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Platinum Group Metals as Water-Borne Contaminants at Mining Operations

by K.A. Morin

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1. Introduction

It is reasonable to expect an element in the Periodic Table to become an environmental contaminant above some solid-phase and aqueous concentration. Nevertheless, many natural elements do not appear on lists of water-quality guidelines and criteria, typically because there is little toxicity data for them. This does not mean that they are not toxic above some concentration, but only that there is insufficient data to identify the toxic level.

For decades, I have expected a water-quality guideline for scandium to appear. Toxicity studies for water show aqueous concentrations of scandium above about 0.5-1.0 mg/L could be unacceptable. However, my expectation of a guideline for scandium was apparently unwarranted.

I worked on a proposed tantalum project in its early stages. The federal government told the mining company that it would have to develop a water-quality criterion for tantalum. The initial intent was a site-specific criterion with a longer-range intention of a countrywide criterion. Thirteen humidity cells showed that tantalum could not be detected above the detection limit of 0.1 ug/L.

As a maximum possible aqueous concentration, the solubility of tantalum in water from tantalite at 20ºC is 23.1 ug/L according to the EU European Chemicals Agency (2020). However, such a high aqueous concentration has not been reported in natural waters, not even at full-scale minesites and in mineralized areas. The aqueous surface-water concentrations of tantalum in the European Union (EU), including mineralized areas, are at and below 0.1 ug/L (Salminen et al., 2010). The U.S. Geological Survey (Schulz et al., 2017) summarized several references showing worldwide average dissolved concentrations in river water is around 0.001 ug/L. Also, Filella (2017) points out that the data "clearly shows that it is highly unlikely that it is the solubility of Ta2O5(s) which constrains its concentration in natural waters" and the maximum observed aqueous concentration in surface water was 0.18 ug/L.

This project did not proceed so no criterion for tantalum was derived from this information. However, the amount of information that would have been needed for the derivation of a criterion for tantalum would likely take many years to obtain and be very costly.

A similar situation has arisen recently in Canada, for the Platinum Group Metals, namely platinum, ruthenium, rhodium, palladium, osmium, and iridium.

2. Platinum Group Metals as Water-Borne Contaminants

Elements such as platinum and palladium are not typically considered aqueous contaminants in the environment. Nevertheless, it is understandable why they would receive increasing attention due to increasing demand and thus increased mining. Some uses for palladium, for example, are catalytic converters, electronics, dentistry, medicine, hydrogen purification, chemical applications, groundwater treatment, and jewelry (Wikipedia, 2022).

The Marathon Project is located in northern Ontario, Canada. It proposes to mine for copper, gold, silver, platinum, and palladium (Generation Mining, 2022). To my knowledge, this is the first mining project in which the federal government (Government of Canada, 2022) and provincial government (Government of Ontario, 2022) have viewed Platinum Group Metals as primary contaminants similar to base metals and mercury.

Here are some quotations from the governmental decision documents:

"'Platinum Group Metals' means the elements platinum, ruthenium, rhodium, palladium, osmium, and iridium."

"The Proponent shall conduct field-scale geochemical testing of waste rock and process solids to verify the magnitude and onset of potential metal leaching, including platinum group metals and mercury, and acid rock drainage in waste rock and tailings during construction and operation."

"... monitor quality of contact water stored in water management ponds, including ... platinum group metals."

"... collection of baseline data for Platinum Group Metals using low-level method detection limits"

"The Proponent shall use the most current release rate predictions and concentrations to inform Site-specific Platinum Group Metals effluent criteria during permitting and approval processes with relevant government authorities."

Thus, the Platinum Group Metals (platinum, ruthenium, rhodium, palladium, osmium, and iridium) require more than baseline delineation at the Marathon Project. They must also be assessed and predicted like ML-ARD, as part of ML-ARD. Effluent criteria at Marathon must be derived based on release rates and concentrations of Platinum Group Metals.

Aqueous concentrations of the Platinum Group Metals could be relatively low. Fortunately, they can be analyzed with detection limits of 0.005 ug/L using Triple Quadrupole ICP-MS (ALS, 2021).

It will be interesting to see how the effluent criteria at Marathon for the Platinum Group Metals might be carried over to other mining projects in Canada and elsewhere.

3. References

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