Natural Resources Canada | Ressources naturelles Canada

April 14, 2022

Victoria Stinson
Manager, Lands, Resources and Consultations
Métis Nation of Ontario
Thunder Bay, ON, P7E 1B4
<email address removed>

Subject: Natural Resources Canada's response to Métis Nation of Ontario's questions during the Public Hearings of the Marathon Palladium Project (CIAR#1263)

Dear Victoria Stinson,

NRCan is participating as a Federal Authority in the environmental assessment of the Marathon Palladium Project (the Project) by providing scientific and technical expertise pursuant to Section 20 of the *Canadian Environmental Assessment Act*, 2012.

Throughout the environmental assessment of the Project, NRCan provided expertise to the Joint Review Panel and the Impact Assessment Agency of Canada in different areas of NRCan's mandate, including seismicity and surficial and bedrock geology. Scientists from the Geological Survey of Canada (GSC) provided their final technical review of the geology and seismicity of the project in NRCan's written submission (CIAR#1079) and Dr. Michel Houlé gave a presentation on NRCan's technical review of the bedrock geology for the project (CIAR#1122) on March 18, 2022 at the Aquatic Environment Session of the Public hearings. Both documents are accessible on the Impact Assessment Registry for the Project.

Following concerns with respect to the presence of serpentine at the mine site raised at the Indigenous Community Session of the Marathon Palladium Project Public Hearings on April 4th, 2022 and in an email on the Impact Assessment Agency Registry for the Project (CIAR#1263), NRCan's scientists from the Geological Survey of Canada (GSC) reviewed your questions and provided responses. The responses to MNO's questions can be found in Annex A.

The GSC is Canada's oldest scientific agency for geoscientific information and research. Its world-class expertise focuses on the sustainable development of Canada's mineral, energy and water resources; stewardship of Canada's environment; management of natural geological and related hazards; and technology innovation. It provides Canadians with timely, reliable, scientific, economic, environmental and governance knowledge and expertise required to support the sustainable development of Canada's land resources.

If you have any questions or require further clarification, please do not hesitate to contact me by email at <email address removed>

Sincerely,

Original signed by
Marie-Eve Lenghan
Senior Environmental Assessment Officer, Impact Assessment, Office of the Chief Scientist
Natural Resources Canada

cc: Luc Desroches, Crown Consultation Team, Impact Assessment Agency of Canada
<email address removed>
Marathon Palladium Project Panel Secretariat, marathonminereview-examenminemarathon@iaac-aeic.gc.ca

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Annex A

Can you confirm if mine site is of "low grade to medium grade stable metamorphic mineral assemblages"?

Effectively, NRCan can confirm that the Coldwell complex is relatively undeformed and unmetamorphosed Proterozoic complex on the eastern margin of the Lake Superior. This response is based mainly on the examination of literature available such as:

Citation from Good et al., 2015 – Economic Geology:

"First, the Two Duck Lake gabbro, the host rock for the Marathon deposit, is undeformed, unmetamorphosed and, with the exception of local hydrothermal alteration, exhibits pristine mineralogy and igneous textures."

References:

Good, D.J., Epstein, R., McLean, K., Linnen, R.L. & Samson, I.M. (2015). Evolution of the main zone at the Marathon Cu–PGE sulfide deposit, Midcontinent Rift, Canada: spatial relationships in a magma conduit setting. Economic Geology 110, 983–1008.

Moreover, this assertion suggesting that the Coldwell complex is undeformed and unmetamorphosed is also supported by the designated NRCan expert geologist (Dr. M.G. Houlé). Effectively, Dr. Houlé visited some exposures of the Two Duck Lake Gabbro during a geological excursion in 2002.

Could there be presence of a variety or form of serpentine at the mine site?

First, serpentine is a hydrated mineral that is generally produced by the alteration of ferromagnesian minerals such as olivine and to lesser extent pyroxene. Despite the proponent's response regarding the absence of serpentine at the mine site, serpentine has been reported in the literature. In fact, the proponent has reported the presence of serpentine at two occasions in the Environmental Impact Statement (EIS) Main report (CIAR#224) under the Section 5.0 – Existing Environment:

Subsection 5.1.3.4 Two Duck Lake Gabbro – p. 5.8

*"An important aspect of TDL Gabbro relative to other Cu-PGM deposits, such as at Lac des Isles north of Thunder Bay, is the fresh unaltered nature of primary minerals and textures. There is some local development of secondary minerals such as chlorite, **serpentine** and calcite, but only at the thin-section scale where original minerals are replaced."*

Subsection 5.1.3.6 Sulphide Mineralization on the TDL Gabbro – p. 5.9

*"Sulphides in the TDL Gabbro consist predominantly of chalcopyrite, pyrrhotite and minor amounts of pentlandite, cobaltite, bornite and pyrite. They occur in between primary silicates and, to a lesser extent, in association with secondary calcite and hydrous silicates such as chlorite and **serpentine** (Watkinson and Ohnenstetter, 1992)."*

Furthermore, NRCan briefly reviewed the master's thesis by R. Ruthart (2013), as pointed out by MNO, and the presence of serpentine is effectively reported in this work. However, it is important to put the presence of serpentine at the Marathon Palladium Project into perspective. As we highlighted in the previous answer, despite the presence of serpentine, these rocks of the Two Duck Lake Gabbro are mainly

unaltered, the degree of serpentinization is minimal and only olivine experienced the serpentinization. Based on Ruthart's work in the section 4.2.1 – p. 43:

*"Overall the **TDLG samples** examined in this study **are unaltered** and **do not contain large scale zones** of low temperature **hydrothermal alteration**."...*

*"These minerals include sericite, chlorite, tremolite, **serpentine**, actinolite and calcite."...*

*..."**Small degrees of serpentinization** of olivine **along grain boundaries** and **fractures are common** in olivine, and **less commonly** olivine grains are **completely serpentinized**."*

As an example, NRCan has inserted below some representative photomicrographs showing the typical well-preserved and unaltered texture of the rocks of the Two Duck Lake Gabbro.

