

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Bibliography of Selected Papers on Geophysical Techniques
In Searching for Ground Water

by

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

ABSTRACT

This report gives a bibliography of selected publications, containing mainly case histories, that deal with searching for ground water using geophysical techniques. A total of 151 references are listed and indexed by geophysical technique employed and by geographical area and by selected geologic topic.

INTRODUCTION

The U.S. Army requested that the U.S. Geological Survey compile a manual discussing the use of geophysical techniques to search for ground water. This report lists the references that were used in writing that Water Manual. All the library research was done at the USGS library, Denver, CO. Initial references were first found by searching two bibliographic databases, GEOREF and Water Resources Abstracts. GEOREF is produced by the American Geological Institute (AGI). It covers worldwide technical literature on geology and geophysics, including over 4,500 serials and other earth science publications. Water Resources Abstracts offers a range of water-related topics. It is produced by the U.S. Department of the Interior, Office of Water Resources and Technology, and is the online counterpart to the printed Selected Water Resources Abstracts (SWRA). GEOREF references publications date from 1785 through 1985, and Water Resources Abstracts covers materials from 1968 to the present. References to both databases are inputted monthly, although in GEOREF there may be a 8 month lag on U.S. materials, and a 20 month lag on foreign materials. An average lag of 16 months can be expected.

METHODS OF STUDY

The purpose of the reference search was to find papers describing case histories where geophysical techniques were used successfully to site water wells, particularly in arid and semi-arid environments. The search was done on the GEOREF and Water Resources Abstracts in November 1985, using different combinations of keywords such as "water wells", "water recovery", "aquifer", "deserts", "ground water", "groundwater", "arid regions", "arid environments", and "semi-arid environments", together with keywords like "geophysics", "gravity", "magnetics", etc. Two further searches used some new keywords and different combinations of the old keywords, and turned up about 160 additional references.

Additional steps were taken to both narrow and expand the bibliography. References that were clearly not on target (e.g., physical property measurements of "heavy water" in nuclear reactors) were dropped from the initial abstract list. References that were available in the USGS library or obtainable through interlibrary loan networks were reviewed for suitability for inclusion in the bibliography. Many were dropped at this stage, including papers on geophysical monitoring of ground water contaminants, papers on geophysical logging of oil wells, papers on ground water flow, papers on ground water that mentioned geophysical work only in passing, and papers solely on geophysical techniques that mentioned ground water work only in passing. Copies of about 10% of the references could not be found, and such references were dropped. The GEOREF and Water Resources Abstracts data represents only about half of the publications listed in this report. Because the reference data bases were known to lag actual publication by 1 1/2 years,

recent issues were scanned of the journals that had been frequently cited in the earlier database search. Sections of the library shelves where many cited references had been found were also scrutinized to find other works of interest. Many appropriate additional references were identified in this way. Some 151 references survived this selection procedure. These references were entered on ACCESS¹, a local database program for Hewlett-Packard model 85¹ desktop computer. Keywords for each reference were assigned based on our examination of each component article. The keywords were chosen from a hierarchy which had been chosen previously.

The 151 references found are listed and numbered in Appendix A. Table 1 lists the references by geophysical method. Table 2 lists the references by geographical area, and Table 3 lists the references by selected geological topics. The reference format follows the USGS standard format. A keyword and note section is added to the citation to further explain the contents of each publication.

DISCLAIMER: This bibliography was put together for a special purpose, and so it reflects particular materials that happened to be available to us and that appeared to be of interest for the Army Manual project. It should not be regarded as exhaustive or complete. However, it may make a useful starting point for further literature searches into sub-areas that fall under this preview.

¹This citation is for purposes of complete description and does not constitute endorsement by the U.S. Geological Survey.

