



## *Field trip and road log references*

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## FIELD TRIP AND ROAD LOG REFERENCES

- Adams, J.W., Hawley, J.W., Pray, L.C., and Love, D.W., 1993, Second-day road log, from Carlsbad to Whites City, Guadalupe Mountains National Park, Salt Flat, Washington Ranch and return to Carlsbad: New Mexico Geological Society, Guidebook 44, p. 43–67, <https://doi.org/10.56577/FFC-44.43>.
- Allen, B.D., and Attia, S., 2021, Geologic map of the Rattlesnake Springs 7.5' Quadrangle, Eddy County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-File Geologic Map OF-GM 291, scale 1:24,000.
- Anderson, R.Y., 2006, Pangean monsoon and climatic cycles in NM-Texas state line outcrop: New Mexico Geological Society, Guidebook 57, p. 80–81, <https://doi.org/10.56577/FFC-80>.
- Anderson, R.Y., and Kirkland, D.W., 1987, Banded evaporites, Delaware Basin, New Mexico: Geological Society of America, Rocky Mountain Section, Centennial Field Guide, p. 455–458, <https://doi.org/10.1130/0-8137-5402-X.455>.
- Anderson, R.Y., Dean, W.E., Jr., Kirkland, D.W., and Snyder, H.I., 1972, Permian varved Castile evaporite sequence, west Texas and New Mexico: Geological Society of America, Bulletin 83, p. 59–86, [https://doi.org/10.1130/0016-7606\(1972\)83\[59:PCVESW\]2.0.CO;2](https://doi.org/10.1130/0016-7606(1972)83[59:PCVESW]2.0.CO;2).
- Attia, S., Allen, B., and Ricci, J., 2023, New latest Eocene Ar-Ar age from the Yeso Hills dikes: Part of a Cordilleran magmatic periphery?: New Mexico Geological Society, this guidebook.
- Bebout, D.G., and Kerans, C., eds., 1993, Guide to the Permian Reef Geology Trail, McKittrick Canyon, Guadalupe Mountains National Park, west Texas: Bureau of Economic Geology, Guidebook 26, The University of Texas at Austin, 48 p.
- Bowen, E.M., 1998, Hydrogeology of Rattlesnake Spring, Eddy County, New Mexico [Independent study for Master's Degree]: Socorro, New Mexico Institute of Mining and Technology.
- Brookins, D.G., 1980, K-Ar age of lamprophyre dike from the Kerr-McGee potash mine, southeastern New Mexico: *Isochron/West*, v. 29, p. 27–28.
- Brown, A., 2006, Delaware (Lamar) limestone roadcut: New Mexico Geological Society, Guidebook 57, p. 73–74, <https://doi.org/10.56577/FFC-73>.
- Calzia, J.P., and Hiss, W.L., 1978, Igneous rocks in northern Delaware Basin, New Mexico and Texas: New Mexico Bureau of Mines and Mineral Resources, Circular 159, p. 39–45.
- Caran, S., 1988, Bottomless Lakes, New Mexico—a model for the origin and development of ground water lakes: Geological Society of America Abstracts with Programs, v. 20, no. 2, p. 93.
- Chaturvedi, L., 1993, WIPP-related geological issues: New Mexico Geological Society, Guidebook 44, p. 331–338, <https://doi.org/10.56577/FFC-44.331>.
- Christiansen, P.W., 1989, The story of oil in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Scenic Trips to the Geologic Past No. 14.
- Cox, E.R., 1967, Geology and Hydrology between Lake McMillan and Carlsbad Springs, Eddy Co., New Mexico: Washington, D.C., U.S. Government Printing Office, 48 p., <https://doi.org/10.1007/978-94-017-3373-1>.
- Cox, K.G., Bell, J.D., and Pankhurst, R.J., 1979, The Interpretation of Igneous Rocks: London, Allen and Unwin, 450 p.
- Crawford, J.E., 1993, K Hill and Yeso Hills selenite occurrence: New Mexico Geological Society, Guidebook 44, p. 8–10.
