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LA-8253-MS

Informal Report

MASTER

Compilation of Cores and Cuttings from U.S. Government-Sponsored Geothermal Wells

University of California

LOS ALAMOS SCIENTIFIC LABORATORY
Post Office Box 1663 Los Alamos, New Mexico 87545

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LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO Holders of LA-8253-MS

DATE September 3, 1980

FROM ISD-6

SUBJECT Errata

SYMBOL

MAIL STOP 418

Substitute the attached pages 83 and 121 for those in your report.

Make the following pen and ink changes.

Pages 41-49, Tables B-IX through B-XXII:
W/m-k in headings should be M/m-k.

Page 127, Line 4, Tables H-I through H-XIII should be
Tables I-I through I-XIII.

COMPILATION OF CORES AND CUTTINGS FROM U.S. GOVERNMENT-SPONSORED GEOTHERMAL WELLS

by

Mark Mathews, David T. Gambill,
and John C. Rowley

ABSTRACT

This compendium lists the repositories holding geothermal core and well cuttings from U.S. government-sponsored geothermal wells. Also, a partial listing of cores and cuttings from these wells is tabulated, along with referenced reports and location maps. These samples are available to the public for research investigations and studies, usually following submission of an appropriate request for use of the samples.

The purpose of this compilation is to serve as a possible source of cores and cuttings that might aid in enhancing rock property studies in support of geothermal log interpretation.

INTRODUCTION

The purpose of this compilation is to identify the repositories of cores and drill cutting collections from geothermal wells. Special emphasis is placed on collections that have been supported by the U.S. Government. This emphasis was felt to be important because access to these valuable, but scarce, samples is available to researchers with appropriate projects.

Petrophysical properties of core and well cuttings, a specific area of geothermal log interpretation, generated the need to locate and identify sources for samples from geothermal wells. Response of logging tool sensors to rock types and in situ properties is a crucial issue in determining reservoir properties, locating producing zones, evaluating permeability, and generally providing reservoir parameters. Reliable and precise definition of geothermal well lithologies, size of reservoirs, production projections, field drilling strategies, and resource quality (Rigby, 1979) depend on proper interpretation of well logs. Improvements in this technology depend on experience obtained in property measurements made on rock samples and on core and drill cuttings obtained from geothermal wells. Although cuttings are routinely obtained, cores are less often taken and, therefore, core availability is important in research studies relating to geothermal log interpretation (Sanyal et al., 1980). Therefore, to strengthen these studies, researchers in this area need access to all possible sources of geothermal well samples.

POTENTIAL SOURCES

Two principal sources of cores and cuttings exist as a result of U.S. Government-funded geothermal programs. The first is summarized in Table I, where samples and repositories are listed. Table II gives the individuals to be contacted to obtain information and potential access to the samples listed in Table I. Table III records the inventory of cores and samples available at each of these repositories.

In addition to the U.S. Department of Energy, Division of Geothermal Energy sponsored wells, an extensive industry-coupled coring, sampling, and logging cost-shared program has yielded a significant number of cores and samples. These holdings are in a repository at the Earth Science Laboratory (ESL), University of Utah Research Institute (UURI), and are listed in Table IV. Access to these samples is through:

P. M. Wright
University of Utah Research Institute
Earth Science Laboratory
420 Chipeta Way, Ste. 120
Salt Lake City, Utah 84108

Although not specifically surveyed during the compilation, three other contacts for potential sources for cores and samples are:

The Continental Drilling for Scientific
Purposes Data Management Program
Nancy W. Howard
UCRL-828-19
GSA, November 5, 1979

Well-Sample and Core Repository
of the United States and Canada
C. K. Fisher and M. P. Erupa
DOI USGS Open File Report 77-567
1977

Inventory of Drilling Activities of the
U.S. Geological Survey in the U.S.
L. J. P. Muffler and C. L. Hofeling
Open File Report 79-1567
Fiscal Years 1979-1980

TABLE I

SUMMARY OF U.S. GOVERNMENT-SPONSORED GEOTHERMAL CORE AND CUTTING HOLDINGS - 1979

Region/Location/Area	Operator	Hole or Well Identification	Cored Interval Depth Feet (m)	Comments	Source Reference
A. ATLANTIC COASTAL PLAIN					
North Carolina	DOE	C19	(226)	32 holes (300 m deep) drilled Oct. 1978 to March 1979. Cuttings collected every 3 m; two core attempts, one in sediments, other near total depth. Thermal conductivity data and lithologic descriptions available.	Costain et al., Fig. A-1 (7)[a]
Virginia	DOE	C24	(306.3)		
Virginia	DOE	C25	(302.4)		
Virginia	DOE	C26	(301.8)		
Maryland	DOE	C28	(306.0)		
Maryland	DOE	C29	(304.6)		
Maryland	DOE	C30A	(368.0)		
Maryland	DOE	C31	(304.6)		
Maryland	DOE	C32	(315.3)		
Maryland	DOE	C33	(309.2)		
New Jersey	DOE	C39A	(301.1)		
New Jersey	DOE	C41	(301.1)		
Maryland/Delaware	DOE	C43	(316.8)		
Maryland	DOE	C46	(297.3)		
Maryland	DOE	C55	(297.0)		
Virginia	DOE	C59	(299.8)		
Virginia	DOE	C60	(283.1)		
Georgia	DOE	PMI	(288.8)		
South Carolina	DOE	EDI	(290.0)		
North Carolina	DOE	RL4	(195.0)		
Georgia	DOE	SM2	(210.0)		
B. CALIFORNIA					
1. Long Valley	USGS	DP	830.0	Six heat-flow holes were drilled in granite. Thermal conductivity and lithology are available.	Sass et al., 1974 (11)
		DC-1	637.0		
		RM	687.0		
		SM	893.0		
		TH	619.0		
		LV	984.8		
2. Randsberg	USGS	CBL	(46- 76)	Fourteen heat-flow holes were drilled; cores were taken at bottom of holes. Thermal conductivity and lithologies are available.	Sass et al., 1978 (11)
		LMT	(34-106)		
		GAR	(46-152)		
		SPH	(30-101)		
		FPK	(61-102)		
		RGA	(85-161)		
		RGB	(90-153)		
		RGC	(21-160)		
		RGD	(26-105)		
		RGE	(33-103)		
		RGD	(53-103)		
		RGG	(30-102)		
		RGH	(24- 88)		
		RGI	(36-102)		
3. Saline Valley	USGS	SVC	285-305 (87-83)	Eight heat-flow holes were drilled. Samples were collected every 6 m, cores were obtained in four wells. Thermal conductivity and lithooligies are available.	Mase et al., 1979 (11)
		SVD	258-361 (79-80)		
		SVE	280-300 (85-91)		
		SVG	500-504 (152-154)		
		SVH	480-500 (146-152)		
		SVI	480-500 (145-152)		
		SVJ	125-145 (32-44)		

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[a] See Table II for addresses of contacts for information on cores, cuttings, and availability for research studies.

