Summary of Detrital Zircon Geochronology of the Athabasca Group, Northern Saskatchewan and Alberta

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Abstract

Five sandstone samples representing four formations and five deposystems from the Athabasca Group have been processed for some 300 detrital zircons that were analysed individually in the Geological Survey of Canada's (GSC) SHRIMP laboratory. The following interpretations refer only to detrital zircons that are assumed to represent four formations within specific deposystems. The Fair Point Formation (Fidler Deposystem) is dominated by Neoarchean zircons with a main peak at 2.6 Ga, a secondary peak at 1.9 Ga, and suggested provenance from the Taltson magmatic zone and western Rae Province. The Manitou Falls Formation member MFb in the Ahenakew Deposystem also shows a pronounced bimodal age distribution with modes at 2.5 Ga and 1.85 Ga and suggested provenance from the Hearne Province and Trans-Hudson orogen respectively, consistent with easterly paleocurrents that characterize the Ahenekew Deposystem. The Manitou Falls Formation member MFd in the Moosonees Deposysytem is characteristic of the Trans-Hudson Orogen with a mode at 1.83 Ga. The sample from the Wolverine Point Formation in the Bourassa Deposystem contains zircons with ages similar to the Fair Point Formation, including a broad mode spanning 2.7 to 2.5 Ga and a pronounced mode spanning 1.88 to 1.78 Ga, reflecting a more southerly provenance from the western Churchill Province. A significantly younger population of detrital zircons (four grains) ca. 1.66 Ga places an important maximum age constraint on the upper part of the Athabasca Group. The spectrum of the stratigraphically highest sample, from the Douglas Formation (McLeod Deposystem), emulates that of the Wolverine Point Formation, supporting common provenance and the idea that both formations are part of the same deposystem. Zircons observed both petrographically (in-situ), and after separation for analysis, show normal ranges of morphology and preservation. There is no textural evidence in the detrital zircons of systematic regional dissolution, unusual extents of alteration, or unusually high uranium contents.

***Keywords**: Paleo-Mesoproterozoic geochronology, northern Saskatchewan-Alberta, Athabasca Group stratigraphy, detrital zircons, provenance, deposystems, uranium deposits.*

1. Introduction

The purpose of this study is to constrain depositional ages and provenances of formations and deposystems in the Athabasca Group of northern Saskatchewan and Alberta. This is part of the larger Geochronology Sub-Project of the EXTECH IV – Athabasca Uranium Multidisciplinary Study. Sandstone samples from the Athabasca Group were collected to represent as many formations and depositional settings as possible. Samples are mainly from drill core; one sample was collected from outcrop (MFb member from the Sue Pit). U-Pb detrital zircon studies commenced in August 2002 with sample preparation and grain selection followed by analysis over a two-week period in September. Five samples from geographically and stratigraphically dispersed localities were analyzed on the GSC SHRIMP (*in situ* U-Th-Pb isotope analysis using the Sensitive High Resolution Ion Microprobe; Table 1; Figure 1).

Table 1 - Stratigraphic and paleogeographic settings of samples collected for detrital zircon analysis. Locations are shown on Figure 1.

Z#/Sample #	Formation	**Sequence**	Deposystem	Location
7464/02JP-20A	Douglas	4	McLeod	Carswell
7460/02JP-7b	Wolverine Point	3	Bourassa	Northwest basin
7462/02JP-15a	Manitou Falls D	2	Moosonees	North-central margin
7465/RAT01-MF1	Manitou Falls B	2	Ahenakew	Eastern margin
7461/02JP-12+13+14	Fair Point	1	Fidler	Northwest basin

