

Sulfide oxidation and acid neutralization reactions in a high-sulfide tailings impoundment

M.C. MONCUR^{1*}, C.J. PTACEK¹, D.W. BLOWES¹
AND J.L. JAMBOR¹

Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, ON, Canada, N2L 3G1

(*correspondence: mmoncur@uwaterloo.ca)

When sulfide minerals contained in mine tailings are exposed to atmospheric oxygen and water, they oxidize releasing acid, dissolved metals and sulfate to the adjacent pore water. Within tailings impoundments, the principal geochemical processes affecting the transport of dissolved metals and sulfate are sulfide oxidation and acid neutralization reactions. During sulfide oxidation, a series of mineral dissolution-precipitation reactions control pH and metal mobility. Typically, the series consists of calcite (pH 6.5-7.5), siderite (pH 4.8-6.3), Al hydroxides (pH 4.0-4.3), Fe(III) hydroxides (2.5-3.5), and aluminosilicates (pH <2). The former Sherritt Gordon Mine, located in Northern Manitoba, Canada, contains a tailings impoundment consisting of 60 wt% sulfide minerals that have undergone over 70 years of weathering. Oxidation reactions in the tailings have resulted in extensive depletion of sulfide minerals in the upper 50 cm tailings. Porewater pH in the tailings increases with depth in 3 distinct steps separated by plateaus occurring at a pH of 1.4, 4.3 and 5.6, corresponding to the dissolution of aluminosilicates, Al hydroxides and carbonates, respectively. The extremely low pH of the pore water (pH 0.67-2) in the upper 90 cm of the tailings has depleted nearly all biotite, chlorite, and smectite. There is also evidence that the more stable aluminosilicates have been susceptible to replacement, thereby contributing to acid neutralization. Grains of albite, cordierite and amphibole exhibit rims and veinlets of secondary silica that have partly replaced the minerals. The depletion of aluminosilicate minerals in the upper meter of the tailings, and the presence of residual sulfide minerals observed at a depth of 50 cm suggest that the zone of low-pH pore water will likely expand as sulfide oxidation and acid generation continue.

Simultaneous back-arc spreading and arc magmatism since upper Triassic in Iranian continental block

I. MONSEF^{1*}, M. RAHGOSHAY¹,
H. SHAFARI MOGHADAM¹ AND H. WHITECHURCH²

¹Shahid Beheshti University, Faculty of Earth Sciences, Tehran, Iran

(*correspondence: iman_monsef@yahoo.com)

²Ecole et Observatoire des Sciences de la Terre, Institute de Physique du Globe, Strasbourg, France

The subduction of the northern Tethyan Ocean beneath the active continental margin (the Sanandaj-Sirjan zone) of Iranian block is documented by arc magmatism and back-arc spreading from upper Triassic to Cretaceous in the Sanandaj-Sirjan zone and from Eocene to Plio-Quaternary in the Urumieh-Dokhtar magmatic zone. By virtue of K-Ar and stratigraphic ages, back-arc spreading was firstly started from upper Triassic (Sikhoran ophiolite) to upper Jurassic-lower Cretaceous (Kahnuj and Baft ophiolites), continued to middle Cretaceous (Nain and Shahr-e-Babak ophiolites). These phases of back-arc opening were due to the oblique subduction of the Tethyan Ocean beneath the Central Iranian blocks. Moreover, during the Mesozoic time, the Sanandaj-Sirjan zone behaves as the active continental margin over the Tethyan subduction, as witness by the presence of calc-alkaline magmatism. Since Eocene to Plio-Quaternary, the magmatic arc migrated to the north, crosscutting the Central Iranian block as the Urumieh-Dokhtar magmatic belt. Change of magmatism from calc-alkaline to shoshonitic and adakitic from Eocene to Plio-Quaternary can be interpreted by change in the dip of the subducted slab or change in the velocity and/or obliquity.