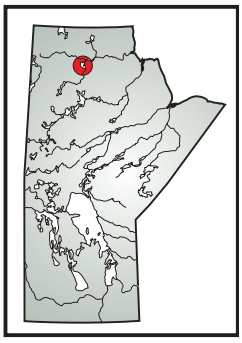
GS-15 Sayisi Dene Mapping Initiative, Tadoule Lake area, Manitoba (part of NTS 64J9, 10, 15, 16)

by L.A. Murphy and A.R. Carlson



Murphy, L.A. and Carlson, A.R. 2009: Sayisi Dene Mapping Initiative, Tadoule Lake area, Manitoba (part of NTS 64J9, 10, 15, 16); *in* Report of Activities 2009, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. 154–159.

Summary

In the summer of 2009, the Manitoba Geological Survey (MGS) conducted the first half of a four-week geological mapping course with the Sayisi Dene First Nation at Tadoule Lake, Manitoba. The goals of the program are to help increase awareness of the region's geology and mineral resources, provide the basic skills needed to work in a mineral-exploration camp and foster information-sharing between First Nation communities and the MGS. Four members of the community were hired as student-trainees and three completed the first half of the program. One of the trainees was hired by the MGS as a field assistant to geologists working in the Seal River–Great Island area between Tadoule Lake and Churchill.

The Tadoule Lake area, and Stony Lake to the north, transect marginal zones of the Great Island, Seal River and Chipewyan domains in the Hearne Province. Preliminary observations confirm the presence of a Paleoproterozoic granitoid complex, granite pegmatite and subordinate metasedimentary units and rafts of possible Archean provenance. Petrology, geochemistry and Sm-Nd isotope analyses of samples collected in the Tadoule Lake area will provide constraints necessary to determine the nature, ages and contact relationships of exposed rock types. This work may help interpret geological domain boundaries in the Tadoule Lake area in conjunction with other projects that are all part of the ongoing Manitoba Far North Geomapping Initiative (Anderson, et al., GS-13, this volume).

Introduction

The Sayisi Dene First Nation community of Tadoule Lake, Manitoba is located approximately 250 km west of Churchill and is accessible by commercial air transportation or charter float plane. The location of the Tadoule Lake project area is outlined in red on the domain map in Figure GS-15-1, and the distribution of rock units in the

