



Pre-Timiskaming folding in the Archean southern Abitibi greenstone belt, Ontario and Quebec, Canada: structural constraints and conundrums.

Frieman, B.M.,
Kuiper, Y.D.,
Monecke, T.,
Kelly, N.M.

Colorado School of Mines,
Department of Geology &
Geological Engineering
1516 Illinois St.
Golden CO 80401



I. INTRODUCTION

The southern Abitibi subprovince (SAS) is one of the largest continuous and best exposed Archean greenstone belts in the world. Despite years of study, relatively little is known about the early lithotectonic development of the region. This is due, in part, to poor early fabric development and extensive late stage (post-Timiskaming) deformation along major regional deformation zones. Regional deformation zones such as the Larder Lake-Cadillac (LLCdZ) and Porcupine-Destor (PDZ) are long lived zones of deformation and fluid migration that extend for 100s of kilometers along strike. This study investigates the extent and significance of early structure in the SAS.

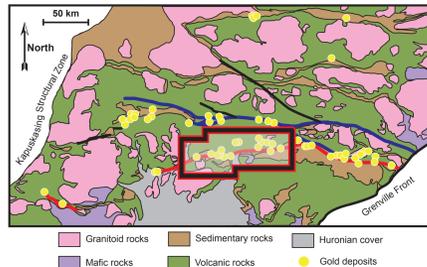


Fig. 1 - Lithotectonic map of southern Abitibi subprovince displaying distribution of rock types, gold deposits, and major deformation zones (LLCdZ in red; PDZ in blue) (after Poulsen et al., 2000).

II. STUDY SIGNIFICANCE & GOAL

The SAS displays an enigmatic lithotectonic progression from early volcanism (i.e., Tisdale-Blake River episodes) to a period of deformation, uplift, erosion, and sedimentary basin formation (i.e., Porcupine-Timiskaming episodes) (Fig. 2). This general lithotectonic progression is common to Archean greenstone belts worldwide (e.g., Yilgarn). Economic mineralization is related to post-Timiskaming deformation and has, therefore, been relatively well characterized. However, little is known about pre-Timiskaming regional structural development.

STUDY GOAL

The goal of this study is to establish pre-Timiskaming structure throughout the SAS to assess geodynamic processes active during the late Archean

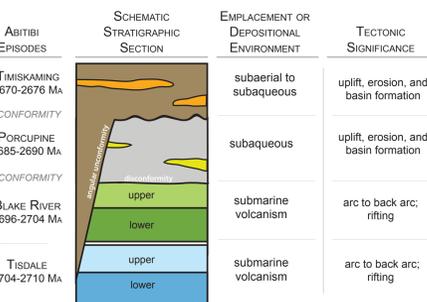
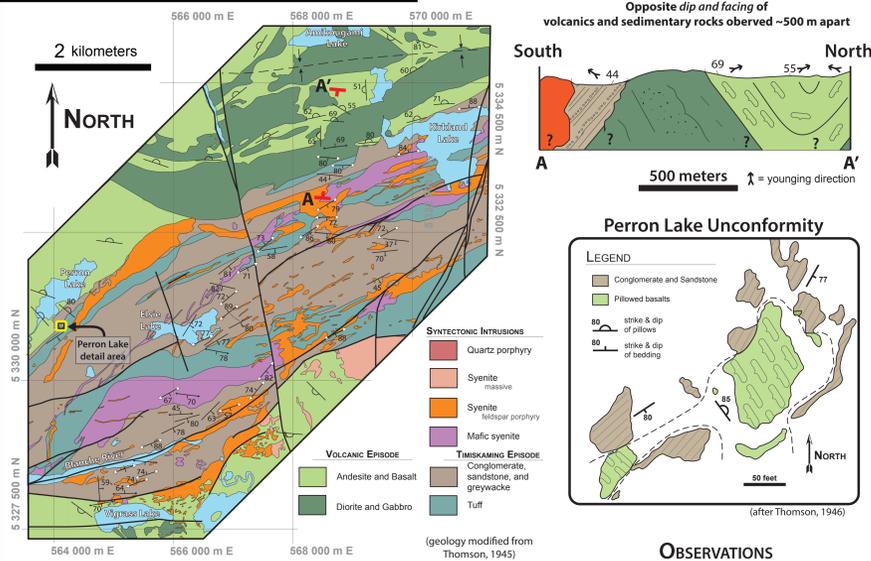


