

NAME**PAUL DRAKOS****TITLE**

Vice President / Senior Geologist, Glorieta Geoscience Inc. (1990-Present) Wyoming PG #3422, Texas PG #10412. Responsible for: (1) soil stratigraphic, geologic and geomorphic mapping, geoarchaeology geomorphology, and dendrochronology investigations; (2) location and design of water wells, multiple aquifer test wells, pumping test design and analysis, and ground water basin analysis (ground water resource evaluation and development); (3) supervision of all staff geologists and hydrologists during field and office activities; and (4) management of site investigations of contaminated soils and ground water.

EXPERIENCE SUMMARY

22 Years Experience encompassing the following areas:

- Geomorphic and geologic mapping
- Geomorphology, geoarchaeology, dendrochronology, dating of sediment deposition
- Drilling supervision, well design, lithologic description of cuttings and continuous core, evaluation of geophysical logs, and development of drilling specifications for ground water production water wells and monitoring wells
- Project management and field supervision of drilling and installation of well nests to depths of up to 3500 feet in bedrock and basin fill aquifer settings
- Development of programs for conducting aquifer tests and sampling of discrete ground water zones in multi-aquifer systems
- Wetland delineation and mitigation
- Aquifer test design, data collection and analysis

SELECTED PROJECT EXPERIENCE

Geomorphologist/Project Manager for Los Alamos National Laboratory (LANL) Canyons Investigations (06/98 to present): Performed detailed geomorphic mapping, soil stratigraphic descriptions, dendrochronology and soil sampling in Los Alamos and Mortandad Canyons, Cañada del Buey, Pajarito, Rendija, Ten Site, Sandia, Portrillo, Fence, Ancho, Chaquehui, and Water Canyons, Cañon de Valle and tributary drainages. Responsibilities include geomorphic mapping, completion of soil stratigraphic descriptions, and characterization of canyons in the vicinity of LANL, collection and analysis of dendrochronology samples, completion of surveys for topographic profiles and cross sections and supervision of all team members for radiological surveys, sample collection, and geomorphic characterization.

Geologic Mapping, Mt. Taylor area (2008-present): Responsible for geomorphic characterization and mapping of surficial deposits for New Mexico STATEMAP 7.5 Minute Quadrangle mapping program. Focus is on the mapping of fluvial and alluvial fan deposits and associated geomorphic surfaces, and completion of soil descriptions to differentiate between Quaternary deposits in the Lobo Springs, Mt. Taylor, Grants, and Seboyetta Quadrangles. Also focused on delineating contacts with underlying Cretaceous stratigraphic units and contributed to mapping of the Cretaceous section.

Geoarchaeology Investigations, Los Alamos National Laboratory (LANL) and Valles Caldera National Preserve (VCNP) (2002 to 2007): Performed detailed geomorphic mapping and soil stratigraphic descriptions to evaluate the geomorphic setting, site context and integrity of archaeological sites in Los Alamos National Laboratory land conveyance parcels and in Valles Caldera National Preserve. Developed stratigraphic context for comparison of relative site ages. Geoarchaeology reports, in collaboration with Dr. Steven Reneau, include LANL Reports LA-UR-03-2630, LA-UR-04-1842, and LA-UR-05-2910.

Geologic Mapping, Valles Caldera (2002-2003): Collaborated with Dr. Steven Reneau in mapping fluvial, lacustrine, and alluvial fan deposits and associated geomorphic surfaces in Valles Caldera sub-basins, including Valle Toledo and Valle Grande. Collected stratigraphic, structural, and soil stratigraphic data. Participated in completion of Valle Toledo, Bland, and Valle San Antonio 7.5 minute Quadrangle geologic maps (see publications in References, below).

Zuni Spring Inventory (2007-2009): Worked in conjunction with the Pueblo Department of Natural Resources to develop a database of springs on Tribal land. Examined geologic and geomorphic setting, collected water samples for isotope and general chemistry to evaluate recharge sources and source aquifer of springs on the Zuni Reservation. Worked with Tribal staff to design and implement permanent monitoring stations at selected springs.

