DO NOT MICROFILM
COVER

Circular 23
Geothermal Resources in Arizona:
A Bibliography

by
Susanna S. Calvo

1982

MASTER

Arizona
Mineral Technology
Branch
GROUP
Arizona

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Geothermal Resources in Arizona: A Bibliography

by
Susanna S. Calvo

State of Arizona
Bureau of Geology and Mineral Technology
Geological Survey Branch
GEOTHERMAL GROUP

1982

Circular 23

FC07-79 2012015

University of Arizona
Tucson

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PURCHASE ORDER NO. 03X-49978
4-20-83
RECEIVED

INTRODUCTION

Since 1977 considerable work has been accomplished in order to locate, understand and evaluate geothermal resources in the State of Arizona. Much of this work has been performed by Geothermal Project geologists of the State of Arizona Bureau of Geology and Mineral Technology. Additional reports addressing problems associated with geothermal development were produced by the Arizona Geothermal Commercialization Team of the Department of Chemical Engineering, University of Arizona. This bibliography references all reports and maps generated by these two groups. In addition, to provide a more comprehensive listing of geothermal energy in Arizona, all available "geothermal" papers from other sources have been included, most of them written in the last few decades. Older reports dating back to 1867, on thermal waters and mineral springs of Arizona and the southwest U.S., also have been listed.

Papers authored by geologists of the Geothermal Project are primarily evaluations of the geothermal potential of specific sites. Reports prepared by the Commercialization Team evaluate the potential for geothermal-energy use in Arizona and cover legislative issues, financial feasibility, area development plans, technical applications for space heating and cooling, and mining and agricultural needs.

Additional references have been incorporated into the bibliography because they provide background in the technical disciplines that support geothermal-energy research in Arizona: geology, hydrology, geophysics and geochemistry. Certain of these publications highlight Arizona localities later explored for geothermal resources; others propose geologic and geophysical models for the occurrence of thermal waters in the deep, alluvium-filled basins of southern and western Arizona. Some papers use geologic, hydrologic and geophysical data to define basin structures and alluvial stratigraphy, which control the occurrence, volume and movement of thermal water. Geochemical studies of well and spring waters discuss water quality and provide estimates of maximum water temperatures at depth. Publications on the thermal characteristics and structure of the crust beneath both the Colorado Plateau and the Basin and Range physiographic provinces are listed because they contain heat flow and thermal gradient data. Much of the regional geothermal data has been summarized on two large-scale maps showing the resource potential of Arizona (References # 82 and # 220).

Finally, selected references on general geology and hydrology have been included in this bibliography because they contain original data on temperatures of well, springs and water quality.

The various types of publications included in this bibliography have been annotated by symbols, shown below under SYMBOL AND ABBREVIATION KEY.

Index headings under SUBJECT AND AREA INDEX group publications by subject and location. Although many cross-references are included, it is advisable to check all possible categories for papers pertinent to one's interests. Specific locations are listed by county (see map preceding INDEX).

Federal funding for the Geothermal Project of the State of Arizona Bureau of Geology and Mineral Technology was provided by the U.S. Department of Energy, Division of Geothermal Energy, and the U.S. Department of Interior, Bureau of Reclamation. The Arizona Geothermal Commercialization Team received funding from the U.S. Department of Energy, Division of Geothermal Energy, and project administration from the Arizona Solar Energy Commission.

The author gratefully acknowledges Claudia Stone for her guidance and support of this compilation; James C. Witcher and Larry A. Goldstone for suggesting many useful sources of information and providing critical review; and Anne Candea and Rhonda Bitterli for editorial assistance. Sincere appreciation is extended to Asalene Hill and Peggy Jackson for competent typing, Bette Holt for cover design and illustrations, and Joe LaVoie for layout.

SYMBOL AND ABBREVIATION KEY

Symbols:

- 4.** Bold numeral indicates report on open-file at, or produced in conjunction with, the State of Arizona Bureau of Geology and Mineral Technology
- (G) Geophysical study
- (H) Report contains heat-flow and geothermal-gradient data
- (O) Older publication, may contain incomplete or obsolete data
- (T) Report contains some thermal well and spring data

Abbreviations:

- AMS Army Map Service
- HDR Hot dry rock
- M.y. Million years

AVAILABILITY OF REPORTS AND MAPS

State of Arizona Bureau of Geology and Mineral Technology publications and open-file reports may be obtained or reviewed at 845 N. Park Ave., Tucson, Arizona 85719 (602/626-2733).

Arizona theses and dissertations are shelved in the libraries at:

- University of Arizona, Tucson 85721 (602/626-0111)
- Arizona State University, Tempe 85281 (602/965-5081)
- Northern Arizona University, Flagstaff 86001 (602/523-9011)

Current compilations of graduate theses on Arizona geology are available from the Arizona Geological Society, P.O. Box 40952, Tucson, Arizona 85717 (Digests XII and XIII), and at the State of Arizona Bureau of Geology and Mineral Technology.

U.S. Geological Survey (U.S.G.S.) publications may be obtained at the following addresses:

- Superintendent of Documents, U.S. Government Printing Office,
Washington, DC 20402 (*texts*)
- U.S.G.S., Western Distribution Branch, Box 25286, Federal Center,
Denver, CO 80225 (*maps*)
- U.S.G.S., Western Distribution Branch, Open-file Services Section,
Box 25425, Federal Center, Denver, CO 80225 (*open-file reports*)

Other government documents may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

BIBLIOGRAPHY

1. Aiken, C.L.V., and Ander, M.E., 1981, Regional strategy for geothermal exploration with emphasis on gravity and magnetotellurics: *Journal of Volcanology and Geothermal Research*, v. 9, no. 1, p. 1-27.
2. Aiken, C.L.V., Lysonski, J.C., Sumner, J.S., and Hahman, W.R., Sr., 1981, A series of 1:250,000 complete residual Bouguer gravity anomaly maps of Arizona: *Arizona Geological Society Digest* v. 13, p. 31-37. (G)
3. Aldrich, M.J., and Laughlin, A.W., 1981, Age and locations of volcanic centers ≤ 3.0 m.y. old in Arizona, New Mexico and the Trans-Pecos area of west Texas (modified from R.G. Luedke and R.L. Smith, 1978): Los Alamos Scientific Laboratory LA-8812-MAP, scale 1:1,000,000.
4. Arizona Geothermal Commercialization Team, 1981, Geothermal energy for copper dump leaching: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-9, 15 p.
5. ———1981, Geothermal energy for the extraction of copper by flotation: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-10, 15 p.
6. ———1981, Maryvale Terrace: Residential district space heating and cooling: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-11, 40 p.
7. ———1981, Geothermal heating for the Environmental Research Laboratory greenhouses: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-12, 20 p.
8. ———1981, Heat pump for heating and cooling with low-temperature geothermal water: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-13, 20 p.
9. ———1981, Advanced process design for ethanol production from cellulose: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-14, 11 p.
10. ———1981, Irrigation pumping using geothermal energy: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-15, in prep.
11. ———1981, Geothermal energy and the manufacture of heavy water: An industry for a remote geothermal site: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-16, in prep.
12. ———1981, Geothermal-assisted power plants: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-8, 22 p.
13. ———1980, Geothermal development plan, Yuma County: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-18, 20 p.
14. ———1980, Geothermal development plan, Cochise-Santa Cruz Counties: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-9, 31 p.
15. ———1980, Geothermal development plan, northern Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-10, 49 p.
16. ———1979, Geothermal development plan, Maricopa County: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-8, 59 p.
17. ———1979, Geothermal development plan, Pima County: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-9, 46 p.
18. ———1979, Geothermal development plan, Graham-Greenlee Counties: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-10, 37 p.
19. ———1979, Geothermal development plan, Pinal County: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-11, 26 p.

