POTASH RESOURCES OF UTAH: AN ANNOTATED BIBLIOGRAPHY

by

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INTRODUCTION

Potash is an important part of Utah's diverse mineral industry and, currently, Utah is one of only two potash-producing states. Potash is a somewhat generic term that includes both natural and manufactured potassium-based compounds or salts such as potassium chloride (KCl or MOP [muriate of potash]), potassium sulfate (K_2SO_4 or SOP [sulfate of potash]), and potassium magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$ or SOPM [sulfate of potash-magnesia]). Because potassium is an essential plant nutrient, most potash is used as fertilizer and, according to the U.S. Geological Survey, 85% of domestically produced potash in 2021 was used for that purpose. The remaining 15% was used in other industrial or chemical applications. In 2018, potash was declared a critical mineral by the U.S. Department of the Interior because the U.S. imports most of its potash (Fortier and others, 2018); however, potash's status as a critical mineral was removed in 2022 (Nassar and Fortier, 2021; U.S. Geological Survey, 2022).

Utah's potash resources are found in surface brines, subsurface brines, subsurface bedded evaporites, and alunite (figure 1). Currently, Utah produces potash from surface brines, subsurface brines, and subsurface bedded evaporites. Notably, Utah produces two types of potash: potassium sulfate from Great Salt Lake and potassium chloride from subsurface brines at the Bonneville Salt Flats and bedded evaporites in the Paradox Basin. In the last decade or so, exploration activities for potash in Utah have focused on subsurface brines, subsurface bedded evaporites, and alunite.

The purpose of this bibliography is to catalog some of the most significant published and unpublished references related to Utah's potash resources, and if available, to provide web links to those references. This list is not exhaustive and priority was given to sources that contain grade information, resource estimates, or production history. Brief annotations of the contents of the references are provided. Following a statewide section, the remaining sections are broken down geographically into different resource areas (with the exception of alunite resources): Great Salt Lake, the Great Salt Lake Desert (includes the Bonneville Salt Flats and Pilot Valley), the Paradox Basin, and Sevier Lake. An alunite section follows these. Ideally, this bibliography will be updated as additional important sources are identified and as opportunity permits.

