Bedrock mapping in the northeastern Cauchon Lake area

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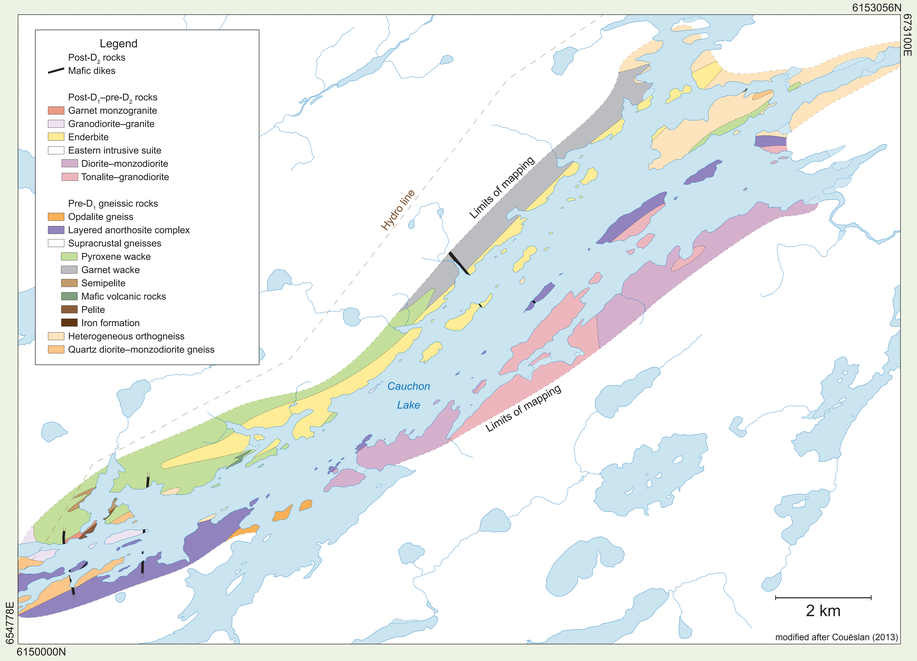
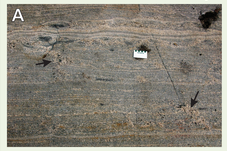
Summary

A project to re-map portions of the Archean Pikwitonei Granulite Domain in central Manitoba with emphasis on interpretation of protoliths continued with mapping in the northeast Cauchon Lake area. The mapped area has been subjected to relatively uniform, high-grade Neoarchean metamorphism and deformation. Exposures in the northeast Cauchon Lake area can be divided into three main groups based on structural observations: Archean pre-D_1 gneissic rocks, Archean post-D_1–pre-D_2 rocks, and post-D_2 rocks. Pre-D_1 gneissic rocks include quartz monzodiorite gneiss, heterogeneous orthogneiss, a gneissic supracrustal sequence (including pyroxene and garnet wackes, semipelite, mafic volcanic rocks, pelite, and banded iron formation), a layered anorthosite complex, and opdalite (orthopyroxene granodiorite) gneiss. Post-D_1–pre-D_2 rocks include an intrusive suite that ranges in composition from diorite to granodiorite, and discrete intrusive bodies of enderbite (orthopyroxene tonalite), granodiorite-granite, garnet monzogranite, and metadiabase. Post-D_2 rocks consist mostly of Paleoproterozoic mafic dykes. The oldest group of rocks in the Cauchon Lake area display an S_1 gneissosity. This early gneissosity was cut by leucosome that formed during a lower granulite-facies metamorphic event that affected all Archean rocks in the area. The rocks were then isoclinally folded and transposed during D_2 deformation which generated S_2 fabrics in all Archean phases.

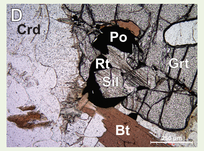
The supracrustal sequence exposed at Cauchon Lake bears many similarities to sequences observed in greenstone belts in the adjacent Superior Province where occurrences of gold and base metals are found.

