Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities

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OVERVIEW

This is a bibliography that we compiled for Research Partnership to Secure Energy for America (RPSEA) subcontract No. 07122-45 titled "Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities". The bibliography consists of three sections: (1) general references which include the Mississippian and Pennsylvanian Systems, (2) Pennsylvanian-age-specific references for the Gothic, Chimney Rock, and Cane Creek shale zones of the Paradox Formation, and (3) Mississippian-age-specific references for the Manning Canyon Shale, Delle Phosphatic Member of the Deseret Limestone/Chainman Shale, and Doughnut Formation.

General References

- Bissell, H.J., 1959, Stratigraphy of the southern Oquirrh Mountains upper Paleozoic succession: Utah Geological Society Guidebook, no. 14, p. 93-127.
- Davis, L.E., Webster, G.D., and Dyman, T.S., 1994, Correlation of West Canyon, Lake Point, and Bannock Peak limestones (Upper Mississippian to Middle Pennsylvanian), basal formations of the Oquirrh Group, northern Utah and southeastern Idaho: U.S. Geological Survey Bulletin B-2088, 30 p.
- Hill, D.G., Curtis, J.B, and Lillis, P.G., 2008, Update on North American shale-gas exploration and development, *in* Hill, D.G., Lillis, P.G., and Curtis, J.B, editors, Gas shale in the Rocky Mountains and beyond: Rocky Mountain Association of Geologists Guidebook, p. 11-43.
- Meissner, F.F, Woodward, J., and Clayton, J.L., 2008, Stratigraphic relationships and distribution of source rocks in the greater Rocky Mountain region (reprint), *in* Hill, D.G., Lillis, P.G., and Curtis, J.B., editors, Gas shale in the Rocky Mountains and beyond: Rocky Mountain Association of Geologists Guidebook, p. 44-84.
- National Energy Technology Lab, 2004, Natural gas resources of the Uinta Basin, Utah and the deep Anadarko Basin, Oklahoma and Texas: compact disk.
- Peterson, J.A., 1997, The Carboniferous-Permian (late Paleozoic) hydrocarbon system, Rocky Mountains, U.S. region, with analysis of evidence for origin of the central Utah tar and heavy oil deposits [abs.]: American Association of Petroleum Geologists Bulletin, v. 81, no. 7, p. 1231.
- Poole, F.G., and Claypool, G.E., 1984, Petroleum source-rock potential and crude-oil correlation in the Great Basin, *in* Woodward, J., Meissner, F.F., and Clayton, J.L., editors, Hydrocarbon source rocks of the Greater Rocky Mountain region: Rocky Mountain Association of Geologists Symposium, p. 179-229.

Schamel, S., 2005, Shale gas reservoirs of Utah - survey of an unexploited potential energy

resource: Utah Geological Survey Open-file Report 461, 114 p.

