Richard K Glanzman
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Academic Background

M.S., Geochemistry, Colorado School of Mines
B.S., Geology, University of Utah

Professional Registrations

Professional Geologist, Wyoming PG-1923
Professional Geologist, Wisconsin PG-990

Distinguishing Qualifications

Over 40 years experience in aqueous geochemistry applied to ground water, vadose zone, surface water and their quantitative interactions under both natural and anthropogenically impacted environments on a worldwide basis. Mr. Glanzman interprets physical and chemical data generated by others to solve site-specific water resource problems.

Broad-based experience with chemical and physical relationships between gases, water and solids involving inorganic, organic and microbial populations in most earth surface ecosystems under ambient and geothermal conditions.

Worldwide experience

Applied geochemical specialties:

- Geochemical Modeling
- Mineralogy, Specializing in Sulfide and Clay Mineralogy
- Stable and Radiogenic Isotope Geochemistry
- Soil Gas Geochemistry
- Sediment Transport and Source Quantification
- Field Portable Chemical and Mineralogical Instruments

Agencies and Industry Experience

- Federal: EPA, DOD, USGS
- Western State Departments of Environmental Quality
- Worldwide Municipal Water Purveyors
- Worldwide Mining Operations
- U.S and Canadian Oil and Gas Operations
- Food Processing and Production
- Waste Water Treatment
- Landfill Operations

Relevant Experience

Mr. Glanzman was a Principal Technologist Geochemist/Geohydrologist in CH2M HILL's Geosciences Discipline. He was responsible for the groundwater work in the western interior states. His responsibilities included planning, developing, interpreting,and reviewing geohydrological and, particularly, geochemical investigations in water supply and hazardous waste. His publications, presentations and reports deal with geohydrology, geochemistry, geomorphology, hydrology, geology, field geochemical techniques, and remote sensing.

Geochemist/Geohydrologist, Worldwide. Aquifer recharge storage and recovery (ASR). Along with David Pyne, he pioneered the applicaton of ASR to municipal wells on a worldwide basis. He extended ASR to include aquifer conditioning to control iron, manganese, arsenic and odor in the subsurface. Mr. Glanzman developed an initial screening analysis that forms a basis for judging geochemical reaction potential between the recharge water and the native groundwater at recharge sites on a worldwide basis. This initial evaluation is a fatal flaw analysis of existing physical, chemical, and biological data for the recharge well, recharge site or area. From this analysis, site-specific tests are designed to address the potential problems. A broad experience in geochemical processes (organic, inorganic, and biological) and clay mineralogy is particularly applicable to the development of a successful recharge project. Over 100 municipal and industrial wells have been successfully recharged using this geochemical technology.

Mr. Glanzman had a key role in the evaluation of geochemical reactions involved in hazardous wastes, water supply systems, and aquifer recharge. Mr. Glanzman uses both field- and computer-based (thermodynamic) models such as PHREEQC and Geochemist's Workbench to evaluate potential inorganic geochemical reactions within the hydrologic system. He has applied these and reviewed other geochemical methods to evaluate hazardous waste fate and transport at sites related to metals (Blackbird Cobalt Mine, Idaho; California Gulch,Colorado; Cherokee County, Kansas; Silver Bow Creek and East Helena sites, Montana), solvents (South Valley site, New Mexico; Des Moines, Iowa),radioactivity (Paducah, Kentucky; Rocky Flats, Colorado), and landfills(OII, California; IWC, Arkansas; Lowry, Colorado). In addition to the Superfund sites, he has worked with many private industry clients involving hazardous wastes in air, water, and many forms of solids.

Mr. Glanzman developed geochemical programs to evaluate the distribution and future concentration of major ions and dissolved metals (specifically arsenic) in a master plan for the groundwater drinking water supply of a major western city. This involved the application of several innovative field methods for both geohydrological and geochemical techniques. Appropriate groundwater sampling and monitoring methodology is critical to an understanding of the groundwater system, particularly estimating the water chemistry of drinking water 10 to 20 years in the future.

Mr. Glanzman has developed and applied several generally considered laboratory analytical techniques for insitu chemical analysis at the field site, generally considered laboratory techniques, to expedite the nature and extent determination of both natural and synthetic chemical elements, compounds, and minerals. X-ray fluorescence (XRF),infrared (IR),and soil gas techniques have been developed for application at field sites. Field portable XRF is used to both screen and analyze the total metals concentration at the field site. IR can determine the presence and amount of organics as well as the types and relative proportion of clay minerals. Soil gas can determine the presence and amount of organic and inorganic gases at a site that can be used to distinguish between natural and anthropogenic sources.