TABLE I (cont)

Region/Location/Area	Operator	Hole or Well Identification	Cored Interval Depth Feet (m)	Comments	Source Reference
C. HAWAII GEOTHERMAL PROJECT					
	Univ. Hawaii	HPG-A Core Designations		Ten cores were taken in a geothermal well ≃7000 ft deep, located near Hilo on the island of Hawaii.	(29)
		A	456- 458		
		B	1057-1068		
		C	1412-1423		
		D	2230-2240		
		E	2876-2886		
		F	3666-3676		
		G	4447-4457		
		H	5396-5406		
		I	6029-2039		
		J	6446-6456		
D. IDAHO					
1. Raft River	ERDA/DOE	RRGE No. 1		Five deep wells were drilled as exploration or production wells from 1974-1979.	(18)
		1	(1364-1382)		
		2	(1423-1426)		
		3	(1520-1521)		
		RRGE No. 2			
		1	931- 936		
		2	1128-1132		
		3	1280-1283		
		4	1326-1328		
		5	1455-1460		
		6	1993-1994		
		RRGE No. 3			
		1	849- 852		
		2	1020-1025		
		3	1203-1208		
		4	1511-1517		
		5	1600-1603		
		6	1686-1686		
		RRGE No. 4			
		1	577- 582		
		2	860- 866		
		3	1400-1418		
		RRGE No. 5			
		1	1136-1141		
2. Boise State University					
Owyhee, CO	Acschte Corp.	Fed. 60-13		Cuttings and logs taken.	(9)
Ada, CO	Halbouty	J.J.James No. 1			
	Al Griffith Gulf Minerals	Bostich 1A			
Boise Front	BSO	BSO			
	BSO	BSO No. 1			
	BSO	Hawkins No. 1			
3. Butte County	DOE	INEL 1		A deep geothermal test well 10,365 ft deep in 1978-1979. (271; seven cores were cut.)	(9)
		1	2340-2518		
		2	2502-2518		
		3	3661-3718		
		4	4839-4878		
		5	9810-9816		
		6	10324-10330		
		7	10330-10356		

TABLE I (cont)

Region/Location/Area	Operator	Hole or Well Identification	Cored Interval Depth Feet (m)	Comments	Source Reference
E. MARYSVILLE, MONTANA					
	ERDA/DOE	Marysville			
		1	(99.1- 102.1)	A deep geothermal test well was drilled to a depth of 6791 ft (2070 m). Fifteen cores were cut.	Blackwell, 1975 (3) and (12)
		2	(132.9- 135.9)		
		3	(177.0- 180.1)		
		4	(280.7- 283.8)		
		5	(303.0- 306.9)		
		6	(464.5- 466.4)		
		7	(699.5- 701.0)		
		9	(848.0- 849.2)		
		10	(1009.5-1010.7)		
		11	(1163.4-1165.9)		
		12	(1297.2-1299.7)		
		13	(1606.3-1608.1)		
		14	(1835.8-1837.6)		
			(1953.8-1955.0)		
F. NEVADA					
1. Buena Vista Valley	USGS	KY-1	(93)	Four heat-flow holes were drilled in 1975 near Kyle Hot Springs.	Sass et al., 1976 (11)
		KY-3	(105)		
		KY-4	(146.3)		
		KY-5	(152.4)		
2. Buffalo Valley	USGS	1	(167.7)	Three heat-flow holes were drilled in 1975.	Sass et al., 1976 (11)
		2	(114.3)		
		3	(96.6)		
3. Leach Hot Springs	USGS	Q-4	(51.8-53.3)		Sass et al., 1976, and Ziogos et al., 1977. (11)
		Q-5	(76.2-77.1)		
		Q-6	(57.0-58.5)		
		Q-7	(32.3-34.1)		
			(57.0-59.4)		
		Q-8	(29.0-30.5)		
			(64.6-66.1)		
		Q-9	(48.0-50.3)		
		Q-10	(33.5-35.1)		
		Q-12	(46.3-47.9)		
			(57.9-59.4)		
		Q-13	(85.3-86.9)		
		Q-14	(29.3-30.8)		
		Q-15	(29.0-30.5)		
			(42.7-44.2)		
		Q-16	(48.8-50.3)		
		Q-17	(75.3-76.8)		
		Q-18	(27.4-29.0)		
		Q-19	(24.4-25.9)		
		Q-22	(24.4-25.9)		
		QH-6	(27.4-19.0)		
		QH-7	(34.4-36.0)		
			(61.0-62.5)		
		QH-8	(34.4-36.0)		
			(44.2-45.7)		
		QH-11	(39.6-41.1)		
			(49.7-51.2)		
		QH-12	(37.6-41.1)		
		QH-13	(35.1-36.6)		
G. REDSTONE, NEW HAMPSHIRE					
North Conway	ERDA/DOE	Redstone	3000	3000 ft of 2-7/8" core was cut.	Hoag and Stewart, 1977 (26)

TABLE I (cont)

