Establishing baseline geochemical conditions at historic gold mines for risk assessment and remediation

M.B. PARSONS[1]*, T.A. GOODWIN[2] AND M.E. LITTLE[1]

[1]Natural Resources Canada, Geological Survey of Canada (Atlantic), Dartmouth, Nova Scotia, Canada (*correspondence: Michael.Parsons@NRCan.gc.ca)
[2]Nova Scotia Department of Natural Resources, Mineral Resources Branch, Halifax, Nova Scotia, Canada

The mining and milling of Au from orogenic lode Au deposits can result in risks to the environment and human health without appropriate mine planning, environmental management, and monitoring programs. These deposits are the main source of Au in Canada, and are presently the focus of considerable exploration and development. Arsenopyrite occurs naturally in the ore and surrounding bedrock in these deposits, and As is generally present at high concentrations in mine wastes and drainage waters. Historically, Hg amalgamation was often used to extract Au from the ore, and high Hg concentrations are common in mine tailings and near abandoned mill sites. The recent surge in global Au prices has generated renewed interest in many former mining districts, and in the possibility of reprocessing historic Au mine wastes. To develop appropriate environmental management plans for these sites, it is essential to characterize both the pre-mining concentrations of metal (oid)s in waters, sediments and soils, as well as the impact from previous mining operations.

This presentation will summarize recent studies of geochemical baselines at lode gold deposits in Nova Scotia and British Columbia, Canada. In Nova Scotia, we determined the vertical distribution of As and Hg in forest soils surrounding two abandoned gold mines to evaluate pre-mining baseline conditions, and the extent of historical mine wastes. In general, the concentrations of As are highest in B and C horizon soils, whereas Hg concentrations are highest in the organic-rich humus (H) layer. Arsenic concentrations in naturally mineralized soils range from 2-270 mg/kg, and are generally greater than the 12 mg/kg Canadian Soil Quality Guideline for As. In British Columbia, samples of stream water and sediment were collected around the past-producing Bralorne, King, and Pioneer Au mines. Background concentrations of As, Hg, and Sb commonly exceed environmental guidelines in sediments, but impacts on water quality were restricted to the immediate vicinity of former mine sites. The results of these studies are being used to inform environmental site assessments and to develop suitable monitoring and remediation strategies for orogenic lode gold deposits across Canada.

Major ion chemistry of subsurface water samples around waste disposal sites of Hyderabad city, India

VANDANA PARTH[1] *, N.N. MURTHY[1] AND PRAVEEN RAJ SAXENA[2]

[1]National Geophysical Research Institute, Council of Scientific and Industrial Research, Hyderabad, India (*correspondence: vandana.parth@gmail.com)
[2]Department of Applied Geochemistry, Osmania University, Hyderabad, India

The present study deals with hydrogeochemistry of groundwater around dumpsites, Hyderabad city, India. The city witness ~4000 tons of solid waste per day dumped in low-lying areas as landfills, affecting groundwater quality. Three waste dumpsites namely; Jawaharnagar, Autonagar and Dundigal were chosen for major ions study in the groundwater. The samples were collected from sixty location points around dumpsites covering entire area and were precisely analysed for physicochemical characters using the standard procedures recommended by APHA [1]. F^- and NO_3^- were determined by double junction electrode at 25°C. The type of water that predominated in the study area was assessed based on hydro-chemical facies. Suitability of groundwater for irrigation was evaluated based on sodium adsorption ratio, per cent sodium, residual sodium carbonate and the US salinity diagram. High concentrations of major ions (Ca^{++}, Mg^{++}, Na^+, F^-) observed in bore wells can be attributed to differential weathering of minerals such as pyroxenes, plagioclase feldspars, and apatite together with dissolution/precipitation reactions along fractures and joints in the granites. The high NO_3^- level >50 mg/l is ascribed to consequence of the oxidation of ammonia and similar sources from leachate emanating from waste. Although the water in the study area is not potable, it is found to be suitable for irrigation purposes with little risk in the development of detrimental level of exchangeable sodium. Based on piper diagram, the groundwater is being classified into Ca-HCO_3^- type, Ca-Cl^- type, Mg-HCO_3^- type and Mg-Cl^- type. The carbonate hardness exceeds 50% of the total ionic composition, which signifies that the chemical properties are dominated by alkaline earth (Ca^{2+}+Mg^{2+}) and week acids (CO_3^{2-}+HCO_3^-). Though the suitability of water for irrigation in the present study is determined based on SAR, RSC, %Na and USSL diagram, it is only an experimental conclusion. In addition to water quality, other factors like soil type, crop pattern, frequency and recharge (precipitation), climatic conditions, etc. have a vital role in determining the suitability of water.

[1] APHA (1998) *Standard methods for the examination of water & wastewater*. American Public Health Association, Washington DC, 20th edn.