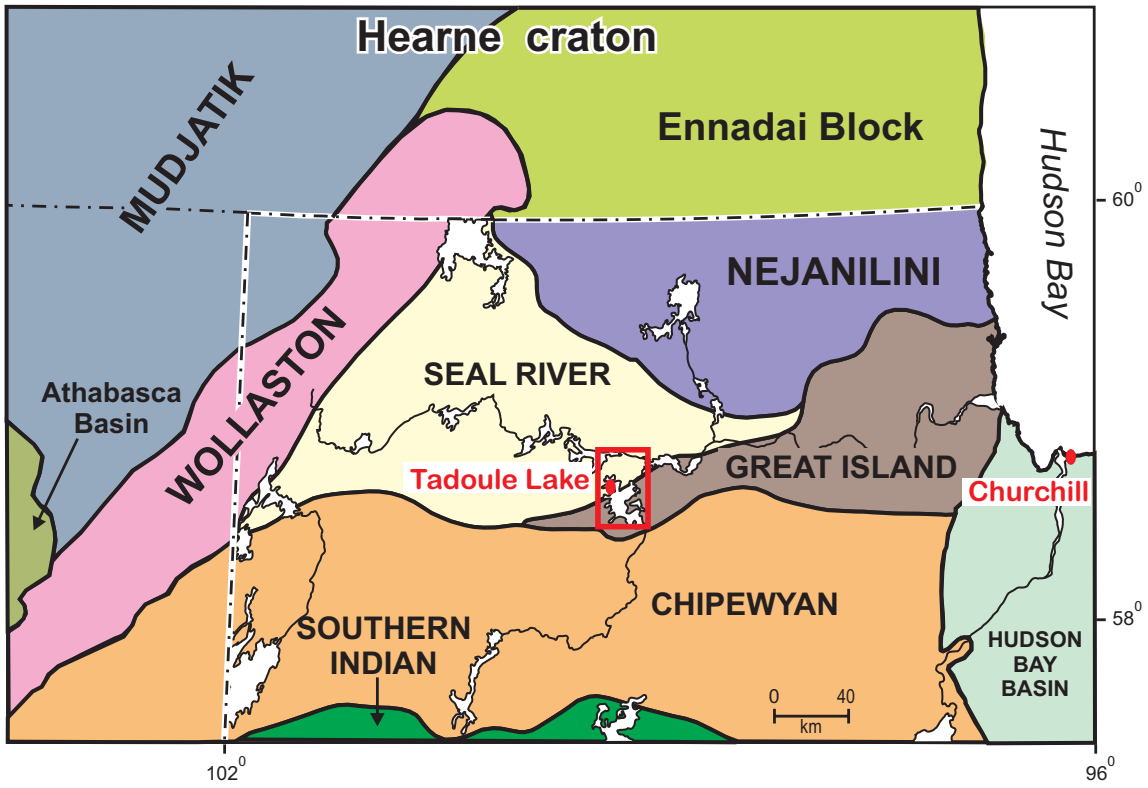


Figure GS-15-1: *Major geological domains along the southern margin of the Hearne craton in northern Manitoba, as interpreted by Schledewitz (1986;* modified after *Manitoba Industry, Trade and Mines, 2002), with the location of the Tadoule Lake map area outlined in red.*

project area is shown on the simplified map in Figure GS-15-2. During the summer of 2009, MGS geologists, in partnership with the Sayisi Dene First Nation, mapped an area totalling 400 km^2 at 1:50 000 scale. The geological mapping program was supported by Manitoba Competitiveness, Training and Trade (Labour Market Skills Division) and Manitoba Science, Technology, Energy and Mines (Manitoba Geological Survey) under the auspices of the Manitoba Far North Geomapping Initiative (Anderson et al., GS-13, this volume). This report provides an overview of the course methodology and the bedrock geology mapped by MGS geologists with the assistance of student-trainees from the Sayisi Dene First Nation community in Tadoule Lake.

The Tadoule Lake area was previously mapped by MGS in the 1970s (Schledewitz, 1986). Tadoule Lake is located at the western edge of the Great Island Domain, sandwiched between the Seal River Domain to the north and the Chipewyan Domain to the south. Metasedimentary rocks in the Seal River Domain were interpreted by Schledewitz (1986) as higher-metamorphic-grade equivalents to those in the Great Island Domain. The geological mapping project in the Tadoule Lake area builds on this previous work with new mapping and collection of a sample set for petrological, geochemical and Sm-Nd isotope-ratio analysis of all rock types found in the Tadoule Lake area, to characterize and help delineate the boundaries of the Seal River and Great Island domains.