20. Arizona State Fuel and Energy Office, 1975, Proceedings of conference on water requirements for lower Colorado River basin energy needs: Office of Arid Land Studies, University of Arizona, Tucson, 344 p.
21. Arizona, State House of Representatives, 1977, 33rd Legislature, first regular session, House Bill 2257 (geothermal energy in Arizona), 17 p.
22. ———1979, 34th Legislature, first regular session, House Bill 2080, sec.38, sec. 27-651, Arizona revised statutes (geothermal energy in Arizona), p. 30-38.
23. Arizona State Land Department, 1978, State well inventory computer listing, Water Division Status Report, Location Order, Phoenix, 575 p. (T)
24. Arizona State Land Department, 1973, Geothermal favorability areas: unpub. preliminary report, Phoenix, unpaginated.
25. Arizona Well Records Company, 1961, Arizona well records, Phoenix (T)
26. Arney, B., Goff, F.E., and Eddy, A., 1980, Volcanic rocks of the Colorado Plateau Transition Zone, northern Arizona (abstract): Geological Society of America Abstracts with Programs, v. 12, no. 6, p. 266.
27. Arteaga, F.E., White, N.D., Cooley, M.E., and Sutheimer, A.F., 1968, Ground water in Paradise Valley, Maricopa County, Arizona: Arizona State Land Department Water Resources Report 35, 76 p. (T)
28. Bedwn, S.G., Schumann, H.H., Kister, L.R., and Johnson, P.W., 1963, Basic ground-water data of the Willcox basin, Graham and Cochise Counties, Arizona: Arizona State Land Department Water Resources Report 14, 93 p.
29. Bell, H., 1978, Development of geothermal energy at Chandler, Arizona: Electric Power Research Institute Annual Geothermal Program, EPRI-ER—660-SR, p. 3.19-3.20.
30. Berry, G.W., Grim, P.J., and Ikelman, J.A., 1980, Thermal springs list for the United States: National Oceanic and Atmospheric Administration Key to Geophysical Records Documentation No. 12, Boulder, map incl., 60 p.
31. Bierman, S.L., Stover, D.F., and Lamont, W.J., 1978, Geothermal energy in the western United States: New York, Praeger Publishers, 466 p.
32. Bissett, D.H., 1958, A survey of hydrothermal uranium occurrences in southeastern Arizona: unpub. M.S. Thesis, University of Arizona, Tucson, 88 p.
33. Blackwell, D.D., and Chapman, D.S., 1977, Interpretation of geothermal gradient and heat flow data for Basin and Range systems, *in* Transactions: Geothermal Resources Council, Davis, Calif., v. 1, p. 19-20.
34. Bowden, C., 1975, The impact of energy development on water resources in arid lands: Office of Arid Lands Studies Research Information Paper No. 6, University of Arizona, Tucson, 278 p.
35. Bryan, K., 1925, The Papago country, Arizona; a geographic, geologic and hydrologic reconnaissance with a guide to desert watering places: U.S. Geological Survey Water-Supply Paper 499, 27 plates, 41 figs., 436 p. (O)
36. Buehrer, T.F., 1927, The radioactivity of the thermal waters of Castle Hot Springs, Arizona: American Journal of Science, 5th Sec., v. 13, p. 445-499. (O)
37. Byerly, D.E., and Stolt, R.H., 1977, An attempt to define the Curie point isotherm in northern and central Arizona: Geophysics, v. 42, p. 1394-1400.
38. Calvo, S.S., Allen, T.J., and Hahman, W.R., Sr., 1981, Subsurface stratigraphy and geothermal resource potential of the Avra valley, Pima County, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-5, 2 plates, 48 p.

39. Campbell, A., and Jones, N.O., 1979, Preliminary geothermal assessment of the Big Sandy valley, Mohave County, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-15, 26 p.
40. City of Mesa, Arizona, Engineering Department, Current well record files. (T)
41. City of Tucson, Arizona, Metropolitan Utilities Management Agency, Water Resources Division, Current well record files. (T)
42. Cloran, C.A., 1977, Geophysics, hydrology and geothermal potential of the Tonopah basin, Maricopa County, Arizona: unpub. M.S. Thesis, Arizona State University, Tempe, 63 p.
43. Coates, D.R., and Cushman, R.L., 1955, Geology and ground-water resources of the Douglas basin, Arizona: U.S. Geological Survey Water-Supply Paper 1354, 56 p. (T)
44. Conley, J.N., and Giardina, S., Jr., 1979, Favorable and potentially favorable areas for hydrocarbon and geothermal energy sources in northeastern Arizona: Arizona Oil and Gas Conservation Commission Report of Investigation 7, Phoenix, 55 p.
45. Conley, J.N., and Stacey, O.A., 1977, Temperature data tabulation to accompany temperature map of subsurface basement rocks map, GT-3A, and temperature map of subsurface suprabasement rocks, GT-3B: Arizona Oil and Gas Conservation Commission, Phoenix, 9 p. (T)
46. Coplen, T.B., 1973, Cooperative geochemical investigation of geothermal resources in the Imperial valley and Yuma areas: Final Report, Bureau of Reclamation, Denver, National Technical Information Service Report 1GPP-UCR-73-48, 29 p.
47. Crook, J.K., 1899, The mineral waters of the United States and their therapeutic uses with an account of various mineral spring localities, their advantages as health resorts, means of access, etc., to which is added an appendix on potable waters: New York, Lea Bros. and Co., 588 p. (O)
48. Cunningham, J.E., 1981, Preliminary detailed geologic map and cross sections of the Clifton Hot Springs and San Francisco River area: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-22, scale 1:24,000.
49. Darton, N.H., 1920, Geothermal data on the U.S.: U.S. Geological Survey Bulletin 701, 97 p. (O)
50. Davidson, E.S., 1973, Water-resources appraisal of the Big Sandy area, Mohave County, Arizona: Arizona Water Commission Bulletin 6, Phoenix, 40 p. (T)
51. Davis, G.E., Hardt, W.F., Thompson, L.K., and Cooley, M.E., 1963, Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico and Utah, part I, records of ground-water supplies: Arizona State Land Department Water Resources Report 12-A, Phoenix, 159 p. (T)
52. De Cook, K.J., 1952, San Simon basin, Cochise County, in Ground water in the Gila River basin and adjacent areas, Arizona: U.S. Geological Survey Open-File Report, p. 59-68. (T)
53. Dellechiaie, F. 1976, A hydrochemical study of the south Santa Cruz basin near Coolidge, Arizona, in Proceedings of the Second United Nations Symposium on the Development and Use of Geothermal Resources, v. 1, San Francisco, p. 339-348.
54. Denis, E.E., 1968, Ground-water conditions in the Waterman Wash area, Maricopa and Pinal Counties, Arizona: Arizona State Land Department Water Resources Report 37, Phoenix, 23 p.
55. Druitt, C.E., and Conley, J.N., 1977, Geothermal areas: Arizona Oil and Gas Conservation Commission, Phoenix, unpub. map, scale 1:1,000,000.
56. Dutt, G.R., and McCreary, T.W., 1970, The quality of Arizona's domestic, agricultural and industrial waters: University of Arizona Agricultural Experiment Station Report 256, Tucson, 83 p. (T)
57. Edmiston, R.C., 1973, Thermal anomalies and sulfide oxidation in the Silver Bell mining district, Arizona: Mining Engineering, v. 25, no. 12, p. 45.