- Cys, J.M., et al., 1977, Capitan Reef—evolution of a concept, in Hileman, M.E., and Mazzullo, S.J., eds., Upper Guadalupian facies, Permian reef complex, Guadalupe Mountains, New Mexico and west Texas: Permian Basin Section SEPM Field Conference, Guidebook 77-16, p. 201–322.
- DuChene, H.R., and McLean, J.S., 1989, The role of hydrogen sulfide in the evolution of caves in the Guadalupe Mountains of southeastern New Mexico, in Harris, P.M., and Grover, G.A., eds., Subsurface and Outcrop Examination of the Capitan Shelf Margin, Northern Delaware Basin: Tulsa, OK, SEPM Core Workshop No. 13, p. 475–481, <https://doi.org/10.2110/cor.89.13.0475>.
- Dunham, R.J., 1972, Capitan Reef, New Mexico and Texas: Facts and questions to aid interpretation and group discussion: Midland, TX, Permian Basin Section-SEPM Publication 72-141, 272 p.
- Engwall, C., 1977, Washington Ranch Morrow (gas): The oil and gas fields of southeast New Mexico: Roswell, NM, Roswell Geological Society, p. 214–215.
- Esteban, M., and Pray, L.C., 1977, Origin of the pisolite facies of the shelf crest, in Hileman, M.E., and Mazzullo, S.J., eds., Upper Guadalupian Facies, Permian Reef Complex, Guadalupe Mountains, New Mexico and west Texas: Midland, TX, Permian Basin Section-SEPM Publication 77-16, p. 479–486.
- Ford, D.C., and Hill, C.A., 1989, Dating results from Carlsbad Cavern and other caves in the Guadalupe Mountains, New Mexico: *Isochrom/West*, v. 54, p. 3–7.
- Frenzel, H.N., 1988, The Indian Basin upper Pennsylvanian gas field, Eddy Co., New Mexico: west Texas Geological Society, 1988 Field Seminar, WTGS Pub. 88-84, p. 169–170.
- Gomez, A., 2022, A moment of hope: New Mexico family and the tortilla that captured a nation returns to the spotlight: *Albuquerque Journal*, November 24, p. 1, 8.
- Hale, J.R., 1955, Groundwater conditions in the vicinity of Rattlesnake Spring, Eddy Co., NM: New Mexico Office of the State Engineer, Technical Report no. 3., prepared in cooperation with the U.S. Geological Survey and National Park Service.
- Handford, C.R., Kendall, A.C., Prezbindowski, D.R., Dunham, J.B., and Logan, B.W., 1984, Salina-margin tepees, pisoliths, and aragonite cements, Lake MacLeod, Western Australia: their significance in interpreting ancient analogs: *Geology*, v. 12, p. 523–527, [https://doi.org/10.1130/0091-7613\(1984\)12<523:STPAAC>2.0.CO;2](https://doi.org/10.1130/0091-7613(1984)12<523:STPAAC>2.0.CO;2).
- Hawley, J.W., and Lozinsky, R.P., 1992, Hydrogeologic framework of the Mesilla Basin in New Mexico and western Texas: New Mexico Bureau of Mines and Mineral Resources, Open-File Report 323, 55 p.
- Hayes, P.T., 1957, Geology of the Carlsbad Caverns East Quadrangle, New Mexico: U.S. Geological Survey, Geological Quadrangle Map GQ-98, scale 1:62,500.
- Hayes, P.T., 1964, Geology of the Guadalupe Mountains, New Mexico: U.S. Geological Survey, Professional Paper 446, 69 p., <https://doi.org/10.3133/pp446>.
- Hayes, P.T., and Bachman, G.O., 1979, Examination and reevaluation of evidence for a Barrera Fault, Guadalupe Mountains, New Mexico: U.S. Geological Survey, Open-File Report 79-1520, 9 p., <https://doi.org/10.3133/ofr791520>.
- Heezen, B.C., and Drake, C.L., 1964, Grand Banks slump: *American Association of Petroleum Geologists, Bulletin* 48, p. 221–225, <https://doi.org/10.1306/BC743BE1-16BE-11D7-8645000102C1865D>.
- Hendrickson, G.E., and Jones, R.S., 1952, Geology and ground-water resources of Eddy County, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Ground-Water Report 3, 169 p.