Municipal well design and installation, design and installation of multiple-aquifer test wells and piezometer nests, evaluation of pumping test data, Town of Taos, New Mexico (1994-2007): Designed and implemented testing programs to evaluate ground water production and ground water quality in several discrete zones at depths between 1000 and 3000 feet in Tesuque Formation sediments within the southern San Luis Basin. Used subsurface lithologic data, outcrop analog analysis, geophysical data, pumping test data, and geochemistry data including stable isotopes and tritium from 45 test or production wells for a hydro-geologic analysis of the basin. Drilling data were used to define subsurface basin fill stratigraphy and the extent of Servilleta basalt flows in the subsurface.

Zuni Well Inventory (2004-2005): Worked in conjunction with the Pueblo Department of Natural Resources to develop a database of all wells on Tribal land and to identify a subset of wells for video logging, water quality sampling, and production testing. Designed sampling and testing program, including isotope sampling to evaluate recharge to aquifers. Identified wells that can be used for public supply, livestock, or long-term ground water monitoring.

Evaluation of hydrologic characteristics of fractured bedrock aquifers, geologic mapping, and sequence stratigraphy in the vicinity of Nations Draw from Zuni Salt Lake to the proposed Fence Lake Coal Mine, south of Fence Lake, New Mexico (1996-2006): Examined Cretaceous and Jurassic sedimentary sequence as outcrop analogs for aquifers penetrated by numerous test and observation wells in the area, and mapped geologic structures in the area to determine if pumping at proposed surface coal mine will effect hydrologic balance and salt formation at Zuni Salt Lake. Evaluated pumping test data from Dakota and Atarque sandstone aquifers to determine appropriate analytical solutions (i.e. confined vs. leaky-confined solutions). Conducted geologic mapping of Zuni Salt Lake maar and an area of approximately 80 square miles between the Salt Lake and the mine area, focusing on Cretaceous sedimentary rocks and structure

EDUCATION

M.S. Geology, University of New Mexico, 1989, Thesis Title: Quaternary geology and tectonic geomorphology of the coastal piedmont and range, Puerto Quepos area, Costa Rica.

Graduate Research Assistant, Los Alamos National Laboratory, 1989-1990: mapping and analysis of recent tectonism across the Colorado Plateau-Rio Grande Rift transition zone in west-central New Mexico.

B.S. Geology, University of Oregon, 1982

PROFESSIONAL DEVELOPMENT/ TRAINING

- Dendrochronology workshop, U. of Arizona Lab of Tree Ring Research
- Environmental Isotopes in Ground Water Resources and Contaminant Hydrogeology
- Fractured Rocks: Characterization, Flow, and Transport
- Introduction to Ground Water Geochemistry and Applications of Ground Water Geochemistry
- MODFLOW (U.S.G.S. Modular flow model) course
- Floodplain Hydrology and Watershed Modeling Seminar
- OSHA 40 - Hour Hazardous Waste Training (40 CFR 1910.120)
- OSHA 8 - Hour Management/Supervisor Training
- Current Annual OSHA 8 - Hour refresher course
- Completion of all training pertinent to LANL training matrix