58. Everit, R.S., 1925, Hot spring water from Clifton, Arizona: *Economic Geology*, v. 20, no. 3, p. 291-292. (O)
59. Felmlee, J.K., and Cadigan, R.A., 1978, Radium and uranium data for mineral springs in eight western states: U.S. Geological Survey Open-File Report 78-561, 45 p.
60. Feth, J.H., and Hem, J.D., 1963, Reconnaissance of headwater springs in the Gila River drainage basin, Arizona: U.S. Geological Survey Water-Supply Paper 1619-H, p. H54.
61. Feth, J.H., White, N.D., and Hem, J.D., 1954, Preliminary report of investigation of springs in the Mogollon rim region, Arizona: U.S. Geological Survey Open-File Report, 77 p. (T)
62. Fitch, W.E., 1927, Mineral waters of the United States and American spas: Philadelphia, Lea & Febiger, 799 p. (O)
63. Foster, K.E., and Johnson, J.D., 1974, Application of remote sensing to state and local government: Office of Arid Lands Studies Annual Report, University of Arizona, Tucson, 113 p.
64. Frank, H., ed., 1981, Arizona's energy future—making the transition to a new mix: 39th Arizona Town Hall, Phoenix, 196 p.
65. Gerlach, T., Norton, D., DeCook, K.J., and Sumner, J.S., 1975, Geothermal water resources in Arizona: Feasibility Study Project Completion Report: U.S. Department of Interior, Office of Water Resources, Research Project A-054-Arizona, Washington, 36 p.
66. Gertsch, W.D., Keller, J.G., Hahman, W.R., Sr., and Ruschmann, D., 1979, The potential for using geothermal energy for space cooling at Williams Air Force Base, Arizona: U.S. Department of Energy, Idaho Operations Office, Report GP-790007, 67 p.
67. Giardina, S., Jr., 1978, Thermal gradient anomalies—southern Arizona: *Interstate Oil Compact Bulletin*, Oklahoma City, v. 20, no. 2, p. 19-28.
68. Giardina, S., Jr., and Conley, J.N., 1978, Thermal gradient anomalies in southern Arizona: Arizona Oil and Gas Conservation Commission Report of Investigation 6, Phoenix, 52 p.
69. Gilbert, G.K., 1875, Report on the geology of portions of California, Nevada, Utah, Colorado, New Mexico and Arizona, examined in the years 1871, 1872, and 1873, in Wheeler, G.M., ed., U.S. Geographic and Geological Surveys W. 100th Meridian Report, v. 3: Geology, pt. 1, p. 19-187. (O)
70. Gish, D.M., Keller, G.R., and Sbar, M.L., 1981, A refraction study of deep crustal structure in the Basin and Range—Colorado Plateau of eastern Arizona: *Journal of Geophysical Research*, v. 86, no. B7, p. 6029-6038. (G)
71. Goff, F.E., 1979, "Wet" geothermal potential of the Kingman-Williams region, Arizona: Los Alamos Scientific Laboratory Report LA-7757-MS, 25 p.
72. Goff, F.E., Arney, B.H., Aiken, C., West, F.G., and Eddy, A.C., 1979, Preliminary evaluation of the Aquarius Mountains hot dry rock geothermal prospect, Arizona, in *Transactions: Geothermal Resources Council*, Davis, Calif., v. 3, p. 257-260.
73. Goff, F.E., and others, 1981, Hot dry rock geothermal prospects, 1981, in *Transactions: Geothermal Resources Council*, Davis, Calif., v. 5, p. 173-176.
74. Goldstone, L.A., 1979, Geothermal direct heat use: market potential/penetration analysis, Arizona, in Powell, W. and Tang, D.K., eds., *Geothermal direct heat use: market potential/penetration analysis for federal region IX*, Jet Propulsion Laboratory Publication 80-41, p. A-75—A-90, 25 p.
75. Goldstone, L.A., and Malysa, L. 1981, Legislative issues in geothermal development in Arizona: Prepared for the Arizona State Legislature with the assistance of the National Conference of State Legislatures, State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-19, p. 000.

76. Griffith, J.L., compiler, 1980, State geothermal commercialization programs in ten Rocky Mountain States, Semi-Annual Progress Report, July—December, 1979: Department of Energy, Idaho Falls, National Technical Information Service Report DOE/ID/12101-1, 325 p.
77. Gutmann, J.T., 1981, Geologic framework and hot dry rock geothermal potential of the Castle Dome area, Yuma County, Arizona: Los Alamos Scientific Laboratory Report LA-8723-HDR, 23 p. (T)
78. Hahman, W.R., Sr., 1981, Geothermal resource potential for a portion of the San Pedro River valley: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-6, 59 p.
79. ———1980, Preliminary geothermal assessment of the Verde valley, Arizona, with a section on the hydrology by Alice Campbell: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-12, 21 p.
80. ———1979, Geothermal energy in Arizona: Geothermal Energy Magazine, v. 7, no. 11, p. 7-18.
81. Hahman, W.R., Sr., Stone, Claudia, and Witcher, J.C., 1978, Preliminary map—geothermal energy resources of Arizona, Geothermal Map No. 1: State of Arizona Bureau of Geology and Mineral Technology, scale 1:1,000,000.
82. Hahman, W. R., Sr., White, D.H., and Wolf, David, eds., 1978, Potential of geothermal energy in Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 78-5, 147 p.
83. Haigler, L.B., 1969, Geothermal resources, in Mineral and water resources of Arizona: Arizona Bureau of Mines Bulletin 180, Tucson, p. 575-580.
84. Hale, M.E., Ed., 1974, Arizona energy, a framework for decision: The University of Arizona Press, Tucson, p. 59-65.
85. Hanny, J.A., and Lunis, B.C., eds., 1979, Hydrothermal commercialization baseline report for the state of Arizona: EG&G Idaho, Inc., 72 p.
86. Hardt, W.F., Cattany, R.E., and Kister, L.R., 1964, Basic ground-water data for western Pinal County, Arizona: Arizona State Land Department Water Resources Report 18, Phoenix, 59 p. (T)
87. Harper, L.W., and Anderson, T.W., 1976, Maps showing ground-water conditions in the Concho, St. Johns, and White Mountains areas, Apache and Navajo Counties, Arizona—1975, basic data compilation—well and spring information: U.S. Geological Survey Water Resources Investigations 76-104. (T)
88. Heindl, L.A., Cosner, O.J., and Kister, L.R., 1961, Hydrologic data and drillers' logs, Papago Indian Reservation, Arizona: Arizona State Land Department Water Resources Report 9, Phoenix, 116 p. (T)
89. Heindl, L.A., and White, N.D., 1965, Hydrologic and drill-hole data, San Xavier Indian Reservation and vicinity, Pima County, Arizona: Arizona State Land Department Water Resources Report 20, Phoenix, 48 p. (T)
90. Hem, J.D., 1950, Quality of water of the Gila River basin above Coolidge dam, Arizona: U.S. Geological Survey Water-Supply Paper 1104, 230 p. (T)
91. Hermance, J.F., and Pedersen, J., 1977, Assessing the geothermal resource base of the southwestern U.S.: Status report of a regional geo-electromagnetic traverse: Geophysics, v. 42, no. 1, p. 155-156.
92. Huntoon, P.W., 1977, Relationship of tectonic structure to aquifer mechanics in the western Grand Canyon district, Arizona: Water Resources Research Institute, University of Wyoming, Laramie Water Resources Series no. 66, 51 p.
93. Johannessen and Girand Consulting Engineers, Inc., 1981, Feasibility study for geothermal water space heating for the Safford Federal Prison Camp, Safford, Arizona: unpub. report for State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-27, 55 p.

