

**RESUME**

**JAMES C. WITCHER**

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**EDUCATION**

New Mexico Military Institute

New Mexico State University, B.S., Geology

New Mexico State University, M.S., Geology

Research Topic: Geochemistry, structural geology, hydrogeology, heat flow, and soil physics with application of a diffusion model for radon soil-gas surveys in geothermal energy exploration.

**EXPERTISE**

Exploration geology and geophysics; geologic mapping; terrestrial heat flow; soil radon occurrence and transport; hydrogeology of geothermal systems; inorganic aqueous geochemistry; forensic isotope hydrogeology; economic geology of geothermal resources; direct-use geothermal utilization and geothermal aquaculture and greenhouses; slim-hole geothermal well drilling operations; development of exploration models and methods for geothermal resources; regional geology of the southwestern United States and Rio Grande rift; ground-water hydrogeology; sources of salinity in groundwater and rivers

**WORK EXPERIENCE**

- 2005-2015** **Consultant and Principal**, Witcher and Associates, Las Cruces, NM
- 1995-2015** **Adjunct Faculty**, Geosciences Department, College of Arts and Sciences, New Mexico State University, Las Cruces
- 1986-2006** **Geothermal Projects Manager**, Southwest Technology Development Institute, Engineering College, New Mexico State University, Las Cruces, NM
- 1983-1986** **Geologist**, Stone and Witcher, Tucson, AZ
- 1977-1983** **Geologist**, Arizona Bureau of Geology and Mineral Technology, University of Arizona, Tucson, AZ

**PROFESSIONAL AFFILIATIONS**

- New Mexico Geological Society (President, 1997 and Honorary Member, 2001)
- Four Corners Geological Society
- The Geological Society of America
- Geothermal Resources Council
- American Geophysical Union
- Association of Ground Water Scientists and Engineers
- Society of Economic Geologists

**MAJOR SYNERGISTIC ACTIVITIES**

**USDOE/LANL, Rio Grande Rift, 2014-2015:** Co-Principal Investigator for development of hydrogeologic windows concept as geothermal play-fairway exploration approach and risk identification and mitigation.

**Hatch (Palomas-Rincon) Valley, NM, 2013-2015:** Consultant on exploring and proving a new ground water resource for drought-plagued farmers of the famous Hatch Chile.

**National Geothermal Database, AZ and NM, 2011-2014:** Consultant to the New Mexico Bureau of Geology and Mineral Resources and Arizona Geological Survey in compiling and organizing the New Mexico and Arizona contributions.

**Graduate Committee Member, 2009-2013:** New Mexico Tech geology/geochemistry PhD candidate, graduated 2013.

**Willcox Tomato Greenhouse, Willcox, AZ, 2010:** Recommended, designed, and managed the drilling of a successful 4,000 ft deep, large-diameter geothermal well capable of producing over 2,000 gpm from a new reservoir.

**Millennium Energy, 2006-2009:** Active member of team contracted by NREL to perform direct-use geothermal evaluations for developers and the USDOE nation wide. Projects included sites in Alaska, California, Colorado, Arizona, and New Mexico.

**New Mexico Water Resources Research Institute, 2000-2003:** Principal Investigator on an Interstate Stream Commission and State Engineer sponsored project to investigate of the sources of salinity in the Rio Grande and Mesilla Basin aquifers with ground-water chemistry and isotopic system analysis and interpretation. The current Rio Grande Salinity Management Project Program is one of the spin offs of this research and others research.

**Masson Greenhouse, Radium Springs, NM (2000):** Sited, designed, and managed the drilling of a 800 ft deep, large-diameter well capable of 1,200 gpm production at 210°F from a previously unexplored reservoir. The Radium Springs Geothermal Greenhouse is among the two largest geothermal greenhouses in the nation and the largest business and employer in northern Dona Ana County.