Table 1. -- REFERENCES INDEXED BY GEOPHYSICAL METHOD

- ELECTRICAL - 1,7,4,5,8,10,11,12,14,16,17,20,22,24,26,27,30,31,32,
35,36,37,38,39,40,42,43,45,48,49,50,51,53,54,55,56,
59,60,62,63,64,66,67,68,70,75,76,77,78,79,81,82,84,
85,86,87,89,90,91,95,99,100,101,102,103,104,105,107,
108,109,111,112,113,115,116,118,119,121,122,124,125,
127,128,131,132,134,137,138,140,142,143,144,146,147,
150,151
- VES - 4,5,7,10,12,23,26,30,32,42,43,51,79,90,91,111,127,
132,142,143,149
- EM - 24,31,32,33,37,43,54,55,59,84,86,105,113,121,122,133,137,150
- AFMAG - 10,22,26,59,84
- VLF - 22,110
- LOG - 14,108
- SEISMIC - 2,9,13,17,18,19,20,21,26,28,37,44,46,47,49,53,59,60,63,
67,72,74,75,79,80,84,88,91,98,99,101,102,109,112,122,
126,128,129,130,134,135,138,144,146,148,149,150
- REFRACTION - 13,20,28,44,47,49,67,72,74,75,88,98,99,109,112,
128,129,130,135,144,148,150
- REFLECTION - 21,67,109,146
- MAGNETIC - 1,4,5,6,13,16,17,32,35,37,40,59,84,110,112,114,118,134,
140,150
- AEROMAGNETIC - 1,6,110,134
- GRAVITY - 4,5,16,17,18,28,37,52,57,65,74,75,84,91,110,114,118,120,
125,126,129,130,139,144,150
- REMOTE SENSING - 1,6,15,29,34,40,58,69,72,84,86,93,94,96,121,136
- LANDSAT - 6,15,29,34,58,69,93,94

Table 2. -- REFERENCES INDEXED BY GEOGRAPHICAL AREA

- Africa -

Arabia - 34
Eastern Africa - 23
Egypt - 29,30,31,68
Kalahari - 142,143
Kenya - 96
Libya - 68
S. Africa - 32,33,85
Tunisia - 93
Uganda - 63
Upper Volta - 6,25,105

- Asia -

Afghanistan - 36
India - 7,10,21,69,86,94,109,112,132
Israel - 84,118
Kazakhstan - 4,5
Sinai - 58,134
Turkey - 12
USSR - 101,102,103

- N. America -

Canada - 10,22,38,53,63,133
 Alberta - 54,147
 NW Territory - 15
 Ontario - 24
 Prarie Provinces - 75

Mexico - 3

US -

AL - 60,72,136
AK - 124
AZ - 71,110,114,120,127,135
AR - 52
CA - 104,149
CO - 64,140
CT - 47
DE - 141
FL - 77,78,91,121,122
GA - 116
HI - 1,108
IL - 2,8,43
IN - 49
KY - 148
MA - 16,65,146
MI - 57,128
MN - 42,50,100
MS - 11,39,95
MO - 41,113
MT - 82
NV - 14

Table 2. -- REFERENCES INDEXED BY GEOGRAPHICAL AREA (continued)

NH	- 13
NJ	- 44
NM	- 88,98
NC	- 28
OH	- 18,20,97,119
OK	- 40
PA	- 89
TX	- 73,125
WA	- 18
WI	- 123
Appalachian Plateau	- 139
New England	- 46
- S. America -	
Argentina	- 27
Brazil	- 26,106,111
Chile	- 129,130
Jamaica	- 131

Table 3. -- REFERENCES INDEXED BY SELECTED GEOLOGIC TOPICS

- Basaltic Aquifers - 49,108,109,132
- Caves or Karst - 15,71,72,91,100
- Crystalline basement - 5,6,7,10,23,25,56,73,76,85,100,123,126,132, 134,140,141
Bedrock Joints and Fissures - 4,5,23,76,109,126,134
- Diabase (Dolorite) Dike - 32,109,114,134,144
- Fresh Water - Salt Water Interface - 30,41,45,121,122

Appendix A:

1. Adams, W. M., Peterson, F. L., Mathur, S. P., Lepley, L. K., Warren, C., and Huber, R. D., 1971, A hydrogeophysical survey using remote-sensing methods from Kawaihae to Kailua-Kona, Hawaii: Groundwater, v. 9, no. 1, p. 42-50. Keywords and notes: aeromagnetic, D.C. resistivity, infrared scanning.
2. Allen, R. D., Trapp, J. S., and Jensen, T. E., 1981, Site characterization for injection of compressed air into an aquifer: 22nd U.S. Symposium on Rock Mechanics, v. 22, p. 447-451. Keywords and notes: seismic. Seismic used to find structural dome in Illinois.
3. Alvarez, R., 1984, Applying tellurics to aquifer evaluation: Expanded Abstracts of the Technical Program, Society of Exploration Geophysicists Fifty-fourth Annual Meeting, December 2-6, 1984, A, p. 148-151. Keywords and notes: case history, tellurics, EM.
4. Anashin, Yu.F., Gavelja, A. P., Kirillov, R. N., and Tychkova, T. V., 1964, Geophysical exploration of hydrogeological conditions of deserts and arid regions of Kazakhstan: 22nd Internat. Geol. Cong., p. 160-178. Keywords and notes: electrical, VES, gravity, magnetic, USSR. In Kazakhstan, magnetic highs together with resistivity low indicate water-bearing fissures.
5. Anashin, Yu.F., Brodovog, V. V., Gavelya, A. P., Kirilov, R. N., Zarazin, G. N., and Frolov, P. M., 1968, The principal criteria of the analysis of geophysical fields with special reference to desert regions of Kazakhstan: Int. Ass. Sci. Hydrol, v. 77, p. 249-261. Keywords and notes: gravity, electrical, seismic, magnetic, crystalline basement. 50-100 gamma mag highs + resistivity lows point to fissures.
6. Astier, J., Savadogo, A., and Ouedraogo, J., 1983, Hydrogeologic import of aeromagnetic maps in crystalline and metamorphic regions: Hydrogeologie', v. 1, p. 51-56. Keywords and notes: landsat, aeromagnetic, crystalline. (in French) In Upper Volta, always drill for water within 600m of faults found by aeromag.
7. Ballukraya, P. N., Sakthivadivel, R., and Babatan, R., 1981, Inadequacies in the technique of resistivity method for location of waterwell sites in hard rock areas: Nordic Hydrology, v. 12, no. 3, p. 185-192. Keywords and notes: VES, case history.
8. Bays, C. A., and Folk, S. H., 1944, Geophysical logging of water wells in northeastern Illinois: Illinois Geologic Survey Circular, no. 113, p. 248-266. Keywords and notes: case histories, electrical resistivity.
9. Beal, P., Sexton, T. F., and Levine, E. N., 1980, Geoscience in municipal groundwater exploration: Geotechnology in Massachusetts, Vol, p. 77-82. Keywords and notes: seismic, Massachusetts.
10. Bhat, M. S., 1974, Correlation of geophysical indications with well drilling data: Waterwell Drilling in hard rock areas of India, p. 205-215. Keywords and notes: electrical resistivity, AFMAG, VES. Very short and brief descriptions of each above method.
11. Bicker, A. R. Jr., and Mellen, F. F., 1964, Well logging by Mississippi geological survey: Mississippi Geol. Econ. and Topog. Survey Bull., v. 104, p. 111-124. Keywords and notes: electrical, radioactivity, case history. Mainly on well logging.

