structure was advanced through the 1990s as part of industrial and academic data acquisition, following on detailed studies of the ancient crustal section of the Slave conducted in the late 1980s.

Given the established nature of geoscientific knowledge of the Kaapvaal craton compared to the Slave craton, and given the exciting new interdisciplinary results coming from the Kaapvaal Project and from Slave craton studies, we thought it opportune to hold a workshop bringing together scientists from both cratons so that they could be compared and contrasted. The workshop was held in Merrickville, Ontario, an hour's drive south of Ottawa, from 5–9 September 2001. There were almost 70 participants at the workshop, with 25 of them coming from outside North America, principally South Africa. The significant financial support we were able to raise for the workshop both facilitated attendance by many students and scientists and also paid for all the logistical costs.

A total of 52 presentations were given: 15 presentations on the Slave craton, 24 on the Kaapvaal craton and 13 comparing the two cratons with each other and with other cratons worldwide. Extended abstracts for these presentations can be found at www.ciw.edu/kaapvaal/abstracts. In addition, there were two evening presentations, one by Wouter Bleeker (included in this volume) discussing the Late Archean record of global cratons, and one by John Gurney giving humorous insight into diamond exploration of the Kaapvaal craton. Of those 54 papers, 24 are included in this volume presenting new results from cratons globally (5 papers), from southern Africa (12 papers) and from northern Canada (7 papers).

There are clearly major similarities and differences between these two Archean cratons. The crust of both was predominantly formed in the Mesoarchean, although the Slave craton does host older rocks than the Kaapvaal craton; the Acasta gneisses at 4.027 Ga (Stern and Bleeker, 1998) compared to the ca. 3.6 Ga Ancient Gneiss Complex of Swaziland (Kröner et al., 1993). Both contain crustal sections consisting of terranes of different ages welded together by Archean accretionary events. Both crustal sections are also underlain by lithospheric mantle sections consisting of peridotites that experienced extensive partial melt

0024-4937/$ - see front matter
doi:10.1016/S0024-4937(03)00108-7

extraction between 2.9 and 3.2 Ga, but this is where the similarities between the cratons end.

One of the most striking differences between the Slave and Kaapvaal cratons is the apparent seismic homogeneity of the Kaapvaal craton's SCLM (James et al., 2001; Gao et al., 2002), whereas the Slave craton is seismically layered (Bostock, 1998; Snyder et al., this volume). The seismic layering in the centre of the craton correlates laterally and with depth with electrical layering (Jones et al., this volume) and geochemical layering (Griffin et al., 1999). These unique attributes of the central Slave SCLM apparently do not extend to the northern or southern Slave craton, despite being overlain by laterally continuous Archean crustal domains (Grütter et al., 1999). Fingerprinting the Slave's diverse crustal and mantle components through the multi-disciplinary studies represented at the workshop permits reconstruction of the Archean cratonic puzzle (Bleeker, this volume), and, by contrast, exposes the relative uniformity with which the Kaapvaal crust and mantle have been regarded for many years.

Detailed geophysical and geochemical studies of the Kaapvaal are currently unravelling the domainal structure of its Archean SCLM (e.g. Silver et al., 2001; Moser et al., 2001), the relationship with overlying Archean crustal domains (de Wit et al., 1992) and mounting evidence for post-Archean mantle reworking. While the influence of the Late Archean Ventersdorp magmatism remains partly enigmatic (Schmitz and Bowring, 2003), a pervasive metasomatic imprint in the northern and western Kaapvaal craton mantle is being correlated in space and time with intrusion of the Paleoproterozoic Bushveld Igneous Complex and western correlatives in Botswana (Shirey et al., this volume; Hoal, this volume). Metasomatic reworking during the Phanerozoic is considered so intense that the mantle sample derived from Kaapvaal Group-1 kimberlites may not represent primary Archean SCLM (Griffin et al., Bell et al., and Simon et al., this volume). The depleted high-Mg/Fe, orthopyroxene-rich peridotite characteristic of the Kaapvaal mantle is now also being regarded as relatively unique, and can no longer be thought of as being universally present in all Archean cratonic SCLMs (Francis, this volume). The preferential growth of diamond in Kaapvaal harzburgite (Gurney, 1984) appears valid also for harzburgite from the central Slave craton (Stachel et al., this volume).

Taken together, these differences suggest that SCLM formation was different for the two cratons, implying that the search for a single causative formation process is bound to fail. We are clearly making progress in our attempts to understand Archean tectonic processes for formation, deformation and destruction of cratonic lithosphere, and their influence on diamond genesis and preservation, but much work needs to be done.

Acknowledgements

We wish to acknowledge the financial support of a number of organizations that was crucial in making the workshop the success it was. The Gold sponsors were DeBeers Canada Exploration and the Continental Dynamics Program of the National Science Foundation. Silver sponsors were Lithoprobe, Kennecott Exploration, the Geological Survey of Canada, and Diamondex Resources. Ashton Mining of Canada was a Bronze sponsor.

This volume came together through many people working with a single objective. However, various factors, including illnesses, commitments and computer crashes for authors and reviewers alike all conspired to make the volume appear later than originally planned. Nevertheless, we thank all those involved in its production.

Finally, the workshop, and this volume, would not have happened without the tireless energy of Gwen Mason (Continental Geoscience Division, Geological Survey of Canada). Thanks Gwen!

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Alan G. Jones*
Geological Survey of Canada, 615 Booth Street, Ottawa, Ontario, Canada K1A 0E9
E-mail address: ajones@nrcan.gc.ca

Richard W. Carlson
Department of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Road, NW, Washington, DC 20015, USA
E-mail address: carlson@dtm.ciw.edu

Herman Grütter
Mineral Services Canada Inc., #1300–409 Granville Street, Vancouver, BC, Canada V6C 1T2
E-mail address: herman.grutter@mineralservices.com

* Corresponding author. Fax: +1-613-943-9285.