

PAUL DRAKOS

Principal / Senior Geologist, Glorieta Geoscience Inc.
AZ #61357, TX PG #10412, WA PG #3044, WY PG #3422.

EXPERIENCE SUMMARY

29 Years of 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
- Development of aquifer testing and groundwater sampling programs
- Analysis of general chemistry and isotopic geochemistry data to evaluate recharge and to identify geochemical signatures of aquifers
- Water rights analysis
- 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
- Wetland delineation and mitigation

SELECTED PROJECT EXPERIENCE

Hydrogeologic Investigation of Phoenix Spring and Development of Source Water Protection Plan, Taos Ski Valley, NM (2017-2018): Installed piezometers, collected groundwater and precipitation samples for isotopic geochemistry analysis, implementer program for water level monitoring and spring discharge analysis to determine seasonal recharge to a spring that is the sole source water supply for the Village of Taos Ski Valley, NM. These data will be used for development of a Source Water Protection Plan for the Village.

Litigation Support, Zuni Pueblo Protest of G-22 Application (2014 - 2017): Provided litigation support for the Tribe's protest of the City of Gallup's application for 5000 acre-ft/yr of groundwater pumping. Work has included geologic mapping on the reservation to document perennial reaches of the Rio Nutria and connectivity of surface water and groundwater in the San Andres/Glorieta aquifer, continuity of the aquifer through the Nutria Monocline, critique of data and reports prepared by opposing side, and preparation of expert reports that were used to reach a negotiated settlement.

Geomorphologist/Lead Investigator for Los Alamos National Laboratory (LANL) Canyons Investigations (1998 - 2015): Performed detailed geomorphic mapping, soil stratigraphic descriptions, dendrochronology and soil sampling for a wide range of contaminants (including radionuclides, PCB congeners, HE, semivolatile and volatile organics, and metals) in canyons draining volcanic highlands in semiarid environment in northern New Mexico to assess contaminant transport from LANL to the Rio Grande.

Wetland Delineation and Compensatory Mitigation, Village of Taos Ski Valley, NM (2004 - 2018): Completed wetland delineation for high-elevation, fen-type wetlands within the Village of Taos Ski Valley, NM. Evaluated potential mitigation sites, selected appropriate mitigation sites and completed compensatory wetland mitigation construction activities in 2004-2007, 2013-2014, and 2014-2018 under Army Corps of Engineers (ACE) Nationwide 404 and Individual 404(b)(1) permits. All monitoring standards have been met for multiple delineation and mitigation projects.



Investigation of Post-Fire Erosion, Sediment Transport, and Deposition in Water Canyon Watershed, Los Alamos National Laboratory (LANL) (2011 - 2014): Completion of repeat cross section surveys, repeat assessment of sediment sample locations, and sediment sample collection to evaluate contaminant transport (including HE, PCBs, radionuclides, and metals), erosion, and sediment deposition over a three-year time period in response to the 2011 Las Conchas Fire in the Jemez Mountains, New Mexico.

Pahrump Valley and Spring Mountains, Nevada Spring and Well Assessment (2012): Worked in conjunction with Nye Co. Nevada Nuclear Waste Repository Project office (NWRPO) to evaluate selected springs and wells in the Spring Mountains and Pahrump Valley, Nevada. Examined geologic and geomorphic setting, collected water samples for isotope and general chemistry to evaluate structural controls on spring discharge and recharge into the Pahrump Valley as part of a larger investigation into contaminant transport pathways from Yucca Mountain to public water supply receptors.

Geologic Mapping, Mt. Taylor area (2008 - Present): Conducted geomorphic characterization, soil and stratigraphic descriptions and mapping of surficial deposits near the Mt. Taylor stratovolcano for New Mexico STATEMAP 7.5 Minute Quadrangle mapping program for Lobo Springs, Mt. Taylor, Grants, Seboyeta, Cubero, McCarty's and Laguna Quadrangles (see References).