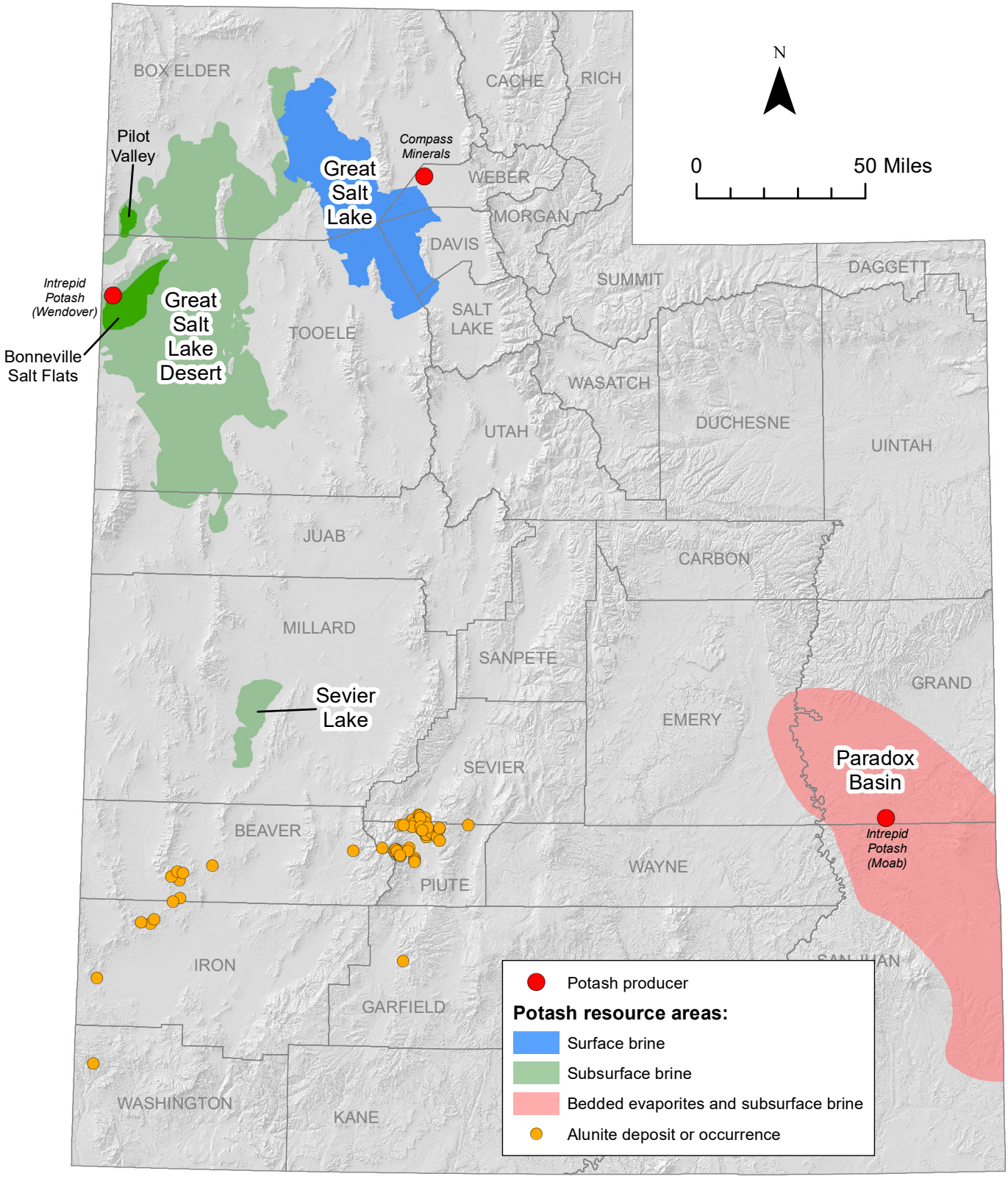

Figure 1. *Potash resource areas and deposits in Utah. Relevant sources for the features on this map include Massoth (2012), Hintze and others (2000), and the Utah Geological Survey's Utah Mineral Occurrence System database (UMOS).*

POTASH BIBLIOGRAPHY

Statewide

Blondes, M.S., Gans, K.D., Engle, M.A., Kharaka, Y.K., Reidy, M.E., Saraswathula, V., Thordsen, J.J., Rowan, E.L., and Morrissey, E.A., 2018, U.S. Geological Survey National Produced Waters Geochemical Database (ver. 2.3, January 2018): U.S. Geological Survey data release, https://doi.org/10.5066/F7J964W8.

- This database includes analytical data from produced brines across Utah, including from areas with potash resource potential.

Kerr, H.S., 1965, An analysis of Utah's potash industry: Salt Lake City, University of Utah, M.B.A. Thesis, 119 p., 2 appendices.

- This thesis includes a comprehensive summary of the potash industry in Utah and includes details on history, production, and the various deposits and deposit types.

Mills, S.E., and Rupke, A., 2020, Critical minerals of Utah: Utah Geological Survey Circular 129, 49 p., https://doi.org/10.34191/c-129.

- This report includes a statewide overview of potash production and potash resource potential.

Rupke, A., 2012, Utah's potash resources and activity: Utah Geological Survey Survey Notes 44-3, p. 1–3, https://doi.org/10.34191/snt-44-3.

- This article includes a brief overview of Utah's potash resources.

Rupke, A. and Boden, T., 2020, Lithium brine analytical database of Utah: Utah Geological Survey Open-File Report 730, 2 p., https://doi.org/10.34191/OFR-730.

- The focus of this database is lithium, but it includes several brine analyses from across Utah, including areas with potash resource potential.

Rupke, A., Mills, S.E., Vanden Berg, M.D., and Boden, T., 2022, Utah mining 2020—metals, industrial minerals, uranium, coal and unconventional fuels: Utah Geological Survey Circular 131, 37 p., https://doi.org/10.34191/c-131.

- This is an annual publication that includes information on potash production in Utah.