Fig. 2 - Schematic stratigraphic section displaying the lithotectonic assemblages that occur along the Larder Lake-Cadillac deformation zone and their relative contact relationships, depositional setting, and tectonic significance

IV. PERRON LAKE-KIRKLAND LAKE AREA



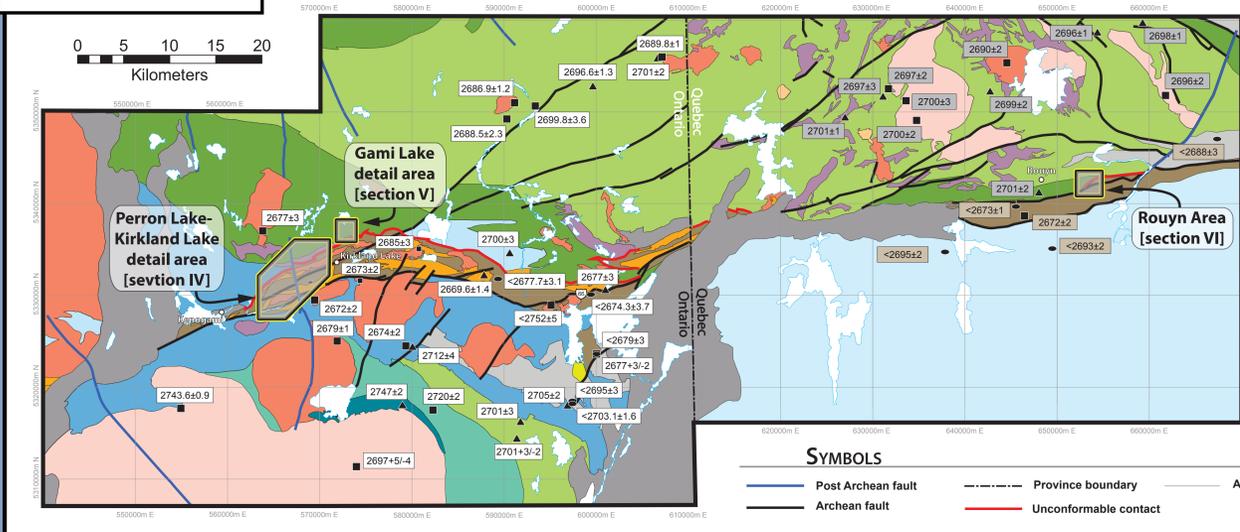
PERRON LAKE-KIRKLAND LAKE GEOLOGY

- Timiskaming episode sedimentary and volcanic rocks are bound to the south by the LLCdZ and unconformably overlie Blake River volcanic greenstones to the north
- Field relationships indicate Blake River volcanic rocks were folded, moderately dipping, and partially denuded at the time of Timiskaming deposition

OBSERVATIONS

- Transsects in Kirkland Lake reveal opposing facing directions in Blake River and Timiskaming episode rocks
- The Blake River-Timiskaming unconformity is preserved in outcrop in the Perron Lake area
 - the relative strike of Timiskaming sediments and pillowed basalts is ~70° different
 - both units are steeply dipping
 - post-Timiskaming strain is relatively low

III. REGIONAL GEOLOGY



Intrusive Rocks

- Late tectonic (2670 to 2660 Ma)
- Syntectonic (2695 to 2670 Ma)
- Synvolcanic felsic to intermediate (2745 to 2696 Ma)
- Synvolcanic mafic to ultramafic (2740 to 2700 Ma)