Zuni Spring Inventory and Well Inventory (2004 - 2009): Worked in conjunction with the Zuni Pueblo Department of Natural Resources to develop a database of wells and 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. Conducted field evaluation and testing of water supply wells to determine aquifer characteristics, production capacity, and water quality of drinking water and stock water sources.

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 program to evaluate ground water production and ground water quality in several discrete zones at depths between 1000 and 3000 feet in Rio Grande Rift 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 hydrogeologic analysis of the basin, including the extent of Servilleta basalt flows and subsurface basin fill stratigraphy.

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, evaluated pumping test data and mapped geologic structures to determine if pumping at proposed surface coal mine would affect hydrologic balance and salt formation at Zuni Salt Lake. Completed reconnaissance 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.

Indian Hills site investigation of hydrocarbon contamination, near Zuzax, New Mexico: Developed investigative program to determine cause and extent of groundwater contamination in three separate aquifers and two localized



perched zones within 240 feet of ground surface in the Abo and Madera Formations. Conducted fracture analysis, completed geohydrologic cross sections, installed and sampled 24 monitoring wells, completed lithologic descriptions of continuously cored samples and supervised completion of well nests. These data were used to delineate two separate contaminant plums, and identify contaminant sources and pathways in a fracture flow system. Conducted long-term aquifer tests and pilot scale remediation for phase separated and dissolve-phase hydrocarbons.

EXPERT TESTIMONY

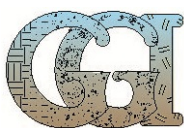
DATE	CASE	CLIENT	JURISDICTION	AREA OF EXPERTISE
1991	White vs. NM State Highway and Transportation Dept.	Robert White	NM District Court	Geology, Geomorphology
1992	State of NM ex rel State Engineer v. Aamodt	Rio Tesuque, Rio Pojoaque, Rio Nambe Acequias	US District Court, New Mexico District	Hydrology, Geology, Geohydrology
1996-2001	Fence Lake Coal Mine Application Hearing	Zuni Pueblo	NM Energy and Minerals Department	Hydrology, Geology, Geohydrology
2001	Townsend et al. v. Twin Mtn Construction Co. and NM Highway & Transportation Dept.	Wayne Townsend	NM District Court	Geology, Geomorphology
2001-2002	Cowan vs. Barton et al. (Rio de los Brazos property boundary dispute)	Steve Polaco	NM District Court	Geomorphology, Fluvial Hydrology
2005	City of Ruidoso Downs v. Village of Ruidoso	City of Ruidoso Downs	NM State Engineer	Geohydrology
2015-2017	Bonds Ranch vs. various protestants	Bonds Ranch	NM State Engineer	Geology, Hydrology
2016-2017	Galaway vs. Various protestants	James Galaway I, LLP	NM State Engineer	Hydrology, Geology
2015-2017	Zuni Pueblo and Western Refining v. City of Gallup	Zuni Pueblo and Western Refining	NM State Engineer	Geology, Hydrology

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 of Plio-Pleistocene geomorphic surfaces, description of sedimentary deposits 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

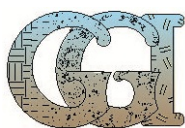


PROFESSIONAL DEVELOPMENT/ TRAINING

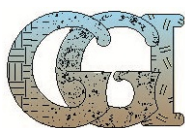
- Dendrochronology workshop, U. of Arizona Lab of Tree Ring Research
- Environmental Isotopes in Ground Water Resources
- Fractured Rocks: Characterization, Flow, and Transport
- Introduction to Ground Water Geochemistry and Applications of Ground Water Geochemistry
- MODFLOW (U.S.G.S. Modular flow model)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