12. Bierschenk, W. H., 1972, Geohydrological and geophysical investigations near Izmir, Turkey: Groundwater, v. 2, no. 4, p. 18-24. Keywords and notes: VES, case histories.
13. Birch, F. S., 1976, A seismic ground-water survey in New Hampshire: Groundwater, v. 14, no. 2, p. 94-100. Keywords and notes: case history, magnetic, seismic refraction.
14. Blankennagel, R. K., 1974, Geophysical logging and hydraulic testing, Pahute Mesa, Nevada test site: Groundwater, v. 6, no. 4, p. 24-31. Keywords and notes: electric log, resistivity, theory.
15. Brook, G. A., 1983, Application of landsat imagery to flood studies in the remote Hahanni Karst, northwest territories, Canada: Journal of Hydrology, v. 61, p. 305-324. Keywords and notes: case history, landsat, Karst.
16. Bruehl, D. H., 1982, Use of geophysics in groundwater exploration in Massachusetts: Geotechnology in Massachusetts, p. 87-90. Keywords and notes: electrical resistivity, gravity. Case histories at 2 sites in glacial terrane.
17. U.S. Bureau of Reclamation, Washington, DC, 1981, Ground water manual, a guide for the investigation, development, and management for groundwater resources: Water Resources Technical Publication, p. 215-224. Keywords and notes: seismic, electrical resistivity, magnetometer, gravity. General discussions of above techniques; not useful. References.
18. Burgdorf, G. J., and Richard, B. H., 1984, Geophysical exploration of buried valley systems in southwestern Ohio for ground water resources: NWWA/EPA, p. 176-205. Keywords and notes: gravity, seismic, case history.
19. Burke, K. B. S., 1970, A review of some problems of seismic prospecting for groundwater in surficial deposits: in Morely, L. W., ed., Mining and Groundwater Geophysics/1967, Geological Survey of Canada, Economic Geology report no. 26, p. 569-579. Keywords and notes: case history.
20. Carpenter, G. C., and Bassarab, D. R., 1972, Case histories of resistivity and seismic groundwater studies: Groundwater, v. 2, no. 1, p. 21-25. Keywords and notes: electrical resistivity, seismic refraction. Local studies near Cincinnati.
21. Chatterji, P. C., and Rao, V. S., 1977, A tentative seismic (refraction) velocity scale for groundwater exploration in Indian arid zones: Geophys. Res. Bull., v. 15, no. 4, p. 71-81. Keywords and notes: refraction, seismic, rock properties. Important chart, case history.
22. Collett, L. S., 1970, Resistivity mapping by electromagnetic methods: in Morely, L. W., ed., Mining and groundwater geophysics/1967, Geological Survey of Canada, Economic Geology report no. 26, p. 615-625. Keywords and notes: AFMAG, VLF.
23. Comite Interfricain d'Etudes Hydrauliques, 1978, Methode d'etude et de reserches de l'eau souterraine des rockes cristallines de l'Afrique de l'ouest: Geohydraulique (10, Rue Eugene Renault-94700 Maisons-Alfort France), p. . Keywords and notes: fissures in crystalline terranes. Three volumes published, in 1978, 1979, and 1981. Only v. III was available, an atlas of photo-interpretation. Appears to have lots.

24. Davis, J. L., Annan, A. P., Vaughan, C., and Killey, R. W. D., 1984, Surface and borehole ground probing radar surveys at Chalk river, Ontario: NWWA/EPA, p. 681-712. Keywords and notes: Paper all on radar.
25. De Jong, S. J., Dirks, F. J. H., Palacky, G. J., and Ritsema, I. L., 1981, Experimentations de methods electromagnetiques appliques a la recherche des eaux souterraines en terrain de socle cristallin en haa: Comite Interafricain d' Etudes Hydrauliques, v. 44, p. 17-26. Keywords and notes: electromagnetic, VES, VLF, EM, case history, crystalline basement. Upper Volta, written in French.
26. De Lima, O. A. L., and Dias, C. A., 1980, Geophysical studies of an experimental area in the semi-arid region of northeastern Brazil for subsurface injection: Rev. Bras. Geocienc., v. 10, no. 2, p. 141-154. Keywords and notes: seismic, resistivity, VES, afmag, case history, Portuguese. Refraction VES case history, in Portuguese.
27. Ducloux, J. J. H., 1983, Groundwater exploration in the central zone of La Pampa province (Argentina): Ground Water in Water Resources Planning, v. 1, p. 115-125. Keywords and notes: resistivity. Very little resistivity and geophysics.
28. Eaton, G. P., and Watkins, J. S., 1970, The use of seismic refraction and gravity methods in hydrogeological investigations: Morley, L. W., ed., Mining and Groundwater Geophysics/1967, Geological Survey of Canada, Economic Geology Report No. 26, p. 544-568. Keywords and notes: Gravity, Refraction seismic, physical properties, case history.
29. El Shazley, E. M., El Rakaiby, M. M., and El Kassas, I. A., 1983, Groundwater investigation in Wadi Arabia area, eastern desert of Egypt, using landsat imagery: Proceedings of the 17th intern. Sym. on remote sensing of environment, Ann Arbor, Michigan, v. 17, p. 1003-1013. Keywords and notes: remote sensing, landsat. Successful case history finding water with landsat.
30. El-Kadi, H., and Mabruk, B. M., 1977, New exploration technique for fresh water wells at the Nile Delta, Egypt: Proceedings of the Colloquium on the Geology of the Aegean region, v. 2, p. 805-811. Keywords and notes: electrical resistivity, VES, well-logging.
31. El-Said, M. A. H., 1956, Geophysical prospecting of underground water in the desert by means of electromagnetic interference fringes: Proceedings of the IRE, p. 24-29. Keywords and notes: theory, case history. Entire paper on electromagnetics.
32. Enslin, J. F., 1955, Some applications of geophysical prospecting in the Union of South Africa: Geophysics, v. 20, no. 4, p. 886-912. Keywords and notes: case history, Wenner VES, resistivity, electromagnetic, magnetic. Drill for water near dolomite dikes found using mag. Decomposed granites and weathered zones at the base of decomposed basic igneous.
33. Enslin, J. F., 1955, A new electromagnetic field technique: Geophysics, v. 20, no. 2, p. 318-334. Keywords and notes: electromagnetic, theory, case history examples. An EM technique using a grounded pole as source and mapping horizontal H field works will pick up fault zones and water-bearing zone.

