Precambrian Research 167 (2008) 171–185

Contents lists available at ScienceDirect

Precambrian Research

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

# Provenance and tectonic setting of Paleoproterozoic metasedimentary rocks along the eastern margin of Hearne craton: Constraints from SHRIMP geochronology, Wollaston Group, Saskatchewan, Canada

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ARTICLE INFO

*Article history:*
Received 15 October 2007
Received in revised form 25 July 2008
Accepted 2 August 2008

*Keywords:*
Saskatchewan
Trans-Hudson Orogen
Wollaston Group
SHRIMP
Detrital zircons
Provenance

ABSTRACT

Single detrital zircon grains from various parts of the Wollaston Group, a Paleoproterozoic metasedimentary succession deposited along the southeastern margin of the Hearne Province, northern Saskatchewan, Canada, were analyzed by SHRIMP U–Pb geochronological techniques. Zircon analyses are mostly concordant and yield ages ranging from ca. 2800 to 1780 Ma, although distinct age populations were detected in all samples. The stratigraphically oldest sample (Geoch 4) is dominated by a bimodal distribution of zircon ages (ca. 1.90 and 2.4–2.6 Ga), which is similar to that preserved in the sample (Geoch 2) from the middle portion of the Wollaston Group. The stratigraphically youngest sample (Geoch 9) contains ca. 2.1 Ga zircons, as well as zircons with the same ages as observed in Geoch 4 and Geoch 2. Zircon ages older than 2450 Ma appear to be consistent with the age of the Hearne Province basement, suggesting that part of the sedimentary detritus was locally derived. Zircons with ages in the 2430–2350 Ma range, found in all samples, may have been derived from a more distant source, such as Rae Province rocks that were affected by the recently identified Arrowsmith orogeny. Significant amounts of 1920–1880 Ma zircon grains are found in all samples; these are interpreted to represent sedimentary detritus derived from juvenile volcanic terranes. Zircons younger than 1860 Ma are interpreted to be the product of post-Wollaston Group thermal overprinting. Our data, together with field relationships and geochemical data, suggest that most of the preserved Wollaston Group was deposited in a back-arc to foreland basin environment. It received detritus from both Archean continental crust to the west and a juvenile continental magmatic arc, likely located to the east, as the youngest zircon ages are not consistent with the age of Taltson Orogen rocks to the west.



## 1. Introduction

Studies of stratigraphic sequences deposited in basinal settings adjacent to active continental margins have revealed two major sources for the detrital sediments: one is the stable continental interior whereas the other is a younger magmatic belt adjacent to the basin (e.g., Condie, 1997). These diverse sources can allow detailed reconstructions of the location of basins and the tectonic processes operative in the mountain belts that were formerly the sites of the sedimentary basins. The evolution of stratigraphic records formed in relatively young sedimentary basins is quite advanced, because the combination of lithologic composition, sedimentary structure, and relative dating using the fossil record has led to accurate reconstruction of the nature of sedimentary successions. In contrast, historical reconstructions of Precambrian metasedimentary records are hampered by a lack of precise chronological constraints. In addition, most Precambrian belts have undergone medium- to high-grade metamorphism as well as polyphase deformation, which has destroyed primary sedimentary structures, and are also deeply eroded.

The Wollaston Group is a multiply deformed, upper amphibolite to granulite facies Paleoproterozoic metasedimentary succession exposed along the western margin of the Trans-Hudson Orogen in northern Saskatchewan (Fig. 1). It has been exhumed from significant depths, and the succession is likely not complete. Although recent studies (Delaney, 1994; Delaney et al., 1995, 1996, 1997; Tran

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doi:10.1016/j.precamres.2008.08.003