Tripp, B.T., 2010, Utah potash—resources, production, and exploration: Utah Geological Survey Survey Notes 42-1, p. 1–3, https://doi.org/10.34191/snt-42-1.

- This article includes a brief overview of Utah's potash resources.

U.S. Geological Survey, 2022, National water information system: Online, https://waterdata.usgs.gov/nwis.

- U.S. Geological Survey water data repository. The system includes analytical data from numerous water-quality samples, including from brines in Utah.

Great Salt Lake

Butts, D., 2002, IMC Kalium Ogden Corporation—Extraction of non-metals from Great Salt Lake, in Gwynn, J.W., editor, Great Salt Lake—an overview of change: Utah Department of Natural Resources Special Publication, p. 227–233, https://doi.org/10.34191/gsl2002.

- This report provides an overview of the potash (potassium sulfate) producer on Great Salt Lake.

Compass Minerals, 2022, Compass Minerals 2021 annual report: Online, https://s22.q4cdn.com/834578860/files/doc_financials/2021/ar/21-35022-1_456019_client.pdf.

- Annual report that provides information on Compass Minerals' operation at Great Salt Lake.

Gwynn, J.W., 2002, The extraction of mineral resources from Great Salt Lake, Utah—History, developmental milestones, and factors influencing salt extraction, in Gwynn, J.W., editor, Great Salt Lake—an overview of change: Utah Department of Natural Resources Special Publication, p. 201–212, https://doi.org/10.34191/gsl2002.

- This report provides an overview of mineral resource extraction from Great Salt Lake.

Gwynn, J.W., 2007, Great Salt Lake brine chemistry databases & reports 1966–2006: Utah Geological Survey Open-File Report, https://doi.org/10.34191/ofr-485.
- This data release includes the Utah Geological Survey brine chemistry database, a compilation of older relevant reports, and the accompanying report includes a compilation of Great Salt Lake brine chemistry prior to 1966.

Havasi, J., 2021, Technical report summary, potassium and sulfate of potash mineral reserve statement: Online, https://www.sec.gov/Archives/edgar/data/0001227654/000122765421000300/cmp-20210930xxex961ogdenpo.htm.
- This technical report includes potash resources and reserves for Great Salt Lake. It also includes extensive details on Compass Minerals' operation on Great Salt Lake.

Rupke, A., and McDonald, A., 2012, Great Salt Lake brine chemistry database, 1966–2011: Utah Geological Survey Open-File Report 596, 7 p., 1 appendix, https://doi.org/10.34191/ofr-596.
- Database includes extensive brine chemistry data for Great Salt Lake.

Utah Geological Survey, 2021, Great Salt Lake brine chemistry database: Online, https://geology.utah.gov/docs/xls/GSL_brine_chem_db.xlsx.
- Database includes extensive brine chemistry data for Great Salt Lake; database is routinely updated; it is the same, but more current, database as from Rupke and McDonald (2012).

Great Salt Lake Desert

Bingham, C.P., 1980, Solar production of potash from the brines of the Bonneville Salt Flats, in Gwynn, J.W., editor, Great Salt Lake—a scientific, historical and economic overview: Utah Geological and Mineral Survey Bulletin 116, p. 229–242, https://doi.org/10.34191/b-116.
- This report describes the potash production history of the Bonneville Salt Flats.

Bowen, B.B., Kipnis, E.L., and Pechmann, J.M., 2018, Observations of salt crust thickness change at the Bonneville Salt Flats from 2003–2016, in Emerman, S.H., Bowen, B., Schamel, S., and Simmons, S., editors, Geofluids of Utah: Utah Geological Association Publication 47, p. 247–285.
- This publication provides recent and detailed information on the salt crust at the Bonneville Salt Flats.

Carroll E. Bradbury & Associates, 1967, Supplementary report on Brine Production at Bonneville, Utah: Unpublished report for Kaiser Aluminum and Chemical Corporation, 31 p.
- This report includes resource estimates for the Bonneville Salt Flats; a supplementary report to Davis (1966).