**U. S. Army, Ft Bliss, McGregor Range, NM (1994-1998):** Recommended, planned, performed, and managed comprehensive geothermal exploration program, including geologic mapping, geochemical and geophysical surveys, drilling of 28 temperature gradient holes and 4 deep continuous wire-line core holes with total footage over 21,000 ft. Area is currently being explored by industry and Army for small-scale binary geothermal power.

**Arizona Department of Commerce, Alpine, AZ (1993):** Sited, designed drilling program, and performed geologic analysis of a 4,505 ft deep continuous wire-line core hole for a hot dry rock (HDR) evaluation of the White Mountains region in east-central Arizona. Area is a current project by industry and Navopache Electric Co-op for EGS (hot dry rock geothermal) power using CO<sub>2</sub> as an innovative reservoir heat transfer fluid.

**State of New Mexico, Rincon, NM (1987-1993):** Discovered hidden intermediate-temperature geothermal system with geologic mapping, radon soil-gas and SP surveys, and heat-flow studies. Supervised drilling and geologic analysis of 1,218 ft continuous wire-line core hole (>212°F). Currently, Rincon is leased and undergoing exploration by industry (Ormat) for commercial geothermal power in NM.

## SELECTED PUBLICATIONS

- Pepin, J., Person, M., Phillips, F., Kelley, S., Timmons, S., Owens, L., **Witcher, J.**, and Gable, C., 2014, Deep fluid circulation within crystalline basement rocks and the role of hydrologic windows in the formation of the Truth or Consequences, New Mexico low-temperature geothermal system: *Geofluids*, doi:10.1111/gfl.12111, 22 p.
- Mack, G. H., Jones, M. C., Taylor, N. J., Ramos, F. C., Scott, S. R., and **Witcher, J. C.**, 2012, Mixed geothermal and shallow meteoric origin of opal and calcite beds in Pliocene-lower Pleistocene axial-fluvial strata, southern Rio Grande rift, Rincon Hills, New Mexico, USA: *Journal of Sedimentary Research*, v. 82, p. 616-631.
- Szynkiewicz, A., **Witcher, J. C.**, Modelska, M., Borrok, D. M., and Pratt, L. M., 2011, Anthropogenic sulfate loads in the Rio Grande, New Mexico (USA): *Chemical Geology*, v. 283, p. 194-209.
- Morgan, P., and **Witcher, J. C.**, 2011, Geothermal resources along the southern Rocky Mountains and the Rio Grande rift: *The Mountain Geologist*, v. 48, no. 4, p. 81-94.
- Moyer, D. L., Anderholm, S. K., Hogan, J. F., Phillips, F. M., Hibbs, B. J., and **Witcher, J. C.**, 2009, Knowledge and understanding of the dissolved solids in the Rio Grande-San Acacia, New Mexico, to Fort Quitman, Texas, and proposed plan for future studies and monitoring: U. S. Geological Survey Report.
- Witcher, J. C.**, 2006, Geothermal energy in New Mexico: *New Mexico Earth Matters: New Mexico Bureau of Geology and Mineral Resources, Socorro, Summer 2006*, p. 1-4.
- Witcher, J. C.**, 2008, Evidence for large-scale Laramide tectonic inversion and a mid-Tertiary caldera ring fracture zone at the Lightning Dock geothermal system, New Mexico: *New Mexico Geological Society 59th Annual Fall Field Conference Guidebook*, p. 177-187.
- Witcher, J. C.**, 2006, Geothermal energy in New Mexico: *New Mexico Earth Matters: New Mexico Bureau of Geology and Mineral Resources, Socorro, Summer 2006*, p. 1-4.
- Witcher, J. C.**, King, J. P., Hawley, J. W., Kennedy, J. F., Williams, J., Cleary, M., and Bothern, L. R., 2004, Sources of salinity in the Rio Grande and Mesilla Basin groundwater: *New Mexico Water Resources Research Institute Technical Report 330*, 168 p.
- Witcher, J. C.**, Lund, J. W., and Seawright, D. E., 2002, Lightning Dock KGRA New Mexico's largest geothermal greenhouse, largest aquaculture facility, and first binary electrical power plant: *GeoHeat Center Quarterly Bulletin, Oregon Institute of Technology, Klamath Falls*, v. 23, no. 4, p. 37-41
- Witcher, J. C.**, 2002, Geothermal energy in New Mexico: *Geo-Heat Center Quarterly Bulletin*, v. 23, no. 4, p. 2-6.
- Witcher, J. C.**, 2002, New Mexico's Geothermal Energy Resources in *New Mexico's Energy, Present and Future – Policy, Production, Economics, and the Environment: New Mexico Bureau of Mines and Mineral Resources Decision-Makers Field Conference Guidebook 2002*, p. 102-104.
- Witcher, J. C.**, 2001, Geothermal direct-use well for commercial greenhouses Radium Springs, New Mexico: *Geo-Heat Center Quarterly Bulletin*, v. 22, no. 4, pp. 1-7.
- O'Donnell, T. M., Miller, K. C., and **Witcher, J. C.**, 2001, A seismic and gravity study of the McGregor geothermal system, southern New Mexico: *Geophysics*, v. 66, no. 4, p. 1002-1014.
- Ross, H. P., Blackett, R. E., and **Witcher, J. C.**, 1995, The self-potential method: cost-effective exploration for moderate-temperature geothermal resources, in *Proceedings of the World Geothermal Congress, 1995, Florence, Italy: International Geothermal Association*, v. 2, p. 875-879.