In addition to equilibrium geochemical conditions involving concentration, pH, oxidation-reduction potential, complexing, ion-exchange, and adsorption, Mr. Glanzman includes volatilization, kinetics, and the role of microbiota in evaluating the nature/extent and fate/transport of geochemical phases involving most media. Both aqueous and vapor phase isotope evaluations have been applied to separate natural and anthropogenic sources.

Quality assurance and control involves the application of both parametric/nonparametric statistical techniques and geostatistical techniques. Basic statistical functions are typically applied. However, other tests that are appropriate for specific applications include cumulative frequency/probability analysis, discriminate function analysis, several types of cluster analysis, principle components analysis, and factor analysis. Geostatistics provides an effective technique to objectively and quantitatively determine the most effective and efficient sample density of physical and chemical parameters in three-dimensional multimedia.

Several levels of remote sensing have been applied by Mr. Glanzman to the physical and geochemical characterization of areas and sites. Relatively inexpensive, rapid, and highly sophisticated computer processing techniques have been developed that can be used to define not only the present surficial conditions but also surficial conditions since the early 1970s through Landsat imagery. Recent improvements in spectroscopy allow fixed-wing imagery that allows the identification, relative quantification, and mapping of such surficial properties as expandable clay and nonexpandable clay, oxidizing sulfide minerals, and geological structures that control groundwater movement on a 10- to 20-foot scale.

Mr. Glanzman, working with the U.S. Bureau of Mines, evaluated techniques for the measurement and removal of radon gas from the mine and industrial environment. His work involved the definition of gas transport, physicochemical interaction between groundwater under unsaturated and saturated conditions, and in both porous media and fracture flow. A position paper on health physics of radon gas was produced and test environments were established for the assessment of removal methods. Groundwater.

Mr. Glanzman authored and was responsible for a series of reports on the geochemistry of arsenic in groundwater for a major city in the southwestern United States. The report on arsenic hydrogeochemistry describes how arsenic moves in the groundwater system, parameters that both increase and decrease its mobility, and case histories of arsenic problems in groundwater. Reports on the analytical methods for the reliable determination of dissolved and total arsenic concentration and speciation in groundwater, water reservoirs, spatial and temporal trends in the groundwater system, identification of problem areas, long-term monitoring program, and the development of methods to treat the water to control and remove arsenic were prepared. He developed an aquifer treatment alternative in which the groundwater is conditioned to immobilize the arsenic in the aquifer matrix.

Geochemist/Geomorphologist, Idaho. Quantified the provenance of sediments deposited by the Snake River into Brownlee Reservoir and in sand bars within Hells Canyon below the Hells Canyon Complex. Chemical and mineralogical signatures of the various sources within the upper and middle Snake River and its tributaries were coupled with the geomorphology to definitively determine the respective amount of sediment from these sources that has accumulated within both the reservoirs and sand bars of the lower Snake River in Idaho.

Areal groundwater studies were conducted by Mr. Glanzman working with the Water Resources Division of the U.S. Geological Survey. Areal studies in Colorado included the evaluation of groundwater/surface water relationships in the San Luis Valley, sandstone aquifers in Baca and Prowers Counties, groundwater in fractured oil shale of the Piceance Basin, and an evaluation of an extensive soil and stream sediment erosion abatement system near Kiowa. A groundwater sampling grid was established to monitor groundwater chemistry in eastern Colorado. Multiphase fluid flow and the impact of gases on both the chemistry and hydraulic characteristics of groundwater were evaluated in essentially all projects. Work in Utah involved the collection, analysis, and interpretation of the water chemistry of surface and ground-water. Work included stream sediment measurements and both suspended and bedload quantification.

In addition to the application of statistical techniques to quality assurance and control, Mr. Glanzman utilizes statistics to more accurately define and discriminate geochemical anomalies. Basic statistical functions and tests including cumulative frequency/probability analysis, discriminate function analysis, several types of cluster analysis, factor analysis, and kriging. The geostatistical technique, kriging, was successfully applied to analyze and interpret three-dimensional multimedia (soil, vegetation, stream sediment, rock,drill cuttings, and remote sensing) sample data. Kriging is an effective technique to quantitatively determine the most efficient and effective sample density to define physical and chemical parameters.

Mr. Glanzman has extensive experience with the geochemistry of natural decay products of both uranium and thorium. The mobility, fate, and transport of radionuclides was investigated in environments that ranged from ambient to 500 degrees Celsius and included solid, liquid, and gaseous phases of both organic and inorganic types. Mr. Glanzman has 5 years of experience focused on the radioactive gases in subsurface environments. Transport experience includes multiphase fluid flow, interaction with other stable gases and organics, and controls on the release of radioactive gases and their products to the environment.