- Henry, C.D., and Price, J.G., 1985, The Van Horn Mountain caldera, Trans-Pecos Texas—geology and development of a small (10 km) ash-flow caldera: Texas Bureau of Economic Geology, Report of Investigations 149, 40 p., <https://doi.org/10.23867/RI0151D>.
- Henry, C.D., and Price, J.G., 1989, Geology, in Bedinger, M.S., Sargent, K.A., Langer, W.H., eds., Studies of geology and hydrology in the Basin and Range province, southwestern United States, for isolation of high-level radioactive waste—characterization of the Trans-Pecos region, Texas: U.S. Geological Survey, Professional Paper 1370-B, p. 4–22.
- Hill, C.A., 1987, Geology of Carlsbad Cavern and other caves in the Guadalupe Mountains, New Mexico and Texas: New Mexico Bureau of Mines and Mineral Resources, Bulletin 117, 150 p.
- Hill, C.A., 1990, Sulfuric acid speleogenesis of Carlsbad Cavern and its relationship to hydrocarbons, Delaware Basin, New Mexico and Texas: *American Association of Petroleum Geologists, Bulletin* 74, p. 1685–1694, <https://doi.org/10.1306/0C9B2565-1710-11D7-8645000102C1865D>.
- Hill, C.A., 1993, Geologic walking tour of Carlsbad Cavern: New Mexico Geological Society, Guidebook 44, p. 117–128, <https://doi.org/10.56577/FFC-44.117>.
- Hill, C.A., 1996, Geology of the Delaware Basin, Guadalupe, Apache, and Glass Mountains, New Mexico and west Texas: Permian Basin Section-SEPM Publication, No. 96-39, 480 p.

- Hill, C.A., 1999, Origin of Caves in the Capitan, *in* Saller, A.H., Harris, P.M., Kirkland, B.L., and Mazzullo, S.J., eds., *Geologic Framework of the Capitan Reef*: Tulsa, OK, SEPM Special Publication No. 65, p. 211–222, <https://doi.org/10.2110/pec.99.65.0211>.
- Horberg, L.H., 1949, Geomorphologic history of the Carlsbad Caverns area, New Mexico: *Journal of Geology*, v. 57, p. 464–476, <https://doi.org/10.1086/625661>.
- Irvine, T.N., and Baragar, W.R.A., 1971, A Guide to the Chemical Classification of the Common Volcanic Rocks: *Canadian Journal of Earth Science*, v. 8, p. 523–548, <https://doi.org/10.1139/e71-055>.
- Jacka, A.D., 1988, Contributions to the road log: Third day—Carlsbad to Dark Canyon, Sitting Bull Falls, and Rocky Arroyo: west Texas Geological Society, Pub. 88-84, p. 93, 94, 97–99.
- Jagnow, D.H., 1979, Cavern development in the Guadalupe Mountains: Columbus, OH, Cave Research Foundation, 55 p.
- Jones, M., Land, L., and Veni, G., 2021, Phase 1 dye trace investigation of a conglomerate karst aquifer, Black River Basin, Eddy County, New Mexico: National Cave and Karst Research Institute, Report of Investigation 11.
- Kelley, V.C., 1971a, Geology of the Pecos Country, southeastern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 24, 75 p., <https://doi.org/10.58799/M-24>.
- Kelley, V.C., 1971b, Stratigraphy and structure of the Pecos Country, southeastern New Mexico: west Texas–Roswell Geological Society Guidebook, Pub. 71-58, 83 p.
- King, P.B., 1948, Geology of the southern Guadalupe Mountains, Texas: U.S. Geological Survey, Professional Paper 215, 183 p., <https://doi.org/10.3133/pp215>.
- King, P.B., 1949, Regional geologic map of parts of Culberson and Hudspeth Counties, Texas: U.S. Geological Survey, Oil and Gas Investigations Preliminary Map 90.
- King, P.B., 1977, *The evolution of North America*: Princeton, New Jersey, Princeton University Press, 197 p.
- Kirkland, D.W., 2003, An explanation for the varves of the Castile evaporites (Upper Permian), Texas and New Mexico, USA: *Sedimentology*, v. 50, p. 899–920, <https://doi.org/10.1046/j.1365-3091.2003.00588.x>.