94. Jones, N.O., 1979, Preliminary geothermal assessment of the Hyder area, with a section on hydrology by Alice Campbell: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-13, 33 p.
95. ————1979, Preliminary geothermal assessment of the Harquahala-Tonopah area, with a section on hydrology by Alice Campbell: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-14, 43 p.
96. Kam, W., Schumann, H.H., Kister, L.R., and Arteaga, F.E., 1966, Basic ground-water data for western Salt River valley, Maricopa County, Arizona: Arizona State Land Department Water Resources Report 27, Phoenix, 72 p. (T)
97. Keller, G.R., Braile, L.W., and Morgan, P., 1979, Crustal structure, geophysical models and contemporary tectonism of the Colorado Plateau: *Tectonophysics*, v. 61, p. 131-147. (H)
98. Keller, G.V., Grose, L.T., and Crewdson, R.A., 1978, Speculations on the nature of geothermal energy in Basin and Range province of western United States: *Colorado School of Mines Quarterly*, v. 73, no. 4, pt. 2, Denver, p.71-76.
99. Kister, L.R., and Hatchett, J.L., 1963, Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico and Utah, Part II, selected chemical analyses of the ground water: Arizona State Land Department Water Resources Report 12-B, Phoenix, 58 p. (T)
100. Knechtel, M.M., 1935, Indian Hot Springs, Graham County, Arizona: *Washington Academy of Science Journal*, v. 25, no. 9, p. 409-413. (O)
101. ———— 1938, *Geology and ground-water resources of the valley of the Gila River and San Simon Creek, Graham County, Arizona*: U.S. Geological Survey Water-Supply Paper 796, 222, p. (T,O)
102. Kron, A., and Heiken, G., 1980, Geothermal gradient map of the United States: Los Alamos Scientific Laboratory Report LA-UR—80-1489, scale 1:5,000,000.
103. Lachenbruch, A.H., and Sass, J.H., 1981, Heat flow and its implications for tectonics and volcanism in the Basin and Range province, in Howard, K.A., Carr, M.D., and Miller, D.M., eds., *Tectonic framework of the Mohave and Sonoran Deserts, California and Arizona*: U.S. Geological Survey Open-File Report 81-503, p. 56-58.
104. ————, 1977, Heat flow in the United States and the thermal regime of the crust, in Heacock, J.G., ed., *The Earth's Crust*: American Geophysical Union, Geophysical Monograph 20, p. 626-675.
105. Lepley, L.K., 1979, Geophysical lineaments of Arizona: Los Alamos Scientific Laboratory Report LA-7953-MS, 22 p.
106. ————1978, Skylab lineament map (1:500,000 scale) of Arizona with tectonic model and exploration guide for geothermal resources: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 78-4, 35 p.
107. ————1977, LANDSAT lineament map of Arizona with emphasis on Quaternary fractures: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 77-2, scale 1:1,000,000, 30 p.
108. Ligner, J.J., White, N.D., Kister, L.R., and Moss, M.E., 1969, Water resources, in *Mineral and water resources of Arizona*: Arizona Bureau of Mines Bulletin 180, Tucson, p. 471-569.
109. Loew, O., 1875, Report upon mineralogical, agricultural and chemical conditions observed in portions of Colorado, New Mexico, and Arizona, in Wheeler, G.M., U.S. Geographic and Geological Surveys, W. 100th Meridian Report, v. 3: *Geology*, p. 569-661. (O)
110. Lovering, T.S., 1948, Geothermal gradients, recent climatic changes and rate of sulfide oxidation in the San Manuel District, Arizona: *Economic Geology*, v. 43, no. 1, p. 1-20. (H)

111. Luedke, R.G., and Smith, R.L., 1978, Map showing distribution, composition and age of late Cenozoic volcanic centers in Arizona and New Mexico: U.S. Geological Survey Miscellaneous Investigation Map I-1901A, scale 1:1,000,000.
112. Lyonski, J.C., Aiken, C.L.V., and Sumner, J.S., 1981, The complete residual Bouguer gravity anomaly map [of Arizona]: State of Arizona Bureau of Geology and Mineral Technology, Open-File Report 81-24, compiled on 271° x 2° AMS sheets, scale 1:250,000. (G)
113. Lyonski, J.C., Sumner, J.S., Aiken, C.L.V., and Schmidt, J.S., 1980, The complete residual Bouguer gravity anomaly map of Arizona (ISGN 71): Laboratory of Geophysics, University of Arizona, Tucson, scale 1:500,000. (G)
114. McGavock, E.H., 1968, Basic ground-water data for southern Coconino County, Arizona: Arizona State Land Department Water Resources Report 33, Phoenix, 49 p. (T)
115. McGavock, E.H., Edwards, R.J., Gillespie, E.L., and Halpenny, P.C., 1966, Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico and Utah, Part, I-A, supplemental records of ground-water supplies: Arizona State Land Department Water Resources Report 12-E, Phoenix, 55 p. (T)
116. McKay, W.A., 1981, Hydrogeochemical inventory and analysis of thermal springs in the Black Canyon—Hoover Dam area, Nevada and Arizona, *in* Transactions: Geothermal Resources Council, Davis, Calif., v. 5, p. 185-187.
117. McKee, E.H., Smith, R.L., and Shaw, H.R., 1974, Preliminary geothermal exploration, San Francisco volcanic field, northern Arizona (abstract): Geological Society of America, Abstracts with Programs, v. 6, no. 5, p. 458.
118. Malysa, L. and others, 1980, Arizona geothermal institutional handbook: Prepared for Arizona Geothermal Commercialization Team, the U.S. Department of Energy and Arizona Solar Energy Commission, State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-7, 70 p.
119. Mann, L.J., 1977, Maps showing ground-water conditions in the Puerco-Zuni area, Apache and Navajo Counties, Arizona — 1975, basic data compilation—well and spring information: U.S. Geological Survey Water Resources Investigations Open-File Report 77-5. (T)
120. ———1976, Ground-water resources and water use in southern Navajo County, Arizona Water Commission Bulletin 10, Phoenix, 106 p. (T)
121. Mariner, R.H., Presser, D.D., and Evans, W.C., 1977, Chemical, isotopic and gas compositions of selected thermal springs in Arizona, New Mexico and Utah: U.S. Geological Survey Open-File Report 77-654, 42 p.
122. Marlin, J.M., Cunniff, R., McDevitt, P., Nowotny, K., and O'Dea, P., 1981, Regional operations research program for commercialization of geothermal energy in the Rocky Mountain Basin and Range, final report, August 1, 1978—February 28, 1980: New Mexico State University, Las Cruces, National Technical Information Service Report DOE/ID/01756-T1, 126 p.
123. Matlick, J.S. III, 1975, A new geothermal exploration method using mercury: unpub. M.S. Thesis, Arizona State University, Tempe, 83 p.
124. Matlock, W.G., and Davis, P.R., 1972, Ground water in the Santa Cruz valley: Technical Bulletin 194, Agricultural Experiment Station, University of Arizona, Tucson, 37 p. (T)
125. Mburu, S.G., 1975, Vertical temperature and chemical gradients in ground water in Tucson basin, Arizona: unpub. M.S. Thesis, University of Arizona, Tucson, 93 p.
126. Metzger, D.G., and Loeltz, O.J., 1973, Geohydrology of the Needles area, Arizona, California, and Nevada: U.S. Geological Survey Professional Paper 486-J, 54 p. (T)
127. Metzger, D.G., Loeltz, O.J., and Ireland, B., 1973, Geohydrology of the Parker-Blythe-Cibola area, Arizona and California: U.S. Geological Survey Professional Paper 486-G, 130 p. (T)