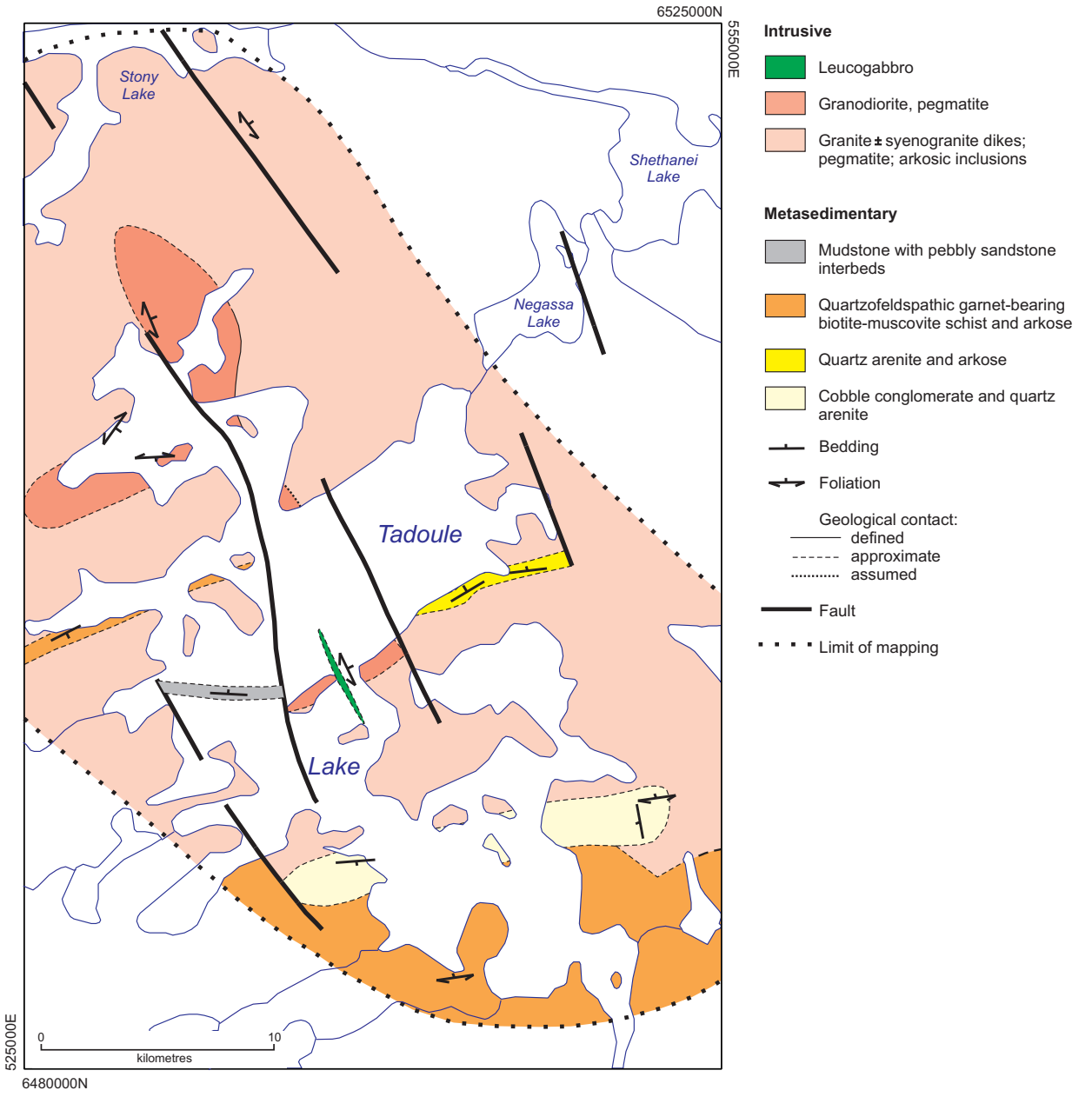


Figure GS-15-2: *Simplified geology of the Tadoule Lake area, integrating data from the 2009 field season with previous mapping by the Manitoba Geological Survey (Schledewitz, 1986).*

Methodology

The focus of the program is to build a working relationship based on open communication and information exchange between MGS geologists and members of the Sayisi Dene First Nation community. In spring 2009, prior to the field season, MGS project geologists conducted two one-day visits to the Tadoule Lake community. The purpose of these visits was to engage community and Band Council members in the planning process for the mapping program, and to pursue possible employment options for the Dene people of Tadoule Lake with the MGS mapping program in the Seal River–Great Island area (Anderson et al., GS-13, this volume). Additional open meetings were held during the summer program to encourage community involvement and the exchange of information. The authors resided in the community from July 15 to 29, 2009 and learned much on how to maintain respectful communication and the importance of traditional perspectives from discussions with student-trainees and community members.

The four student-trainees who participated in the geological mapping program have different life and work experience: two of the student-trainees are artists (one of whom also teaches), one is a hunting guide and one is a recent high-school graduate. Classroom time was flexible and limited to four-hour segments. Teaching components for the mapping program started at the Grade 10 science level and progressed to basic first-year university geology. During this process, underlying concepts in science, such as mineral shapes, crystallization and relative age relationships, were cognitively reinforced during geological field mapping by having the student-trainees assist in identifying minerals, measuring foliation and bedding of the rock exposures and determining the age relationship between Precambrian rocks and the Quaternary landforms in the Tadoule Lake area. Of the 140 hours in the mapping program, student-trainees participated in 25 hours of classroom time, learning basic geological concepts, and designing and selecting pictures for the community poster; 20 hours of practical experience in the use of scientific field equipment; 10 hours of preparation for and attendance at community information meetings; 25 hours of field equipment maintenance; and 60 hours in the field assisting in geological mapping. The mapping program gave the student-trainees an opportunity to learn safe work practices according to MGS standards, use field equipment, input GIS data and gain hands-on geological mapping experience within their traditional land-use area. Each individual was responsible for various aspects of geological fieldwork, including maintaining field equipment, preparing daily traverses and recording of data.