Abitibi Episodes

- Timiskaming (2676 to 2670 Ma)
 - Sedimentary
 - Volcanic
- Porcupine (2690 to 2685 Ma)
 - Sedimentary
 - Volcanic
- Blake River (2704 to 2696 Ma)
 - Upper Unit
 - Lower Unit
- Tisdale (2710 to 2704 Ma)
 - Upper Unit
 - Lower Unit
- Stoughton-Roquemaure (2723 to 2720 Ma)
- Pacaud (2750 to 2735 Ma)

HURONIAN COVER

GEOCHRONOLOGY SAMPLES

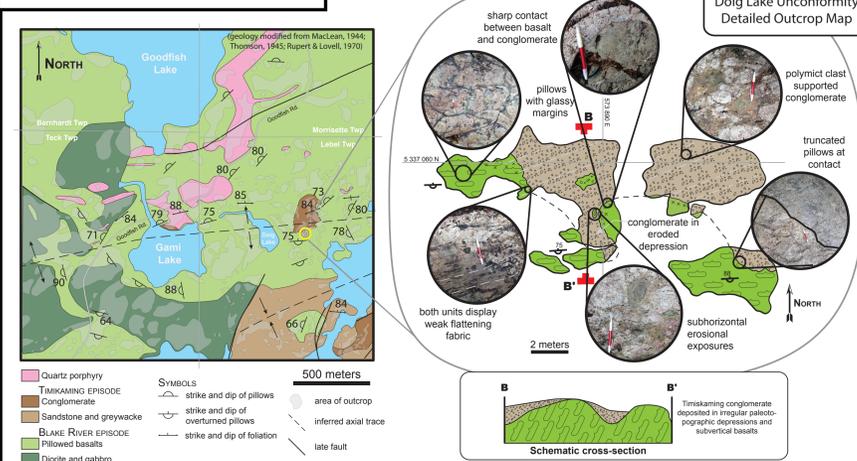
- ▲ Volcanic
- Intrusive
- Sedimentary

▲ 2681±3 age compiled by Ayer et al., 2005
 ■ 2697±2 age compiled by Goutier & Melançon, 2007
 ● <2693±2 age reported by Davis, 2002

*"c" indicates the maximum (inferred) depositional age based on the youngest detrital zircon analyzed.

(after Goutier & Melançon, 2007; Ayer et al., 2009)

V. GAMI LAKE-DOIG LAKE AREA



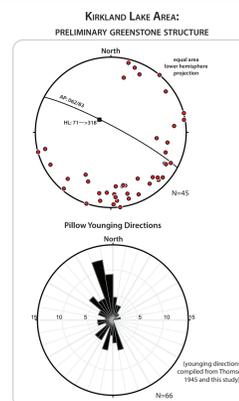
OBSERVATIONS

- Erosional outliers of Timiskaming sedimentary rocks occur at:
 - N. Shore of Gami Lake
 - conglomerate and pillows truncated by post-Timiskaming intrusion
 - East of Doig Lake
 - » Doig Lake area preserves near primary Timiskaming-Blake River contact «