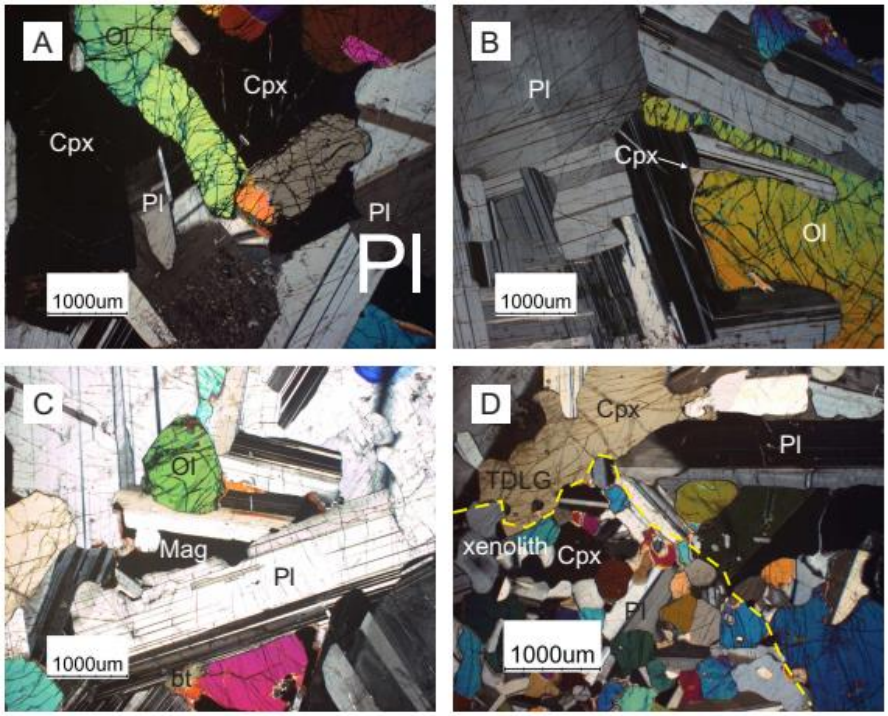

Figure 4.1: Photomicrographs of silicate minerals in thin section taken under cross polarized light. A. Representative ophitic texture of the TDLG. The black clinopyroxene (Cpx) grain exhibits continuous extinction and encases olivine (Ol) and plagioclase (Pl) grains. B. Representative texture of the TDLG showing the scalloped irregular Pl grain boundaries. The Ol grain is wrapped around earlier formed Pl. A fine veneer of Cpx rims the Ol. C. Representative TDLG showing interstitial magnetite (Mag) and biotite (Bt). D. Contact (highlighted with yellow dashed line) between a fine grained gabbro xenolith (lower left corner) and TDLG (upper right corner). From Ruthart's M.Sc. thesis (2013).

In addition, it is important to note these observations in order to put the presence of serpentine in perspective at the Marathon Palladium Project:

- Olivine are the only serpentinized mineral;
- Olivine are commonly very weakly serpentinized, and

- Most rocks of the Two Duck Lake Gabbro does not contain lots of olivine, olivine is not the most predominant mineral in these rocks (see picture above) – These are not peridotite, which contain mainly olivine;

All these points mentioned above suggest that even if the presence of serpentine is reported at the Marathon Palladium Project, the amount of serpentine is very marginal.

References:

Ruthart, R., 2013. Characterization of high-PGE, low-sulphur mineralization at the Marathon PGE-Cu deposit, Ontario: M.Sc. thesis, Waterloo, ON, University of Waterloo, 145 p.

What varieties of serpentine are present at the mine site and in what habit are they present? Please provide the study that has determined this.

Serpentine minerals have been identified at the Marathon Palladium Project (see above), however, the varieties of serpentine present at the mine site have not been reported within the EIS. Furthermore, NRCan is not aware of any study that has determined the type of serpentine (e.g., chrysotile, antigorite, and lizardite) at the mine site. Some varieties of serpentine have a fibrous habit (i.e., asbestiform), of which the most common one is the chrysotile. This variety of serpentine typically occurs as cm- to meter-scale veins in most Asbestos deposits. In the case of the Marathon Palladium Project, the habit of the serpentine has not been described directly, however, no serpentine veins have been reported. Furthermore, based on the very low intensity of the serpentinization occurring at the mine site in conjunction with the actual composition of the rocks (olivine gabbro rather than peridotite), it is unlikely that these veins occur. As noted above, serpentine occurs mainly along the grain boundaries and fractures within olivine.

It is correct that technically speaking, *"*Asbestos*"* does not refer to a single mineral but to several minerals with a fibrous crystal habits that are generally subdivided into two main groups such as the serpentine asbestos (e.g., chrysotile) and the amphibole asbestos (e.g., amosite, crocidolite, anthophyllite, tremolite, and actinolite) groups.