- Schamel, S., 2006, Shale gas resources of Utah assessment of previously undeveloped gas discoveries: Utah Geological Survey Open-file Report 499, 85 p.
- Schamel, S., 2008, Potential shale gas resources of Utah, *in* Hill, D.G., Lillis, P.G., and Curtis, J.B, editors, Gas shale in the Rocky Mountains and beyond: Rocky Mountain Association of Geologists Guidebook, p. 119-161.
- Swetland, P.J., Clayton, J.L., and Sable, E.G., 1978, Petroleum source-bed potential of Mississippian-Pennsylvanian rocks in parts of Montana, Idaho, Utah, and Colorado: Mountain Geologist, v. 14, p. 79-87.
- Tooker, E.W., and Roberts, R.J., 1970, Upper Paleozoic rocks in the Oquirrh Mountains and Bingham mining district, Utah: U.S. Geological Survey Professional Paper 629-A, p. A1-A76.
- Wavrek, D.A., Ali-Adeeb, J., Chao, J.C., Santon, L.E., Hardwick, E.A., Strickland, D.K., and Schelling, D.D., 2007, Paleozoic source rocks in the central Utah thrust belt - organic facies response to tectonic and paleoclimatic variables: American Association of Petroleum Geologists, Rocky Mountain Section Meeting Official Program, p. 58-59.
- Wavrek, D.A., Strickland, D., Schelling, D.D., Johnson, K.R., and Vrona, J.P., 2005, A major paradigm shift - Carboniferous versus Permian petroleum systems in the central Rocky Mountains, U.S.A. [abs.]: American Association of Petroleum Geologists Annual Convention, Official Program with Abstracts, v. 14, non-paginated.
- Webster, G.D., Gordon, M., Jr., Langenheim, R.L., Jr., and Henry, T.W., 1984, Road logs for the Mississippian-Pennsylvanian boundary in the eastern Great Basin - Salt Lake City, Utah, to Las Vegas, Nevada, field trip 1, *in* Lintz, J., Jr., editor, Western geologic excursions, volume 1: Department of Geological Sciences, University of Nevada at Reno, p. 1-86.
- Welsh, J.E., 1972, Upper Paleozoic stratigraphy, Plateau-Basin and Range transition zone, central Utah, *in* Baer, J.L., and Callaghan, E., editors, Plateau-Basin and Range transition zone, central Utah: Utah Geological Association Publication 2, p. 13-20.
- Welsh, J.E., 1979, Paleogeography and tectonic implications of the Mississippian and Pennsylvanian in Utah, *in* Newman, G.W., and Goode, H.D., editors, Basin and Range symposium and Great Basin field conference: Rocky Mountains Association of Geologists symposium and field conference, p. 93-106.
- Welsh, J.E., and Bissell, H.J., 1979, The Mississippian and Pennsylvanian (Carboniferous) Systems in the United States – Utah: U.S. Geological Survey Professional Paper 1110-Y, 8 p.

Pennsylvanian

- Baars, D.L., Parker, J.W., and Chronic, J., 1967, Revised stratigraphic nomenclature of Pennsylvanian System, Paradox basin: American Association of Petroleum Geologists Bulletin, v. 51, p. 393-403.
- Bereskin, S.R., and McLennan, J., 2008, Hydrocarbon potential of Pennsylvanian black shale reservoirs, Paradox Basin, southeastern Utah: Utah Geological Survey Open-file Report 534, 53 p.
- Doelling, H.H., 1988, Geology of Salt Valley anticline and Arches National Park, Grand County, Utah, *in* Doelling, H.H., Huntoon, P.W., and Oviatt, C.G., editors, Salt deformation in the Paradox region, Utah: Utah Geological and Mineral Survey Bulletin 122, p. 1-58.
- Fetzner, R.W., 1960, Pennsylvanian paleotectonics of Colorado Plateau: American Association of Petroleum Geologists Bulletin, v. 44, p. 1371-1413.
- Gianniny, G.L., 2004, Eustacy and tectonism in the ancestral Rocky Mountains, eastern Paradox basin, CO [abs.]: Geological Society of America Abstracts with Programs, v. 36, no. 5, p. 509.
- Harr, C.L., 1996, Paradox oil and gas potential of the Ute Mountain Ute Indian Reservation, *in* Huffman, A.C., Jr., Lund, W.R., and Godwin, L.H., editors, Geology of the Paradox basin: Utah Geological Association Publication 25, p. 13-28.
- Hite, R.J., Anders, D.E., and Ging, T.G., 1984, Organic-rich source rocks of Pennsylvanian age in the Paradox basin of Utah and Colorado, *in* Woodward, J., Meissner, F.F, and Clayton, J.L., editors, Hydrocarbon source rocks of the greater Rocky Mountain region: Rocky Mountain Association of Geologists Guidebook, p. 255-274.
- Hite, R.J., and Buckner, D.H., 1981, Stratigraphic correlations, facies concepts and cyclicity in Pennsylvanian rocks of the Paradox basin, *in* Weigand, D.L, editor, Geology of the Paradox basin: Rocky Mountain Association of Geologists Field Conference, p. 147-159.
- Homewood, P.W., and Eberli, G.P., 2000, Genetic stratigraphy on the exploration and production scales - case studies from the Upper Devonian of Alberta and the Pennsylvanian of the Paradox Basin: Bulletin des Centre de Recherches Exploration-Production Elf-Aquitaine, Memoire 24, p. 17-27.
- Huntoon, P.W., 1988, Late Cenozoic gravity tectonic deformation related to the Paradox salts in the Canyonlands area of Utah, *in* Doelling, H.H., Huntoon, P.W., and Oviatt, C.G., editors, Salt deformation in the Paradox region, Utah: Utah Geological and Mineral Survey Bulletin 122, p. 79-93.