128. Meyer, R.T., and Davidson, R., 1978, Southwest regional geothermal operations research program, summary report, first project year, June, 1977—August, 1978: Western Energy Planners Ltd., Denver, National Technical Information Service Report IDO-10080, 165 p.
129. Moorman, J.J., 1871, Mineral springs of North America: Philadelphia, J.B. Lippincott and Co., 294 p. (O)
130. ———1867, Mineral waters of the United States and Canada: Baltimore, Kelly and Piet, 507 p. (O)
131. Muffler, L.J.P., ed., 1979, Assessment of geothermal resources of the United States-1978: U.S. Geological Survey Circular 790, 163 p.
132. Norton, Denis, 1977, Exploration criteria for low permeability geothermal resources: U.S. Department of Energy, Geothermal Energy TID-28733, University of Arizona, Tucson, 111 p.
133. O'Connell, M.F., and Kaufmann, R.F., 1976, Radioactivity associated with geothermal waters in the western United States: U.S. Environmental Protection Agency, Office of Radiation Programs, Technical Note ORP/LV-75-8A, Las Vegas, 25 p.
134. Olmsted, F.H., 1980, Temperature logs of wells and test wells in the Yuma area, Arizona and California: U.S. Geological Survey Open-File Report 80-335, 300 p. (T)
135. Olmsted, F.H., Loeltz, O.J., and Irelan, B., 1973, Geohydrology of the Yuma area, Arizona and California: U.S. Geological Survey Professional Paper 486-H, 227 p. (T)
136. Oppenheimer, J.M., and Sumner, J.S., 1981, Gravity modeling of the basins in the Basin and Range province, Arizona: Arizona Geological Society Digest v. 13, including 1:1,000,000 scale depth-to-bedrock map, p. 111-115. (G)
137. Pasqualetti, M.J., 1981, Geothermal energy, site specificity and resource reserves: *GeoJournal*, supplementary issue on geography and energy, 12 p.
138. ———1981, Land use considerations in non-electric geothermal development (abstract), in Kane, P. and Hernbeck, D., eds., Program Abstracts of the Association of American Geographers, Annual Meeting, Los Angeles, p. 236
139. ———1981, Land use planning for geothermal development — Scottsdale (abstract): Proceedings, 4th Annual Applications of Geography Conference, Tempe, v. 4, p. 426.
140. Pasqualetti, M.J., Goldstone, L.A., and Stone, Claudia, 1981, Land use planning for geothermal development — Scottsdale: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-8, 280 p.
141. Peale, A.V., 1894, Natural mineral waters of the United States: U.S. Geological Survey, 14th Annual Report, 1892-1893, pt. 2, p. 49-88. (O)
142. ———1886, Lists and analyses of the mineral springs of the United States (a preliminary study): U.S. Geological Survey Bulletin 32, 235 p. (O)
143. Peirce, H.W., and Scurlock, J.R., 1972, Arizona well information: Arizona Bureau of Mines Bulletin 185, Tucson, 195 p. (T)
144. Peterson, J.E., Buell, S.E., Cadigan, R.A., Felmlee, J.K., and Sprakis, C.S., 1977, Uranium, radium and selected metallic-element analyses of spring water and travertine samples from the Grand Canyon, Arizona: U.S. Geological Survey Open-File Report 77-36, 7 p.
145. Phoenix Geophysics Incorporated, 1979, Report on the reconnaissance resistivity and VLF-EM surveys of the Safford valley area, Graham Co., Arizona: unpub. report for State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-22, 10 figures, 15 plates, 14 p. (G)
146. Pima Association of Governments, 1979, Upper Santa Cruz ground-water quality baseline report: Pima Association of Governments, Tucson, v. 1 and 2, 184 p. (T)

147. Reiter, M., Mansure, A.J., and Shearer, C., 1978, Geothermal characteristics of the Colorado Plateau, *in* Plateau Uplift, Mode and Mechanism: compiled by the Lunar and Planetary Institute, Contribution 329, Houston, 43 p.
148. Reiter, M., and Shearer, C., 1979, Terrestrial heat flow in eastern Arizona, a first report: *Journal of Geophysical Research*, v. 84, no. B11, p. 6115-6120.
149. Roeske, R.H., and Werrell, W.L., 1973, Hydrologic conditions in the San Pedro River valley, Arizona, 1971: *Arizona Water Commission Bulletin* 4, 76 p. (T)
150. Ross, C.P., 1923, The Lower Gila region, Arizona, a geographic, geologic, and hydrologic reconnaissance, with a guide to desert watering places: U.S. Geological Survey Water-Supply Paper 498, 237 p. (O)
151. Ross, P.P., and Farrar, C.D., 1980, Map showing potential geothermal resource areas, as indicated by the chemical character of ground water in Verde valley, Yavapai County, Arizona: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-13, scale 1:126,720.
152. Roy, R.F., Blackwell, D.D., and Birch, F., 1968, Heat generation of plutonic rocks and continental heat flow provinces: *Earth and Planetary Science Letters*, v. 5, no. 1, p. 1-12. (H)
153. Roy, R.F., Decker, E.R., Blackwell, D.D., and Birch, F., 1968, Heat flow in the United States: *Journal of Geophysical Research*, v. 73, no. 16, p. 5207-5221. (H)
154. Sass, J.H., Munroe, R.J., and Stone, Claudia, 1981, Heat flow from five uranium test wells in west-central Arizona: U.S. Geological Survey Open-File Report 81-1089, 42 p. (H)
155. Sass, J.H., Lachenbruch, A.H., Munroe, R.J., Greene, G.W., and Moses, T.H., Jr., 1971, Heat flow in the western United States: *Journal of Geophysical Research*, v. 76, no. 26, p. 6376-6413. (H)
156. Sass, J.H., and others, 1976, A new heat-flow contour map of the conterminous United States: U.S. Geological Survey Open-File Report 76-756, 24 p. (H)
157. Satkin, R.L., 1980, A geothermal resource evaluation of Castle Hot Springs, Arizona: unpub. M.S. Thesis, Arizona State University, Tempe, 147 p.
158. Satkin, R.L., Wohletz, K.H., and Sheridan, M.F., 1980, Water geochemistry at Castle Hot Springs, Arizona, *in* Transactions: Geothermal Resources Council, Davis, Calif., v. 4, p. 177-180.
159. Sauck, W.A., and Sumner, J.S., 1971, Residual aeromagnetic map of Arizona: University of Arizona, Tucson, scale 1:1,000,000. (G)
160. Sbar, Marc L., 1980, Analyses of short term microearthquake activity related to potential geothermal areas in Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-1c, 14 p.
161. Schwennesen, A.T., 1918, Ground water in the San Simon valley, Arizona and New Mexico: U.S. Geological Survey Water-Supply Paper 425, 35 p. (O)
162. Shearer, Charles, 1979, A regional terrestrial heat flow study in Arizona: unpub. Ph.D. Dissertation, New Mexico Institute of Mining and Technology, Socorro, 184 p. (H,T)
163. Shearer, Charles and Reiter, M., 1981, Terrestrial heat flow in Arizona: *Journal of Geophysical Research*, v. 86, no. B7, p. 6249-6260. (H,T)
164. Sheridan, M.F., and Maisano, M., 1976, Zeolite and sheet silicate zonation in a late-Tertiary geothermal basin, near Hassayampa, central Arizona: *in* Proceedings of the Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, v. 1, p. 597-608.
165. Sheridan, M.F., Wohletz, K.H., Ward, M.B., and Satkin, R.L., 1979, Geologic setting of Castle Hot Springs, Arizona, *in* Transactions: Geothermal Resource Council, Davis, Calif., v. 3, p. 643-645.

166. Sheridan, M.F., Satkin, R.L., and Wohletz, K.H., 1980, Geothermal resource evaluation at Castle Hot Springs, Arizona: State of Arizona Bureau of geology and Mineral Technology Open-File Report 80-5, 55 p.
167. Sinno, Y.A., Keller, G.R., and Sbar, M.L., 1981, A crustal seismic refraction study in west-central Arizona: *Journal of Geophysical Research*, v. 86, no. B6, p. 5023-5038. (G)
168. Smalley, R.C., 1981, Thermal waters in the Safford basin, Arizona—an isotopic and geochemical test for non-magmatic heat source hypothesis (abstract): Department of Geosciences 9th Annual Geoscience Daze, University of Arizona, p. 36.
169. Smith, Spencer, 1981, Geothermal resources: their characterization, ownership and relationship to water law in Arizona: unpub. Substantial Paper, University of Arizona College of Law and Technology, Tucson, 101 p.
170. Sonnichsen, J.C., Jr., 1980, Review of water resource potential for developing geothermal resource sites in the western United States: Hanford Engineering Development Laboratory, Richland, Wash., National Technical Information Service Report HEDL-TME—79-74, 86 p.
171. Stauber, D.A., 1980, Short-period teleseismic P residual study of San Francisco volcanic field, Arizona (abstract), in *EOS, Transactions: American Geophysical Union*, v. 61, no. 46, p. 1025.
172. Stearns, N.D., Stearns, H.T., and Waring, G.A., 1937, Thermal springs in the United States: U.S. Geological Survey Water-Supply Paper 679-U p. 59-206 (O)
173. Stone, Claudia, 1981, A preliminary assessment of the geothermal resource potential of the Yuma area, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-4, 28 p.
174. ———1981, Geothermal energy potential at the Papago Farms, Papago Indian Reservation, south-central Arizona (abstract): *Geological Society of America Abstracts with Programs, Cordilleran Section*, v. 13, no. 2, p. 108.
175. ———1981, Geothermal potential of the northern Hassayampa plain, Part II: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-25, 33 p.
176. ———1981, Preliminary assessment of the geothermal potential—City of Scottsdale, Paradise Valley, Maricopa County, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-29, 22 p.
177. ———1980, Heat flow along the southern Colorado Plateau margin, east-central Arizona (abstract), in *EOS, Transactions: American Geophysical Union*, v. 61, no. 17, p. 363.
178. ———1980, Springerville geothermal project—geology, geochemistry, geophysics—final report: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-4, 23 p.
179. ———1980, Preliminary assessment of the geothermal potential at the Papago Farms, Papago Indian Reservation, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-6, 62 p.
180. ———1979, An overview of the geothermal potential of the Springerville area, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-2a, 26 p.
181. ———1979, Springerville—Alpine geothermal project: Results of heat flow drilling: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-16, 23 p.
182. ———1979, Preliminary assessment of the geothermal potential of the northern Hassayampa plain, Maricopa County, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-17, 42 p.
183. Stone, Claudia, and Hahman, W.R., Sr., 1978, Geothermal exploration in Arizona (abstract): *EOS, Transactions, American Geophysical Union*, v. 59, no. 4, p. 388.