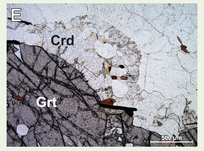


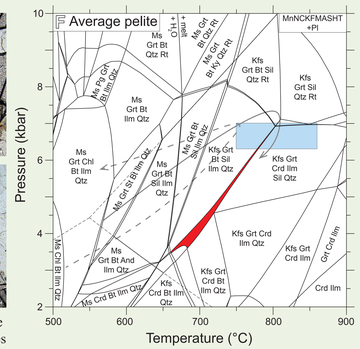
Structure and metamorphism



A) Orthopyroxene-bearing M_2 leucosome (arrows) cutting across the S_1 gneissosity in dioritic gneiss. B) Cordierite- and garnet-bearing M_2 leucosome in pelitic gneiss. C) Orthopyroxene-bearing M_2 leucosome in enderbite. The leucosome is foliated and folded by D_2, suggesting the M_2 metamorphic event largely pre-dates the D_2 deformation event.







Ilmenite is the dominant Ti-phase found included in garnet in pelites from Cauchon Lake; however, rutile is present in the groundmass and partially enclosed along garnet grain margins (D). The rutile in (D) partially encloses prismatic sillimanite. These textures suggest metamorphic conditions progressed into the field of stable rutile after a period of significant sillimanite growth, and that minor garnet growth was ongoing. E) Cordierite overgrown on garnet in pelite could suggest decompression during high-grade metamorphism and therefore, a clockwise P-T path. F) Equilibrium assemblage diagram in the system MnNCKFMASHT for average Pipe Formation pelite (Couëslan and Pattison, 2012). The metamorphic assemblage observed in pelite from Cauchon Lake is indicated by the red field. The light blue field indicates the limits of previous pressure and temperature estimates (Mezger et al., 1990; Vry and Brown, 1992), and the heavy, grey dashed line is the interpreted anti-clockwise P-T path of Mezger et al. (1990). Based on the mineral assemblages and textures in this study, a clockwise P-T path similar to that indicated by the grey solid line is proposed. The diagram was calculated using the Theriak-Domino software package (de Capitani and Petrakakis, 2010) using the updated 2003 ds5.5 thermodynamic dataset of Holland and Powell (1998). The activity models used are those outlined Couëslan et al. (2011). Abbreviations: And, andalusite; Bt, biotite; Chl, chlorite; Crd, cordierite; Grt, garnet; Ilm, ilmenite; Kfs, potassium feldspar; Ky, kyanite; Ms, muscovite; Pg, paragonite; Pl, plagioclase; Po, pyrrhotite; Qtz, quartz; Rt, rutile; Sil, sillimanite; St, staurolite.

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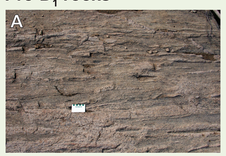
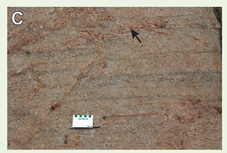
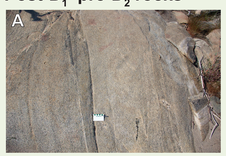
Pre-D_1 rocks





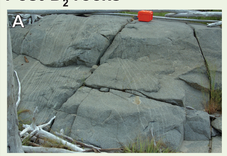
A) Quartz diorite–monzodiorite gneiss with pegmatitic pods. B) Heterogeneous orthogneiss consisting of granodioritic and dioritic gneiss with centimeter-scale bands of gabbroic gneiss and granitic pegmatite. C) Opdalitic gneiss with irregular pods of M_2 leucosome cross-cutting the S_1 gneissosity (arrow). D) Megacrystic anorthosite, hornblende interstitial to the plagioclase megacrysts may be pseudomorphous after pyroxene. E) Interbanded gabbro and leucogabbro, part of the layered anorthosite complex. F) Garnet wacke with diffuse bands of leucosome. G) Disrupted bands of pyroxene wacke in a matrix of semipelitic diatexite. The wacke may represent metamorphosed volcaniclastic deposits. H) Pelite with abundant garnet and sillimanite, cordierite is also present in the groundmass. I) Variably sulphidic iron formation (gossanous) hosted in garnet wacke. J) Heterogeneous mafic gneiss interpreted as metavolcanic rocks.