Huntoon, J.E., Hansley, P.L., and Naeser, N.D., 1999, The search for source rock for the giant

Tar Sand Triangle accumulation, southeastern Utah: American Association of Petroleum Geologists Bulletin, v. 83, p. 467-495.

- McClure, K., Morgan, C.D., Chidsey, T.C., and Eby, D.E., 2003, Regional Paradox Formation structure and isochore maps, Blanding sub-basin, Utah: Salt Lake City, unpublished Utah Geological Survey deliverable for Department of Energy contract no. DE-2600BC15128, Heterogeneous shallow-shelf carbonate buildups in the Paradox Basin, Utah and Colorado targets for increased oil production and reserves using horizontal drilling techniques, Deliverable 1.1.1, 44 p.
- McClure, K., Morgan, C.D., Chidsey, T.C., Eby, D.E., and Scott P., 2003, Regional Paradox Formation cross sections, Blanding sub-basin, Utah and Colorado: Salt Lake City, unpublished Utah Geological Survey deliverable for Department of Energy contract no. DE-2600BC15128, Heterogeneous shallow-shelf carbonate buildups in the Paradox Basin, Utah and Colorado - targets for increased oil production and reserves using horizontal drilling techniques, Deliverable 1.1.2, 29 p.

Montgomery, S., 1992, Paradox basin - Cane Creek play: Petroleum Frontiers, v. 9, 66 p.

- Morgan, C.D., 1992a, Cane Creek exploration play area, Emery, Grand, and San Juan counties, Utah: Utah Geological Survey Open-file Report 232, 5 p.
- Morgan, C.D., 1992b, Horizontal drilling potential of the Cane Creek shale, Paradox Formation, Utah, *in* Schmoker, J.W., Coalson, E.B., and Brown, C.A., editors, Geological studies relevant to horizontal drilling - examples from western North America: Rocky Mountain Association of Geologists Guidebook, p. 257-265.
- Morgan, C.D., 1993, Paradox Formation, *in* Hjellming, C.A., editor, Atlas of major Rocky Mountain gas reservoirs: New Mexico Bureau of Mines and Mineral Resources, p. 92-93.
- Nuccio, V.F., and Condon, S.M., 1996a, Burial and thermal history of the Paradox basin, Utah and Colorado, and petroleum potential of the Middle Pennsylvanian Paradox Formation, *in* Huffman, A.C., Jr., Lund, W.R., and Godwin, L.H., editors, Geology and resources of the Paradox basin: Utah Geological Association Publication 25, p. 57-76.
- Nuccio, V.F., and Condon, S.M., 1996b, Burial and thermal history of the Paradox basin, Utah and Colorado, and petroleum potential of the Middle Pennsylvanian Paradox Formation: U.S. Geological Survey Bulletin 2000-O, 41 p.
- Peterson, J.A., 1992, Aneth field U.S.A., Paradox Basin, Utah, *in* Foster, N.H., and Beaumont, E.A., editors, Stratigraphic traps III: American Association of Petroleum Geologists Treatise of Petroleum Geology Atlas of Oil and Gas Fields, p. 41-82.
- Peterson, J.A., 2001 (updated 2003), Carboniferous-Permian (late Paleozoic) hydrocarbon system, Rocky Mountains and Great Basin U.S. region - major historic exploration objective: Rocky Mountain Association of Geologists Open-file Report, 54 p.