Region/Location/Area	Operator	Hole or Well Identification	Cored Interval Depth Feet (m)	Comments	Source Reference
H. FENTON HILL, NEW MEXICO					
	ERDA/DOE	GT-2 (1973-74)		Two deep wells have been drilled to depths of 3 km and one to 4 km. Twenty-nine cores were taken.	Laughlin and Eddy, 1977 (15)
		1	(633- 639)		
		2	(685- 688)		
		3	(776- 786)		
		4	(739- 792)		
		5	(863- 867)		
		6	(867- 871)		
		7	(960- 970)		
		8	(1056-1059)		
		9	(1127-1129)		
		10	(1304-1306)		
		11	(1491-1493)		
		12	(1498-1500)		
		13	(1595-1597)		
		14	(1672-1674)		
		15	(1723-1725)		
		16	(1823-1825)		
		17	(1875-1876)		
		18	(1876-1878)		
		19	(1934-1935)		
		20	(1935-1937)		
		21	(2041-2042)		
		22	(2164-2165)		
		23	(2413-2413.6)		
		24	(2614-2617)		
		25	(2941-2904)		
		26	(2944-2907)		
		27	(2928-2929)		
		28	(2672-2674)		
		29	(2713-2715)		
	DOE	EE-1 (197)			
		1	(2095-2099)		
		2	(3011-3012)		
	DOE	EE-2 (1979)			
		1	(11737-11743)		
		2	(12848-12856)		
I. SOUTHEASTERN OREGON					
Blue Mountain	USGS	FU-1	(37-100)	Seventeen heat-flow holes were drilled in 1975. Thermal conductivity data and lithology are available.	(11)
			(130-250)		
			(250-300)		
			(400-465)		
Burns		S1	(50-190)		
		S2	(65- 93)		
		S3	(40-203)		
Catlow Valley		1	(50- 95)		
		2	(65- 93)		
		3	(68- 70.7)		
		4	(65- 91)		
		5			
Diamond Craters		MR-1	(40- 91)		
		MR-2	(89.3-92.0)		
Foster Lake		BLM	(61-107)		
Alvord Valley		AD-1	(55- 96)		
		AD-2	(57- 96)		
		MH-1	(40- 51)		
		MH-2	(10- 35)		
J. SOUTH CAROLINA					
Clubhouse Corners, Charleston	USGS	Clubhouse Corners	Continuous core (367.6 to 787.9)	A single heat-flow hole was drilled in 1975 to a depth of (792 m).	Ziagos et al., 1976. (11)

TABLE II

LIST OF REPOSITORIES HOLDING GEOTHERMAL CORE AND WELL CUTTINGS

(1) Carl Austin
Commander (Code 266)
Naval Weapons Center
China Lake, CA 93555

(2) Jack T. Barraclough
U.S. Geological Survey
P. O. Box 2230
Idaho Falls, ID 83401

(3) Dave Blackwell
Southern Methodist University
Dallas, TX 75275

(4) J. Glenn Blevins
U.S. Geological Survey
345 Middlefield Road, MS 67
Menlo Park, CA 94025

(5) Scott Butters
Terra Tek
420 Wakara Way
Salt Lake City, UT 84108

(6) Robert Christiansen
Coordinator, Geothermal Research Program
U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

(7) John Costain
Virginia Polytechnic Institute and State University
Department of Geology
Blacksburg, VA 24061

(8) Harry Covington
U.S. Geological Survey
Denver Federal Center
P. O. Box 25046, MS 918
Denver, CO 80225

(9) Paul Donaldson
Geology Department
Boise State University
Boise, ID 83725

(10) Wilfred Elders
University of California
Department of Earth Science
Riverside, CA 92502

(11) S. Peter Gallis
U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

(12) J. J. Jacobson
Battelle Pacific Northwest Laboratories
Applied Engineering and Development Section
Battelle Boulevard
Richland, WA 99352

(13) George V. Keller
Colorado School of Mines
Geophysics Department
Golden, CO 80401

(14) W. Scott Keys
U.S. Geological Survey
Denver Federal Center
P. O. Box 25046, MS 918
Denver, CO 80225

(15) A. W. Laughlin
Los Alamos Scientific Laboratory
University of California
P. O. Box 1663
Los Alamos, NM 87545

(16) Robert B. Leonard
U.S. Geological Survey
P. O. Box 1696
Helena, MT 59601

(17) Robert E. Lewis
U.S. Geological Survey
Federal Building, Rm. 365
P. O. Box 036
550 West Fort Street
Boise ID 83724

(18) Roy Mink
Department of Energy
550 Second Street
Idaho Falls, ID 83401

(19) Charles W. Naeser
U.S. Geological Survey
Denver Federal Center
P. O. Box 25046, MS 424
Denver, CO 80225

(20) Steven S. Oriel
U.S. Geological Survey
Denver Federal Center
P. O. Box 25046, MS 913
Denver, CO 80225

(21) Larry Owen
Lawrence Livermore Laboratory
University of California
P. O. Box 808
Livermore, CA 94550

(22) James H. Robison
U.S. Geological Survey
345 Middlefield Road, MS 67
Menlo Park, CA 94025

(23) F. Eugene Rush
U.S. Geological Survey
Denver Federal Center
P. O. Box 25046, MS 416
Denver, CO 80225

(24) Edward A. Sammel
U.S. Geological Survey
345 Middlefield Road, MS 67
Menlo Park, CA 94025

(25) John H. Sass
U.S. Geological Survey
345 Middlefield Road, MS 18
Menlo Park, CA 94025

(26) Glen Stewart
University of New Hampshire
Geology Department
Durham, NH 13824

(27) Thomas C. Urban
U.S. Geological Survey
345 Middlefield Road, MS 77
Menlo Park, CA 94025

(28) P. Mike Wright
University of Utah Res. Inst.
Earth Science Laboratory
391 Chipeta Way
Salt Lake City, UT 84108

(29) Paul Yuen
University of Hawaii
Hawaiian Geothermal Project
Holms Hall, Rm. 240
2540 Dole Street
Honolulu, HI 96822

TABLE III

CORES AND CUTTINGS FROM WESTERN U.S. GEOTHERMAL WELLS
HOLDINGS OF THE EARTH SCIENCE LABORATORY
UNIVERSITY OF UTAH RESEARCH INSTITUTE

