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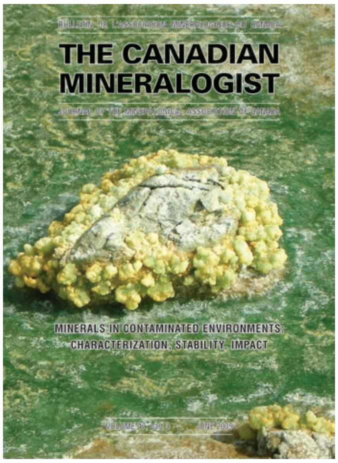
MINERALS IN CONTAMINATED ENVIRONMENTS: CHARACTERIZATION, STABILITY, IMPACT

New Thematic Issue of The Canadian Mineralogist



Environmental awareness over the past several decades has led to renewed interest in understanding and predicting the cycling and impacts of contaminants in environments at the Earth's surface. Contaminants are substances that have been added in quantities sufficient to exceed background, or natural, concentrations. Although this definition suggests that contaminants can be any element or compound, recent research has focused on those (known as "pollutants") that are potentially harmful to humans or ecosystems, namely, metals, metalloids, organic compounds, nutrients, and radionuclides. These are found in diverse environments affected by natural processes and anthropogenic activities, such as weathering, mining, waste disposal, agriculture, and vehicle emissions. Environmental minerals play a significant role in controlling contaminant cycling, by acting as potential sources via dissolution and as storage media via surface interactions (adsorption, surface precipitation) or coprecipitation processes.

This new thematic issue of *The Canadian Mineralogist* stems from the session "Minerals in Contaminated Environments: Characterization, Stability, Impact," which was part of the Frontiers in Mineral Sciences meeting held in Cambridge, UK, in June 2007, and organized by Karen Hudson-Edwards. The Frontiers meeting highlighted recent advances in research on the properties and behavior of minerals, and in this context, the "Minerals in Contaminated Environments" session focused on new discoveries in environmental mineralogy. Karen Hudson-Edwards (Birkbeck, University of London), Kaye Savage (Vanderbilt University), Heather Jamieson (Queen's University), and Kevin Taylor (Manchester Metropolitan University) acted as guest editors for the thematic issue.

The first six papers examine the character and impacts of minerals in contaminated natural environments, especially those affected by the mining, extraction, and processing of metals and coal. These activities have caused degradation of water, soil, and air quality throughout the world, and can leave behind huge volumes of spectacular, multicolored waste that contains a complex cocktail of contaminants and minerals. These environments have been intensively researched, but the nature, origin, and stability of the minerals present are still poorly understood because they are often ultrafine-grained and poorly crystalline. The papers in this section add to our understanding, with synergistic approaches combining classical and innovative techniques to characterize the minerals.

In one of these contributions, Steve Walker and his colleagues have combined conventional petrographic and mineral-analysis techniques with synchrotron microanalytical techniques and have identified numerous As-hosting phases, commonly intergrown. These include secondary arsenates, As-bearing ferric oxyhydroxides, sulfates, and sulfides in tailings accumulated from the mining of arsenopyrite-bearing gold ores in the 19th and 20th centuries in Nova Scotia, Canada. Arsenic is toxic and carcinogenic. It is a common contaminant in Au-bearing mining districts, where it can pose a risk to human health if particles containing it are ingested or inhaled. Various factors, including the presence or absence of mill concentrates, the degree of water saturation, and the abundance of carbonates, are proposed to cause the differences in mineralogy. The authors stress the importance of proper characterization of all As-bearing phases present, because the bioaccessibility of As, and thus the risk to humans, is partly due to differences in their solubility.

The second part of the volume contains seven papers describing the structures, chemistries, stabilities, and mechanisms of contaminant incorporation for natural, synthetic, and computer-generated minerals and analogues. The first contribution in this section is a comprehensive review by Maggy Lengke and her colleagues of the oxidation and dissolution of the As-bearing sulfides arsenopyrite, orpiment, realgar, tennantite, and amorphous As_2S_3 and AsS, which are extracted as ores or discarded as waste minerals. Both biotic and abiotic factors, such as the presence of acidophilic bacteria and changes in pH, are shown to play major roles in the rates of these processes. A common observation is that coatings of secondary minerals are formed on the parent arsenic-bearing sulfide surfaces. Lengke et al. suggest that these may be useful in reducing the redistribution of As and, thus, the environmental impacts of mining.

This thematic issue is available for purchase at **www.mineralogicalassociation.ca**.

Papers are available online at **www.canmin.geoscienceworld.org** and **www.canmin.org**.