#3. Contaminants is Soils, Water, Air, Manure and Plants: Fact and Misconceptions

Contaminants in the environment may arise from natural or anthropogenic sources; some originate from both. Contaminants may be inorganic, organic, or organometallic; some are radioactive, Potentially toxic “heavy metals” such as Ag (silver), Cd (cadmium), Pb (lead), Sb (antimony) and Tl (thallium) all occur naturally, but human activities such as mining, smelting, and refining, as well as fossil fuel combustion, have considerably increased emissions of these elements to the environment. In fact, on a global scale, emissions of heavy metals to the environment from natural sources are dwarfed by those from human activities. “Contamination” of the natural environment refers to an enrichment which significantly exceeds the range of natural abundance of that element or compound in any given geosphere (e.g. atmosphere, biosphere, pedosphere, hydrosphere). “Pollution” refers to a concentration or enrichment great enough to have a documented deleterious impact upon a specific organism.

The extent of enrichment of contaminants such as heavy metals in the environment is usually expressed by an enrichment factor: the enrichment factor (EF) is the ratio of a given heavy metal to a lithophile element such as aluminum (which is assumed to be supplied exclusively by natural sources), and normalized to the corresponding ratio in the Earth’s Crust. The potential toxicity of a contaminant, however, is related not only to its concentration or the extent of its enrichment, but also the physical and chemical form of that element or compound (ie the predominant chemical species). In this presentation, using peat cores from bogs and ice cores from the Arctic, examples will be provided of the changing cycles of heavy metals during the past 15,000 years caused by both natural processes as well as human activities.

Despite the release of heavy metals to the environment from three millenia of mining and metallurgy, trace metal concentrations in natural waters may be extremely low, highlighting the need for ultraclean lab methods and procedures for sampling, handling, preparation and analysis. The new ultraclean SWAMP lab at the University of Alberta, for measuring trace metals in the Soil Water Air Manure Plant system, is an example of a lab designed and constructed specifically for this purpose.