Area	Operator	Hole	Footage	Comments
Roosevelt Hot Spgs., UT	Phillips	9-1	6875	
Roosevelt Hot Spgs., UT Sec. 21-T27S-R9W	Thermal Power	14-2	6100	10-ft sample interval to 1800 ft, 5-ft sample interval, 1800-TD
Roosevelt Hot Spgs., UT	Thermal Power	72-16	1245	10-ft sample interval
Roosevelt Hot Spgs., UT Sec. 21-T27S-R9W	Getty	52-21	7500	10-ft sample interval
Roosevelt Hot Spgs., UT	Geothermal Power	18 holes	Av. 300	
Cove Fort, UT Sec. 29-T25S-R6W	Union	Forminco No. 1	1040	20-ft sample interval (800-920, no sample)
Cove Fort, UT Sec. 7-T26S-R6W	Union	42-7	7730	20-ft sample interval (23 samples missing)
Cove Fort, UT Sec. 33-725S-R6W	Union	31-33	5220	10-ft sample interval (20 samples missing)
San Emidio, NV	Chevron	Kosmos 1-8	4013	
San Emidio, NV Sec. 29-T20N-R38E	Chevron	Kosmos 1-9	5356	30-ft sample interval
Soda Lake, NV	Chevron	44-5	5069	
Soda Lake NV Sec. 29-T20N-R38E	Chevron	1-29	4306	30-ft sample interval
Beowawe, NV Sec. 19-T31N-R47E	Chevron	Rossi 21-19	5686	30-ft sample interval
Beowawe, NV Sec. 13-T31N-R47E	Chevron	Ginn 1-13	9515	30-ft sample interval
Beowawe, NV Sec. 15-T31N-R33E	Phillips	Cambell E No. 2	8061	10-ft sample interval
Baltazor, NV	Earth Power	16 holes	Av. 300	
Coso, Inyo Co., CA	Battelle	BDSH-1	1392	Essentially continuous core
Coso, Inyo Co., CA	DOE	CGEH-1	4824	Chips and not continuous core
Coso, Inyo Co., CA	DOE	18 holes	Av. 300	Not continuous cores
Raft River, ID	DOE	9 holes	3000-5000	Not continuous cores
Stillwater, NV Sec. 6-T19N-R31E	Union	Debraga No. 2	6700	20-ft sample interval
Cove Ft/Sulphurdale, UT	Union	CF-SU Nos. 14-29	2620	
Desert Peak, NV	Phillips	Desert Peak B-23-1	9615	10-ft sample interval
Humboldt House, NV	Phillips	Cambell E No. 2	8060	
Soda Lake, NV	Chevron	66-33	2000	
Soda Lake, NV	Chevron	11-33	2000	
Butte County, ID	DOE	INEL (chips)	10 324	10-ft sample interval
Butte County, ID Sec. 1-T3N-R29E	DOE	INEL (core)		Not continuous core
Pershing Co., NV	DOE	Dixie Valley (7 holes)		5-ft sample interval, not finished
Pershing Co., NV	Getty Oil Co.	Colado (18 holes)		

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[a] Information on these samples is available from contact (28) in Table II.

TABLE IV

SUMMARY OF GEOTHERMAL CORES AND CUTTINGS

ID Nos. Table II	Contact(s)	Sample Holdings	Remarks
(1)	C. Austin	a. Samples from wells and heat-flow holes in the Coso Hot Springs, California KGRA.	Some of these cores and cuttings may also be found at UURI (27)
(2)	J. Barraclough		May have some cores/cuttings from Raft River.
(3)	D. Blackwell	a. Fifteen cores and cuttings from one Marysville, Montana deep test well.	
(4) (6) (11) (22) (24) (25) (27)	J. Blevins R. Christiansen P. Gallis J. Robison E. Sammel J. Sass T. Urban	a. Cores and cuttings from six Long Valley, California heat-flow holes. b. Cores and cuttings from 14 heat-flow holes from Randsburg, California, KRGA. c. Cuttings from eight heat-flow holes and core from four holes, Saline Valley, California. d. Core and cuttings from four heat-flow holes, Kyle Hot Springs, Nevada. e. Cores and cuttings from three heat-flow holes, Buffalo Valley, Nevada. f. Cores and cuttings from 32 heat-flow holes, Leach Hot Springs, Nevada. g. Cores and cuttings from 17 heat-flow holes in southeastern Oregon. h. Cored deep test hole for heat-flow, Charleston, South Carolina.	Some samples from northeastern California (Surprise Valley, area) may also be in this holding.
(5)	S. Butters		Terra Tek may have samples and core from Roosevelt Hot Springs, Utah; East Mesa, California; Cerro Prieto, Mexico; Raft River, Idaho; and perhaps the Geysers, California fields.
(7)	J. Costain	a. Cuttings and cores from 32 heat-flow holes, Atlantic Coastal Plain.	
(8) (14) (19) (20) (23)	H. Covington W. Keys C. Naeser S. Oriel F. Rush		Some cuttings and cores from the Raft River, Idaho field. In addition, some samples from Roosevelt Hot Springs, Utah; Pagosa Springs, Colorado; and the San Luis Valley of Colorado.
(9)	P. Donaldson	a. Cores from five deep wells in the Raft River, Idaho field. b. Cuttings from six deep wells and three heat-flow holes in the Raft River, Idaho field. c. Core from three Boise Front, Idaho wells.	
(10)	W. Elders	a. Cores and cuttings from East Mesa, California. b. Cores and cuttings from Cerro Prieto, Mexico.	Repository may contain samples from other Imperial Valley, California wells.
(12)	J. Jacobson	a. Cuttings from Coso Hot Springs, California. b. Cores and cuttings from Marysville, Montana deep heat well.	

TABLE IV (cont)

ID Nos. Table II	Contact(s)	Sample Holdings	Remarks
(13)	G. Keller	a. Cores and cuttings from deep test at HVO, MI	Holdings may include cores and cuttings from other geothermal wells.
(15)	A. Laughlin	a. Cores and cuttings from three deep, hot dry rock, granite wells. b. Core splits from Redstone, New Hampshire well.	
(16)	R. Leonard		May have cores and cuttings from Marysville region.
(17)	R. Lewis		May have cores and cuttings from Raft River, Idaho.
(18)	L. Mink		Samples from Raft River and INEL, Idaho wells. Samples are stored at UURI (28)
(21)	L. Owen		Samples from Salton Sea and Imperial Valley, California wells.
(26)	G. Stewart	a. Core from Redstone, New Hampshire deep test well.	
(28)	P. Wright	See Table III	
(29)	P. Yuen	a. Cores and cuttings from deep well HGP-A near Pahoa and Hilo, Hawaii.	Well penetrated basalts and has extremely high bottomhole temperature. Many have other core and cuttings from Hawaii wells