Dames & Moore, 1978, Inventory and market analysis of the potash resources of the Great Salt Lake Desert, Utah: Unpublished report prepared by Dames & Moore for the U.S. Bureau of Land Management, variously paginated.
- This report contains potash resource estimates for the shallow brine at the Bonneville Salt Flats, Pilot Valley, and the regional shallow aquifer; it also includes a potash resource estimate for the regional deep brine aquifer.

Davis, S.N., 1966, Brine production at Bonneville, Utah: Unpublished Carroll E. Bradbury & Associates consultant's report for Kaiser Aluminum and Chemical Corporation, 45 p., 1 appendix.
- This report includes brine chemistry data and resource estimates for Bonneville Salt Flats; also see supplementary report by Carrol E. Bradbury & Associates packaged with this report.

Durgin, D., 2012, Geology and mineral resources, Bounty potash project, Box Elder and Tooele Counties, Utah, USA: Unpublished technical report prepared for Mesa Exploration Company, 41 p., https://geology.utah.gov/apps/reportviewer/reports/PilotValleyPotash2012NI43-101.pdf.
- This report compiles and summarizes data from previous work at Pilot Valley.

Durgin, D., 2013, Geology and mineralization, Bounty potash project, Box Elder and Tooele Counties, Utah, USA: Unpublished amended technical report prepared for Mesa Exploration Company, 41 p., https://geology.utah.gov/apps/reportviewer/reports/PilotValley2013_NI43-101.pdf.
- This report compiles and summarizes data from previous work at Pilot Valley.

Gwynn, J.W., 2002, History of potash production from the Salduro Salt Marsh (Bonneville Salt Flats), Tooele County, in Gwynn, J.W., editor, Great Salt Lake—an overview of change: Utah Department of Natural Resources Special Publication, p. 421–422, https://doi.org/10.34191/gsl2002.
- This article provides a brief history of potash production at the Bonneville Salt Flats.

Gwynn, J.W., Clem, K., Shubat, M., Tripp, B., and Sturm, P., 1985, Mineral occurrences in the Emergency Withdrawal Area and adjacent lands in the Great Salt Lake Desert: Utah Geological and Mineral Survey Report of Investigation 200, unpaginated, https://doi.org/10.34191/ri-200.
- Includes general brine chemistry for various areas in the Great Salt Lake Desert.

Intrepid Potash, 2021, United States Securities and Exchange Commission, form 10-K, Intrepid Potash, Inc. annual report: Online, https://s28.q4cdn.com/607153883/files/doc_financials/2020/ar/2020-10-K.pdf.
- Annual report that provides information on proven and probable reserves for Intrepid Potash's operations in Utah.

Jones, B.F., White, W.W. III, Conko, K.M., Webster, D.M., and Kohler, J.F., 2009, Mineralogy and fluid chemistry of surficial sediments in the Newfoundland Basin, Tooele and Box Elder Counties, Utah: Utah Geological Survey Open-File Report 539, 96 p., https://doi.org/10.34191/ofr-539.
- Report on the shallow-brine aquifer in the Newfoundland Basin to characterize mineral resources in the area; includes extensive chemistry of brine and pore fluids.

Kipnis, E.L., 2021, Geologic change, hydrologic drivers, and resource use at the Bonneville Salt Flats, Utah, USA: Salt Lake City, University of Utah, PhD dissertation, 100 p., 2 appendices.
- Includes brine geochemistry from the Bonneville Salt Flats.

Kipnis, E.L. and Bowen, B.B, 2018, Observations of salt crust change from 1960–2016 and the role of humans as geologic agents at the Bonneville Salt Flats, Utah, in Emerman, S.H., Bowen, B., Schamel, S., and Simmons, S., editors, Geofluids of Utah: Utah Geological Association Publication 47, p. 287–303.
- This publication provides detailed information on the salt crust at the Bonneville Salt Flats. The study includes information on possible mining impacts.

Kohler, J.F., 2002, Effects of the West Desert pumping project on the near-surface brines in a portion of the Great Salt Lake Desert, Tooele and Box Elder Counties, Utah, in Gwynn, J.W., editor, Great Salt Lake—an overview of change: Utah Department of Natural Resources Special Publication, p. 487–498, https://doi.org/10.34191/gsl2002.
- This report includes brine chemistry for the West Pond (Newfoundland Basin).

