Geochemical evaluation of coal processing facility drainage: Preliminary results of kinetic testing

L. LEFTICARIU[1], P.T. BEHUM, JR[2] AND Y.P. CHUGH[3]

[1]Department of Geology, Southern Illinois University (lefticariu@geo.siu.edu)
[2]Environmental Resources and Policy PhD Program, Southern Illinois University and Sr. Hydrologist, Office of Surface Mining Reclamation and Enforcement (pbehum@osmre.gov)
[3]Department of Mining and Mineral Engineering, Southern Illinois University (ypchugh1@yahoo.com)

Coal is an abundant source of fossil fuel and a significant energy resource worldwide. Organic matter is the main constituent of coal, but it is the inorganic matter in coal that can cause serious environmental and technological problems associated with the use of coal.

The present study was undertaken to evaluate good management practices (GMPs) for minimizing sulphate and metal discharges from coal mines within the state of Illinois, USA. Previous investigations have identified coal processing and refuse disposal areas as a significant source of elevated sulphate and metal concentrations in coal-mine discharges. The sources of these compounds include: (1) the oxidation of sulphide minerals, and (2) the dissolution of carbonate, sulphate, and clay minerals inherent in the mined coal and refuse.

A series of field and laboratory tests have been performed to: (1) evaluate the major and trace-element concentrations in water discharges for raw coal stockpiles and (2) demonstrate the advantages of several proven GMPs identified for the reduction of sulphate and trace metal levels from coal refuse disposal areas. In the laboratory tests, we employed ten leaching columns (15.3-cm-diameter by 154.8-cm-high) and compared the geochemical data of water discharges from a compacted blend of dewatered fine and coarse coal mine refuse to the control columns containing only compacted coarse refuse. The fine coal refuse was dewatered to 55-60 percent solids content and either blended or inter-layered with coarse refuse. Preliminary results show that addition of fine refuse particles decreases the high concentrations of sulphate and metals in the leachate. We interpret these result as resulting from increased compaction of the fill material, which in turn reduces infiltration of oxidizing fluids and implicit, the oxidation of sulphide minerals. We will also discuss the field implications of our results.

Bacterial and archaeal diversity in Kartchner Caverns, a carbonate cave in southwestern USA

A. LEGATZKI[1]*, M. ORTIZ[1], J.W. NEILSON[1], B.M. PRYOR[2], L.S. PIERSON III[2] AND R.M. MAIER[1]

[1]Department of Soil, Water and Environmental Science (*correspondence: legatzki@email.arizona.edu)
[2]Division of Plant Pathology, Department of Plant Sciences University of Arizona, Tucson, AZ, 85721, USA

Kartchner Caverns is a 3.9 km long wet living carbonate cave in southwestern USA near Benson, Arizona. In 2006 Kartchner Caverns was added to a worldwide network of Microbial Observatories funded by the National Science Foundation. The goal of our studies is to analyze the microbial community and its activities and to understand its role in the cave ecosystem, especially in speleothem formation (secondary mineral deposition). Kartchner Caverns represents an extremely oligotrophic environment with high humidity (average 99.4% RH) and elevated atmospheric CO_2 (varying seasonally from approx. 1,000 to over 5,000 ppm) [1]. The extremely oligotrophic conditions make this cave a challenging environment for survival and growth of microorganisms. As such, some populations may be dependent on autotrophic redox reactions. In this nonculture-based study, the dominant microbial populations on two different speleothems were examined. Bacterial and archael community fingerprints of triplicate samples from each speleothem were generated by denaturing gradient gel electrophoresis (DGGE) analysis of 16S rRNA gene fragments (which arguably show the dominant populations within the community). Selected bands in the DGGE profiles were excised and sequenced. All of the sequences were most similar to uncultured (most of them unidentified) clones isolated mainly from soil or sediment samples. Sequence information suggests that bacterial populations belong to the phyla Proteobacteria, Chloroflexi, Actinobacteria and Acidobacteria. For the archaea a similar approach was used. The profiles contained fewer bands and exhibited more variation among the three replicates. The majority of the excised bands belong to the Euryarchaeota. In summary, our results show that there is an unusual population distribution present in Kartchner, for example approximately 20% of the total selected bacterial bands belong to the Chloroflexi. We are currently exploring the bacterial and archael communities further to provide a better understanding of community structure and diversity.

[1] Buecher (1999) *J. Cave and Karst Stud.* **61**, 108-120.