GEOTHERMAL LOG INTERPRETATION NEEDS

Petrophysical property measurements on cores and samples from geothermal wells is an essential element in log interpretation. As previously demonstrated in oil and gas resource development, the economic production of geothermal fluids dictates a knowledge of the three factors that influence the potential, life, and productivity of the reservoir. These factors are: 1) the characteristics of the reservoir rock; 2) the characteristics of the subsurface fluid; 3) the type of porosity and permeability; and 4) the identification of production zones. Core analysis and well tests, together with geophysical logs and areal correlation, give an insight into the first factor; fluid samples taken under reservoir conditions of pressure and temperature and liberated under controlled laboratory procedures give subsurface fluid characteristics; and pressure history, production history, and other field tests estimate well life and efficiency. Core and sample analyses are the important tools in the determination of reservoir rock characteristics. Core analysis, in addition to being an important element in well completions and the most important tool for reservoir rock characterization, lends itself especially to specific and special tests, such as connate water, relative permeability, and acid solubility (among others), from which productivity and well treatment can be deduced.

An especially effective technique in well log analysis, the triporosity cross plot, has not yet been developed for geothermal applications. These triporosity cross plots (Burke et al., 1969), which involve porosity measurements from acoustic, density, and neutron logging tools, remove a major uncertainty from the interpretation process. A thorough understanding of a reservoir requires a complete knowledge of the kinds of rock in the formation through which a well has been drilled. Coring is a very expensive and risky process and can give this information directly; examination of drill cuttings can also be used but is less satisfactory. Much information about the lithology of different formations can be determined from a triporosity cross plot, which cross correlates porosity from different tools with the characteristics of the formation that influence these measurements. In the oil and gas industry experience, a very large data base of core properties exists for sedimentary rocks with which the reliability of the triporosity technique has been substantiated. The technique, in full development for the petroleum industry, cannot be applied yet for geothermal simply because it is not known where on the plots the unusual metamorphic or igneous lithologies would lie.

To realize the potential utility of this technique and other logging applications (Duba, 1978), a considerable effort in core analysis is needed to establish a geothermal data base. Some of the core measurements will need to be performed at temperatures and pressures that simulate the downhole environment. Table V shows a list of recommended properties to be evaluated for a broad range of geothermal cores. To properly interpret these laboratory tests, a thorough chemical and petrographic analysis and characterization is recommended, which would include:

- emission spectrography
- neutron activation analysis
- x-ray fluorescence spectrography
- thin-section petrography
- x-ray diffraction
- electron microprobe analysis

TABLE V

RECOMMENDED GEOTHERMAL CORE PROPERTY MEASUREMENTS[a]

Permeability (horizontal and vertical)
Porosity (total and effective)
Grain Density
Bulk Density (wet and dry)
Natural Gamma-Ray Spectroscopy
Gamma-Gamma Backscatter Density
Compressive Strength
Acoustic Speed--P Wave and S Wave
Electrical Resistivity (various frequencies)
Magnetic Susceptibility
Heat Capacity
Thermal Conductivity
Thermal Expansion
Thermal Diffusivity
Cation Exchange Capacity
Field Fluid Resistivity

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[a] All except grain density and compressive strength should be performed at both standard and field conditions of temperature and pressure.

When these measurements are extensively performed, data will be available to facilitate the field recalibrations that are so important to producing valid log interpretations. They will enable the extension of the several empirical formulas, common in the log interpretation methods used by the major service companies in oil and gas environments, to the geothermal environment and will further identify specific conditions under which naive use of those analysis methods becomes invalid.

It is hoped that a wider knowledge of the availability and potential access to the sources of geothermal cores and cuttings will aid in the establishment of the needed data base. Any further contributions to the list of repositories of geothermal cores that could be accessible to researchers interested in log interpretation or to a collection of rock property data of interest to geothermal reservoir formation analyses is welcome. These contributions should be sent to:

Mark Mathews
Geothermal Log Interpretation Program
Los Alamos Scientific Laboratory
P. O. Box 1663, MS 977
Los Alamos, NM 87545

Appendixes A through J contain additional details on the core and sample collections presented in Table I.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to those who submitted data for this report. We also thank the many individuals who were contacted and provided aid in the search for the locations of the sample repositories listed.

APPENDIX A

ATLANTIC COASTAL PLAIN

Between October 1, 1978, and March 15, 1979, 32 holes were drilled to 300 m along the Atlantic Coastal Plain (Fig. A-1). In each hole, cuttings were taken every 3 m and sealed in airtight bags. At least two attempts at taking core were made in each hole; one in silty, clayey, or consolidated sediments, the other near maximum depth. Detailed descriptions of the cores are being prepared. Lithologic descriptions of each hole have been determined from the cuttings and are available in Costain et al., 1979. Conductivity measurements on the cores have been performed. The data are presented in Tables A-I through A-XXII.