PUBLICATIONS

- Drakos, P.**, Davis, J., Riesterer, J., and Lazarus, J., 2017, Muddy River spring inventory and habitat protection: Proceedings of the Devils Hole Workshop, Beatty, Nevada.
- Cikoski, C.T., **Drakos, P.G.**, Riesterer, J., 2017, Geologic Map of the McCarty's 7.5-Minute Quadrangle, Cibola County, New Mexico, New Mexico Bureau of Geology and Mineral Resources Open File Geologic Map 265, available online at:
<http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?volume=265>
- Cikoski, C.T., **Drakos, P.G.**, Riesterer, J., 2016, Geologic Map of the Cubero 7.5-Minute Quadrangle, Cibola County, New Mexico, New Mexico Bureau of Geology and Mineral Resources Open File Geologic Map 256, available online at:
<https://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?volume=256>
- Goff, F.E., Kelley, S.A., Goff, C.J., McCraw, D.J., Osburn, G.R., Lawrence, J.R., **Drakos, P.G.**, and Skotnicki, S.J., 2015, Geologic Map of Mount Taylor, Cibola and McKinley Counties, New Mexico: NM Bureau of Geology and Mineral Resources Open-file Report 571, 1:36,000 scale. Available on-line at: <https://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=571>
- Drakos, P.** and Reneau, S., 2013, Surficial processes and preservation of Ancestral Puebloan archaeological sites on the Pajarito Plateau, New Mexico, *in: Vierra, B.J., From Mountain Top to Valley Bottom: Understanding Past Land Use in the Northern Rio Grande Valley, New Mexico*, University of Utah Press, Salt Lake City, p. 33-53.
- Drakos, P.G.**, Riesterer, J.W., and Bemis, K., 2013, Recharge sources and characteristics of springs on the Zuni Reservation, New Mexico: New Mexico Geological Society 64th Annual Field Trip Guidebook, p. 205-213.
- Drakos, P.G.** and Riesterer, J.W., 2013, Water Canyon/Timber Canyon fan complex on the southeast flank of Mount Taylor, New Mexico: New Mexico Geological Society 64th Annual Field Trip Guidebook, p. 175-179.
- Skotnicki, S.J., **Drakos, P.G.**, Goff, F.E., Goff, C.J., and Riesterer, J., 2012, Geologic map of the Seboyeta 7.5' Quadrangle, Cibola County, NM: NM Bureau of Geology and Mineral Resources Open-file Map 226, 1:24,000 scale. Available on-line at:
<http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=226>
- Zeigler, K.E., Cikoski, C.T., **Drakos, P.G.**, and Riesterer, J., 2012, Geologic map of the Grants 7.5' Quadrangle, Cibola County, NM: NM Bureau of Geology and Mineral Resources Open-file Map 224, 1:24,000 scale. Available on-line at:
<http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=224>
- Drakos, P. G.**, Reneau, S.L, Schultz-Fellenz, E.S., Riesterer, J.W., Miller, E.D., Goetze, P.R., and Chamberlain, P., 2012, Post-Fire Sediment Transport and Erosion in the Water Canyon and Cañon de Valle Watershed, Jemez Mountains New Mexico: 11th Annual Española Basin Workshop, Abstracts and Program, p. 16.
- 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
- Osburn, G. R., Kelley, S. A., Goff, F., **Drakos, P. G.**, and Ferguson, C. A., 2009, Preliminary geologic map of the Mount Taylor 7.5-Minute Quadrangle map, Otero and Cibola County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, OF-GM 186, scale 1:24,000. Available on-line at:
<http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=186>
- 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. Available on line at:
<http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=181>



- 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. Available on-line at: http://www.glorietageo.com/pubs/Drakos_Reneau_mesa_top_final.pdf
- 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/58/58_p0441_p0448.pdf
- 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/58/58_p0398_p0408.pdf
- 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/57/57_p0287_p0295.pdf
- 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. Available on-line at: <http://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=133>
- 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. Available on-line at: <https://geoinfo.nmt.edu/publications/maps/geologic/ofgm/details.cfm?Volume=132>
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- 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/55/55_p0405_p0414.pdf
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- 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/54/54_p0419_p0424.pdf
- Drakos, P.**, Rytí, 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. Available on-line at: http://nmgs.nmt.edu/publications/guidebooks/downloads/50/50_p0419_p0424.pdf
- 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.
- 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.
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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.

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