184. Stulick, R.S., 1974, Ground-water conditions in the lower Hassayampa area, Maricopa County, Arizona: Arizona Water Commission Bulletin 8, Phoenix, 52 p. (T)
185. Stulick, R.S., and Mooseburner, O., 1969, Hydrologic conditions in the Gila Bend basin, Maricopa County, Arizona: Arizona State Land Department Water Resources Report 39, Phoenix, 63 p. (T)
186. Supkow, D.J., 1971, Subsurface heat flow as a means for determining aquifer characteristics in the Tucson basin, Pima County, Arizona: unpub. Ph.D. Dissertation, University of Arizona, Tucson, 182 p.
187. Swanberg, C.A., 1980, Application of the NaKCa-Mg and silica geothermometers to thermal and non-thermal groundwaters of Arizona (abstract), in EOS, Transactions: American Geophysical Union, v. 61, no. 17, p. 363.
188. ———1979, Chemistry of thermal and nonthermal ground waters in the Rio Grande Rift and adjacent tectonic provinces, in R.E. Riecher, ed., Rio Grande Rift: Tectonics and Magmatism, American Geophysical Union, Washington, p. 279-288.
189. ———1978, Chemistry, origin and potential of geothermal resources in southwestern New Mexico and southeastern Arizona, in Callender, J.F., Wilt, J.C., and Clemons, R.E., eds., Land of Cochise, New Mexico Geological Society Guidebook, 29th Field Conference, Socorro, p. 349-352.
190. Swanberg, C.A., and Stoyer, C.H., 1977, Correlation among water chemistry, regional heat flow and the geothermal potential of Arizona (abstract): Geophysics, v. 42, no. 1, p. 186.
191. Swanberg, C.A., Morgan, P., Stoyer, C.H., and Witcher, J.C., 1977, Regions of high geothermal potential, an appraisal study of the geothermal resources of Arizona and adjacent areas in New Mexico and Utah, and their value for desalination and other uses: New Mexico Energy Institute Report No. 6, Las Cruces, 76 p.
192. Swanberg, C.A., and Rybarczyk, S.M., 1980, Potential for geothermal desalination in the southwest United States: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-lb, 10 p.
193. Tellier, A.H., 1974, Arizona—Gillard Hot Springs: Geothermal Energy Magazine, v. 2, no. 5, p. 20-31.
194. Thomaidis, N.D., 1974, Development in Four Corners—Intermountain area in 1973: American Association of Petroleum Geologists Bulletin, v. 58, no. 8, p. 1581-1585.
195. Trehan, R., Cohen, A., Gupta, J., Jacobsen, W., Leigh, J., and True, S., 1978, Site specific analysis of geothermal development—data files of prospective sites, v. II: U.S. Department of Energy, National Technical Information Service Publication HCP/T4014-01/2, p. XXIII-I-II, XXVII-I-9.
196. U.S. Geological Survey, WATSTORE: National Water Data Storage and Retrieval System (computer tape): U.S. Geological Survey, Reston. (T)
197. U.S. Bureau of Reclamation, Phoenix, well record files. (T)
198. Waring, G.A., revised by Blankenship, R.R., and Bentall, R., 1965, Thermal springs of the United States and other countries of the world—a summary: U.S. Geological Survey Professional Paper 492, 383 p.
199. Warren, R.E., Sclater, J.G., Vacquier, V., and Roy, R.F., 1969, Comparison of terrestrial heat flow and transient geomagnetic fluctuations in the southwestern United States: Geophysics, v. 34, no. 3, p. 463-478. (H)
200. West, F.G., and Laughlin, A.W., 1979, Aquarius Mountain area, Arizona: A possible HDR prospect: Geothermal Energy Magazine, v. 7, no. 8, p. 13-20.
201. White, D.E., and Williams, D.L., 1975, Assessment of geothermal resources of the United States—1975: U.S. Geological Survey Circular 726, 155 p.

202. White, D.H., and others, 1978, Potential of geothermal energy in Arizona: final report for 1977-1978, Prepared by the Arizona Geothermal Planning/Commercialization Team for Department of Energy and Four Corners Regional Development Commission: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 78-6, 147 p.
203. White, I.L., Chartock, M.A., Leonard, R.L., Ballard, S.C., and Calzonetti, F.J., 1978, Work plan for completing a technology assessment of western energy resource development: Oklahoma University Report PB-277771, Science and Public Policy Program, Norman, 71 p.
204. White, N.D. 1963, Analysis and evaluation of available hydrologic data for the San Simon basin, Cochise and Graham Counties, Arizona: U.S. Geological Survey Water-Supply Paper 1619-DD, 33 p. (T)
205. White, N.D., and Smith, C.R., 1965, Basic hydrologic data for San Simon basin, Cochise and Graham Counties, Arizona, and Hidalgo County, New Mexico: Arizona State Land Department Water Resources Report 21, Phoenix, 42 p. (T)
206. White, N.D., Matlock, W.G., and Schwalen, H.C., 1966, An appraisal of the ground-water resources of Avra and Altar valleys, Pima County, Arizona: Arizona State Land Department Water Resources Report 25, Phoenix, 66 p. (T)
207. Wilson, R.D., and White, N.D., 1975, Maps showing ground-water conditions in the San Simon area, Cochise and Graham Counties: U.S. Geological Survey Water Resources Investigations Open-File Report 76-89. (T)
208. Witcher, J.C., 1981, Geothermal energy potential of the lower San Francisco River region, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-7, 141 p.
209. ———1981, Thermal springs of Arizona, *in* Fieldnotes: State of Arizona Bureau of Geology and Mineral Technology, v. 11, no. 2, p. 1-4.
210. ———1981, Geothermal resource potential of the Safford—San Simon basin, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 81-26, 125 p.
211. ———1982, Geothermal resource potential of the Tucson basin, Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 82-3, in prep.
212. ———1982, Geothermal resource potential of the Willcox, Arizona area: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 82-4, in prep.
213. ———1979, A progress report of geothermal investigations in the Clifton area: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-1b, 16 p.
214. ———1979, A preliminary report on the geothermal energy potential of the Safford basin, southeastern Arizona: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-2c, 31 p.
215. ———1979, A preliminary study of the geothermal potential of the Tucson metropolitan area: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-2d, 19 p.
216. ———1979, Geothermal space heating/cooling: A direct use of naturally occurring hot water in southern Arizona, *in* Fieldnotes: State of Arizona Bureau of Geology and Mineral Technology, v. 9, no. 4, p. 1.
217. ———1979, Proven, potential and inferred geothermal resources of Arizona and their heat contents: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 79-5, 65 p.
218. Witcher, J.C., and Stone, Claudia, 1981, Thermal regime of the Clifton-Morenci area, Arizona (abstract): Geological Society of America Abstracts with Programs, Cordilleran Section, v. 13, no. 2, p. 114.
219. ———1980, Heat flow and the thermal regime in the Clifton, Arizona area: State of Arizona Bureau of Geology and Mineral Technology Open-File Report 80-1a, 29 p.