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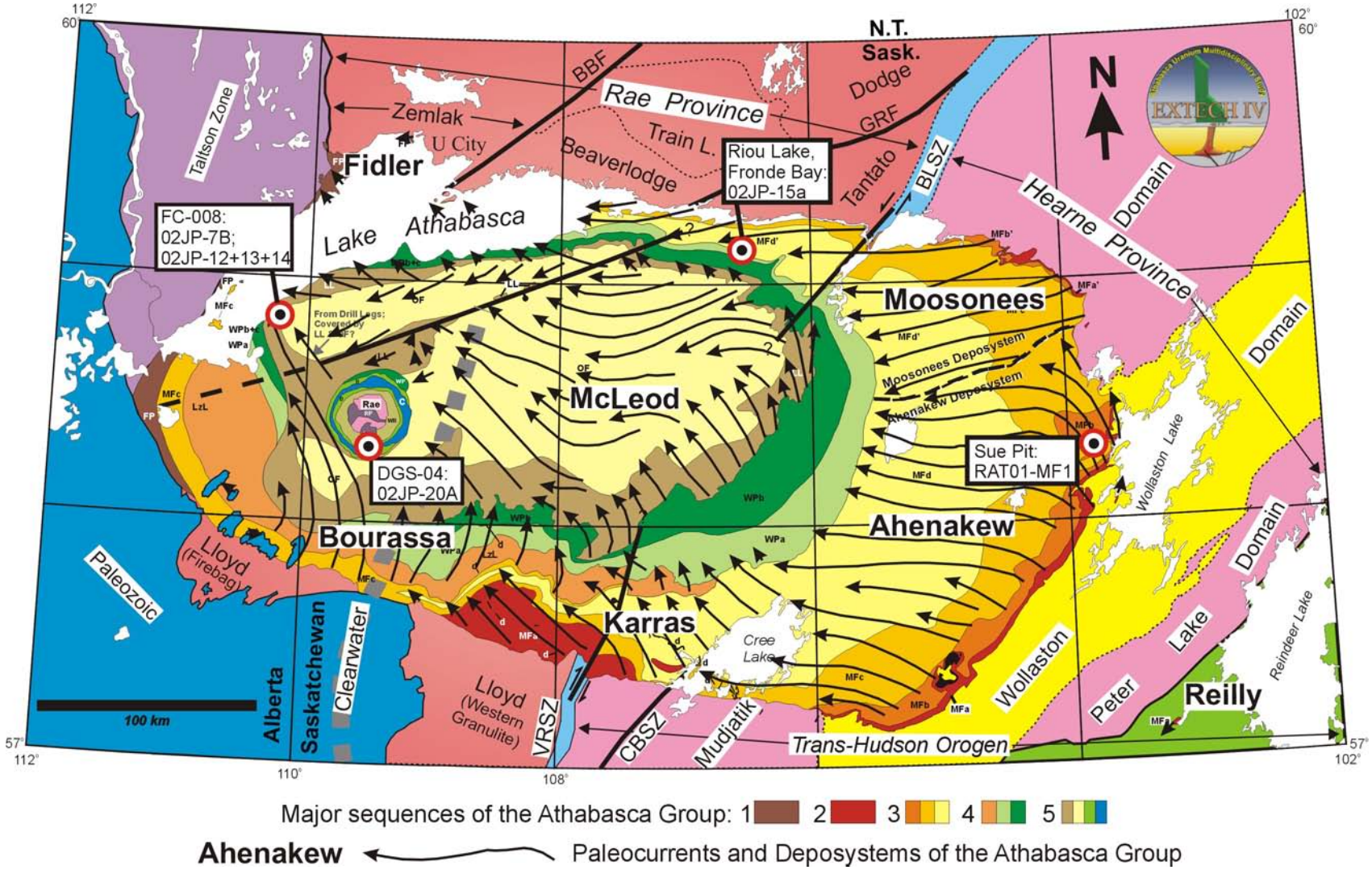

Figure 1 - Location of detrital zircon samples, with respect to major basement domains, stratigraphy, paleocurrents, and deposystems of the Athabasca Basin (after Ramaekers et al. (2001) and Thomas et al. (2002)). BBF=Black Bay Fault; GRF=Grease River Fault; BLSZ=Black Lake Shear Zone; CBSZ=Cable Bay Shear Zone; and VRSZ=Virgin River Shear Zone.

Preliminary U-Pb ages have been derived from SHRIMP analysis of approximately 300 detrital zircon grains.

The sample from the Fair Point Formation (Fidler Deposystem) is dominated by Neoarchean zircons with a peak at 2.6 Ga. and there is a significant secondary peak at 1.9 Ga. Provenance from the Taltson Magmatic Zone and western Rae Province is suggested.

The sample from the Manitou Falls Formation member MFb in the Ahenakew Deposystem also shows a pronounced bimodal age distribution, with modes at 2.58 Ga and 1.85 Ga. These data support provenance from the Hearne Province and Trans-Hudson Orogen respectively, consistent with the easterly paleocurrents that characterize the Ahenakew Deposystem.

The Manitou Falls Formation member MFd sample from the Moosonees Deposysytem is dominated by detrital zircons with ages characteristic of the Trans-Hudson Orogen and a mode at 1.83 Ga.

Detrital zircons from the Wolverine Point Formation in the Bourassa Deposystem yield a similar age distribution to the Fair Point Formation, with a broader and less pronounced mode spanning 2.7 to 2.5 Ga and a pronounced mode spanning 1.88 to 1.78 Ga. The similarities, in part, reflect a more southerly provenance from the western Churchill Province, consistent with Bourassa paleocurrents. A significantly younger population of detrital zircons (four grains) ca. 1.66 Ga also was identified in the Wolverine Point sample, placing an important maximum age constraint on the upper part of the Athabasca Group.

The stratigraphically highest sample comes from the Douglas Formation (McLeod Deposystem), preserved in the Carswell Structure in the western part of the basin. The detrital zircon age spectrum emulates that of the Wolverine Point Formation, supporting common provenance and the idea that both formations are part of the same deposystem.

Zircons observed both petrographically (*in situ*), and after separation for analysis, show normal ranges of morphology and preservation. There is no textural evidence in the detrital zircons of systematic regional dissolution, unusual extents of alteration, or unusually high uranium contents.

2. Acknowledgments

The ages provided above are preliminary, to provide general context and direction to stratigraphic studies, and should not be directly quoted at this time. A substantive paper in preparation will provide proper analytical context. Samples were collected by Paul Ramaekers (7462/02JP-15a), Darrel Long (7465/RAT01-MF1), Gary Yeo (7464/02JP-20A), and Charlie Jefferson (7460/02JP-7b, 7461/02JP-12+13+14). Laboratory assistance was provided by Nicole Sanborn.

3. References

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