- Kirkland, D.W., and Anderson, R.Y., 1970, Microfolding in the Castile and Todillo evaporites, Texas and New Mexico: *Geological Society of America, Bulletin* 81, p. 3259–3282, [https://doi.org/10.1130/0016-7606\(1970\)81\[3259:MITCAT\]2.0.CO;2](https://doi.org/10.1130/0016-7606(1970)81[3259:MITCAT]2.0.CO;2).
- Knapp, R., 1992, Parks Ranch cave system, *in* Belski, D., ed., *GYPKAP Report #2: Southwestern Region of the National Speleological Society, Albuquerque*, New Mexico, Adobe Press, p. 34.
- Kreitler, C.W., and Sharp, J.M., Jr., eds., 1990, *Hydrogeology of Trans-Pecos Texas*: Texas Bureau of Economic Geology, Guidebook 25, 120 p.
- Land, L., 2003, Evaporite karst and regional ground-water circulation in the Lower Pecos Valley of southeastern New Mexico, *in* Johnson, K.S., and Neal, J.T., eds., *Evaporite karst and engineering/environmental problems in the United States*: Oklahoma Geological Survey, Circular 109, p. 227–232.
- Land, L., 2020, Brantley Lake State Park, *in* Scholle, P., Ulmer-Scholle, D.S., Cather, S.M., and Kelley, S.A., eds., *The geology of southern New Mexico's parks, monuments, and public lands*: Socorro, New Mexico, New Mexico Bureau of Geology and Mineral Resources, p. 323–327.
- Land, L., 2021, Evaporite karst as a transportation and infrastructure geohazard in the Lower Pecos region, southeastern New Mexico and west Texas, *in* Johnson, K.S., Land, L., and Decker, D.D., eds., *Evaporite karst in the Greater Permian Evaporite Basin (GPEB) of Texas, New Mexico, Oklahoma, Kansas, and Colorado*: Oklahoma Geological Survey, Circular 113, p. 63–77, <https://doi.org/10.1130/abs/2022AM-382748>.
- Land, L., and Asanidze, L., 2015, Rollalong resistivity surveys reveal karstic paleotopography developed on near-surface gypsum bedrock, *in* Doctor, D.H., Land, L., and Stephenson, J.B., eds., *Proceedings of the Fourteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impact of Karst*, Rochester, Minnesota: National Cave and Karst Research Institute Symposium 5, Carlsbad, New Mexico, p. 365–370, <https://doi.org/10.5038/9780991000951.1006>.
- Land, L., and Love, D., 2006, Geologic walking tour of Washington Ranch: New Mexico Geological Society, Guidebook 57, p. 15–16, <https://doi.org/10.56577/FFC-15>.
- Land, L., and Newton, B.T., 2008, Seasonal and long-term variations in hydraulic head in a karstic aquifer: Roswell Artesian Basin, New Mexico: *Journal of the American Water Resources Association*, v. 44, p. 175–191, <https://doi.org/10.1111/j.1752-1688.2007.00146.x>.
- Land, L., and Veni, G., 2012, Electrical resistivity surveys of anthropogenic karst phenomena, southeastern New Mexico: *New Mexico Geology*, v. 34, no. 4, p. 117–125.
- Land, L., Lueth, V., Raatz, B., Boston, P., and Love, D., eds., 2006, *Caves and Karst of Southeastern New Mexico*: New Mexico Geological Society, Guidebook 57, 344 p.
- Lawson, E.G., 1989, Subaqueous gravity flows and associated deposits in the Rader Member, Capitan reef complex (Permian), Delaware Mountains, west Texas [Master's thesis]: Madison, WI, University of Wisconsin-Madison, 160 p., <https://doi.org/10.2110/cor.89.13.0427>.
- Le Maitre, R.W., 1989, *A Classification of Igneous Rocks and Glossary of Terms*: Oxford, Blackwell Scientific.
- Loucks, R.G., and Folk, R.L., 1976, Fanlike rays of former aragonite in Permian Capitan reef pisolite: *Journal of Sedimentary Petrology*, v. 46, p. 483–485, <https://doi.org/10.1306/212F6FC8-2B24-11D7-8648000102C1865D>.
