

## PAUL DRAKOS

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

### EXPERIENCE SUMMARY

#### 27 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 programs for conducting aquifer tests and sampling of discrete ground water zones in multi-aquifer systems
- Analysis of general chemistry and isotopic geochemistry data to evaluate recharge to groundwater systems and to identify geochemical signatures of aquifers
- Aquifer test design, data collection and 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

#### **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 - 2016):**

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 and 2013-2014 under Army Corps of Engineers (ACE) Nationwide 404 and Individual 404(b)(1) permits. All monitoring standards have been met for both projects.

**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 and McCarty's Quadrangles (see References).

#### **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.

**Zuni Spring Inventory (2007 - 2009):** Worked in conjunction with the Zuni 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.

**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 |



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| 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      | 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 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
- Completion of all training pertinent to LANL training matrix

## PUBLICATIONS

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>



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- 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: 11<sup>th</sup> 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: 9<sup>th</sup> 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: 9<sup>th</sup> 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](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](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](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](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>
- 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, Los Alamos and Sandoval Counties, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map OF-GM 112, scale 1:24,000. Available on-line at:  
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- 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, 55<sup>th</sup> Field Conference Guidebook, p.391-404. Available on-line



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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:  
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- 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](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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