UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Maps Showing Distribution, Thickness, and Depth of Salt Deposits of the United States

By

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Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps

[References preceded by an asterik (*) apply to all basins and salt bodies]

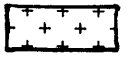
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
				*Johnson, K. S., and Gonzales, Serge, 1978, Salt deposits in the United States and regional geologic characteristics important for storage of radioactive waste: U.S. Department of Energy, Office of Waste Isolation, Y/OWI/SUB-7414/1, 188 p. *LeFond, S. J., 1969, Handbook of world salt resources: New York, Plenum Press, 384 p. *Pierce, W. G., and Rich, E. I., 1962, Summary of rock salt deposits in the United States as possible storage sites for radioactive waste materials: U.S. Geological Survey Bulletin 1148, 91 p.
APPALACHIAN (New York, Ohio, Pennsylvania, West Virginia)	Silurian 	Sea level	Thickness: 100 Structural: 500	NEW YORK Kreidler, W. L., 1957, Occurrence of Silurian salt in New York State: New York State Museum and Science Service Bulletin 361, 56 p., 2 pls. _____ 1963, Silurian salt of New York State, in Bersticker, A. C., ed., Symposium on salt, 1st, Cleveland, 1962, Proceedings: Northern Ohio Geological Society, p. 10-18. Kreidler, W. L., Van Tyne, A, M., and Jorgensen, K. M., 1972, Deep wells in New York State: New York State Museum and Science Service Bulletin 418A, 335 p. Rickard, L. V., 1969, Stratigraphy of the upper Silurian Salina Group New York, Pennsylvania, Ohio, Ontario: New York State Museum and Science Service, Map and Chart Series 12, 57 p., 14 pls. OHIO Clifford, M. J., 1973, Silurian rock salt of Ohio: Ohio Geological Survey Report of Investigations 90, 42 p., 4 pls. Pepper, J. F., 1947, Areal extent and thickness of the salt deposits of Ohio: Ohio Journal of Science, v. 47, no. 6, p. 225-239; reprinted as Ohio Geological Survey Report of Investigations 3, 15 p., 1948.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
APPALACHIAN--Continued				PENNSYLVANIA
				Cox, D. P., and Edgerton, C. D., 1968, Salines in Mineral resources of the Appalachian region: U.S. Geological Survey Professional Paper 580, p. 327-337.
				Ferguson, W. P., and Prather, B. A., 1968, Salt deposits in the Salina Group in Pennsylvania: Pennsylvania Topographic and Geologic Survey Mineral Resources Report M-58, 41 p.
				Fettke, C. R., 1950, Summarized record of deep wells in Pennsylvania: Pennsylvania Topographic and Geologic Survey Bulletin M-31. 148 p.
				_____1954, Structure contour maps of the Plateau region of north-central and western Pennsylvania: Pennsylvania Topographic and Geologic Survey Bulletin G-27, 48 p., 10 maps.
				_____1955, Occurrence of rock salt in Pennsylvania: Pennsylvania Geological Survey, 4th Series Progress Report 145, 1 p.
				WEST VIRGINIA
				Cross, A. T., and Schemel, M. T., 1956, Economic resources of the Ohio River Valley in West Virginia, Pt. 2, p. 38-42, of Geology and economic resources of the Ohio River Valley in West Virginia: West Virginia Geological Survey, v. 22, 129 p., includes Map 1--Geologic map of the Ohio River Valley, and Map 2, Geologic map of the Ohio River Valley, 3 sheets (sheet 1, northern section; sheet 2, central section; sheet 3, southern section), scale 1:250,000.
				Erwin, R. B., written commun., 1982.
				Martens, J. H. C. 1943, Rock salt deposits of West Virginia: West Virginia Geological Survey Bulletin 7, 67 p.
				Price, P. H., and Nolting, J. P., 1949, Salt resources of West Virginia: American Institute of Mining and Metallurgical Engineering Transactions, v. 184, p. 259-263.
				Smosna, R. A., Patchen, D. G., Warshauer, S. M, and Perry W. J., Jr, 1978, Relationships between depositional environments Tonoloway limestone, and distribution of evaporites in the Salina formation, West Virginia: West Virginia Geological and Economic Survey Report of Investigation RI-28, 142 p.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