Lerback, J.C., Hynek, S.A., Bowen, B.B., Bradbury, C.D., Solomon, D.K., and Fernandez, D.P., 2019, Springwater provenance and flowpath evaluation in Blue Lake, Bonneville basin, Utah: Chemical Geology, v. 529, 19 p., https://doi.org/10.1016/j.chemgeo.2019.119280.
- This publication includes supplementary geochemical data for brines at and around the Bonneville Salt Flats.

Lindenburg, G.J., 1974, Factors contributing to the variance in the brines of Great Salt Lake Desert and the Great Salt Lake: Salt Lake City, University of Utah, Master's thesis 70 p.
- Thesis includes brine chemistry data for the Bonneville Salt Flats and to the east near I-80.

Lines, G.C., 1979, Hydrology and surface morphology of the Bonneville Salt Flats and Pilot Valley playa, Utah: U.S. Geological Survey Water-Supply Paper 2057, 107 p., https://doi.org/10.3133/wsp2057.
- This report includes a detailed description and discussion of the hydrology of the Bonneville Salt Flats and Pilot Valley playas; includes a limited amount of brine chemistry data from the Bonneville Salt Flats and Pilot Valley.

Lines, G.C., 1978, Selected ground-water data, Bonneville Salt Flats and Pilot Valley, western Utah: U.S. Geological Survey Utah Basic-Data Release No. 30, 14 p., https://waterrights.utah.gov/docSys/v920/i920/i920000s.pdf.
- This report includes extensive brine chemistry data from the Bonneville Salt Flats and Pilot Valley.

Mason, J.L., Brothers, W.C., Gerner, L.J., and Muir, P.S., 1995, Selected hydrologic data for the Bonneville Salt Flats and Pilot Valley, western Utah, 1991–93: U.S. Geological Survey Open-File Report 95-104, 56 p., https://doi.org/10.3133/ofr95104.
- This report includes extensive brine chemistry data from the Bonneville Salt Flats and Pilot Valley.

Mason, J.L., and Kipp, K.L., Jr., 1998, Hydrology of the Bonneville Salt Flats, northwestern Utah, and simulation of groundwater flow and solute transport in the shallow-brine aquifer: U.S. Geological Survey Professional Paper 1585, 108 p., https://doi.org/10.3133/pp1585.
- This report includes an in-depth discussion of the hydrology of the Bonneville Salt Flats; includes some discussion relevant to the potash resource.

Mayo, A.L., and Tingey, D.G., 2021, Shallow groundwater chemical evolution, isotopic hyperfiltration, and salt pan formation in a hypersaline endorheic basin—Pilot Valley, Great Basin, USA: Hydrogeology Journal, https://doi.org/10.1007/s10040-021-02371-7.
- This publication discusses the development of the brine in Pilot Valley; includes brine density maps and other relevant information for Pilot Valley.

Nackowski, M.P., 1962, Brine exploration—Bonneville Salt Flats: Unpublished report prepared for Bonneville Limited, 50 p., 1 plate.
- This report includes potassium concentrations from wells in the Bonneville Salt Flats; also includes a discussion of potassium depletion over time due to potash production.

Nackowski, M.P., 1967, Brine supply and reserves—Northwest Bonneville Area: Unpublished report prepared for Quintana Petroleum Corporation, 121+ p.
- This report includes brine chemistry and density data from wells in Pilot Valley; also includes potash resource estimates.

Nackowski, M.P., and Mehrhoff, J., 1960, Bonneville Limited brine supply research project—Progress report, six month period, April–September 1960: Unpublished report prepared for Bonneville Limited, 39 p.
- This report includes potassium concentration data from Bonneville Salt Flats brine trenches.

Nackowski, M.P., and Mehrhoff, J., 1961, Bonneville Limited brine supply research project—Progress report, six month period, September 1960–March 1961: Unpublished report prepared for Bonneville Limited, 43 p.
- This report includes potassium concentration data from Bonneville Salt Flats brine trenches.

