Reiche Zeche Mine Water Geochemistry

Veronika Zhiteneva[1], Jürgen Brune[1], Helmut Mischo[2], Jürgen Weyer[2], André Simon[2], David Lipson[3]

[1]*Colorado School of Mines, Golden, CO, USA,*
vee013@gmail.com, jbrune@mines.edu
[2]*Technische Universität Bergakademie Freiberg, 09599 Freiberg, Germany,*
helmut.mischo@mabb.tu-freiberg.de, juergen.weyer@mabb.tu-freiberg.de, Andre.Simon@mabb.tu-freiberg.de
[3]*Hydro Science + Engineering, Arvada, CO, USA,*
dave.lipson@hydrose.co

Extended Abstract

Historical water quality sampling of the Reiche Zeche mine in Freiberg, Saxony, Germany, has been inconsistent and infrequent after a 2002 flood that destroyed underground sampling equipment. The need for a present day analysis of water quality is important to understand current leaching and quality conditions within the mine. Historical data analysis and comparison to present day sampling data shows that metal and ion concentrations have decreased over the last 15 years, leading to overall improvements in water quality across most sampling locations within the mine.

Underground mine water samples were taken in June 2015 and analyzed for metal content to determine what compounds are still present in the mine. In addition, sample metal levels were compared to federal surface and groundwater contaminant threshold allowances. Historical data was catalogued, and results of 2015 sampling were compared to historical levels to demonstrate that concentrations of metals and ions both within and coming out of the mine have decreased over time. This is perhaps due to an 'armoring' of pyrite surfaces within areas of the mine. As pyrite oxidation is the primary mechanism by which sulfides are released, and since no fresh surfaces have been exposed in nearly 50 years, previously exposed sulfide surfaces have likely been weathered enough that no more oxidation is occurring, leading to decreases in minerals leaching from the ore. Results show decreases in metals leaching from well documented areas, but high (average sum total metals > 1,000 mg/l) metal content in areas lacking historical data. Metal transformation was predominantly precipitation of secondary minerals and hydroxides, with some adsorption. Results also show an interesting correlation between electrical conductivity and total organic carbon, as well as zinc and cadmium concentrations.

Metal concentrations were predictably highest in the deepest parts of the mine where water flow was little to none. Greatest concentrations of Pb and Fe were measured on the third level below ground level, far from any previous mined veins. All sampled points were undersaturated for all modeled compounds, except for barite, bixbyite, anglesite, goethite, and quartz, which precipitated at certain locations. Highest SO_4^{2-} and Mg concentrations were observed in slow flow water leaving a main mined vein, seen in Fig. 1. Highest concentrations of Zn were also observed at the same location. All measured metals were below federal surface, ground, and drinking water contaminant thresholds by the points at which adit water left the mine, signifying adequate natural buffering or neutralization of metals.

Figure 1: *High SO_4^{2-} and Mg content water.*

This water quality assessment will enable planning of future projects at the Reiche Zeche to reference up to date water and geochemistry data. Information from this study will be useful for TU Bergakademie Freiberg, other parties associated with the mine, and regional authorities.

Key words: Mine water, geochemistry