Trace metals

What are trace metals and where do they come from?

Trace metals are elements such as chromium, cobalt, copper, iron, magnesium, selenium, and zinc that normally occur at very low levels in the environment. Living things need very small amounts of some trace metals, but high levels of these same metals can be toxic. For example, iron is an essential element for many living things. In human blood, iron transports oxygen around the body. If too much iron is consumed, however, there can be negative effects on human health.

Levels of trace metals in the environment increase when they are released from rocks. These releases can occur through natural processes or through human activities. Natural processes include breakdown of rocks, spreading of mid-ocean ridges, and volcanic activity. Natural sources of metals can be very important. For example, moose and caribou in the North West Territories have significantly higher cadmium levels than in other locations across northern Canada. These high levels occur because the underlying rock in this area is particularly rich in cadmium. In some caribou, the cadmium levels are so high that it might affect the animal's kidney function.

Human activities that release trace metals into the environment include mining, smelting, burning of coal, and wastewater disposal. The tar sands and diamond and metal mining can release trace metals into the surrounding environment. This often occurs when contaminated waste is not properly disposed of or when a lot of dust from the mine site blows around. For the most part, human contributions of trace metals to the environment have been approaching, or even exceeding, natural inputs. The photo below shows an open pit copper mine in British Columbia.

Photo credit: Gord McKenna

Trace metals in the environment

It is often difficult to determine how toxic a trace metal is. Toxicity depends not only on the level of the trace metal in the environment, but also where it is found in the environment (water, soil or air), the source (mining or natural rock breakdown), how acidic the environment is in the area of interest (trace metals are more of a problem in acidic areas), and whether the metal exists by itself or as part of larger chemical compounds. In the North, we are most often concerned about trace metals in areas with mining, especially when there are old, abandoned mines with tailings that have leaked into lakes or streams. At the time that many of these older mines were operating, there were not many regulations about how to store and discharge tailings, so there was often pollution of local lakes and streams. Because these lakes and streams have often also become acidic due to the mine pollution, trace metals can become a problem and have toxic effects on local fish and bugs.

References/For more information

Gamberg, M., Braune, B., Davey, E., Elkin, B., Hoekstra, P.F., Kennedy, D., Macdonald, C., Muir, D., Nirwal, A., Wayland, M., and Zeeb, B. 2005. Spatial and temporal trends of contaminants in terrestrial biota from the Canadian Arctic. *Science of the Total Environment*, 351-352:148-164.

Kelly, E. N., Schindler, D. W., Hodson, P. V., Short, J. W., Radmanovich, R. and C. C. Nielsen. 2010. Oil sands development contributes elements toxic at low concentrations to the Athabasca River and its tributaries. *Proc. Natl Acad. Sci. USA*. 107:16178–16183. www.pnas.org/cgi/doi/10.1073/pnas.1008754107

Morel, F. M. M. and N. M. Price. 2003. The Biogeochemical Cycles of Trace Metals in the Oceans. *Science*. 300(5621):944-947. DOI: 10.1126/science.1083545.

Naeth, M.A., and Wilkinson, S.R. 2008. Lichens as biomonitors of air quality around a diamond mine, Northwest Territories, Canada. *Journal of Environmental Quality*. 37:1675-1684.

Schindler, D. W. 2010. Tar sands need solid science. *Nature*. 468:499-501.