220. Witcher, J.C., Stone, Claudia, and Hahman, W.R., Sr., 1982, The geothermal resources of Arizona (map): National Geophysical and Solar-Terrestrial Data Center, National Oceanic and Atmospheric Administration, in cooperation with the U.S. Department of Energy and the Arizona Bureau of Geology and Mineral Technology, University of Arizona, scale 1:500,000.
221. Wojniak, W.S., and Sumner, J.S., 1980, Deep resistivities under Tucson, Arizona, from a magnetotelluric sounding (abstract): *Geophysics* v. 45, no. 4, p. 522. (G)
222. Wolfe, E., Ulrich, G., and Moore, B., 1977, San Francisco Peaks, Arizona, in McGetchin, Thomas, and others, eds., *Hot dry rock geothermal energy: status of exploration and assessment*: National Technical Information Service 77-74, p. 126-133.
223. Wright, J.J., 1971, Occurrence of thermal ground water in the Basin and Range province of Arizona, in *Hydrology and Water Resources in Arizona and the southwest: Proceedings of the Arizona Section and the Hydrology Section of the American Water Resources Association and the Arizona Academy of Sciences*, v. 1, p. 269-290.
224. Young, C.T., 1979, Geo-electrical studies near Springerville, Arizona, in *Transactions: Geothermal Resources Council*, Davis, Calif., v. 3, p. 805-808. (G)

AREA/SUBJECT INDEX

AGRICULTURAL UTILIZATION OF GEOTHERMAL ENERGY	9,10
APACHE COUNTY	
Area assessment studies	
Four Corners area	194
Springerville-Alpine	178, 180, 181, 224
Ground-water studies; data	
Navajo Indian Reservation	51, 99, 115
Concho, St. Johns, White Mountains	87
Puerco-Zuni area	119
AREA ASSESSMENTS FOR GEOTHERMAL ENERGY	
Arizona, general	24, 31, 55, 64, 65, 81, 82, 83, 84, 85, 91, 108, 128, 131, 183, 189, 190, 191, 195, 201, 202, 217, 220, 223
Aquarius Mountains	72, 200
Avra valley	38
Big Sandy valley	39
Castle Hot Springs	157, 166
Clifton area	208, 213, 218, 219
Harquahala-Tonopah	42, 95
Hyder area	94
Kingman-Williams	71
Northern Arizona	44, 194
Northern Hassayampa area	175, 182
Papago Indian Reservation	174, 179
Safford-San Simon	168, 210, 214
Salt River valley (western)	90
San Francisco volcanic field	73, 117, 222
San Pedro River valley	80
Scottsdale	176
Springerville-Alpine	178, 180, 181
Tonopah basin	42, 95
Tucson basin	211, 215
Verde valley	79, 151
Willcox basin	212
Williams Air Force Base	66
Yuma area	46, 173
BASIN AND RANGE PROVINCE (see also appropriate counties)	
Crustal properties	45, 70, 103, 136, 148, 167
Energy potential	31, 131, 201
CASTLE HOT SPRINGS	36, 157, 158, 165, 166
CLIFTON	208, 213, 218, 219
COCHISE COUNTY	
Area assessment studies	
San Pedro valley	78
Willcox basin	212
Ground-water studies; data	
Douglas basin	43
San Simon basin	52, 161, 204, 205, 207
Willcox basin	28
Resource development plan	14

COCONINO COUNTY	
Area assessment studies	
San Francisco volcanic field	73, 117, 222
COLORADO PLATEAU (see also appropriate counties)	
Crustal properties	37, 70, 92, 97, 147, 177, 181
Energy potential	44, 131, 194, 201
COMMERCIAL APPLICATIONS OF GEOTHERMAL ENERGY	
Agricultural	9, 10
Heating and cooling	6, 7, 8, 29, 66, 93, 118, 140, 216
Mining and industrial	4, 5, 11
Power generation	12
Research	31, 122, 202
DESALINATION OF GEOTHERMAL WATER	191, 192
DEVELOPMENT, see Geothermal Resource, Development	
ENVIRONMENTAL IMPACT OF GEOTHERMAL RESOURCE DEVELOPMENT	
Water resources	20, 34, 170, 191, 192
Land-use planning	137, 138, 139, 140
Radioactivity of thermal water	133
EXPLORATION METHODS (see also individual surveys, e.g. Geophysical Surveys)	
Geophysics	1, 63, 91, 160, 186
Geochemistry	123, 132
Geohydrology	92
Lineaments	105, 106, 107
GEOCHEMICAL MODELS OF GEOTHERMAL SYSTEMS	125, 157, 158, 166, 168, 179, 208, 210, 211
GEOCHEMICAL SURVEYS	
Soil mercury	38, 175, 182, 210
Water chemistry	46, 53, 127, 144, 151, 157, 158, 166 168, 178, 179, 182, 208, 210, 212
GEOHYDROLOGY, see Ground Water	
GEOLOGIC MODELS	
Basin and Range	80, 84, 98, 116, 132, 189, 223
Colorado Plateau	84, 171, 177
GEOLOGY	
Aquarius Mountains area	72, 200
Avra valley	38
Castle Dome Mountains	77
Castle Hot Springs	157, 165
Clifton area	48, 208
Douglas basin	43
Northern Hassayampa area	164, 175
Safford-San Simon basin	210
San Francisco volcanic field	3, 26, 111, 171
Silver Bell mining district	57
Springerville-Alpine	178
Tucson basin	211
Willcox basin	212

GEOPHYSICAL MODELS	
Crustal structure	70, 97, 167
Depth to bedrock	136
Regional thermal characteristics	33, 37, 103, 104, 147, 148, 152, 163 171, 177, 199, 219
GEOPHYSICAL SURVEYS (see also Heat Flow)	
Arizona, general	2, 91, 105, 112, 113 , 136, 159, 160, 162, 163, 191
Eastern Arizona	70, 148
Northern Hassayampa area	175
Regional	155, 156
Safford valley	145
San Francisco volcanic field	171
Springerville-Alpine	178, 224
Tonopah basin	42
Tucson basin	221
West-central Arizona	154, 167
GEOTHERMAL COOLING, see Geothermal Space Heating and Cooling	
GEOTHERMAL-GRADIENT STUDIES (see also Area Assessments)	
Basin and Range Province, general	33, 45, 67, 68, 84
Colorado Plateau, general	37, 84, 147
Regional	81, 102, 220
San Manuel district	110
Tucson basin	125, 186
Yuma area	134
GEOTHERMAL HEATING, see Geothermal Space Heating and Cooling	
GEOTHERMAL RESOURCE, AREAL ASSESSMENTS, see Area Assessments for Geothermal Energy	
GEOTHERMAL RESOURCE, DEVELOPMENT	
Arizona, general	76, 85 , 122
Chandler	29
Land-use planning	137, 138, 139, 140
Legal aspects	75, 118, 169
Plans for, by county	13, 14, 15, 16, 17, 18, 19, 202,
Plans for Scottsdale	139, 140
Technology assessment	203
Water resources	20, 34, 108, 169 , 170, 191, 192
GEOTHERMAL RESOURCE, ECONOMIC ANALYSIS	64, 74 , 93
GEOTHERMAL RESOURCE, LEGAL ASPECTS	
GEOTHERMAL RESOURCE, LOW-TO-MODERATE TEMPERATURE	
Geologic model, Arizona	80
Heating and cooling capabilities	8, 216
Maps, Arizona	81, 220
GEOTHERMAL SPACE HEATING AND COOLING	6, 7, 8 , 29, 31, 66 , 93, 118, 140 , 191, 216
GEOTHERMOMETRY (See also Area Assessments)	46, 53, 116, 151, 157, 158, 166 , 187 188, 189, 190