- Rasmussen, D.L., Rasmussen, D.L., and Coskey, R.J., 2004, Analysis of the Pennsylvanian petroleum system in the Paradox basin fold and fault belt, Colorado and Utah [abs.]: American Association of Petroleum Geologists Rocky Mountain Section, v. 2004, unpaginated.
- Rueger, B.F., 1996, Palynology and its relationship to climatically induced depositional cycles in the Middle Pennsylvanian (Desmoinesian) Paradox Formation of southeastern Utah: U.S. Geological Survey Bulletin 2000-K, 22 p.
- Tischler, K.L., 1995, Paradox basin source rock, southeastern Utah organic geochemical characterization of Gothic and Chimney Rock units, Ismay and Desert Creek zones, within a sequence stratigraphic framework: Austin, University of Texas, M.S. thesis, 123 p.
- Tromp, D.E., 1995, Clays as indicators of depositional and diagenetic conditions in Pennsylvanian black shales, Paradox basin, Utah and Colorado: Golden, Colorado School of Mines, M.S. thesis, 152 p.
- Trudgill, B.D., and Arbuckle, W.C., 2009, Reservoir characterization of clastic cycle sequences in the Paradox Formation of the Hermosa Group, Paradox basin, Utah: Utah Geological Survey Open-file Report 543, 145 p.

Mississippian

- Chamberlain, A.K., 1984, Shallow-water clastic sediments of Great Blue Formation and Manning Canyon Shale, Oquirrh basin, Utah: American Association of Petroleum Geologists Bulletin, v. 68, p. 934.
- Chidsey, T.C., Jr., DeHamer, J.S., Hartwick, E.E., Johnson, K.R., Schelling, D.D., Sprinkel, D.A., Strickland, D.K., Vrona, J.P., and Wavrek, D.A., 2007, Petroleum geology of Covenant oil field, central Utah thrust belt, *in* Willis, G.C., Hylland, M.D., Clark, D.L., and Chidsey, T.C., Jr., editors, Central Utah – diverse geology of a dynamic landscape: Utah Geological Association Publication 36, p. 273-296.
- Hall, R.B., and Schnabel, L., 1985, Brick clay of the Manning Canyon Shale, *in* Hall, R.B., editor, Clays and clay minerals, western Colorado and eastern and central Utah - field trip guidebook: United States, AIPEA Publishers, p. 54-67.
- Hebertson, K.M., 1950, Origin and composition of the Manning Canyon Formation in central Utah: Provo, Brigham Young University, M.S. thesis, 71 p.
- Hebertson, K.M., 1957, Some characteristics of the Manning Canyon Formation in central Utah: Intermountain Association of Petroleum Geologists Guidebook, 8th Annual Field Conference, unpaginated.