- Witcher, J. C., Hahman, W. R., and Swanberg, C. A., 1994, Alpine/Federal corehole – Subsurface stratigraphy of the eastern White Mountains, Apache County, Arizona, in Mogollon Slope: New Mexico Geological Society 45<sup>th</sup> Annual Field Conference Guidebook, p. 233-240.
- Witcher, J. C., 1991, The Rincon geothermal system, southern Rio Grande rift, New Mexico: a preliminary report on a recent discovery: Transactions, Geothermal Resources Council, v. 15, p. 205-212.
- Witcher, J. C., 1991, Radon soil-gas surveys with diffusion-model corrections in geothermal exploration: Transactions, Geothermal Resources Council, v. 15, p. 301-308.
- Witcher, J. C., 1988, Geothermal resources in southwestern New Mexico and southeastern Arizona, in Cretaceous and Laramide Tectonic Evolution of Southwestern New Mexico: New Mexico Geological Society 39th Annual Field Conference Guidebook, p. 191-197.
- Stone, C., and Witcher, J. C., 1982, Geothermal Energy in Arizona: Arizona Bureau of Geology and Mineral Technology Open File Report 83-12, 398 p.
- Witcher, J. C., Stone, C., and Hahman, W. R., 1982, The Geothermal Resources of Arizona: U. S. Department of Energy and the State of Arizona Bureau of Geology and Mineral Technology, University of Arizona, Tucson, 1:500,000 scale.
- Witcher, J. C., 1981, Thermal springs of Arizona: Fieldnotes, State of Arizona Bureau of Geology and Mineral Technology, v. 11, no. 2, p. 1-3.

#### HONORS

**2009 New Mexico Earth Science Achievement Award:** “Jim Witcher is recognized as the pre-eminent researcher on geothermal energy in New Mexico with thirty years of professional experience in geothermal exploration and development,” stated Deputy Secretary Reese Fullerton. “He understands the limitations of geothermal development in a state where water resources are scarce.” The award is co-sponsored by the New Mexico Energy, Minerals and Natural Resources Department and the New Mexico Bureau of Geology and Mineral Resources, a division of New Mexico Tech in Socorro. Awards were initiated in 2003 to honor champions of earth science issues vital to the future of New Mexico. The recipients were selected from a state-wide nominating process. James C. Witcher received the award for outstanding contributions advancing the role of earth science in areas of applied science and education in New Mexico.