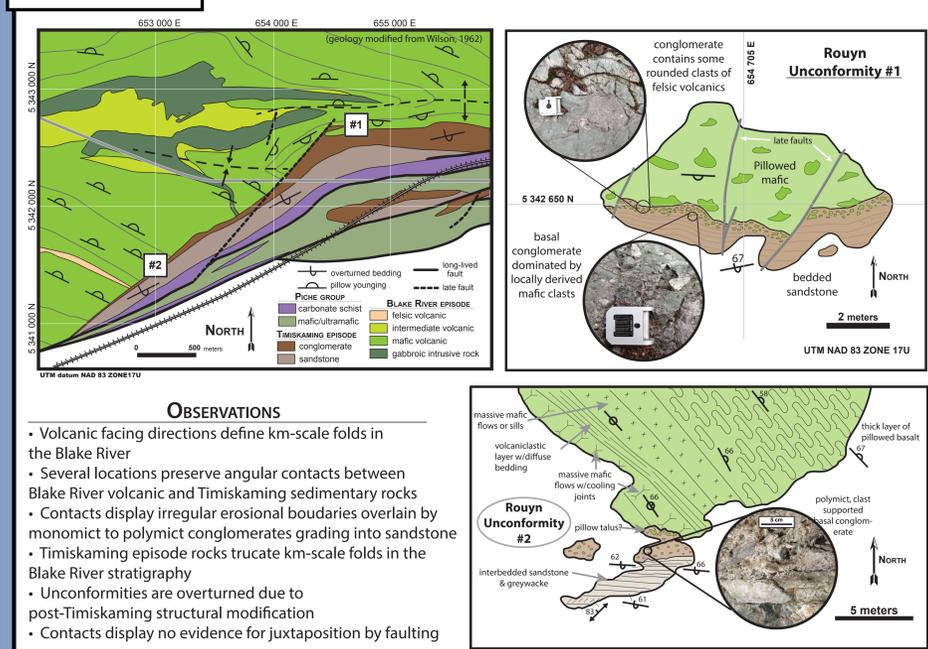
VII. DISCUSSION

PRELIMINARY OBSERVATIONS

- Primary volcanic facing directions define km-scale folds in older volcanic episode rocks
 - folds are inclined, E-W trending, and moderately west plunging
 - generally, no penetrative fabric is attributed to pre-Timiskaming structure
- Observations at a number of localities along ~100 km of strike indicate that these folds are regionally extensive
- Timiskaming episode sedimentary rocks unconformably overlie pre-Timiskaming structure
- It is unclear to what degree post-Timiskaming deformation augmented these structures



VI. ROUYN AREA



OBSERVATIONS

- Volcanic facing directions define km-scale folds in the Blake River
- Several locations preserve angular contacts between Blake River volcanic and Timiskaming sedimentary rocks
- Contacts display irregular erosional boundaries overlain by monomict to polymict conglomerates grading into sandstone
- Timiskaming episode rocks truncate km-scale folds in the Blake River stratigraphy
- Unconformities are overturned due to post-Timiskaming structural modification
- Contacts display no evidence for juxtaposition by faulting

VIII. WORKS CITED

Allmendinger, R.W., Cardozo, N. C., and Fisher, D., 2012. Structural Geology Algorithms: Vectors & Tensors: Cambridge, England, Cambridge University Press, p. 289.

Ayer, J.A., Thurston, P.C., Bateman, R., Dubé, B., Gibson, H.L., Hamilton, M.A., Hathway, B., Hocker, S.M., Houle, M.G., Hudak, G., Isoplatov, V.O., Lafrance, B., Leshar, C.M., MacDonald, P.J., Pelouquin, A.S., Piercey, S.J., Reed, L.E. and Thompson, P.H., 2005. Overview of results from the Greenstone Architecture Project: Discover Abitibi Initiative, Ontario Geological Survey, Open File Report 6154, p. 146.

Cardozo, N., and Allmendinger, R.W., 2013. Spherical projections with OSSTereonet: Computers & Geosciences, v. 51, no. 0, p. 193-205.

Davis, D.W., 2002. U-Pb geochronology of Archean metasedimentary rocks in the Pontiac and Abitibi subprovinces, Quebec, Precambrian Res. 115, p. 97-117.

Goutier, J. and Melançon, M., 2007. Compilation géologique de la Sous-province de l'Abitibi (version préliminaire). Ministère des Ressources naturelles et de la Faune, Québec, échelle 1/500 000.

MacLean, A., 1944. Township of Lebel, District of Timiskaming, Ontario; Ontario Department of Mines Map 53a, 1:12,000.

Rupert, R.J., and Lovell, H.L., 1970. Townships of Bernhardt and Morrisette, District of Timiskaming, Ontario; Ontario Department of Mines Preliminary Map 2193, scale 1:31,680.

Thomson, J.E., 1945. Township of Teck, District of Timiskaming, Ontario; Ontario Department of Mines Map 1945-1, scale 1:12,000.

Thomson, J.E., 1946. The Kewatin-Timiskaming unconformity in the Kirkland Lake district, Roy. Soc. Canada Trans., Ser. 8, 40, Sect. 4, p. 113-124.

Wilson, M.E., 1962. Rouyn-Beauchastel map areas, Quebec. Geol. Surv. Can., Memoir 315, p. 140.