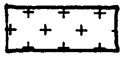
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
MICHIGAN (Michigan, Ontario)	Devonian  Silurian 	Sea level	Thickness: 200 Structural: 500	Dorr, J. A., Jr., and Eschman, D. F., 1970, Geology of Michigan: Ann Arbor, University of Michigan Press, 476 p. Hardenberg, H. J., 1949, Mineral resource map--Map 100-Contours on first salt of Detroit River Group, southern pennisula; Map 100A-Isopach map of all salt, Detroit River Group, southern pennisula; Map 101-Contours on first salt in Salina Group, southern pennisula; Map 101A-Isopach map of all salt, Salina Group, southern pennisula: Michigan Geological Survey. Landes, K. K., 1945, The Salina and Bass Island rocks in the Michigan Basin: U.S. Geological Survey Oil and Gas Investigations Preliminary Map 40, scale 1:1,457,280. _____1951, Detroit River Group in the Michigan Basin: U.S. Geological Survey Circular 133, 23 p.
SALTVILLE (Virginia)	Mississippian 	Ground surface	Thickness: not contoured Depth: not contoured	Cooper, B. N., 1966, Geology of the salt and gypsum deposits in the Saltville area, Smyth and Washington Counties, Virginia, in Rau, R. L., ed., Symposium on salt, 2d, Cleveland, 1965, Proceedings: Northern Ohio Geological Society, v. 1, p. 11-34. LeVan, D. C., written commun., 1982. Stose, G. W., 1913, Geology of the salt and gypsum deposits of southwestern Virginia: U.S. Geological Survey Bulletin 530, p. 232-255. Withington, C. F., 1965, Suggestions for prospecting for evaporite deposits in southwestern Virginia, in Geological Survey research 1965: U.S. Geological Survey Professional Paper 525-B, p. 29-33.
SUNNILAND (Florida)	Cretaceous 	Ground surface	Thickness: not contoured Depth: 500	Applin, P. L. and Applin, E. R., 1965, The Comanche series associated rocks in the subsurface in central and south Florida: U.S. Geological Survey Professional Paper 447, 84 p., 11 pls. Halbouty, M. T., 1967, Salt dome, Gulf region, United States and Mexico: Houston, Gulf Publishing Co., 425 p.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

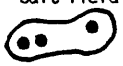
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
GULF COAST (Alabama, Arkansas, Florida, Louisiana, Mississippi Texas)	Jurassic (Louann salt) 	Ground surface	Thickness: not contoured Depth: 2,000	Anderson, R. E., Eargle, D. H., and Davis, B. O., 1973, Geologic and hydrologic summary of salt domes in Gulf Coast region of Texas, Louisiana, Mississippi and Alabama: U.S. Geological Survey Open-File Report 73-7, 294 p. Andrews, D. I., 1960, The Louann salt and its relationship to Gulf Coast salt domes, in Johnson, W. B., ed., Convention of Gulf Coast Association of Geological Societies, 10th Annual, Biloxi, Mississippi, 1960, Transactions: Gulf Coast Association of Geological Sciences, v. 10, p. 215-240. Applegate, A. V., written commun., 1982. Garrison, L. E., and Martin, R. E., Jr., 1973, Geologic structures in the Gulf of Mexico Basin: U.S. Geological Survey Professional Paper 773, 85 p. Halbouty, M. T., 1967, Salt domes, Gulf Coast region, United States and Mexico: Houston, Gulf Publishing Co., 425 p. Hawkins, M. E., and Jirik, C. J., 1966, Salt domes in Texas, Louisiana, Mississppi, Alabama and offshore tidelands--a survey: U.S. Bureau of Mines Information Circular 8313, 78 p. Hazzard, R. T., Spooner, W. C., and Blanchied, B. W., 1947, Notes on the stratigraphy of the formations which underlie the Smackover limestone in south Arkansas, northeast Texas, and north Louisiana: Shreveport Geological Society, v. 2, p. 483-503. Hohlt, R. B., 1977, Aspects of the subsurface geology of south Louisiana: Houston, Rice University, Ph. D. thesis, 145 p. Imlay, R. W., 1940, Lower Cretaceous and Jurassic formations of southern Arkansas and their oil and gas possibilities: Arkansas Geological Survey Information Circular 12, 64 p. Luper, E. E., written commun., 1982. Martin, R. G., 1973, Salt structure and sediment thickness, Texas, Louisiana continental slope, northwestern Gulf of Mexico: U.S. Geological Survey Open-File Report 73-179, 21 p. Murray, C. E., 1966, Salt structures of Gulf of Mexico Basin: American Association of Petroleum Geologists Bulletin, v. 50, p. 439-478. Pontigo, Felipe, Jr., written commun., 1982. Raymond, D. E., written commun., 1982.
Salt domes 				
Salt field 				