34. Everett, J. R., Russell, O. R., and Nichols, D. A., 1984, Landsat surveys of southeastern Arabia: Deserts and Arid Lands, p. 171-194. Keywords and notes: remote sensing.
35. Farr, J. L., Spray, P. R., and Foster, S. S. D., 1982, Groundwater supply exploration in semi-arid regions for livestock extension--a technical and economic appraisal: Water Supply and Manag., v. 6, no. 4, p. 343-353. Keywords and notes: resistivity, magnetic, theory, case history. A proposal, only--very short descriptions are given of possible geophysical work still to be done.
36. Flathe, H., 1970, Interpretations of geoelectrical resistivity measurements for solving hydrogeological problems: in Morely, L. W., ed., Mining and Groundwater Geophysics/1967, Geological Survey of Canada, Economic Geology report no. 26, p. 580-597. Keywords and notes: resistivity, case history, theory.
37. Flether, J. E., and Bender, G. L., 1965, Ecology of groundwater in the southwestern United States: Arizona State University, p. 64-70. Keywords and notes: resistivity, induced polarization, electromagnetic, gravity, seismic. Small paragraphs only on some geophysical methods; not useful.
38. Fraser, D. C., 1982, Airborne mapping of water resources with Dighem systems: Toronto, Canada; Dighem Ltd., p. 1-67. Keywords and notes: electrical resistivity.
39. Frederking, R. L., and Rainey, A. D., 1983, Investigations of an alluvial valley fill utilizing Schlumberger sounding methods: Expanded Abstracts of the Technical Program, Society of Exploration Geophysicists Fifty-third Annual Meeting, September 11-15, 1983, p. 93-95. Keywords and notes: electrical resistivity, case history.
40. Frischknecht, F. C., Muth, L., Grette, R., Buckley, T., and Kornegay, B., 1978, Geophysical methods for locating abandoned wells: U.S. Geological Survey Open-File Report, v. 4, p. 1-5. Keywords and notes: magnetic, electrical, remote sensing. Not about siting water wells; good discussion of magnetic surveying technique.
41. Frohlich, R. K., 1974, Combined geoelectrical and drill-hole investigations for detecting fresh-water aquifers in northwestern Missouri: Geophysics, v. 39, no. 3, p. 340-352. Keywords and notes: resistivity, case history. Grundy County, northwestern Missouri.
42. Gapanski, G., Julik, J., and Bassou, O., 1984, Assessment of buried aquifers in Minnesota using computer generated Wenner electric sounding curves: NWWA/EPA, p. 107-129. Keywords and notes: resistivity, VES, case history.
43. Gilkeson, R. H., and Cartwright, K., 1982, The applications of surface geophysical methods in monitoring network design: Proceedings of the Second National Symposium on Aquifer Restoration and Groundwater Monitoring, p. 169-183. Keywords and notes: electrical, self-potential, EM, VES, case histories.
44. Gill, H. E., Vechioli, J., and Bonini, W. E., 1965, Tracing the continuity of Pleistocene aquifers in northern New Jersey by seismic methods: Groundwater, v. 3, no. 4, p. 33-35. Keywords and notes: seismic refraction, case history. All about seismic.