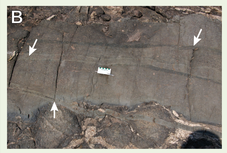
Post-D_1–pre-D_2 rocks



A) Interbanded diorite and monzodiorite of the eastern intrusive suite. B) Tonalite of eastern intrusive suite with M_2 leucosome (arrow). C) Granodiorite with metadiabase dyke from the southwestern portion of the map area. M_2 leucosome derived from the granodiorite is invading the metadiabase in the foreground. D) Enderbite with typical mafic and intermediate schollen (xenoliths). E) Schollen-rich portion of the enderbite intrusion. The S_1 gneissosity displayed by the schollen is randomly oriented.

Post-D_2 rocks

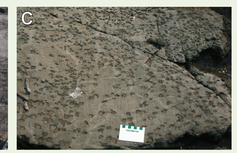


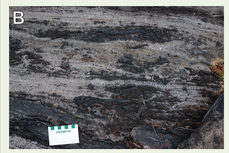


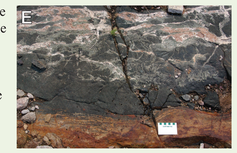
A) Gabbro dyke with igneous cross-bedded layering. The orientation of the dyke is consistent with the Mackenzie swarm (~120–140°, LeCheminant and Heaman, 1989). B) Multiple cross-cutting diabase dykes (arrows).

Manitoba

Economic considerations







A) Moderate and B) intense carbonate alteration of metavolcanic rocks in the southern basin of Cauchon Lake. Intensely altered metavolcanic rocks appear as olivine-spinel marbles. C) Ultramafic metavolcanic rocks are locally in contact with D) iron formation in the southern basin of Cauchon Lake. E) This contact is locally marked by the presence of metamorphosed quartz-carbonate veins. Quartz-carbonate veins and pervasive carbonate alteration is commonly assocaited with orogenic gold mineralization.

Iron formations are known to form chemical traps for sulphide- and Au-bearing fluids channeled along fold hinges, shear zones or faults in many Archean and Paleoproterozoic greenstone belts (Kerswill, 1995). This association is also found in greenstone belts in the northwest Superior Province (including at Bear, Utik, and Oxford lakes) where gold and base metals are associated with altered volcanic rocks and exhalative deposits (Hartlaub and Böhm, 2006; Böhm et al., 2007; Anderson et al., 2012). Mafic gneiss interpreted as metavolcanic rocks in the southwest portion of the map area hosts bands of gossanous silicate-facies iron formation up to 6 m wide which contain disseminated and vein sulphide, and possible quartz veins, and may be prospective for Au mineralization. A sample was taken for assay and results are pending.

Pervasive carbonatization and stockworks of quartz-carbonate veins in mafic volcanic rocks are commonly associated with orogenic gold deposits (Robert, 1995; Dubé and Gosselin, 2007). Quartz-carbonate veins and pervasive carbonate alteration in mafic volcanic rocks was observed at two separate localities in the south basin of Cauchon Lake. Metamorphic mineral assemblages and deformation fabrics suggests that hydrothermal systems were active in the volcanic rocks prior to high-grade metamorphism. Pervasive carbonatization can also be associated with volcanogenic massive sulphide (VMS) mineralization (Franklin, 1995; Anderson et al., 2012). A mapping program in the south basin of Cauchon Lake may be warranted to further investigate the potential for gold and VMS mineralization.