

Steven G. Axen

Senior Hydrogeologist

Expertise Well Design, Well Testing, Data Analysis, Field Management, In-situ Mining

Education B.S. (Geological Engineering), 1974, University of Arizona, Tucson

Professional Societies Member, North West Mining Association, 2008

Registrations Registered Professional Engineer: Colorado (#23201)

Certifications MSHA (Mining Safety and Health Administration), First Aid, CPR

Professional Experience

2007 – Present *HCItasca Denver (formerly Hydrologic Consultants, Inc, Colorado)
Senior Hydrogeologist*

2004 – 2007 *Hydrologic Consultants, Inc. of Colorado, Lakewood, Colorado
Associate Geological Engineer*

2000 – 2007 *Ray V. Huff and Associates, Inc., Golden, Colorado
Vice President, Geological Engineer*

1994 – 1997 *E.L. Montgomery and Associates, Inc., Tucson, Arizona
Geological Engineer*

1982 – 1990 *Ray V. Huff and Associates, Inc., Golden, Colorado
Geological Engineer*

1978 – 1982 *Occidental Materials Corp., Lakewood, Colorado
Mining Engineer*

Project Experience

Mining Hydrology: Responsible for geological services during investigations of mines and prospects for dewatering and mine design purposes, as well as field supervision of operations: well design, deep core drilling, core description, rotary drilling, pumping tests, packer (airlift and injection) tests, flow and shut-in tests, borehole instrumentation, and construction of wells and piezometers. Sites have been located in remote areas in South America and Canada. Managed groundwater exploration and well installation for a large copper mine development in Chile.

Mining Geology and Engineering: Areas of specific expertise include design, testing and technical/economic evaluations of in-situ mining processes for copper, uranium, gold, boron, manganese and sulfur extraction. Responsible for designing, planning and executing in-situ leaching field tests in

Arizona, Chile, and Saskatchewan, Canada. Co-authored the well-design section of an in-situ copper mine design manual published by the U.S. Bureau of Mines.

Field Geology: Conducted various field investigations including well design, construction, well testing, mud logging, core logging, geophysical logging, underground bulk sampling, gold placer evaluation, and soil and water sampling.

Research and Development: Experience includes technology and process development related to novel well equipment and well repair methods. R&D involving in-situ mining has included invention of a process for installation of underground fluid flow barriers, design and field testing of large-diameter hydraulic fractures for in-situ leaching, invention and laboratory evaluation of a non-cyanide gold leaching chemical system. Non-mining R&D has included the invention and field-testing of a manganese-based dry sorbent process for removal of NO_x and SO_x gases and elemental mercury from flue gas streams. Co-inventor on several patents related to these processes.