45. Gorhan, H. L., 1976, The determination of the saline/fresh water interface by resistivity soundings: Bulletin of the Association of Engineering Geologists, v. 13, no. 3, p. 163-177. Keywords and notes: resistivity, case history.
46. Haeni, F. P., 1986, Applications of seismic refraction methods in groundwater modeling studies in New England: Geophysics, v. 51, no. 2, p. 236-249. Keywords and notes: case history.
47. Haeni, F. P., and Melvin, R. L., 1984, High resolution continuous seismic reflection study of a stratified drift deposit in Connecticut: NWWA/EPA, p. 237-258. Keywords and notes: seismic refraction, case history.
48. Hansen, H. J., 1967, The electric log: geophysics' contribution to groundwater prospecting and evaluation: Maryland Geological Survey Information Circular, no. 4, p. 1-11. Keywords and notes: resistivity, self potential, case history.
49. Harmon, E. J., 1984, Investigation on a previously unexplored basaltic aquifer using complementary geophysical methods: NWWA/EPA, p. 273-287. Keywords and notes: airborne methods, resistivity, refraction, dipole-dipole.
50. Hawkinson, C. F., and Verry, E. S., 1975, Specific conductance identifies perched and ground water lakes: Forest Service - U.S. Department of Agriculture; North Central Forest Experiment Station, St. Paul, Minnesota, p. 1-5. Keywords and notes: electrical, physical properties.
51. Heigold, P. C., Gilkeson, R. H., Cartwright, K., and Reed, P. C., 1979, Aquifer transmissivity from surficial electrical methods: Groundwater, v. 17, no. 4, p. 338-345. Keywords and notes: Theory, VES resistivity.
52. Henry, G., Jr., 1984, Use of the gravity method in mapping bedrock topography: NWWA/EPA, p. 220-236. Keywords and notes: theory. A very good paper on gravity geophysics.
53. Hobson, G. D., Wyder, J. E., and Brandon, L. V., 1960, Aquifer exploration in Canada by geophysical methods: Geological Survey of Canada, p. 1073-1081. Keywords and notes: seismic, electrical resistivity.
54. Hoekstra, P., and Standish, R. P., 1984, Applications of fixed frequency conductivity profiling and transient soundings to ground water exploration: NWWA/EPA, p. 150-175. Keywords and notes: electromagnetic, case histories, EM. Northern Alberta.
55. Houck, R. T., 1984, Measuring moisture content profiles using ground-probing radar: NWWA/EPA, p. 637-653. Keywords and notes: theory. Paper on radar only.
56. Huntley, D., and Mishler, H. M., 1984, Relationship between permeability and electrical resistivity in granular and fractured-rock aquifers: NWWA/EPA, p. 18-36. Keywords and notes: theory. Not much geophysics in this paper.
57. Ibrahim, A., and Hinze, W. J., 1972, Mapping buried bedrock topography with gravity: Groundwater, v. 10, no. 3, p. 18-23. Keywords and notes: theory, case history.
58. Issar, A., and Gilad, D., 1982, Groundwater flow systems in the arid crystalline province of southern Sinai: Hydrological Sciences Journal, v. 27, no. 3, p. 309-325. Keywords and notes: remote sensing, landsat case history.