The majority of fieldwork was conducted along the Tadoule Lake shoreline using aerial photographs as the base map, with a one-day excursion to Stony Lake approximately 15 km north of the community. Stony Lake is accessible from Tadoule Lake by vehicle using a road atop an esker. Forty-four stations were recorded. Thin sections were made from thirteen of the collected rock samples for petrographic analysis, eight samples were sent for geochemical analysis and one sample was sent to be assayed for Cu-Ni and platinum-group elements.

Regional setting

The Tadoule Lake area, and Stony Lake to the north, transect marginal zones of the Great Island, Seal River and Chipewyan domains in the Hearne Province (Figure GS-15-1). The domains in the Hearne craton are delineated, in part, by the distribution of assumed Archean basement, the type of overlying Paleoproterozoic cover rock, and metamorphic grade (Schledewitz, 1986). Metamorphosed sedimentary rocks in the Tadoule Lake area were interpreted as greenschist-grade sedimentary rocks of the Great Island Domain, whereas similar sedimentary rocks to the north at Stony Lake are of higher metamorphic grade and part of the Seal River Domain.

This project captured structural data and geological contacts from the original Seal River Project mapping of Schledewitz (1986) and combined them with the new mapping data compiled during the 2009 field season (Figure GS-15-2). Bedrock in the Tadoule Lake area is commonly obscured by glacially derived clay, sand, gravel and boulders that are deposited as eskers, so aerial photographs were used to locate the rare exposures. In addition, unusually high water levels during the summer of 2009 further limited the number of bedrock exposures along the lakeshore.

The abundance of pegmatitic granitoid rock, particularly along the south shore of Tadoule Lake, is attributed to granitic plutonism along the northern margin of the ca. 1.86 Ga Chipewyan Batholith (Fumerton et al., 1984; Van Schmus and Schledewitz, 1986). This period of major pegmatitic magmatism is interpreted to have succeeded a D_1 folding event indicated by a moderate to tight, northeast-trending fold pattern at map scale in metasedimentary rocks of the Tadoule Lake area (Schledewitz, 1986).

Bedrock geology

The geology of the Tadoule Lake area is dominated by a felsic plutonic complex that includes granite, syenogranite, granodiorite and their pegmatitic equivalents. Sedimentary rocks include quartz arenite, arkose and rare arkosic inclusions within or along margins of the plutonic suite, garnet-bearing quartzofeldspathic mica schist, and mudstone interbedded with pebbly sandstone. A single leucogabbro outcrop, interpreted by Schledewitz (1986) as a dike intruding granite, was resampled to test a historical assay value of 0.6% Cu (Davison, 1962).

Sedimentary rocks

Quartz arenite and arkose

Quartz arenite is exposed in rare locations on the east shore of Tadoule Lake. It trends southwest, is white to light grey and consists of blocky quartz-rich layering up to 60 cm thick alternating with thin biotite layers that are up to 1 cm thick and locally slightly magnetic (Figure GS-15-3a). Rare arkosic sandstone is exposed on the west shore of Tadoule Lake (Figure GS-15-2). The unit

