A review of recent research relating to the safe disposal of sulphide-rich mine wastes

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The mining industry in Canada makes a very important contribution to the national economy. In the period 1993 to 1997, the value of exports from the mining industry accounted for approximately 15% of total national exports. Within specific regions of the country, the significance of the industry to the local economy is much greater. This societal dependence on the economic benefits of mining is often perceived as being in conflict with increasing concerns for the quality of air and water resources, and the health of ecosystems. In response to demands from society for protection of environmental quality, practices of waste disposal in the mining industry have changed dramatically over the past 50 years. In particular, disposal of tailings and waste rock from sulphide-rich ores has caused degradation of water quality in areas that, in some cases, extends far beyond the physical boundaries of mining operations. Prior to the 1980's, this problem was addressed by constructing confined storage areas for tailings and waste rock; however, it became clear that physical confinement of the waste was not completely effective. Dispersion of contaminants to the surrounding environment remained a problem as a result of geochemical processes that combine with surface and groundwater hydrological transport mechanisms. During the past 15 years, the mining industry and governments have responded by supporting research with the aim of understanding the geochemical mechanisms and hydrological processes that lead to environmental contamination from sulphide-rich mine wastes. This research has contributed to a greater understanding of the mineralogical, chemical, microbiological and kinetic influences on the chemical evolution of mine waste water. The important role of hydrology in the control of sulphide oxidation, containment of metals and acidity within the waste impoundments, and design of more effective waste disposal systems has been recognized. The integration of geochemical concepts with dynamic hydrological systems has resulted in a mature understanding or conceptual model for the geochemical evolution of tailings. The understanding of hydrogeochemistry in waste rock lags behind somewhat, mostly due to the more complex hydrology compared to tailings. The knowledge that has been gained in the past 15 years should allow mining companies and government regulators to design waste disposal systems for new mining operations that will greatly reduce the rate of sulphide oxidation, and prevent the transport of metals and acidity to the surrounding environment.