Braden Hanna

ITASCA Denver, Inc.
An Itasca International Company

Principal Geochemist

Expertise	Environmental Geochemistry, Mining Geochemistry, Isotope Geochemistry, Geochemical Modeling, Site Characterization, Biogeochemistry
Education	M.S. (Earth Sciences), 2003, Montana State University B.S. (Geology), 2000, Portland State University
Registration	Professional Geologist, Wyoming
Professional Affiliations	Member: International Mine Water Association, International Association of Geochemistry Associate Editor: *Mine Water and the Environment*
Certifications	OSHA, MSHA, Advanced Training Course for the Mining Visualization System and Environmental Visualization System

Professional Experience

2017 – Present	*Itasca Denver, Inc., Lakewood, Colorado* *Principal Geochemist*
2008 – 2017	*Itasca Denver, Inc., Lakewood, Colorado* *Senior Geochemist*
2003 – 2008	*Geomega, Inc., Boulder, Colorado* *Geochemist, co-lead Mining Business Unit*
2001 – 2003	*Thermal Biology Institute, Bozeman, Montana* *Graduate Research Assistant*
2000 – 2001	*Montana State University, Dept. of Earth Sciences, Bozeman, Montana* *Graduate Research Assistant, Graduate Teaching Assistant*
1999 – 2000	*NASA-SETI – Portland State University, Portland, Oregon* *Research Assistant/Laboratory Technician*

Project Experience

Performed various geochemical characterizations of rock, water, soil, and gas for a combination of oil and gas, industrial, and mining clients. Performed geochemical assessments and predictive geochemical simulations, and prepared numerous technical documents for various mining and industrial clients. Characterization projects have included determination and evaluation of chemical composition and reactivity of various rock materials, characterization of groundwater chemistry, evaluation of potential water-treatment needs and options associated with mine dewatering, limnological and geochemical characterization of mine pit lakes, mineralogical and compositional evaluations in support of risk

assessments, forensic fingerprinting of contaminant sources in soil and water, and determination of contaminant extent and distribution. Experience includes a wide range of analytical techniques for organic and inorganic soil, rock, and water characterization.

Domestic mining geochemistry projects have included Newmont's Cripple Creek & Victor, Genesis, Gold Quarry, Lone Tree, Phoenix, Tara, and Twin Creeks mines; Placer Dome's Pipeline/South Pipeline mine; Barrick's Cortez Hills mine; Barrick's Goldrush Project; Goldcorp's Marigold mine; the Getchell mine; the Turquoise Ridge Joint Venture mine; Mesabi Nugget; Kinross's Buckhorn mine; the Celatom diatomite mine; and the former Johnny M uranium mine.

Foreign mining geochemistry projects have included BHP Billiton's Les Mines Selbaie in Quebec, Raven Coal mine in British Columbia, De Beers' Finsch and Venetia mines in South Africa, De Beers' Victor mine in Ontario, Xstrata's Ernest Henry mine in Australia, the Elkon uranium mine in Russia, El Gallo gold and silver mine in Mexico, Sulliden's Shahuindo mine in Peru, and Newmont's Yanacocha gold mine in Peru. Overall, Mr. Hanna's experience extends to more than 50 mines around the word. Mining work has included technical document production in support of the following: environmental assessments (EA) and environmental impact statements (EIS), evaluation of remedial and mitigation strategies, water management permitting, solution mining modeling, site closure, and technical reviews. Mining work has also included work as a third-party contractor to author sections in NEPA documents, to provide technical review of NEPA studies, and as a contractor to project proponents to conduct technical studies in support of the NEPA.

Mr. Hanna has worked closely with programmers to develop data-analysis and visualization tools and numerical models that integrate site-specific kinetic leach testing, saturated/vadose zone hydrologic model outputs, thermodynamic speciation models, and oxidation model outputs to predict water quality in pit lakes, waste rock facilities, and underground mines. Developed a numerical oxidation model incorporating both pressure- and temperature-driven advection, diffusion, oxygen consumption, and oxidation kinetics. Developed multiple site-specific solution mining models to evaluate cavern development rates, cavern distributions, and production rates under various operating conditions. Performed site characterizations and geochemical evaluations in support of litigation and/or remediation at various mining and petrochemical-related sites. Determined probable source locations and contaminant plume pathways of chlorinated solvents in petroleum-hydrocarbon-contaminated aquifers and distinguished petroleum hydrocarbon influences by multiple contamination sources based on cumulate plume organic geochemistry and geochemical evolution.

Research

Investigated geochemical (rock and water) metabolic energy and nutrient sources for archaea from Yellowstone National Park and characterized the geochemical influence on their environment using a combination of microbial and environmental techniques coupled with geochemical modeling.

Evaluated mineralogy of geothermal hot-spring deposits in support of assessment of implications for biological preservation.