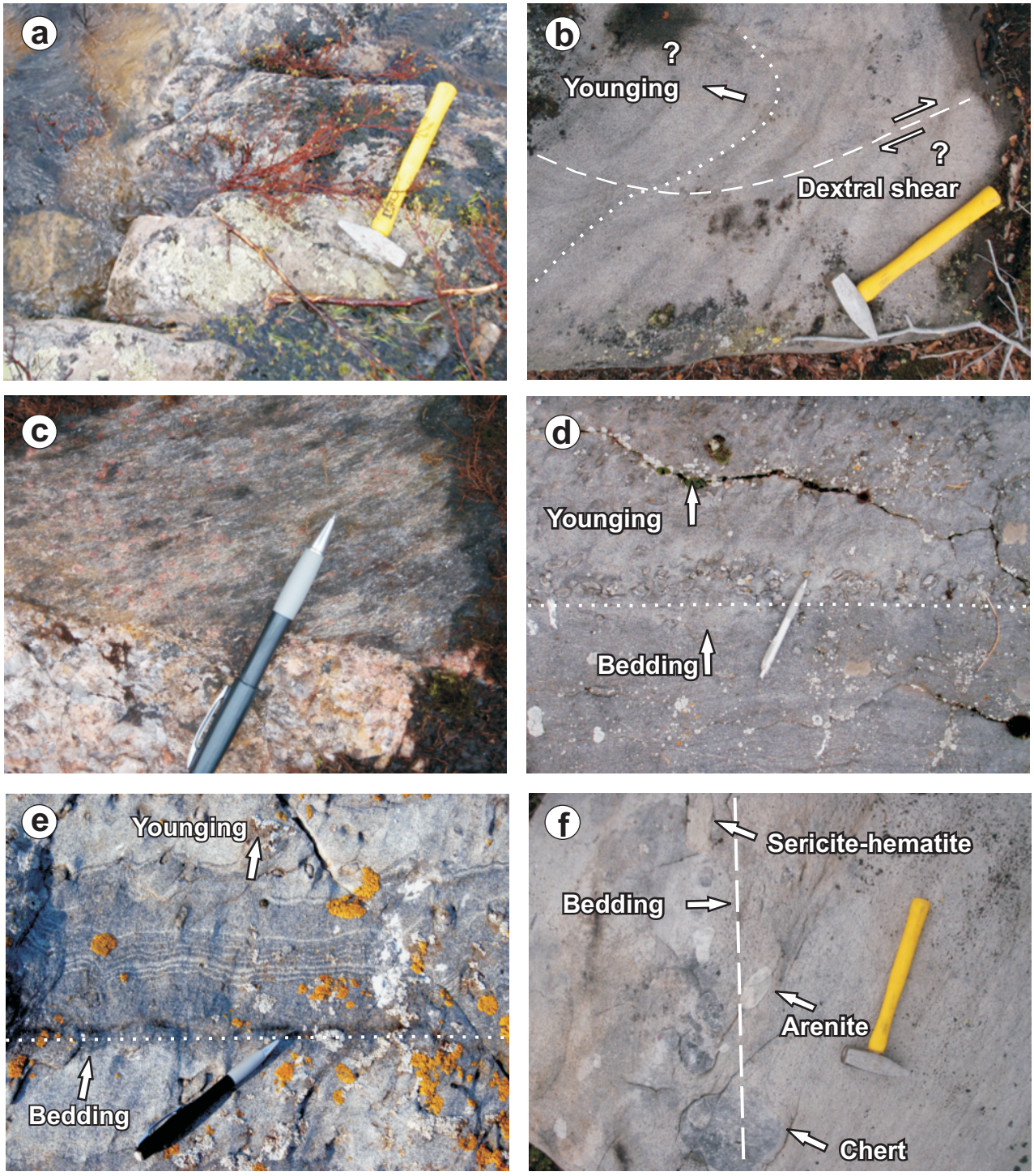


Figure GS-15-3: *Field photographs of characteristic sedimentary rock types in the Tadoule Lake area (35 cm long hammer for scale with handle pointing north; 14 cm long pen with nib pointing north):* ***a)*** *quartz arenite;* ***b)*** *drag-folding and shearing or trough crossbedding in layered arkose;* ***c)*** *garnet-bearing quartzofeldspathic mica schist intruded by pegmatitic granite;* ***d)*** *pebbly layer in sandstone;* ***e)*** *flame structures in mudstone-sandstone bed;* ***f)*** *arenite boulder containing heterolithic cobble bed.*

is light grey and fine grained, and displays a faint biotite-rich layering that can be interpreted either as trough crossbeds, indicating that the unit youngs to the west, or as drag folding caused by dextral shear (Figure GS-15-3b). A second arkosic rock type, north of Tadoule Lake, comprises rare brown or grey lenticular inclusions up to 2 m long within granite and granodiorite. The inclusions are characterized by 5 cm wide alternating feldspar- and quartz-rich layers.

Garnet-bearing quartzofeldspathic mica schist

Garnet-bearing quartzofeldspathic mica schist is intruded by pegmatitic granite in the central part of Tadoule Lake (Figure GS-15-3c). The sedimentary schist contains millimetre-scale grains of quartz rimmed by plagioclase that is elongated along schistosity. Porphyroblastic garnets become more abundant within 1 m of the sharp, irregular intrusive contact.