SELECTED PUBLICATIONS

- Reneau, S.L., **Drakos, P. G.**, Riesterer, J.W., Goetze, P.R., Schultz-Fellenz, E.S., Miller, E.D., and Katzman, D., 2010, Watershed-scale investigation of sediment contamination – chromium and PCBs in Sandia Canyon, Pajarito Plateau, New Mexico: 9th Annual Española Basin workshop: Watersheds and surface water of the Española Basin, Abstracts and Program, p. 20
- Reneau, S.L., **Drakos, P. G.**, and Schultz-Fellenz, E.S., 2010, Use of congener homologs to evaluate PCBs in the Rio Grande near Los Alamos National Laboratory, New Mexico: 9th Annual Española Basin workshop: Watersheds and surface water of the Española Basin, Abstracts and Program, p. 21
- Drakos, P.**, Lazarus, J., Riesterer, J., Sims, K., and Hodgins, M., 2008, Structural controls on ground water flow and recharge into the southern San Luis Basin near Taos, NM, *New Mexico Geology*, v. 30, no. 2, p. 53.
- Goff, F., Kelley, S.A., Zeigler, K., **Drakos, P.**, and Goff, C., 2008, Geologic map of the Lobo Springs Quadrangle, Valencia County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, OF-GM 181, scale 1:24,000.
- Drakos, P.** and Reneau, S., 2007, Episodic eolian events and preservation of mesa top archaeological sites on the Pajarito Plateau, *Geology of the Jemez Region II, New Mexico: New Mexico Geological Society 58th Annual Field Trip Guidebook*, p. 449-458.
- Drakos, P.** Reneau, S., and Morgan, G., 2007, *Bison Antiquus* occurrence and Pleistocene-Holocene stratigraphy, Cañada del Buey, Pajarito Plateau, New Mexico, *Geology of the Jemez Region II, New Mexico: New Mexico Geological Society 58th Annual Field Trip Guidebook*, p. 441-448.
- Reneau, S., **Drakos, P.**, and Katzman, D., 2007, Post-resurgence lakes in the Valles Caldera, New Mexico, *Geology of the Jemez Region II, New Mexico: New Mexico Geological Society 58th Annual Field Trip Guidebook*, p. 398-408.
- Riesterer, J., **Drakos, P.**, Lazarus, J., and Chudnoff, M., 2006, Hydrogeology of Hale Spring and evaluation of declining spring discharge, Ruidoso Downs, New Mexico, *Caves and Karst of Southeastern New Mexico, New Mexico Geological Society 57th Annual Field Trip Guidebook*, p. 287-296.
- Drakos, P.** and Reneau, S., 2006, Soil-stratigraphic framework, timing of recent eolian events, and preservation of archaeological sites on the Pajarito Plateau, New Mexico: Geological Society of America Rocky Mountain Section, 58th Annual Meeting, Abstracts with Programs, p. 8.
- Gardner, J.N., Goff, F., Reneau, S.L., Sandoval, M.M., **Drakos, P.G.**, Katzman, D., and Goff, C.J., 2006, Preliminary geologic map of the Valle Toledo quadrangle, Los Alamos and Sandoval Counties, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map OF-GM 133, scale 1:24,000.
- Goff, F., Reneau, S.L., Goff, C.J., Gardner, J.N., **Drakos, P. G.**, and Katzman, D., 2006, Preliminary geologic map of the Valle San Antonio quadrangle, Sandoval County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map OF-GM 132, scale 1:24,000.
- Drakos, P.** and Reneau, S., 2005, Surficial units and processes associated with archaeological sites in selected land conveyance parcels, Los Alamos National Laboratory, Volume III: Western Rendija Canyon Tract sites: Los Alamos National Laboratory report LA-UR-03-2630, Los Alamos, New Mexico.
- Goff, F., Reneau, S.L., Goff, C.J., Gardner, J.N., **Drakos, P.**, and Katzman, D., 2005, Preliminary geologic map of the Bland 7.5-minute quadrangle: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map OF-GM 112, scale 1:24,000.
- Malmon, D., Reneau, S., Dunne, T., Katzman, D., and **Drakos, P.**, 2005, Influence of sediment storage on Downstream delivery of contaminated sediment: *Water Resources Research*, vol. 41, WO5008, doi: 10.1029/2004WR003288.
- Drakos, P.**, Lazarus, J., Riesterer, J., White, B., Banet C., Hodgins, M., and Sandoval, J., 2004, Subsurface stratigraphy in the southern San Luis Basin, New Mexico *in* *New Mexico*