- Love, D., and Land, L., 2006, Surficial geology in the vicinity of Washington Ranch: New Mexico Geological Society, Guidebook 57, p. 311–316, <https://doi.org/10.56577/FFC-311>.
- Love, D.W., Hawley, J.W., Kues, B.S., Adams, J.W., Austin, G.S., and Barker, J.M., eds., 1993, *Carlsbad region, New Mexico and west Texas*: New Mexico Geological Society, Guidebook 44, 357 p.
- Mayer, J.R., and Sharp, J.M., Jr., 1998, Fracture control of regional ground-water flow in a carbonate aquifer in a semi-arid region: *Geological Society of America, Bulletin* 110, no. 2, p. 269–283, [https://doi.org/10.1130/0016-7606\(1998\)110<0269:FCORGW>2.3.CO;2](https://doi.org/10.1130/0016-7606(1998)110<0269:FCORGW>2.3.CO;2).
- McLemore, V.T., 1996, Great Plains Margin (alkalic-related) gold deposits in New Mexico, *in* Cyner, A.R., and Fahey, P.L., eds., *Geology and ore deposits of the American Cordillera*: Geological Society of Nevada Symposium Proceedings, Reno/Sparks, Nevada, April 1995, p. 935–950.
- McLemore, V.T., and Guilinger, J.R., 1993, Geology and mineral resources of the Cornudas Mountains, Otero County, New Mexico and Hudspeth County, Texas: New Mexico Geological Society, Guidebook 44, p. 145–154, <https://doi.org/10.56577/FFC-44.145>.
- McLemore, V.T., and Guilinger, J.R., 1996, Industrial specifications of the Wind Mountain nepheline-syenite deposit, Cornudas Mountains, Otero County, New Mexico, *in* Austin, G.S., Barker, J.M., Hoffman, G., Gilson, N., and Zidec, J., eds., *Proceedings of the 31st Forum on the Geology of Industrial Minerals, Borderland Forum*: New Mexico Bureau of Mines and Mineral Resources, Bulletin 154, p. 121–126.
- McLemore, V.T., Guilinger, J.R., and Oumiette, M.A., 1994, Geology of the Wind Mountain nepheline syenite deposit, Cornudas Mountains, Otero County, New Mexico: Society Mining, Metallurgy, and Exploration, Preprint 94-63, 10 p.
- McLemore, V.T., Lueth, V.W., Pease, T.C., and Gulinger, J.R., 1996a, Petrology and mineral resources of the Wind Mountain laccolith, Cornudas Mountains, New Mexico and Texas: *Canadian Mineralogist*, v. 34, pt. 2, p. 335–347.
- McLemore, V.T., Lueth, V.W., Guilinger, J.R., and Pease, T.C., 1996b, Geology, mineral resources, and marketing of the Wind Mountain nepheline-syenite porphyry, Cornudas Mountains, New Mexico and Texas, *in* Austin, G.S., Barker, J.M., Hoffman, G., Gilson, N., and Zidec, J., eds., *Proceedings of the 31st Forum on the Geology of Industrial Minerals, Borderland Forum*: New Mexico Bureau of Mines and Mineral Resources, Bulletin 154, p. 127–136.
- McLemore, V.T., Iverson, N., Woodard, M., Attia, S., Dietz, H., Owen, E.J., Haft, E.B., Childress, T., Trivitt, A., and Kelley, R., 2022, Geology and Mineral Deposits of the Cornudas Mountains, Otero County, New Mexico: New Mexico Bureau of Geology and Minerals Resources, Open-File Report 619, 149 p., <https://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=619>.
- Meinzer, D.E., Renich, B.C., and Bryan, K., 1926, Geology of No. 3 Reservoir Site of the Carlsbad Irrigation Project, New Mexico with respect to water tightness: U.S. Geological Survey, Water Supply Paper 580, p. 12–13.
- Middleton, G.V., 1973, Johannes Walther's law of the correlation of facies: *GSA Bulletin*, v. 84, no. 3, p. 979–988, [https://doi.org/10.1130/0016-7606\(1973\)84<979:JWLOTG>2.0.CO;2](https://doi.org/10.1130/0016-7606(1973)84<979:JWLOTG>2.0.CO;2).