Mudstone, sandstone and pebbly sandstone

One island centrally located at Tadoule Lake consists of medium to light grey mudstone and sandstone, locally with pebbly beds. Mudstone and sandstone beds are 0.5–1 m thick, and quartz pebbles up to 1 cm in size occur at the bases of some beds. Primary sedimentary structures, such as normal grading and flame structures, indicate younging to the north (Figure GS-15-3d, e).

Cobble conglomerate

A cobble conglomerate unit near the south end of Tadoule Lake, previously mapped by Schledewitz (1986), could not be found during the 2009 mapping, likely due to high water levels. Traversing in the area revealed an abundance of subrounded to rounded quartz arenite boulders, up to 2 m in size, that contain heterolithic pebble to cobble conglomeratic beds. Lithology of the pebbles and cobbles includes grey cherty quartz, white quartz arenite, sericite-hematite–altered arenite, and granitoid (Figure GS-15-3f).

Intrusive rocks

Granodiorite

Granodiorite forms much of the exposure in the central part of Tadoule Lake (Figure GS-15-2). It is buff to light pink and orange, with medium- to coarse-grained hornblende (Figure GS-15-4a). The unit contains granite to granite-pegmatite phases and often includes metasedimentary rafts.

Granite, syenogranite and granite pegmatite

Granite is pink to pale pink and usually medium to coarse grained with scattered granite-pegmatite phases. The unit locally contains medium- to coarse-grained red poikilitic garnets and up to 1% euhedral magnetite (Figure GS-15-4b). Syenogranite is coarse grained to pegmatitic and occurs as dikes that are in sharp contact with the granite. The granite pegmatite is feldspar rich, containing perthitic feldspar and books of biotite and muscovite.