Nolan, T.B., 1927, Potash brines in the Great Salt Lake Desert: U.S. Geological Survey Bulletin 795-B, 44 p., https://doi.org/10.3133/b795B.
- This report includes potassium concentration data of brines throughout the Great Salt Lake Desert (including the Bonneville Salt Flats, Pilot Valley, and elsewhere).

Orris, G.J., 2011, Deposit model for closed-basin potash-bearing brines: U.S. Geological Survey Open-File Report 2011-1283, 11 p., https://doi.org/10.3133/ofr20111283.
- The deposit model for the Great Salt Lake Desert.

Petersen, E.C., 1993, Geochemical evolution of groundwater with implications for groundwater flow patterns in the Pilot Valley closed basin, Utah and Nevada: Provo, Utah, Brigham Young University, M.S. thesis, 125 p.
- This report includes extensive brine chemistry data from Pilot Valley.

Stephens, J.C., 1974, Hydrologic reconnaissance of the northern Great Salt Lake Desert and summary hydrologic reconnaissance of northwestern Utah: Utah Department of Natural Resources Technical Publication No. 42, 55 p., 2 plates, https://waterrights.utah.gov/docSys/v920/w920/w9200094.pdf.
- This report includes brine chemistry data from Great Salt Lake Desert.

Stephens, J.C., and Hood, J.W., 1973, Hydrologic reconnaissance of Pilot Valley, Utah and Nevada: Utah Department of Natural Resources Technical Publication No. 41, 38 p., https://waterrights.utah.gov/docSys/v920/w920/w9200093.pdf.
- This report includes a discussion of the hydrology of Pilot Valley; includes some groundwater chemistry data from wells in the Pilot Valley area.

Turk, L.J., 1973, Hydrogeology of the Bonneville Salt Flats, Utah: Utah Geological and Mineral Survey Water-Resources Bulletin 19, 81 p., 1 plate., https://doi.org/10.34191/wrb-19.
- This report includes a discussion of the hydrogeology of the Bonneville Salt Flats; presents general groundwater data including brine chemistry data; includes brine chemistry data from both the shallow and deep aquifers.

Paradox Basin

Allen, G.J., 2009, Report on the potash potential of the Green River potash project area, Grand County, Utah: Unpublished Canadian National Instrument (NI) 43-101 technical report prepared for American Potash LLC, 32 p., https://geology.utah.gov/apps/reportviewer/reports/GreenRiver2009_NI43-101.pdf.

- This report describes the Green River project area and summarizes available information on potential potash resources; includes interpretations of potash intervals from a few wells.

Blanc, R.P., 1963, Cane Creek area potash project: Unpublished report prepared for the Richfield Oil Corporation Production Department—Research Division [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming].

- This report includes some potash resource estimates.

Britt, T.L., 1977, Geologic report on the Robert's potash property, Grand County, Utah: Unpublished report for the Anaconda Company [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming].

- This report contains potash resource estimates, interpreted potash intervals for numerous wells, potash bed maps, analytical data for a potash core hole (Natural Gas Long Canyon Unit #1), drilling records, and a few brine analyses; the study area is west of Moab.

Britt, T.L., 1978, Summary of trip to Moab and meeting with Buttes regarding Anaconda's potash project: Unpublished memorandum to R.W. Knostman dated September 1, 1978 [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming], 4 p.

- This report contains information on Buttes' potash project and potash grade and interval information are available for Buttes Minerals 1-78-E (section 33, T. 24 S., R. 19 E.) in an attached table.

Britt, T.L., 1979, Review of Buttes Potash data and revised reserve calculations for Paradox Basin potash project: Unpublished memorandum to R.W. Knostman dated January 3, 1979 [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming], 3 p.

- This short memorandum includes resource estimates for potash cycle 5 and 9 in the Buttes Ten Mile and Roberts Option areas.

Dames & Moore, 1978, Inventory and market analysis of the potash resources of the Paradox Basin of Utah: Unpublished report prepared by Dames & Moore for the U.S. Bureau of Land Management, variously paginated, 3 appendices.

- This report contains a discussion on potential potash resources within multiple cycles in the Paradox Basin; an appendix includes an extensive table with interpreted potash intervals and grades.