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

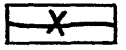
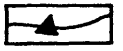
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
				KANSAS AND OKLAHOMA
PERMIAN (Kansas, Colorado, Oklahoma, Texas, New Mexico)	Permian  Ochoan  Guadalupian  Leonardian 	Ground surface	Thickness: 100 and 200 Depth: 500	Bayne, C. K., 1972, Supplemental areas for storage of radioactive wastes in Kansas: Kansas Geological Survey Special Distribution Publication 60, 20 p. Holdoway, Katrine, 1978, Deposition of evaporites and red beds of the Nippewalla Group, Permian, Western Kansas: Kansas Geological Survey Bulletin 215, 43 p. Johnson, K. S., written commun., 1976. _____, written commun., 1982. Jordan, Louise, and Vosburg, D. L., 1963, Permian salt and associated evaporites in the Anadarko Basin of the western Oklahoma-Texas panhandle region: Oklahoma Geological Survey Bulletin 102, 76 p. Kulstad, R. O., 1959, Thickness and salt percentage of the Hutchinson salt, in A symposium on geophysics in Kansas: Kansas Geological Survey Bulletin 137, p. 241-247. Schumaker, R. D., 1966, Regional study of Kansas Permian evaporite formations: Wichita, Kans., Wichita State University M.S. thesis, 87 p. Watney, W. L., and Paul, Shirley, 1980, Maps and cross section of the lower Permian Hutchinson salt in Kansas: Kansas Geological Survey open-file report, 11 p.
				TEXAS
				Baumgardner, R. W., Jr., Hoadley, A. D., and Goldstein, A. G., 1982, Formation of the Wink sink, a salt dissolution and collapse feature, Winkler County, Texas: Austin, University of Texas Bureau of Economic Geology Report of Investigations 114, 38 p. Budnik, R. T., written commun., 1982. Dutton, S. P., and others, 1979, Geology and geohydrology of the Palo Duro Basin Texas Panhandle--a report on the progress of nuclear waste isolation feasibility studies (1979): Austin, University of Texas Bureau of Economic Geology Geological Circular 79-1, 99 p.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
PERMIAN--Continued				Gustavson, T. C., and others, 1981, Geology and geohydrology of the Palo Duro basin, Texas panhandle: Austin, University of Texas Bureau of Economic Geology Geological Circular 81-3, 173 p. Gustavson, T. C., Presley, M. W., Handford, C. R., Finley, R. J., Dutton, S. P., Baumgardner, R. W., Jr., McGillis, K. A., and Simpkins, W. W., 1980, Geology and geohydrology of the Palo Duro basin, Texas panhandle: Austin, University of Texas Bureau of Economic Geology Geological Circular 80-7, 99 p. Simpkins, W. W., Gustavson, T. C., Alhades, A. B., and Hoadley, A. D., 1981, Impact of evaporite dissolution and collapse on highways and other cultural features in the Texas panhandle and eastern New Mexico: Austin, University of Texas Bureau of Economic Geology Geological Circular 81-4, 23 p. University of Texas Bureau of Economic Geology, Austin, written commun., 1982. West Texas Geological Society, 1949, East-west cross section through Permian Basin of West Texas: Midland, Tex., West Texas Geological Society. _____ 1951, North-south cross section through Permian Basin of West Texas: Midland, Tex., West Texas Geological Society. _____ 1953, North-south cross section through Permian Basin of West Texas: Midland, Tex., West Texas Geological Society. NEW MEXICO Alto, B. R., Fulton, R. S. and Haigler, L. B., 1965, Salines, in Mineral and water resources of New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 87, p. 299-306. Austin, G. S., written commun., 1982. Jones, C. L., 1974, Salt deposits of the Clovis-Portales area east-central New Mexico: U. S. Geological Survey Open-File Report 74-60, 22 p.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