- Motts, W.S., 1962, Geology of the West Carlsbad Quadrangle, New Mexico: U.S. Geological Survey, Geologic Quadrangle Map GQ-167.
- Mruk, D., and Bebout, D.G., 1993, Slope, in Bebout, D.G., and Kerans, C., eds., 1993, Guide to the Permian Reef Geology Trail, McKittrick Canyon, Guadalupe Mountains National Park, west Texas: Bureau of Economic Geology, Guidebook 26, The University of Texas at Austin, p. 14–22.
- Nance, R.G., 1993, Application of the standard tablet method to a study of denudation in gypsum karst, Chosa Draw, southeastern New Mexico [Master's thesis]: Greeley, CO, University of Northern Colorado, 83 p.
- Newell, N.D., Rigby, J.K., Fischer, A.G., Whiteman, A.J., Hickox, J.E., and Bradley, J.S., 1953, The Permian Reef Complex of the Guadalupe Mountains Region, Texas and New Mexico: San Francisco, CA, Freeman and Co., 236 p.
- Olive, W.W., 1957, Solution-subsidence troughs, Castile formation of Gypsum Plain, Texas and New Mexico: Geological Society of America, Bulletin 68, p. 351–358, [https://doi.org/10.1130/0016-7606\(1957\)68\[351:STC-FOG\]2.0.CO;2](https://doi.org/10.1130/0016-7606(1957)68[351:STC-FOG]2.0.CO;2).
- Palmer, A.N., and Palmer, M.V., 2009, Caves and Karst of the USA: Huntsville, AL, National Speleological Society, USA.
- Polyak, V.J., McIntosh, W.C., Guven, N., and Provencio, P., 1998, Age and Origin of Carlsbad Cavern and related caves from  $^{40}\text{Ar}/^{39}\text{Ar}$  of alunite: Science, v. 279, p. 1919–1922, <https://doi.org/10.1126/science.279.5358.1919>.
- Potter, L.S., 1996a, Chemical variation along strike in feldspathoidal rocks of the eastern alkali belt, Trans-Pecos magmatic province, Texas and New Mexico: The Canadian Mineralogist, v. 34, p. 241–264.
- Potter, L.S., 1996b, Chemical and isotopic variation along strike in the eastern alkali belt, Trans-Pecos magmatic province, Texas and New Mexico [Ph.D. dissertation]: Austin, University of Texas at Austin, 267 p.
- Pratt, E., 1954, Evidence of igneous activity in the northwestern part of the Delaware Basin: New Mexico Geological Society, Guidebook 5, p. 143–147, <https://doi.org/10.56577/FFC-5.143>.
- Pray, L.C., 1988, Geologic guide for U.S. Highway 62-180 from El Paso to southern Guadalupe Mountains at the junction of U.S. 62-180 with Texas 54 from Van Horn, in Sarg, J.F., Rossen, C., Lehmann, P.J., and Pray, L.C., eds., Geologic Guide to the Western Escarpment, Guadalupe Mountains, Texas: Permian Basin Section-SEPM Publication 88-30, Midland, TX, p. 9–13.
- Pray, L.C., and Adams, J.W., 1993, Geology of the west face of the Guadalupe Mountains: New Mexico Geological Society, Guidebook 44, p. 63–65.
- Pray, L.C., and Esteban, M., 1977, Upper Guadalupian Facies, Permian Reef Complex, Guadalupe Mountains, New Mexico and west Texas—Road logs and locality guides: Midland, TX, Permian Basin Section-SEPM Publication 77-16, p. 194.
- Queen, J.M., and Hose, L.D., 2006, Trail guide to and discussion of the geology of Carlsbad Cavern: Main Corridor and Big Room: New Mexico Geological Society, Guidebook 57, p. 151–160, <https://doi.org/10.56577/FFC-151>.
- Reid, S.T., Bass, R.O., and Welch, P., 1988, Guadalupe Mountains Revisited, Texas and New Mexico: Midland, TX, west Texas Geological Society, Publication 88-84, p. 200.