- Jewell, P.W., Silberling, N.J., and Nichols, K.M., 2000, Geochemistry of the Mississippian Delle phosphatic event, eastern Great Basin, U.S.A.: Journal of Sedimentary Research, v. 70, p. 1222-1233.
- Lyman, J.E., and Ronald, H.A., 2002, A thick-skinned basin inversion model for the tectonic evolution of Santaquin and Payson Lakes quadrangles, southern Wasatch Range, Utah [abs.]: Geological Society of America Rocky Mountain Section Abstracts with Programs, v. 34, p. 10.
- Maughan, E.K., Jennings, J.R., and Tidwell, W.D., 1981, Shoaling-upward marine and deltaic sequences identified within Manning Canyon Shale: U.S. Geological Survey Professional Paper, Report P 1275, 36 p.
- Morgan, C.D., 1993, Mississippian Leadville Limestone, *in* Hjellming, C.A., editor, Atlas of major Rocky Mountain gas reservoirs: New Mexico Bureau of Mines and Mineral Resources, p. 94.
- Moyle, R.W., 1958, Paleoecology of the Manning Canyon Shale in central Utah: Brigham Young University Research Studies, v. 5, no. 7, 86 p., 7 plates.
- Nichols, K.M., and Silberling, N.J., 1990, Delle Phosphatic member an anomalous phosphatic interval in the Mississippian (Osagean-Meramecian) shelf sequence of central Utah: Geology, v. 18, no. 1, p. 46-49.
- Nichols, K.M., and Silberling, N.J., 1991, Petrology and significance of a Mississippian (Osagean-Meramecian) anoxic event, Lakeside Mountains, northeastern Utah: U.S. Geological Survey Bulletin, Report B 1787-S T, p. T1-T12.
- Prince, D., 1964, Mississippian coal cyclothems in the Manning Canyon Shale of central Utah: Brigham Young University Research Studies Geology Series, v. 10, p. 82-103.
- Rose, P.R., 1976, Mississippian carbonate shelf margins, western United States: U.S. Geological Survey Journal of Research, v. 4, no. 4, p. 449-466.
- Sandberg, C.A., and Gutschick, R.C., 1984, Distribution, microfauna, and source-rock potential of Mississippian Delle Phosphatic Member of Woodman Formation and equivalents, Utah and adjacent states, *in* Woodward, J., Meissner, F.F., and Clayton, J.L., editors, Hydrocarbon source rocks of the Greater Rocky Mountain region: Rocky Mountain Association of Geologists Symposium, p. 135-178.
- Sandberg, C.A., Poole, F.G., and Gutschick, R.C., 1980, Devonian and Mississippian stratigraphy and conodont zonation of Pilot and Chainman shales, Confusion Range, Utah, *in* Fouch, T.D., and Magathan, E.R., editors, Paleozoic paleogeography of the west-central United States, Rocky Mountain paleogeography: Society of Economic Paleontologists and Mineralogists Symposium 1, p 71-79.

- Silberling, N.J., and Nichols, K.M., 1992, Petrology and regional significance of the Mississippian Delle Phosphatic Member, Lakeside Mountains of northwestern Utah: Utah Geological Survey Miscellaneous Publication, 92-3, p. 147-159.
- Silberling, N.J., Nichols, K.M., Trexler, J.H., Jr., Jewell, P.W., and Crosbie, R.A., 1997, Overview of Mississippian depositional and paleotectonic history of the Antler foreland, eastern Nevada and western Utah, *in* Link, P.K., and Kowallis, B.J., editors, Proterozoic to Recent stratigraphy, tectonics, volcanology, Utah, Nevada, southern Idaho and central Mexico: Brigham Young University Geology Studies, v. 42, pt. I, p. 161-196.
- Tidwell, W.D., 1988, Flora of Manning Canyon Shale, part III Sphenophyta: Brigham Young University Geology Studies, v. 35, p. 15-32.
- Tidwell, W.D., and Rigby, J.K., 1978, The Pennsylvanian flora and sedimentary environments of the Manning Canyon Shale, Utah [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 150.
- Welsh, J.E., 1984a, Structural complexities that control localization of Mississippian shalegenerated oil prospects in eastern Great Basin, Utah and Nevada: American Association of Petroleum Geologists Bulletin, v. 68, no. 7, p. 944.
- Welsh, J.E., 1984b, West Wendover, Nevada, south through Ferguson Flat to Gold Hill, Utah, *in* Kerns, G.J., and Kerns, R.L., Jr., editors, Geology of northwest Utah, southern Idaho, and northeast Nevada: Utah Geological Association Publication 13, p. 275-276.