Durgin, D., 2011, Technical report, geology and mineral resources, Green Energy project, Grand County, Utah, USA: Unpublished Canadian National Instrument (NI) 43-101 technical report prepared for Mesa Exploration Corp., 35 p., https://geology.utah.gov/apps/reportviewer/reports/GreenEnergy2011_NI43-101.pdf.

- Describes the Green Energy project area and summarizes available information on potential potash resources.

Durgin, D., 2011, Technical report, geology and mineral resources, Utah potash project, White Cloud, Salt Wash and Whipsaw areas, Grand County, Utah, USA: Unpublished Canadian National Instrument (NI) 43-101 technical report prepared for Mesa Exploration Corp., 46 p., https://geology.utah.gov/apps/reportviewer/reports/MesaPotash2011_NI43-101.pdf.

- Describes the relevant project areas and summarizes available information on potential potash resources.

Gilbride, L.J., and Santos, V., 2012, NI 43-101 technical report, Green River potash project, Grand County, Utah, USA: Unpublished Canadian National Instrument (NI) 43-101 technical report prepared by Agapito Associates, Inc. for Magna Resources, variously paginated, https://geology.utah.gov/apps/reportviewer/reports/GreenRiver2012_NI43-101.pdf.

- This report provides a summary of the Green River potash project including a description of the exploration plan; includes tables of relevant wells with interpreted potash intervals and grade for cycles 5, 9, 13, and 18; report also contains an estimated exploration target tonnage.

Gwynn, J.W., and Tripp, B.T., 2009, Lisbon Valley potash resource evaluation, San Juan County, Utah: Report by Utah Geological Survey prepared for Bureau of Land Management, 25 p.

- Report examines and makes recommendations for updates to the KPLA boundary of Lisbon Valley.

Hite, R.J., 1961, Potash-bearing evaporite cycles in the salt anticlines of the Paradox Basin, Colorado and Utah, in Short papers in geologic and hydrologic sciences: U.S. Geological Survey Professional Paper 424-D, p. D135–D138, https://doi.org/10.3133/pp424D.
- A brief report describing the potash deposits in the Paradox Basin.

Hite, R.J., 1976, A potential target for potash solution mining in cycle 13, Paradox Member, near Moab, Utah: U.S. Geological Survey Open-File Report 76-755, 5 p., 5 plates, https://doi.org/10.3133/ofr76755.
- This report includes a summary of potash potential for cycle 13; includes an approximate grade and resource estimates; includes maps of the distribution and thickness of potash in cycle 13.

Hite, R.J., 1978, A potential target for potash solution mining in cycle 18—Paradox Member of the Hermosa Formation, San Juan County, Utah, and Dolores and Montezuma Counties, Colorado: U.S. Geological Survey Open-File Report 78-147, 3 p., 1 plate, https://doi.org/10.3133/ofr78147.
- Report includes a very brief summary of potash potential in cycle 18.

Hite, R.J., 1978, The geology of the Lisbon Valley potash deposits, San Juan County, Utah: U.S. Geological Survey Open-File Report 78-148, 21 p., https://doi.org/10.3133/ofr78148.
- Report contains analytical grade data for potash intervals from several drill holes in Lisbon Valley; includes a comprehensive table summarizing potash drilling in Lisbon Valley; includes a good summary report of the Lisbon Valley potash deposits.

Hite, R.J., 1982, Potash deposits in the Gibson Dome area, southeast Utah: U.S. Geological Survey Open-File Report 82-1067, 8 p., https://doi.org/10.3133/ofr821067.
- This is a brief report that includes analytical grade data from the Gibson Dome #1 core in San Juan County.

Hite, R.J., 1983, Preliminary mineralogical and geochemical data from D.O.E. Gibson Dome corehole No. 1, San Juan County, Utah: U.S. Geological Survey Open-File Report 83-780, 57 p., https://doi.org/10.3133/ofr83780.
- This report contains numerous figures providing geochemical and mineralogical information on the Gibson Dome # 1 core in San Juan County.