- Ross, C.A., 1983, Late Paleozoic Foraminifera as depth indicators: AAPG, Bulletin 67, p. 542–543, <https://doi.org/10.1306/03B5B498-16D1-11D7-8645000102C1865D>.
- Salvati, R., and Sasowsky, I.D., 2002, Development of collapse sinkholes in areas of groundwater discharge: Journal of Hydrology, v. 264, p. 1–11, [https://doi.org/10.1016/S0022-1694\(02\)00062-8](https://doi.org/10.1016/S0022-1694(02)00062-8).
- Sares, S.W., 1984, Hydrologic and geomorphic development of low-relief evaporite karst drainage basin, southeastern New Mexico [M.S. thesis]: Albuquerque, University of New Mexico, 123 p.
- Sares, S.W., and Wells, S.G., 1986, Geomorphic and hydrologic development of the Gypsum Plain karst, Delaware Basin, New Mexico, in Jagnow, D.H., and DuChene, H.R., eds., Geology field trip guidebook: National Speleological Society Convention, Tularosa, New Mexico, June 22–28, p. 11–31.
- Sarg, J.F., 1976, Sedimentology of the carbonate-evaporite facies transition of the Seven Rivers Formation (Guadalupian, Permian) in southeast New Mexico [Ph.D. dissertation]: Madison, University of Wisconsin, 313 p.
- Scholle, P.A., 2022, Introduction to the geology of the Permian reef complex, Guadalupe and Delaware Mountains, New Mexico and west Texas, <https://geoinfo.nmt.edu/tour/federal/parks/PermianReef/home.html#stratnom> (accessed September 2022).
- Scholle, P.A., and Ulmer-Scholle, D., 2006, First Day Road Log, Trip 3: New Mexico Geological Society, Guidebook 57, p. 25–36.
- Scholle, P.A., Goldstein, R.H., and Ulmer-Scholle, D.S., 2007, Classic Upper Paleozoic reefs and bioherms of west Texas and New Mexico: Field guide to the Guadalupe and Sacramento Mountains of west Texas and New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-File Report 504, 174 p., <https://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=504>.
- Sigstedt, S.C., Phillips, F.M., and Ritchie, A.B.O., 2016, Groundwater flow in an “underfit” carbonate aquifer in a semiarid climate: Application of environmental tracers to the Salt Basin, New Mexico (USA): Hydrogeology Journal, v. 24, p. 841–863, <https://doi.org/10.1007/s10040-016-1402-2>.
- Stafford, K.W., 2006, Gypsum karst of the Chosa Draw area: New Mexico Geological Society, Guidebook 57, p. 82–83, <https://doi.org/10.56577/FFC-82>.
- Stafford, K.W., and Nance, R., 2009, Evaporite speleogenesis of the Gypsum Plain: New Mexico and far west Texas, in Palmer, A., and Palmer, M., eds., The Caves and Karst of the USA: Huntsville, AL, National Speleological Society, p. 267–272.
- Stafford, K.W., and Shields, J., 2021, Speleogenetic evolution of Castile karst manifestations of the Delaware Basin, west Texas and southeastern New Mexico, in Johnson, K.S., Land, L., and Decker, D.D., eds., Evaporite karst in the Greater Permian Evaporite Basin (GPEB) of Texas, New Mexico, Oklahoma, Kansas, and Colorado: Oklahoma Geological Survey, Circular 113, p. 151–163.
- Stafford, K.W., Nance, R., Rosales-Lagarde, L., and Boston, P.J., 2008a, Epigene and hypogene karst manifestations of the Castile Formation: Eddy County, New Mexico and Culberson County, Texas, USA: International Journal of Speleology, v. 37, no. 2, p. 83–98, <https://doi.org/10.5038/1827-806X.37.2.1>.
- Stafford, K.W., Rosales-Lagarde, L., and Boston, P.J., 2008b, Castile evaporite karst potential map of the Gypsum Plain, Eddy County, New Mexico and Culberson County, Texas: A GIS methodological comparison: Journal of Cave and Karst Studies, v. 70, no. 1, p. 35–46.