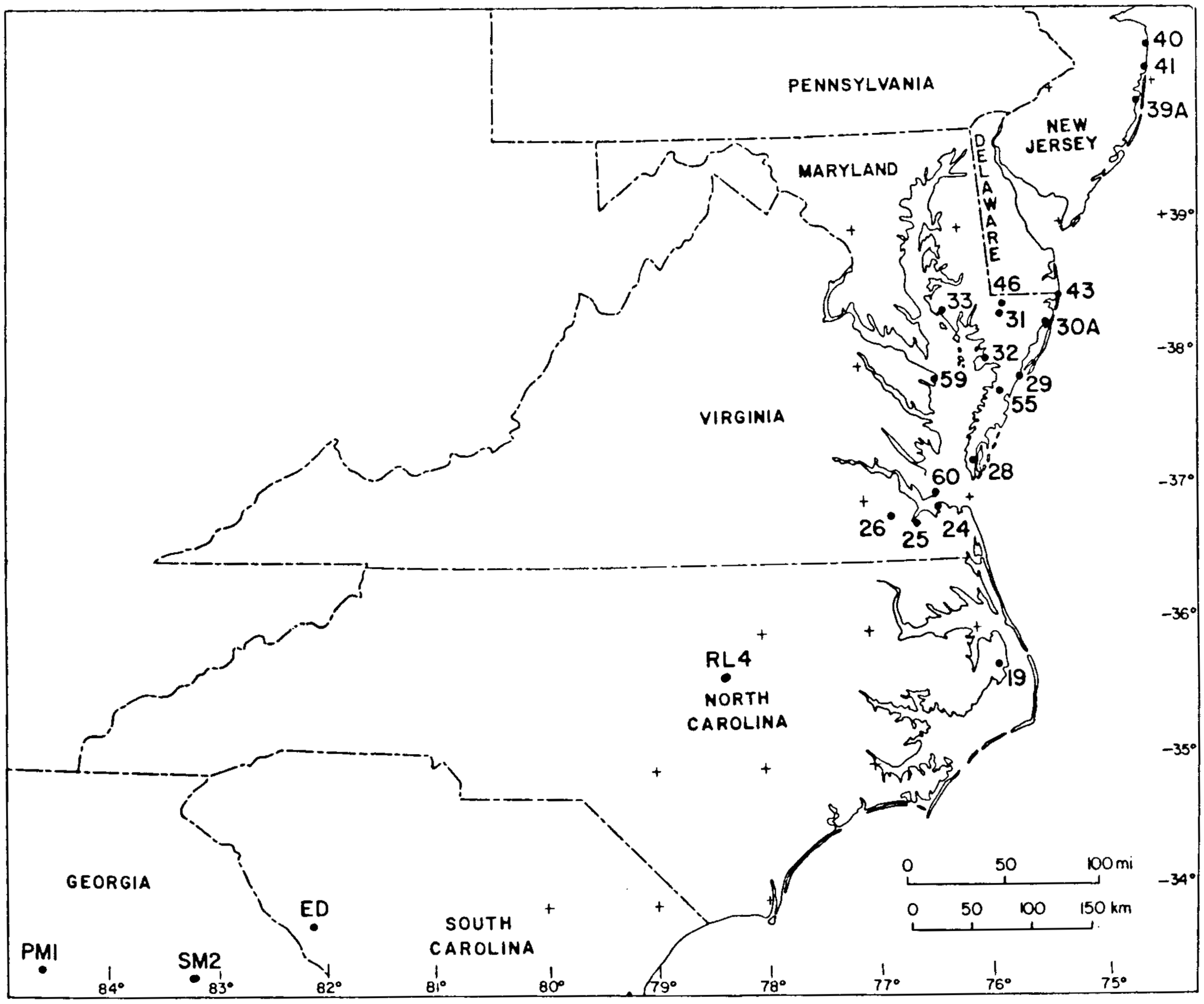

Fig. A-1. Locations of Atlantic Coastal Plains and Piedmont wells.

TABLE A-I

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C19

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C19- 650.5	198.3	3.2	C19- 954.5	290.9	3.1
C19- 651.5	198.6	3.1	C19- 955.5	291.2	3.9
C19- 652.5	198.9	3.3	C19- 956.5	291.5	3.9
C19- 653.5	199.2	3.3	C19- 957.5	291.8	3.6
C19- 654.5	199.5	3.2	C19- 958.5	292.2	4.2
C19- 655.5	199.8	3.6	C19- 959.5	292.5	4.6
C19- 656.5	200.1	3.1	C19- 960.5	292.8	3.6
C19- 657.5	200.4	3.7	C19- 961.5	293.1	3.6
C19- 658.5	200.7	3.3	C19- 964.5	294.0	2.4
C19- 659.5	201.0	3.2	C19- 966.5	294.6	6.5
C19- 661.0	201.5	3.1	C19- 967.5	294.9	3.5
C19- 662.0	201.8	3.4	C19- 968.5	295.2	3.3
C19- 663.0	202.1	3.2	C19- 969.5	295.5	4.1
C19- 654.0	202.4	3.4	C19- 970.5	295.8	3.3

Mean	3.56
Standard Deviation	0.72

Location: 35° 45.12'N
75° 47.65'W

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[a] Units of K = mcal/cm-s-°C

TABLE A-II

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C24

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C24- 535.5	163.2	3.1	C24- 553.5	168.7	3.4
C24- 536.5	163.5	3.1	C24- 555.5	169.3	4.4
C24- 537.5	163.8	3.1	C24- 556.5	169.6	4.4
C24- 538.5	164.1	3.1	C24- 557.5	169.9	4.3
C24- 539.5	164.4	3.2	C24- 558.5	170.2	4.3
C24- 540.5	164.7	3.1	C24- 559.5	170.5	3.6
C24- 541.5	165.0	3.2	C24-1000.0	304.8	3.3
C24- 542.5	165.4	3.3	C24-1000.0	304.8	3.0
C24- 543.5	165.7	3.1	C24-1000.0	304.8	5.5
C24- 544.5	166.0	3.1	C24-1000.0	304.8	5.7
C24- 545.5	166.3	3.4	C24-1005.0	306.3	4.4
C24- 546.5	166.6	3.2	C24-1005.0	306.3	3.7
C24- 547.5	166.9	3.2	C24-1005.0	306.3	3.2
C24- 548.5	167.2	3.2	C24-1005.0	306.3	3.3
C24- 549.5	167.5	3.1	C24-1005.0	306.3	3.1
C24- 550.5	167.8	3.3	C24-1005.0	306.3	3.1
C24- 551.5	168.1	3.0	C24-1005.0	306.3	3.1
C24- 552.5	168.4	3.3			

Mean	3.51
Standard Deviation	0.68

Location: 36° 57.40' N
76° 16.20' W

[a] Units of K = mcal/cm-s-°C

TABLE A-III

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C25
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C25- 975.0	297.2	4.9	C25- 987.5	301.0	5.4
C25- 976.0	297.5	5.7	C25- 988.5	301.3	4.9
C25- 977.0	297.8	6.4	C25- 989.5	301.6	4.7
C25- 983.0	299.6	7.3	C25- 990.0	301.8	4.4
C25- 984.5	300.1	4.5	C25- 991.0	302.1	4.7
C25- 985.5	300.4	5.3	C25- 992.0	302.4	4.3
C25- 986.5	300.7	5.1			