Hite, R.J., and Cater, F.W., 1972, Pennsylvanian rocks and salt anticlines, Paradox Basin, Utah and Colorado, in Mallory, W.W., editor, Geologic atlas of the Rocky Mountain region: Rocky Mountain Association of Geologists, p. 133–138.
- This publication provides an outline of potash mineralization for the Paradox Basin.

Hodges, P.A., and Banfield, A.F., 1962, Potash resources of Lisbon Valley, San Juan County, Utah: Behre Dolbear & Company report to Superior Oil Company [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming], 110 p.
- This report contains detailed potash resource estimates, potash interval data for several wells (including estimated and analytical grade data), a geological overview, and a variety of maps from Lisbon Valley.

Intrepid Potash, 2021, United States Securities and Exchange Commission, form 10-K, Intrepid Potash, Inc. annual report: Online, https://s28.q4cdn.com/607153883/files/doc_financials/2020/ar/2020-10-K.pdf, accessed September 2021.
- Annual report that provides information on proven and probable reserves for Intrepid Potash's operations in Utah.

Knostman, R.W., 1978, Roberts potash property, Grand County, Utah: Anaconda memorandum dated February 17, 1978 [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming].
- This memorandum contains a variety of attachments including analytical data for a core hole (Buttes Minerals 1-78-E [TMP1-78E], section 33, T. 24 S., R. 19 E., SLM) in Grand County; also included are interpretations of some gamma-ray logs with estimated KCl content from a few wells.

Knostman, R.W., 1979, Buttes Oil & Gas Company, Ten Mile project: Unpublished memorandum to G.A. Barber dated January 19, 1979 [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming], 4 p.
- This memorandum includes some potash thickness and grade data for cycle 5 from a few wells in the Ten Mile project area.

Kohler, J.F., 2009, Determination whether prospecting is necessary—potassium prospecting permit applications, UTU-086426 to UTU-086431, UTU-086568 to UTU-086602, San Juan County, Utah (T. 28-30 S., R. 20-23 E.): U.S. Bureau of Land Management Mineral Report Form 3060-1, May 12, 2009, 39 p.

- This report examines available data in the Hatch Point area to determine if additional exploration is needed to define a potential potash resource in the area; includes some potash data from wells in the area.

Lewis, R.W., 1965, Potassium, in U.S. Bureau of Mines, Mineral facts and problems—1965 edition: U.S. Bureau of Mines Bulletin 630, 721–731.

- This report includes a brief overview of potash resources in the Paradox Basin, including a rough resource estimate.

Massoth, T.W., 2012, Well database and maps of salt cycles and potash zones of the Paradox Basin, Utah: Utah Geological Survey Open-File Report 600, https://doi.org/10.34191/ofr-600.

- This is a comprehensive database of wells/drill holes with potash data in the Paradox Basin; includes information on depths and thicknesses of potash zones, potash grade data, and maps showing the extent of important potash beds.

Massoth, T.W., and Tripp, B.T., 2011, Well database of salt cycles of the Paradox Basin, Utah: Utah Geological Survey Open-File Report 581, https://doi.org/10.34191/ofr-581.

- This report is a precursor to Massoth (2012).

Mayhew, E.J., 1965, Castle Valley unit #1 report: Unpublished report prepared for Gold Bar Resources, Inc. dated August 2, 1965 [copy obtained from Anaconda Collection, American Heritage Center, University of Wyoming], 7 p.

- This report includes a formation log (as interpreted by Mayhew?) showing potash cycles for the Castle Valley Unit #1 (also known as the Gold Bar Resources well).

Mayhew, E.J., and Heylmun, E.B., 1965, Concentrated subsurface brines in the Moab region, Utah: Utah Geological and Mineralogical Survey Special Study 13, 28 p., https://doi.org/10.34191/SS-13.

- Includes chemistry data for subsurface brines near Moab.

Merrell, H.W., 1979, Mineral resource inventory of the Paradox salt basin, Utah and Colorado: Utah Geological Survey Report of Investigation 143, 65 p., 16 plates, https://doi.org/10.34191/ri-143.

- This report includes a brief summary of potash potential in the Paradox Basin; includes a map with KPLAs and past application areas.

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