GILLARD HOT SPRINGS	193, 208
GRAHAM COUNTY	
Area assessment studies	
Safford-San Simon	145, 168, 210, 214
Ground-water studies; data	
San Simon basin	101, 204, 205, 207
Indian Hot Springs	100, 210
Resource development plan	18
GREENLEE COUNTY	
Area assessment studies	
Clifton	48, 58, 208, 213, 218, 219
Lower San Francisco River	48, 208
Gillard Hot Springs	193, 208
Resource development plan	18
GROUND WATER (Many of these publications contain thermal well and spring data.)	
Basic data compilations	
Avra and Altar valleys	206
Black Canyon-Hoover Dam area	116
Coconino County (southern)	114
Concho, St. Johns, White Mountains	87
Municipal data listings	40, 41
Navajo and Hopi Indian Reservations	51, 99, 115
Papago Indian Reservation	88, 89
Pinal County (western)	86
Puerco-Zuni area	119
Regional data listings	30, 59, 196, 198
Salt River valley (western)	96
San Simon basin	204, 205
State-wide data listings	23, 25, 81, 121, 143, 196, 197, 209, 220
Tucson basin-Santa Cruz valley	146
Willcox basin	28
Hydrologic reports	
Big Sandy valley	50
Douglas basin	43
Gila Bend basin	185
Gila River basin	60, 70, 150
Lower Hassayampa area	184
Navajo County (southern)	120
Needles area	126
Papago Indian Reservation	88
Paradise valley	27
Parker-Blythe-Cibola area	127
Pinal County (western)	86
San Pedro River valley	149
San Simon valley	52, 101, 161, 207
Tucson basin-Santa Cruz valley	124, 146
Waterman Wash area	54
Willcox basin	28
Yuma area	135

HEAT FLOW	
Arizona, general	81, 162, 163, 190, 220
Basin and Range province	33, 103, 148, 154, 179, 189, 218, 219
Colorado Plateau	97, 147, 148, 177, 181
Southwestern U.S.	155, 199
United States, general	104, 152, 153, 156
HEAT PUMPS	8
HEAT SOURCE	3, 26, 80, 103, 111
HOT DRY ROCK, AREAS EXPLORED FOR	
Aquarius Mountains	72, 200
Castle Dome Mountains	77
General	73
San Francisco volcanic field	73, 222
HOT SPRINGS	
Arizona, general	61, 116, 209
Castle Hot Springs	36, 157, 158, 165, 166
Gillard Hot Springs	193, 208
Hydrogeochemistry	59, 116, 121, 191
Indian Hot Springs	100, 210
United States	30, 198
HOT SPRINGS, EARLY RESEARCH	
Arizona, general	35, 36, 58, 100, 150
Listings for the U.S.	47, 49, 62, 129, 130, 141, 142, 172
Southwest U.S.	69, 109
HYDROLOGIC REPORTS, see Ground water	
HYDROLOGY OF AREAS EXPLORED FOR GEOTHERMAL ENERGY	
(see also Area Assessments for Geothermal Energy)	
Basin and Range province	223
Big Sandy valley	39
Harquahala-Tonopah area	42, 95
Hyder area	94
Verde valley	79, 151
HYDROTHERMAL DEPOSITS ASSOCIATED WITH FOSSIL GEOTHERMAL SYSTEMS	32, 57, 110, 164
INDIAN HOT SPRINGS	100, 210
KGRAs (KNOWN GEOTHERMAL RESOURCE AREAS)	
Federal: Clifton, Gillard	193, 213, 219
State	55, 81, 217
LAND-USE PLANNING	137, 138, 139, 140
LEGAL ASPECTS OF GEOTHERMAL RESOURCES, see	
Geothermal Resource, Legal Aspects	
Arizona state laws	21, 22
Development in Arizona	75, 118
Water law	169
LINEAMENTS	105, 106, 107
LOW-TEMPERATURE GEOTHERMAL RESOURCES, see Geothermal Resource, Low-to-Moderate Temperature	

MAPS

Arizona	159
Aeromagnetic	81, 131, 220
Geothermal resources	2, 112, 113
Gravity	45
Subsurface temperatures	3, 81, 111
Volcanic centers	48, 208
Clifton geology	
United States	102
Geothermal gradient	131
Geothermal resources	156
Heat flow	30
Thermal springs locations	151
Verde valley geothermal resource	

MARICOPA COUNTY

Area assessment studies	
Chandler	29, 66
Harquahala-Tonopah	42, 95
Hyder area	94
Northern Hassayampa area	164, 175, 182
Phoenix area	6, 40, 139, 140, 176
Williams Air Force Base	66
Ground-water studies; data	
Gila Bend basin	185
Lower Hassayampa area	184
Phoenix area	27
Salt River valley	96
Waterman Wash	54
Resource development plans	16, 139, 140

MINERAL INDUSTRY, UTILIZATION OF GEOTHERMAL RESOURCES **4, 5**

MOHAVE COUNTY

Area assessment studies	
Aquarius Mountains	72, 200
Big Sandy valley	39
Kingman-Williams	71

NAVAJO COUNTY (see also Colorado Plateau)

Area assessment studies	44, 194
Ground-water studies; data	51, 87, 99, 115, 119, 120
Resource development plan	15

PIMA COUNTY

Area assessment studies	7, 38, 78, 174, 179, 211
Ground-water studies; data	41, 88, 89, 124, 125, 146, 149, 186, 206
Resource development plan	17

PINAL COUNTY

Area assessment studies	53
Ground-water studies; data	54, 86
Resource development plan	19

POWER GENERATION

12

SAN FRANCISCO VOLCANIC FIELD

26, 73, 117, 171, 222

SANTA CRUZ COUNTY	
Resource development plan	14
STATE LAWS, see Geothermal Resource, Legal Aspects	
STATIGRAPHY, LATE CENOZOIC ALLUVIUM	
Avra valley	38
Lower Hassayampa area	164
Safford basin	210
Tucson basin	211
THERMAL SPRINGS, see Hot Springs; Ground Water	
VOLCANIC ROCKS, LATE CENOZOIC	3, 81, 111
WATER CHEMISTRY (see also Area Assessments; Ground Water)	
Ground Water	
Arizona, general	56, 133, 187, 188, 189, 190
Coolidge	53
Papago Indian Reservation	179
Safford basin	168, 210
Springerville-Alpine	178
Tucson basin	125
Verde valley	151
Yuma area	46
Springs	
Arizona	59, 121
Black Canyon-Hoover Dam area	116
Castle Hot Springs	157, 158, 166
Gillard Hot Springs	193, 208
Grand Canyon (western)	144
Indian Hot Springs	100, 210
Mogollon Rim area	61
WATER-RESOURCES AND GEOTHERMAL DEVELOPMENT,	
see Geothermal Resource, Development	
YAVAPAI COUNTY	
Area assessment studies	79, 151
Castle Hot Springs	36, 157, 158, 165, 166
Heat flow	154
YUMA COUNTY	
Area assessment studies	46, 77, 94, 173
Ground-water studies; data	20, 127, 135
Resource development plan	13
Temperature gradient logs	134

NOTES

DO NOT MICROFILM
THIS PAGE

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 10/10/01 BY 60322 UCBAW

NOTES

DO NOT MICROFILM
THIS PAGE

NOTES

DO NOT MICROFILM
THIS PAGE

STATE OF ARIZONA BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY

The Arizona Bureau of Geology and Mineral Technology was established in 1977 by an act of the State legislature. This act represents a reorganization of the Arizona Bureau of Mines which first was created in 1915 and placed under the authority of the Arizona Board of Regents. This authority has not changed. The Bureau continues its service in the fields of geology, metallurgy and mining in response to public inquiries, state agency requirements, and various research grants. In order to carry out these functions, two basic branches now are recognized:

The Geological Survey Branch is charged with the responsibility of acquiring, disseminating and applying basic geologic data that are designed to (a) enhance our understanding of Arizona's general geologic and mineralogic history and to assist in determining the short and long range influences these have on human activity, and (b) assist in developing an understanding of the controls influencing the locations of metallic, nonmetallic and mineral fuel resources in Arizona.

The Mineral Technology Branch conducts research and investigations into, and provides information about, the development of Arizona's mineral resources, including the mining, metallurgical processing and utilization of metallic and nonmetallic mineral deposits. These activities are directed toward the efficient and safe recovery of Arizona's mineral resources as well as insuring that recovery and treatment methods will be compatible with the basic environmental needs of the state.