Mr. Glanzman was Division Geochemist for Chevron Resources. His responsibilities included counseling and advising management and professionals in the use and interpretation of geochemical techniques applied to both domestic and foreign operations. He identified, developed, and applied new technologies for field site geochemistry and mineralogy. He developed and maintained quality assurance and control programs and procedures for analytical data from commercial laboratories.

Mr. Glanzman was project manager of a clay minerals program with the U.S. Geological Survey. The project involved the smectite-type clays and their particular fluid-retaining and permeability-reducing characteristics that make them suitable for use in hydrologic barriers. The work defined chemical and physical paths for the development of clay minerals in sedimentary, igneous, and hydrothermal environments. He has extensive experience with clay mineral response to intense environmental, particularly chemical conditions involving ambient to high pressures, temperatures, and salinity.

Mr. Glanzman has applied stable and radiogenic isotopes for specific purposes in multiple aquifers involving a waste disposal site in Idaho. Stable and radiogenic isotopes were used to distinguish relatively shallow local alluvial groundwater from the regional deep carbonate aquifer and their mixtures across the entire southeastern quarter of the state of Nevada for water rights purposes. Stable and radiogenic isotopes were used to model the geochemistry and age of groundwater in the multiple aquifers of the Boise ID basin. Isotopes provide unique signatures in groundwater chemistry identifying specific sources and document not only the location(s) of their origin(s) but also their mixing with groundwater originating from other sources. As with most aqueous geochemical parameters, interpretation of isotope activities is supported and validated by major, minor and trace constituents in the groundwater.

Stable isotopes and carbon-14 age dating were combined with major, minor and trace element geochemistry to estimate the deep carbonate aquifer groundwater system for central and southern Nevada. A previously unknown groundwater source was identified in the Tule Basin and another large potential source of groundwater was identified by the geochemical evaluation of the regional deep carbonate aquifer groundwater.

Water Rights Expert Witness. Mr. Glanzman was an expert witness for cases involving the Sandy Valley, Kane Springs Valley and Tule Basin water rights hearings before the Nevada State Engineers Office. He authored a geochemical investigation showing the deep regional carbonate groundwater flow paths throughout southestern Nevada from north of Ely, Nevada through Las Vegas to the Ivanpah Playa in California. These hearings involved the U.S. National Park Service, U.S. Bureau of Land Management, U.S. Geological Survey as well as public and municipal advocacies opposed to the development of a new groundwater source. Interpretation of geochemical data was instrumental in the State Engineer awarding the majority of the requested water right.

Membership in Professional Organizations

American Association for the Advancement of Science
Association of Applied Geochemists (two terms as Councilor)
Clay Mineral Society
Colorado Groundwater Association
Colorado Scientific Society
Geochemical Society
Geological Society of America
International Mine Water Association
National Water Well Association
Sigma Xi
Society for Environmental Geochemistry and Health

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Pierce Gulch Sand Aquifer

Groundwater chemistry indicates that the Pierce Gulch Sand Aquifer (PGSA) is a discrete aquifer recharged from the Boise River with no apparent hydraulic connection with other aquifers

PGSA groundwater chemistry type is uniquely constrained showing very limited variability over many miles separating individual well locations.

PGSA groundwater chemistry is indicative of a highly permeable aquifer with a consistent minimally soluble aquifer mineralogy.

Similar to water chemistry type, PGSA groundwater total dissolved solids (TDS) show little change throughout the well locations.

Spring Valley Ranch Area

Groundwater chemistry in the Spring Valley Ranch is dominantly recharged from precipitation infiltrating into aquifer sediments with a variable soluble mineralogy resulting in a suite of highly different water chemistry types and TDS.

Spring Valley Ranch (SVR) groundwater generally contains elevated potassium and arsenic concentrations that is not present in groundwater from either the PGSA or other aquifers in this part of the Boise Basin.

SVR groundwater chemistry indicates the most variable aquifer mineralogy of all the aquifers in this part of the Boise Basin.

Willow Creek Aquifer

Groundwater chemistry from the Willow Creek Aquifer (WCA) shows considerable variability suggesting localized recharge and variable hydraulic connection with other aquifers.

WCA groundwater chemistry suggests a variable similarity with groundwater chemistry in the Tertelling Springs Formation.

Tertelling Springs Formation

Groundwater chemistry of the Terteling Spring Formation indicates considerable variability but unlike the SVR and WCA is indicative of increasing dissolution of a discrete aquifer mineralogy.

Groundwater chemistry in the Terteling Springs Formation indicates that the mineralogy is discretely different from that of the PGSA and Spring Valley Ranch aquifer mineralogy.