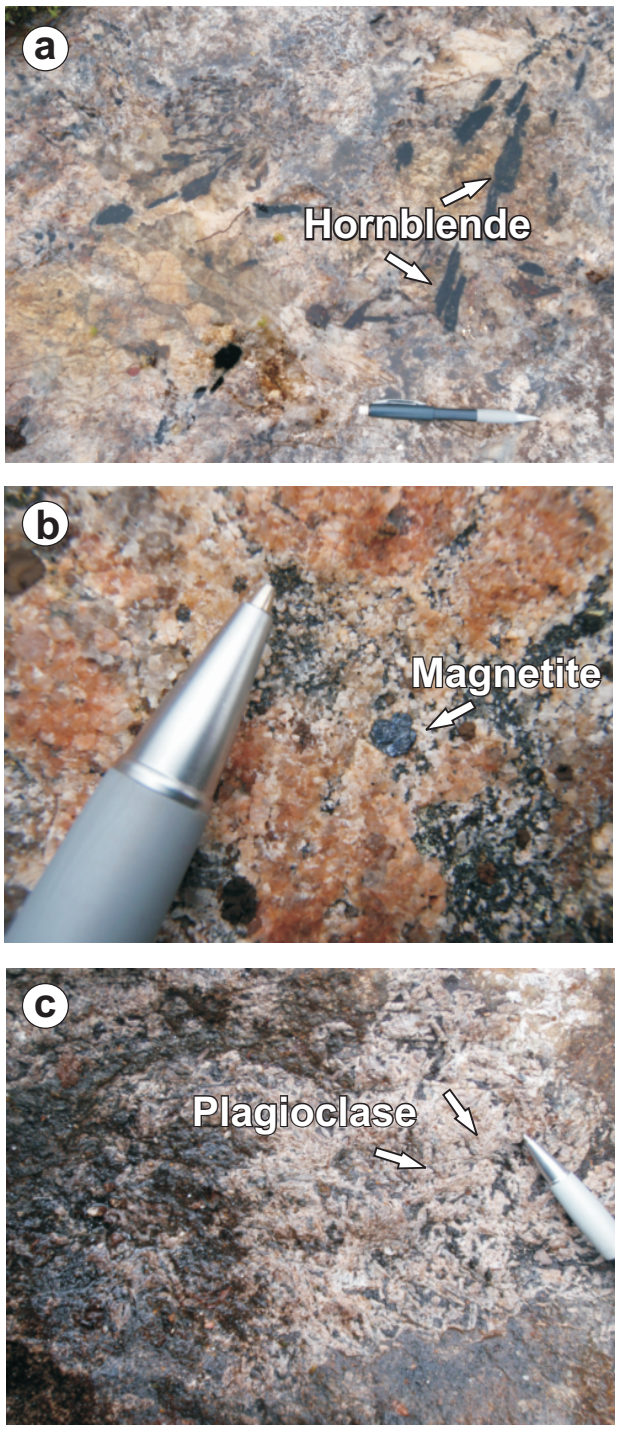


Figure GS-15-4: *Field photographs of typical intrusive rock types in the Tadoule Lake area:* ***a)*** *granodiorite with coarse hornblende;* ***b)*** *granite and syenogranite;* ***c)*** *leucogabbro with coarse plagioclase phenocrysts.*

Leucogabbro

Leucogabbro is light grey to buff and medium to coarse grained, with hornblende and plagioclase crystals (Figure GS-15-4c). The unit locally contains 1–2% disseminated pyrite and pyrrhotite with possible trace amounts of disseminated chalcopyrite. Leucogabbro, exposed in one outcrop centrally located at Tadoule Lake, has a previously reported value of 0.6% Cu (Davison, 1962). The unit was resampled in 2009 to test the historical analysis.

Discussion and economic considerations

Sharing of geological information has been crucial to discoveries in the mining industry, to academia, and to federal and provincial geological surveys, with the result being a healthy expanding economy. It is a relatively new process to integrate First Nation and remote communities into the communication loop. To be successful, the MGS community mapping program requires input from student-trainees, community members and local and provincial governments over a period of time. While teaching the geological mapping process, the authors learned how to foster good communication and gained a clearer understanding of the land-use issues that face all stakeholders.

Tadoule Lake is home to a number of talented artists of the Sayisi Dene First Nation, who produce a variety of sculptures, carvings, paintings and traditional beadwork. A marble occurrence southwest of the Tadoule Lake community has the potential to be used as a stone quarry for local artists. Further work to assess its economic potential will include a joint and fracture analysis to identify the size of blocks that could be quarried. The cost effectiveness of such a quarry is reduced by the remote location of the community, which means higher-than-usual transportation costs; locally produced marble sculptures, however, are rare in Manitoba and may therefore represent a commercial niche.

The forthcoming assay result from the resampled leucogabbro will be compared to the historical value of 0.6% Cu, with particular attention being paid to the platinum-group elements, which were not part of the original analysis. A historical molybdenite occurrence could not be located during the 2009 mapping, likely due to unusually high lakewater levels. Schledewitz (1986) reported rare exposures of weakly uraniferous granitic pegmatite within the Tadoule and Shethanei Lake areas. No evidence for such mineralization was observed during the 2009 field program.

Acknowledgments

The authors thank the Tadoule Lake student-trainees G. Yassie, J.J. Jawbone, J. Thorassie and L. Bussidor for taking time to learn how MGS conducts mapping projects and for teaching us about the Sayisi Dene people throughout the process. We also thank N. Brandson and E. Anderson for logistical support. In addition, the project could not have been successful without the help and support of the Chief and Council of Tadoule Lake, and insightful discussions with community members.

References

Davison, W.L. 1962: Geology, Tadoule Lake, Manitoba; Geological Survey of Canada, Preliminary Map 30-1962, scale 1:253 440.

Fumerton, S.L., Stauffer, M.R. and Lewry, J.F. 1984: The Wathaman Batholith: largest known Precambrian pluton; Canadian Journal of Earth Sciences, v. 21, p. 1082–1097.

Manitoba Industry, Trade and Mines 2002: Nejanilini Lake, NTS 64P; Manitoba Industry, Trade and Mines, Manitoba Geological Survey, Bedrock Geology Compilation Map Series, NTS 64P, scale 1:250 000.

Schledewitz, D.C.P. 1986: Geology of the Cochrane and Seal Rivers area; Manitoba Energy and Mines, Geological Services, Geological Report GR80-9, 139 p.

Van Schmus, W.R. and Schledewitz, D.C.P. 1986: U-Pb zircon geochronology of the Big Sand Lake area, northern Manitoba; *in* Report of Field Activities 1986, Manitoba Energy and Mines, Minerals Division, p. 207–210.