**2012 Hall of Fame, New Mexico State University Geosciences Department**

#### SUMMARY OF OTHER ACTIVITIES

**Expert Testimony before the U. S. House of Representatives, Subcommittee on Energy and Mineral Resources of the House Committee on Resources, Washington D.C., 22 July, 2003:** support of H. R., 2772, The John Rishel Geothermal Steam Act Amendments, introduced by Representative Jim Gibbons (R-NV). My testimony provided advice and supported provisions to change geothermal leasing and royalty schedules for direct-use geothermal operations on Federal mineral domain. These provisions were eventually adopted and included in the Energy Act of 2005.

Witcher, J. C., 2003, Testimony and Statement: Legislative Hearing, H. R. 2772, "The John Rishel Geothermal Steam Act Amendments of 2003", Subcommittee on Energy and Mineral Resources, Committee on Resources, U. S. House of Representatives, 108th Congress, First Session Serial No. 108-43, Tuesday, July 22, 2003, p. 25-28

**In-State-Agent:** Designated In-State-Agent for the Masson Radium Springs Farm geothermal greenhouse for permitting, reporting, and royalties with the NM Oil Conservation, New Mexico Office of the State Engineer, and the US Bureau of Land Management.

**US DOE Geothermal Powering the West:** Active member of the New Mexico, Arizona, and Colorado Geothermal Working Groups and adviser to Sandia National Laboratory on low-temperature geothermal resources and direct-use. Tasks include leading and presenting at numerous workshops on geothermal greenhouses, aquaculture, low-temperature drilling operations, and cost-effective exploration methods. More than 30 presentations include the Arizona, Colorado, New Mexico, and Utah Geothermal Working Groups and several national workshops in Reno, Salt Lake City, Denver and Dallas.

**Technical Reports, Maps, and Formal Journal Publications:** More than 100 detailed comprehensive reports and formal reviewed journal and guidebook publications,

**Consultant to Native America Tribes in the Southwest:** This work has covered a gamut of projects relating to geothermal and ground water. Tribes include the White Mountain Apache in Arizona, the Piute in eastern California, and Jicarilla Apache, Zuni Pueblo, Jemez Pueblo, Zia Pueblo, Laguna Pueblo, and Acoma Pueblo in New Mexico. The work at Jemez Pueblo has provided the basis for an on going project the pueblo has with U. S. DOE, industry, the NM Bureau of Geology, and others to test a reservoir and feasibility for geothermal power. In collaboration with the NMSU Civil Engineering Department and the U. S. Bureau of Indian Affairs in Washington, Dr. Phil King, NMSU Civil Engineering Department and James Witcher were formally presented with Certificates of Appreciation along with a ceremonial dance by Zuni Pueblo members and tribal leadership for work and studies that protect the sacred Zuni Salt Lake. Witcher is currently apart of a team, developing a renewable energy business plan for Zia Pueblo, that includes Los Alamos National Lab, an Albuquerque bank and the State of New Mexico Renewable Transmission Authority.

**NMSU Physical Plant (now Office of Facilities and Services):** Assisted in the closure plan for the NMSU landfill and drilling plans, drilling oversight, and testing of the two currently used high production water wells on the west side of the NMSU campus.

**White Sands NASA Test Facility:** Evaluation of detailed borehole temperature gradients to determine velocity of vertical flow of a contamination plume across potential aquitards.

**New Mexico Department of Economic Development:** Principal Investigator on geothermal resource evaluation of Montezuma Hot Springs/United World College in collaboration with Sandia National Laboratory, Los Alamos National Laboratory, and United World College.

#### OTHER EXPERIENCE

1969-1972 U. S. Army Signal Corp, Southeast Asia, Ft. Benning GA, Ft. Gordon, GA, Ft. Huachuca, AZ, Ft. Bliss, TX.

1973 Underground miner, ASARCO, Groundhog Mine, Vanadium, NM.