- Geological Society, 55th Field Conference Guidebook, p. 374-382.
- Drakos, P.**, Lazarus, J., White, B., Banet C., Hodgins, M., Riesterer, J., and Sandoval, J., 2004, Hydrologic characteristics of basin-fill aquifers in the southern San Luis Basin, New Mexico *in* New Mexico Geological Society, 55th Field Conference Guidebook, p.391-404.
- Drakos, P.**, Sims, K., Riesterer, J., Blusztajn, J., and Lazarus, J., 2004, Chemical and isotopic constraints on source-waters and connectivity of basin-fill aquifers in the southern San Luis Basin, New Mexico *in* New Mexico Geological Society, 55th Field Conference Guidebook, p.391-404.
- Reneau, S., **Drakos, P.**, Katzman, D., Malmon, D., McDonald, E., and Ryti, R., 2004, Geomorphic controls on contaminant distribution along an ephemeral stream: Earth Surface Processes and Landforms, vol. 29, p. 1209-1223.
- Drakos, P.** and Reneau, S., 2004, Geomorphic setting of archaeological sites and timing of recent eolian events on the Pajarito Plateau (Abstract): New Mexico Geological Society Proceedings Volume, 2004 Annual Spring Meeting, p. 13.
- Reneau, S., **Drakos, P.**, and Katzman, D., 2004, Post-resurgence lakes of the Valles Caldera, New Mexico (Abstract): New Mexico Geological Society Proceedings Volume, 2004 Annual Spring Meeting, p. 59.
- Drakos, P.** and Reneau, S., 2004, Surficial units and processes associated with archaeological sites in selected land conveyance parcels, Los Alamos National Laboratory, Volume II: Rendija Canyon and Airport Tract sites: Los Alamos National Laboratory report LA-UR-04-1842, Los Alamos, New Mexico.
- Drakos, P.**, Lucas, S., Morgan, G., and Reneau, S., 2003, Stratigraphy and paleontology of Trapped Rock Draw mastodon site, Zuni, New Mexico *in* New Mexico Geological Society 54th Annual Field Trip Guidebook, p. 419-424.
- Drakos, P.** and Reneau, S., 2003, Surficial units and processes associated with archaeological sites in selected land conveyance parcels, Los Alamos National Laboratory, Volume I: Los Alamos National Laboratory report LA-UR-03-2630, Los Alamos, New Mexico.
- Drakos, P.**, Lazarus, J., and Riesterer, J., 2002, Will pumping from the fractured Dakota Sandstone aquifer at the Fence Lake mine lower water levels at the Sacred Zuni Salt Lake or are pumping effects limited to the mine site? – a tale of conflicting analytical models, *in*, Fractured-Rock Aquifers 2002, NGWA, p. 126-130.
- Drakos, P.**, Ryti, R., Reneau, S., and Greene, K., 2000, Evaluation of possible sediment contamination in the White Rock land transfer parcel: Reach CDB-4: Los Alamos National Laboratory report LA-UR-00-5071, Los Alamos, New Mexico.
- Drakos, P.**, and Lazarus, J., 1999, Hydrogeologic characterization of fractured Abo and Madera Formation aquifers, hydrocarbon contamination and transport along the Zuzax Fault, Tijeras Canyon, New Mexico, New Mexico Geological Society 50th Annual Field Trip Guidebook, Albuquerque Country III, p. 419-424.
- Drakos, P.**, and Lazarus, J., 1998, Hydrogeologic characterization, surface water-ground water interaction, and water quality in the southern San Luis Basin in the vicinity of Taos, NM, Proceedings of the 1998 Ground Water Protection Council Annual Forum, p. 104-114.
- Drakos, P.**, Lazarus, J., and Inoué, C., 1996, Holocene evolution of canyons and implications for contaminant transport, Pajarito Plateau, New Mexico Geological Society 47th Annual Field Trip Guidebook, Jemez Mountains Region, p. 399-406.
- Lazarus, J., and **Drakos, P.**, 1995, Geohydrologic characteristics and hydrocarbon contamination of the shallow alluvial/Tesuque Formation aquifer within the city of Santa Fe, NM, New Mexico Geological Society 46th Annual Field Trip Guidebook, p. 307-311.
- Drake [Drakos], P.G.**, and Harrison, J.B.J., 1994, Geomorphology of the Cuchillo Negro project area: On the periphery of the Mimbres-Mogollon, Cuchillo Negro Archaeological Project, Volume 1, Office of Contract Archaeology, University of New Mexico, Albuquerque, OCA/UNM Report 185-403D.
- Drake [Drakos], P.G.**, Harrington, C.D., Wells, S.G., Perry, F.V., and Laughlin, A.W., 1991, Late Cenozoic geomorphic and tectonic evolution of the Rio San Jose and tributary drainages within the Basin and Range/Colorado Plateau transition zone in west-central New Mexico, *in* Julian, B. and Zidek, J., eds, Field guide to excursions in New Mexico and adjacent areas of Texas and Colorado, N. M. Bureau of Mines and Mineral Resources Bulletin 137, p.149-157.
- Drake [Drakos], P.G.**, Geologic map of the Puerto Quepos area, Costa Rica: Instituto Geografico Nacional, Costa Rica: Escala 1:50,000