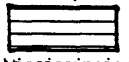
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
PERMIAN--Continued				COLORADO Argall, G. O., Jr., 1949, Industrial minerals of Colorado: Quarterly of the Colorado School of Mines, v. 44, no. 2, 477 p. Barb, C. F., 1946, Selected well logs of Colorado: Quarterly of Colorado School of Mines, v. 41, no. 1, 435 p.
WILLISTON (North Dakota, South Dakota, Montana)	Jurassic  Permian/Triassic  Mississippian  Devonian 	Ground surface	Thickness: 100 Depth: 1,000	Anderson, S. B., 1964, Salt deposits in North Dakota, in The mineral resources of North Dakota: Grand Forks, N. Dak., University of North Dakota, p. 60-79. Anderson, S. B., and Hansen, D. E., 1967, Halite deposits in North Dakota: North Dakota Geological Survey Report of Investigation 28, 3 pls. Anderson, S. B., and Swinehart, R. P., 1979, Potash salts in the Williston Basin, USA: North Dakota Report of Investigation 68, 19 p. Beekly, B. W., 1956, East Poplar field, Roosevelt County, Montana, in Williston Basin symposium: North Dakota Geological Society and Saskatchewan Geological Society, p. 61-65. Sandburg, C. A., 1962, Geology of the Williston Basin, North Dakota, Montana, and South Dakota, with reference to subsurface disposal of radioactive waste: U.S. Geological Survey TEI-809, 148 p. Zieglar, D. L., 1956, Pre-Piper post-Minnekahta red beds in the Williston Basin, in Williston Basin symposium: North Dakota Geological Society and Saskatchewan Geological Society, p. 170-178.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
NORTH DENVER (Colorado, Wyoming, Nebraska)	Permian 	Ground surface	Thickness: 100 Depth: 500	Argall, G. O., 1949, Industrial minerals of Colorado: Quarterly of the Colorado School of Mines, v. 44, no. 2, p. 362-366. Barb, C. F., 1946, Selected well logs of Colorado: Colorado School of Mines Quarterly, v. 41, no. 1, 435 p. Burchett, R. R., written commun., 1983. MacLachlan, James, and Bieber, Alan, 1963, Permian and Pennsylvanian geology of the Hartville Uplift-Alliance Basin-Chadron Arch, in Boyard, D. W., and Katich, P. J., eds., Guidebook to the geology of the northern Denver Basin and adjacent uplifts: Denver, Rocky Mountain Association of Geologists, 14th Field Conference, p. 84-94. Maher, J. C., and Collins, J. B., 1952, Correlation of Permian and Pennsylvanian rocks from western Kansas to the Front Range of Colorado: U.S. Geological Survey Oil and Gas Investigations Chart OC-46. Rocky Mountain Association of Geologists Research Committee, 1976, Subsurface cross sections of Colorado: Rocky Mountain Association of Geologists Special Publication 2, 139 p., 23 pls. Wilson, J. M., 1978, Permo-Pennsylvanian of the west-central Nebraska Panhandle, in Energy resources of the Denver Basin: Rocky Mountain Association of Geologists Symposium 1978, p. 129-140.
POWDER RIVER (Wyoming)	Permian 	Ground surface	Thickness: 50 Depth: 1,000	DeBruin, R. H., written commun., 1981. Lane, D. W., 1973, The Phosphoria and Goose Egg Formations in Wyoming: Geological Survey of Wyoming Preliminary Report 12, 24 p.
GREEN RIVER (Wyoming)	Tertiary 	Ground surface	Thickness: 50 Depth: 500	Culbertson, W. C., 1966, Trona in the Wilkins Peak Member of the Green River Formation, southwestern Wyoming in Geological Survey research 1966: U.S. Geological Survey Professional Paper 550-B, p. B159-B164.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