59. Jennings, C. M. H., 1971, Note on hydrological research in Botswana with special emphasis on research in the hydrogeological field: South Africa Journal of Science, v. 67, no. 1, p. 12-21. Keywords and notes: borehole, electrical resistivity, magnetic, electromagnetic, afmag, seismic. Magnetics not used substantially here.
60. Joiner, T. J., Warman, J. C., and Scarbrough, W. L., 1967, An evaluation of some geophysical methods for water exploration in the Piedmont area: Groundwater, v. 6, no. 1, p. 19-25. Keywords and notes: seismic, electrical resistivity.
61. Kaufman, W. J., and Todd, D. K., 1955, Methods of detecting and tracing the movement of groundwater: Annual Progress Report No. 1 Canal Seepage Research, v. 93, no. 1, p. 53-108. Keywords and notes: electrical resistivity, seismic refraction and reflection. Section 5., Geophysical methods for investigating subsurface water in the Annual Progress.
62. Kean, W. F., Taylor, R. W., and Byers, J. M., 1984, Electrical conductivity, clay content and porosity of unconsolidated sediments: NWWA/EPA, p. 1-17. Keywords and notes: resistivity, theory.
63. Kelly, S. F., 1962, Geophysical exploration for water by electrical resistivity: The Journal of the New England Water Works Association, v. 76, no. 2, p. 118-189. Keywords and notes: seismic, case history. Gives illustrations of the geophysical techniques.
64. Keys, W. S., 1970, Borehole geophysics as applied to groundwater: in Morely, L. W., ed., Mining and Groundwater Geophysics/1967, Geological Survey of Canada, Economic Geology report no. 26, p. 598-614. Keywords and notes: gamma-gamma, resistivity, radioactive tracer, case history. Clear Creek, CO.
65. Kick, J. F., 1982, Applications of the gravity method in Massachusetts: Geotechnology in Massachusetts, p. 90-95. Keywords and notes: gravity. Explains mapping gravity but not much groundwater.
66. Kirk, K. G., 1977, Geophysical methods used to locate zones of secondary porosity: First Eastern Gas Shales Symposium, p. 366-370. Keywords and notes: electrical resistivity.
67. Kopsick, D. A., and Stander, T. W., 1983, Refinement of the shallow seismic reflection technique in determining subsurface alluvial stratigraphy: Proceedings of the Third National Symposium on Aquifer Restoration and Groundwater Monitoring, p. 301-306. Keywords and notes: reflection, refraction, electrical. Discusses reflection-vs-refraction.
68. Krulc, Z., and Mladenovic, M. L. J., 1969, The application of geoelectrical methods to groundwater exploration of unconsolidated formations on semi-arid areas: Geoexploration, v. 7, p. 83-95. Keywords and notes: electrical resistivity, AC, DC, case history. Investigations in Egypt and Libya.
69. Kumar, S. S., 1983, Satellite data in aid of groundwater exploration; a case study from Karnataka, India: Inter. Conf. on Groundwater and Man, v. 8, p. 169-173. Keywords and notes: remote sensing, landsat.
70. Kwader, T., 1985, Estimating aquifer permeability from resistivity factors: Groundwater, v. 23, no. 6, p. 762-766. Keywords and notes: theory, electrical, gamma.

71. Lamar, D. L., 1964, Geology of the Wupatki blowhole system: Plateau, v. 37, no. 1, p. 35-40. Keywords and notes: gravity. Gravity used in searching for caves and limestone.
72. LaMoreaux, P. E., and Madison, D. O., 1984, The occurrences of sinkholes in the vicinity of the southern natural Gas Company Dry Valley Pipeline, Shelby County, Alabama: NWWA/EPA, p. 259-272. Keywords and notes: Remote sensing, seismic refraction, caves. Integrated programs for ground water exploration.
73. Landers, R. A., and Turk, L. J., 1973, Occurrence and quality of ground water in crystalline rocks of the Llano area, Texas: Groundwater, v. 11, no. 1, p. 5-10. Keywords and notes: case history. Approximately 90 miles northeast of Austin.
74. Laudon, K. J., 1984, Geophysical investigation of the Duck Lake ground water subarea near Omak, Washington: NWWA/EPA, p. 206-219. Keywords and notes: seismic refraction, gravity.
75. Lennox, D. H., and Carlson, V., 1970, Integration of geophysical methods for groundwater exploration in the prairie provinces, Canada: in Morely, L. W., ed., Mining and Groundwater Geophysics/1967, Geological Survey of Canada, Economic report no. 26, p. 517-535. Keywords and notes: seismic refraction, gravity, resistivity, case history.
76. Leonard-Mayer, P. J., 1984, Development and use of azimuthal resistivity surveys for jointed formations: NWWA/EPA, p. 52-91. Keywords and notes: electrical, theory, case history.
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