Mean	5.20
Standard Deviation	0.86

Location: 36° 51.01'N
76° 28.835'W

[a] Units of K = mcal/cm-s-°C

TABLE A-IV

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C26
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C26- 971.5	296.1	5.7	C26- 984.5	300.1	6.3
C26- 972.5	296.4	5.7	C26- 985.5	300.4	5.6
C26- 979.5	298.6	5.5	C26- 986.5	300.7	5.9
C26- 980.5	298.9	5.2	C26- 987.0	300.8	4.9
C26- 981.5	299.2	5.9	C26- 988.0	301.1	5.8
C26- 982.5	299.5	6.0	C26- 989.0	301.4	4.3
C26- 983.5	299.8	6.0	C26- 990.0	301.8	3.9

Mean	5.49
Standard Deviation	0.68

Location: 36° 54.51
76° 42.13

[a] Units of K = mcal/cm-s-°C

TABLE A-V

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C28

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C28- 696.5	212.3	3.2	C28- 975.5	297.3	2.2
C28- 697.5	212.6	3.4	C28- 976.5	297.6	2.2
C28- 698.5	212.9	3.4	C28- 977.5	297.9	2.2
C28- 699.5	213.2	3.4	C28- 978.5	298.2	2.3
C28- 700.5	213.5	3.6	C28- 979.5	298.6	1.8
C28- 701.5	213.8	3.9	C28- 980.5	298.9	2.1
C28- 702.5	214.1	3.3	C28- 981.5	299.2	2.1
C28- 703.5	214.4	3.2	C28- 982.5	299.5	2.2
C28- 704.5	214.7	3.2	C28- 983.5	299.8	2.2
C28- 705.5	215.0	3.0	C28- 984.5	300.1	2.1
C28- 706.5	215.3	2.9	C28- 985.5	300.4	2.1
C28- 707.5	215.6	2.8	C28- 986.5	300.7	2.1
C28- 708.5	216.0	2.8	C28- 987.5	301.0	2.0
C28- 709.5	216.3	2.9	C28- 988.5	301.3	1.9
C28- 710.5	216.6	3.0	C28- 989.5	301.6	2.0
C28- 711.5	216.9	2.8	C28- 990.5	301.9	2.0
C28- 712.5	217.2	3.1	C28- 991.5	302.2	2.0
C28- 713.5	217.5	3.0	C28- 992 5	302.5	1.9
C28- 714.5	217.8	3.7	C28- 993.5	302.8	2.0
C28- 715.5	218.1	3.7	C28- 994.5	303.1	2.0
C28- 716.5	218.4	3.4	C28- 995.5	303.4	2.1
C28- 717.5	218.7	3.7	C28- 996.5	303.7	2.3
C28- 718.5	219.0	3.0	C28- 997.0	303.9	2.3
C28- 719.5	219.3	3.2	C28- 998.5	304.3	2.3
C28- 720.5	219.6	3.7	C28- 999.5	304.6	2.3
C28- 721.5	219.9	3.4	C28-1001.0	305.1	2.3
C28- 722.5	220.2	3.4	C28-1002.0	305.4	2.3
C28- 723.5	220.5	3.1	C28-1003.0	305.7	2.2
C28- 724.5	220.8	3.3	C28-1004.0	306.0	2.1
C28- 725.5	221.1	3.1			

Mean	2.70
Standard Deviation	0.62

Location: 37° 17.79'N
75° 55.86'W

[a] Units of K = mcal/cm-s-°C

TABLE A-VI

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C29
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C29- 584.5	178.2	2.8	C29- 598.5	182.4	4.2
C29- 585.5	178.5	3.4	C29- 599.5	182.7	3.7
C29- 586.5	178.8	3.6	C29- 990.5	301.9	4.1
C29- 587.5	179.1	5.1	C29- 991.5	302.2	4.2
C29- 588.5	179.4	4.8	C29- 992.5	302.5	4.1
C29- 589.5	179.7	5.2	C29- 993.5	302.8	3.7
C29- 590.5	180.0	4.9	C29- 994.5	303.1	3.9
C29- 591.5	180.3	4.6	C29- 995.5	303.4	3.0
C29- 592.5	180.6	5.1	C29- 996.5	303.7	3.0
C29- 593.5	180.9	6.2	C29- 997.5	304.0	3.4
C29- 594.5	181.2	4.9	C29- 998.5	304.3	3.4
C29- 595.5	181.5	4.1	C29- 999.5	304.6	3.5
C29- 596.5	181.8	5.1			

Mean	4.15
Standard Deviation	0.85

Location: 37° 56.60'N
75° 27.27'W

[a] Units of K = mcal/cm-s-°C

TABLE A-VII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C30A

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C30- 241.5	73.6	3.5	C30-1016.0	309.7	2.7
C30- 242.5	73.9	3.2	C30-1017.0	310.0	2.5
C30- 243.5	74.2	3.0	C30-1018.0	310.3	2.5
C30- 244.5	74.5	4.0	C30-1019.0	310.6	2.4
C30- 245.5	74.8	3.6	C30-1020.0	310.9	2.5
C30- 246.5	75.1	3.2	C30-1021.0	311.2	2.4
C30- 247.5	75.4	4.1	C30-1022.0	311.5	2.3
C30- 535.5	163.2	4.3	C30-1023.0	312.0	2.3
C30- 536.5	163.5	3.5	C30-1024.0	312.3	2.4
C30- 537.5	163.8	3.7	C30-1025.0	312.6	2.5
C30- 538.5	164.1	3.8	C30-1026.0	312.9	2.5
C30- 539.5	164.4	3.4	C30-1027.0	313.2	2.5
C30- 540.5	164.7	3.4	C30-1029.0	313.6	2.6
C30-1009.0	307.5	2.6	C30-1030.0	313.9	2.6
C30-1010.0	307.8	2.5	C30-1031.0	314.2	2.7
C30-1011.0	308.2	2.8	C30-1032.0	314.6	2.7
C30-1012.0	308.5	2.8	C30-1203.5	366.8	2.4
C30-1013.0	308.8	3.0	C30-1204.5	367.1	2.2
C30-1014.0	309.1	2.9	C30-1207.5	368.0	2.0
C30-1015.0	309.4	2.6			