- Stafford, K.W., Land, L., and Klimchouk, A., 2008c, Hypogenic speleogenesis within Seven Rivers evaporites: Coffee Cave, Eddy County, New Mexico: Journal of Cave and Karst Studies, v. 70, p. 47–61.
- Stafford, K.W., Brown, W., Ehrhart, J., Majzoub, A., and Woodard, J., 2017, Evaporite karst geohazards in the Delaware Basin, Texas: Review of traditional karst studies coupled with geophysical and remote sensing characterization: International Journal of Speleology, v. 46, no. 2, p. 169–180, <https://doi.org/10.5038/1827-806X.46.2.2089>.
- Stoudt, E.L., Trentham, R.C., and Scholle, P.A., 2004, Recent Advances in Sequence Stratigraphy and Reservoir Compartmentalization in Upper Guadalupian Carbonates—Guadalupe Mountains, west Texas and Southeastern New Mexico: west Texas Geological Society Symposium Fall Field Trip, v. #04-113, 93 p.
- Taylor, S.R., and McLennan, S.M., 1985, The Continental Crust: Its Composition and Evolution: Carlton, Blackwell Scientific Publication, 312 p.
- Tomlinson, S., Bass, R.O., and Welch, P., 1988, Guadalupe Mountains Revisited, v. 88-84: Midland, TX, west Texas Geological Society, 202 p.
- Tyrrell, W.W., Jr., 1969, Criteria useful in interpreting environments of unlike but time-equivalent carbonate units (Tansill-Capitan-Lamar), Capitan Reef complex, west Texas and New Mexico, in Friedman, G.M., ed., Depositional Environments in Carbonate Rocks: SEPM, Special Publication No. 14., Tulsa, OK, p. 80–97, <https://doi.org/10.2110/pec.69.03.0080>.
- Tyrrell, W.W., Jr., Bell Jr., G.L., Diemer, J.A., and Nestell, M.K., 2006, Occurrences of the fusulinid *Yabeina Texana* in the basal parts of the Tansill Formation and Lamar limestone member in the Guadalupe Mountains area, west Texas and New Mexico: New Mexico Geological Society, Guidebook 57, p. 64–67, <https://doi.org/10.56577/FFC-64>.
- U.S. Fish and Wildlife Service, 2022, Southwestern Native Aquatic Resources and Recovery Center, <https://www.fws.gov/office/southwestern-native-aquatic-resources-and-recovery-center> (accessed January 2023).



- Veni, G., 2022, International Show Caves Association Pre-congress Field Trip: the Show Caves of west Texas and Southeast New Mexico: National Cave and Karst Research Institute Field Guide 2, 57 p., <https://nckri.org/publications/field-guides/>.
- Watkinson, A.J., and Alexander, J.I.D., 1993, Castile microfolding: New Mexico Geological Society, Guidebook 44, p. 14–15.
- Weart, W.D., Rempe, N.T., and Powers, D.W., 1998, The Waste Isolation Pilot Plant: Geotimes.
- Welder, G.E., 1983, Geohydrologic framework of the Roswell ground-water basin, Chaves and Eddy Counties, New Mexico: New Mexico State Engineer Technical Report 42, 28 p., <https://doi.org/10.3133/ofr83206>.
- Wilde, G.L., Rudine, S.F., and Lambert, L.L., 1999, Formal designation, Reef Trail Member, Bell Canyon Formation, and its significance for recognition of the Guadalupian-Lopingian boundary, *in* Saller, A.H., Harris, P.M., Kirkland, B.L., and Mazzullo, S.J., eds., Geologic framework of the Capitan Reef: SEPM Special Publication 65, p. 63–83, <https://doi.org/10.2110/pec.99.65.0063>.
- Wilson, M., 1989, Igneous Petrogenesis: London, Unwin Hyman, 499 p., <https://doi.org/10.1007/978-1-4020-6788-4>.
- Wood, R., 1999, Paleoecology of the Capitan Reef, *in* Saller, A.H., Harris, P.M., Kirkland, B.L., and Mazzullo, S.J., eds., Geologic Framework of the Capitan Reef: Tulsa, OK, SEPM Special Publication No. 65, p. 129–137, <https://doi.org/10.2110/pec.99.65.0129>.