Senior Geochemist

Expertise	Mining Geochemistry, Water Quality Modeling, Mine Waste Characterization
Education	Ph.D. (Environmental Engineering Science), 2022 Colorado School of Mines, Golden, Colorado, USA
	M.S. (Environmental Science and Engineering), 2006 Colorado School of Mines, Golden, Colorado, USA
	B.S. (Chemistry), 2002 University of Texas at Austin, Austin, Texas, USA
Professional Affiliations	Member: Society for Mining, Metallurgy & Exploration (SME); International Mine Water Association

Professional Experience

2022 – Present	*Itasca Denver, Inc., Lakewood, Colorado* *Senior Geochemist*
2017 – 2022	*Colorado School of Mines, Golden, Colorado* *Graduate Student Researcher*
2014 – 2017	*Integral Consulting, Louisville, Colorado* *Senior Scientist/Geochemist*
2013 – 2014	*Knight Piésold, Denver, Colorado* *Geochemist*
2011 – 2013	*ARCADIS, Lakewood, Colorado* *Geochemist*
2006 – 2011	*Golder Associates, Lakewood, Colorado* *Project Scientist*

Project Experience

Dr. Doyle has 15 years of experience working on issues related to mine water quality. Her research experience focuses on recycling of manganese in mining-impacted environments and the impacts to associated elements, including molybdenum, lead, copper, and zinc. Her project experience includes the prediction of acid-generating and metals-leaching potential of mine waste, development of site-wide water quality and water balance models, and calibrated unsaturated-zone models of flow through waste rock, tailings, and associated covers. Representative project experience includes the following:

- *Water Quality Modeling*: Developed a pre-feasibility level, site-wide water balance and water quality model for a gold mine project in Colombia. The water and solute balances were developed

using *GoldSim*, with solubility controls evaluated with *PHREEQC*. The model was used to predict water quality in waste-rock containment ponds and the tailings supernatant pond.

- *Unsaturated-Zone Modeling*: Developed an unsaturated-zone model to estimate the infiltration rate through waste-rock piles and test covers across the Questa mine site. Calibrated *HYDRUS-1D* model using seepage data from field lysimeters and weather data from on-site meteorological stations.

- *Waste-Rock Research*: Evaluated zinc, copper, and lead phases in a 100-year-old waste-rock pile near Silverton, Colorado, and the potential for these metals to be mobilized by cover amendments. Sequential extraction tests demonstrated that the largest extractable fraction of metals is associated with iron and manganese oxides. This finding suggests that the geochemically reducing conditions induced by organic amendments in the cover will lead to an environmental risk of metal release from the stockpiles. Metals in the waste rock were also found to be mobilized by formation of stable aqueous organic-metal complexes and ligand-exchange with phosphates in fertilizer.

Dr. Doyle has also taught short courses on acid rock drainage throughout the mine life cycle at both the Mine Water Solutions conference and at internal trainings for clients.