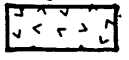
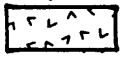
Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
PREUSS (Wyoming, Idaho, Utah)	Jurassic 	Ground surface	Thickness: not contoured Depth: not contoured	Peterson, J. A., 1953, Marine Jurassic rocks, northern and eastern Uinta Mountains and adjacent areas [Colorado-Utah-Wyoming]: Wyoming Geological Association Guidebook, 10th Annual Field Conference, 1955, p. 75-79. Petroleum Information Corporation, 1978, The overthrust belt: Denver, Petroleum Information Corporation, 140 p.
PARADOX (Colorado)	Pennsylvanian 	Ground surface	Thickness: 1,000 Depth: 500	Pierce, W. G., and Rich, E. I., 1962, Summary of rock-salt deposits in the United States as possible storage for radioactive waste material: U.S. Geological Survey Bulletin 1148, 91 p., 6 pls.
PICEANCE (Colorado)	Tertiary 	Ground surface	Thickness: not contoured Depth: not contoured	Ege, J. R., Leavesley, G. H., Steele, S. G., and Weeks, J. B., 1978, Site evaluation of U.S. Bureau of Mines experimental oil-shale mine, Piceance Creek Basin, Rio Blanco County, Colorado: U.S. Geological Survey Open-File Report 78-390, 42 p. Weeks, J. B., Leavesley, G. H., Welder, F. A., and Saulnier, G. J., Jr., 1974, Simulated effects of oil-shale development on the hydrology of Piceance Basin, Colorado: U.S. Geological Survey Professional Paper 908, 84 p., 1 pl.
EAGLE VALLEY (Colorado)	Pennsylvanian 	Ground surface	Thickness: not contoured Depth: not contoured	Mallory, W. W., 1966, Cattle Creek anticline, a salt diapir near Glenwood Springs, Colorado, in Geological Survey research, 1966: U.S. Geological Survey Professional Paper 550-B, p. B12-B15. Rocky Mountain Association of Geologists Research Committee, 1976, Subsurface cross sections of Colorado: Rocky Mountain Association of Geologists Special Publication 2, 139 p., 23 pls.

Table 1.--Explanation for salt deposit maps and refeences identifying sources of salt data used on maps--Continued

Basin or salt body (State	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
SEVIER (Utah)	Jurassic 	Ground surface	Thickness: not contoured Depth: 1,000	Mitchell, G. C., 1979, Stratigraphy and regional implications of the Argonaut Energy No. 1 Federal, Millard County, Utah, in Rocky Mountain Association of Geologists, Basin and Range Symposium 1979: Rocky Mountain Association of Geologists, p. 503-514 Moulton, F. C., 1975, Lower Mesozoic and upper Paleozoics petroleum potential of the Hingeline area, central Utah, in Bolyard, D. W., ed., Deep drilling frontiers of the central Rocky Mountains, Symposium 1975: Rocky Mountain Association of Geologists, p. 87-97.
VIRGIN VALLEY (Nevada)	Tertiary 	Ground surface	Thickness: not contoured Depth: not contoured	Longwell, C. R., 1928, Geology of the Muddy Mountains, Nevada, with a section through the Virgin River to Grand Wash Cliffs, Arizona: U.S. Geological Survey Bulletin 798, 152 p. Mannion, L .E., 1963, Virgin Valley salt deposits, Clark County, Nevada, in Bersticker, A. C., ed., Symposium on salt, 1st, Cleveland, 1962, Proceedings: Northern Ohio Geological Society, p. 166-174.
SUPAI (Arizona)	Permian 	Ground surface	Thickness: 100 Depth: 500	Gerrard, T. A., 1966, Environmental studies of Fort Apache Member, Supai Formation, east-central Arizona: American Association of Petroleum Geologists Bulletin, v. 50, p. 2434-2463. Peirce, H. W., 1969, Salines, in Mineral and water resources of Arizona: Arizona Bureau of Mines Bulletin 180, p. 417-424. Peirce, H. W., and Scurlock, J. R., 1972, Arizona well information: Arizona Bureau of Mines Bulletin 185, 195 p.
RED LAKE (Arizona)	Tertiary 	Ground surface	Thickness: 500 Depth: not contoured	Peirce, H. W., 1972, Red Lake salt mass: Arizona Bureau of Mines Fieldnotes, v. 2, no. 1, p. 4-5. _____ 1976, Tectonic significance of Basin and Range thick evaporite deposits: Arizona Geological Society Digest, v. 10, p. 325-339, March.

Table 1.--Explanation for salt deposit maps and references identifying sources of salt data used on maps--Continued

Basin or salt body (State)	Geologic age and symbol	Base level for top of salt	Contour interval (ft)	References
LUKE (Arizona)	Tertiary 	Ground surface	Thickness: 500 Depth: not contoured	Eaton, G. P., Peterson, D. L., and Schuman, H. H., 1972, Geophysical, geohydrological and geochemical reconnaissance of the Luke salt body, central Arizona: U.S. Geological Survey Professional Paper 753, 28 p. Mytton, J. W., 1973, Two salt structures in Arizona--the Supai salt basin and the Luke salt body: U.S. Geological Survey Open-File Report 73-202, 40 p. Peirce, H. W., written commun., 1982.