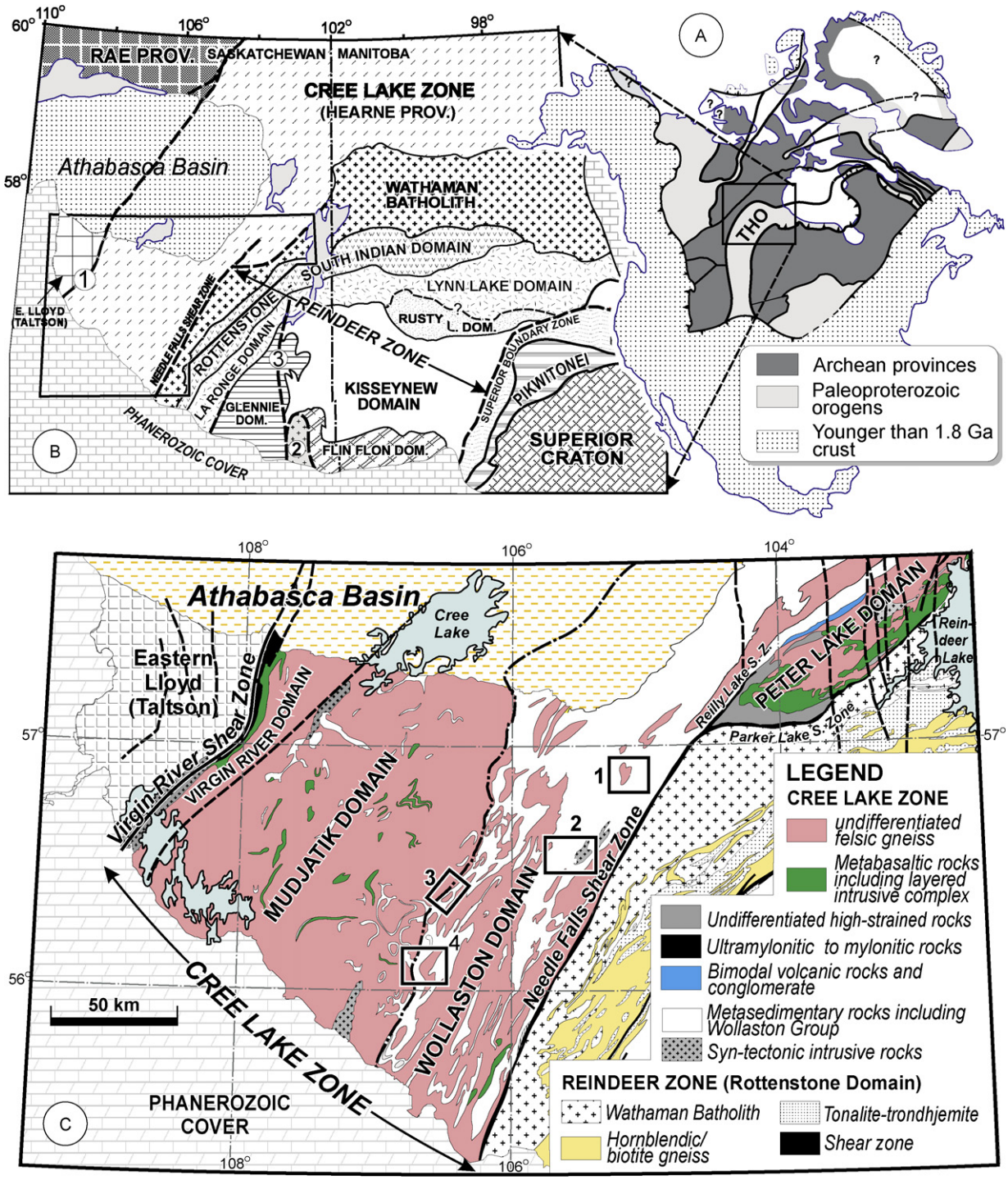


**Fig. 1.** (A) Location of the Trans-Hudson Orogen (THO) and other tectonic elements of the Canadian Shield in North America (modified from Hoffman, 1988); (B) major tectonic divisions of the exposed Precambrian crust in Saskatchewan and Manitoba, Canada; symbols: (1) Virgin River Shear Zone (Snowbird Tectonic Zone), (2) Hanson Lake Block, (3) Tabbernor Fault Zone, dashed lines are major fault/shear zones, shaded area are lakes; closed box is the area of (C); (C) tectonic divisions of the south-central exposed portion of the Cree Lake Zone in Saskatchewan; rectangular boxes are areas of detailed study from which samples were obtained for this study. The reader is referred to Tran (2001) for descriptions of these areas.

and Yeo, 1997; Tran and Smith, 1999; Tran et al., 1998, 1999; Yeo and Savage, 1999) have led to a better understanding of the relative relationships and stratigraphic order of lithologic members, its depositional setting, age, and provenance are still problematic. Was the detritus comprising the Wollaston Group derived from a distal continental highland and deposited in a passive marginal setting (e.g., Yeo and Savage, 1999) or was at least part of the detritus derived from a more proximal source and deposited in a back arc and/or foreland basin on an active continental margin (e.g., Lewry and Collerson, 1990; Tran and Smith, 1999; Tran et al., 2000)? Yeo and Savage (1999) suggest that no detritus would have been derived from the juvenile arc rocks of the Trans-Hudson Orogen, whereas Tran et al. (2003) suggest that these rocks may have provided significant detritus based on whole rock Nd isotopic data.