Mean	2.89	Location:	38° 18.61'N
Standard Deviation	0.57		75° 07.07'W

[a] Units of K = mcal/cm-s-°C

TABLE A-VIII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C31
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C31- 732.5	223.3	4.1	C31- 982.5	299.5	3.7
C31- 733.5	223.6	2.5	C31- 983.5	299.8	3.7
C31- 734.5	223.9	3.1	C31- 984.5	300.1	3.7
C31- 735.5	224.2	4.2	C31- 986.5	300.7	3.4
C31- 736.5	224.5	3.8	C31- 987.5	301.0	3.1
C31- 737.5	224.8	4.5	C31- 988.5	301.3	3.0
C31- 738.5	225.1	6.6	C31- 989.5	301.6	2.5
C31- 739.5	225.4	4.1	C31- 990.5	301.9	2.8
C31- 740.5	225.7	3.9	C31- 991.5	302.2	2.8
C31- 741.5	226.0	4.0	C31- 992.5	302.5	2.7
C31- 742.5	226.3	4.2	C31- 992.5	302.5	2.5
C31- 743.5	226.6	4.1	C31- 993.5	302.8	2.8
C31- 744.5	226.9	3.9	C31- 994.5	303.1	2.8
C31- 745.5	227.2	4.1	C31- 995.5	303.4	2.5
C31- 746.5	227.5	4.0	C31- 996.5	303.7	2.7
C31- 747.5	227.8	4.0	C31- 997.5	304.0	2.7
C31- 980.5	298.9	3.4	C31- 998.5	304.3	2.8
C31- 981.5	299.2	3.5	C31- 999.5	304.6	3.0

Mean	3.45	Location:	38° 20.55 'N
Standard Deviation	0.81		75° 36.43 'W

[a] Units of K = mcal/cm-s-°C

TABLE A-IX

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C32
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C32- 541.5	165.0	3.1	C32- 553.5	168.7	2.9
C32- 542.5	165.4	3.1	C32- 554.5	169.0	2.9
C32- 543.5	165.7	3.0	C32- 555.5	169.3	2.9
C32- 544.5	166.0	2.7	C32- 556.5	169.6	2.7
C32- 545.5	166.3	2.8	C32- 557.5	169.9	2.8
C32- 546.5	166.6	2.9	C32- 558.5	170.2	2.7
C32- 547.5	166.9	3.0	C32- 559.5	170.5	2.9
C32- 548.5	167.2	2.6	C32- 560.5	170.8	2.5
C32- 549.5	167.5	2.7	C32-1019.5	310.6	3.0
C32- 550.5	167.8	3.2	C32-1020.5	311.0	4.1
C32- 551.5	168.1	2.7	C32-1034.5	315.3	4.8
C32- 552.5	168.4	3.1			

Mean	3.00
Standard Deviation	0.50

Location: 38° 00.97 'N
75° 49.57 'W

[a] Units of K = mcal/cm-s-°C

TABLE A-X

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C33
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C33-1013.5	308.9	5.4	C33-1015.5	309.5	4.0
C33-1014.5	309.2	4.1			

Mean	4.50
Standard Deviation	0.78

Location: 38° 24.13 'N
76° 11.19 'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XI

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C39A
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C39- 723.5	220.0	3.2	C39- 739.5	225.4	3.2
C39- 724.5	220.8	2.8	C39- 740.5	225.7	3.1
C39- 732.5	223.3	2.9	C39- 741.5	226.0	3.6
C39- 733.5	223.6	3.3	C39- 742.5	226.3	3.4
C39- 734.5	223.9	3.1	C39- 744.5	226.9	3.7
C39- 735.5	224.2	3.6	C39- 745.5	227.2	3.2
C39- 736.5	224.5	3.4	C39- 746.5	227.5	3.1
C39- 737.5	224.8	4.1			

Mean 3.31
Standard Deviation 0.33

Location: 39° 50.44'N
74° 10.87'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C40
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C40- 764A	232.9	3.2	C40- 967	294.7	5.5
C40- 746B	227.4	4.5	C40- 967	294.7	6.4
C40- 765A	233.2	2.9	C40- 971A	296.0	4.2
C40- 765B	233.2	3.2	C40- 971B	296.0	4.3
C40- 767A	233.8	5.5	C40- 973A	296.6	6.0
C40- 767B	233.8	4.9	C40- 973B	296.6	6.9
C40- 768	234.1	1.6	C40- 973C	296.6	6.7
C40- 769A	234.4	4.0	C40- 973D	296.6	6.5
C40- 769B	234.4	4.3	C40- 985A	300.2	4.6
C40- 770	234.6	3.9	C40- 985B	300.2	4.3
C40- 966A	294.4	7.0	C40- 987A	300.8	5.6
C40- 966B	294.4	4.9	C40- 987B	300.8	4.1

Mean 4.79
Standard Deviation 1.38

Location: 40° 18.81'N
74° 03.02'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XIII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C41
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C41- 813	247.7	2.6	C41- 979	298.3	4.3
C41- 814	248.0	2.9	C41- 980	298.6	4.5
C41- 815	248.3	3.0	C41- 981	298.9	3.9
C41- 816	248.6	2.9	C41- 982	299.2	4.8
C41- 964	293.8	3.2	C41- 983	299.3	5.2
C41- 965	294.1	3.1	C41- 984	299.6	3.3
C41- 975	297.2	4.6	C41- 986	300.4	5.9
C41- 976	297.4	4.7	C41- 987	300.5	3.9
C41- 977	297.8	4.8	C41- 988A	301.1	3.6
C41- 978	298.0	2.4	C41- 988B	301.1	3.8

Mean 3.87

Standard Deviation 0.95

Location: 40° 7.26'N
74° 2.25'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XIV

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C43
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C43- 550.5	167.8	3.3	C43- 562.5	171.4	3.5
C43- 551.5	168.1	2.9	C43- 563.5	171.8	3.7
C43- 552.5	168.4	3.0	C43- 564.5	172.1	3.5
C43- 554.5	169.0	2.9	C43- 566.5	172.7	3.3
C43- 555.5	169.3	3.2	C43- 567.5	173.0	3.0
C43- 556.5	169.6	3.1	C43- 568.5	173.3	3.1
C43- 557.5	169.9	3.4	C43- 569.5	173.6	2.9
C43- 558.5	170.2	3.2	C43- 571.2	174.1	4.3
C43- 559.5	170.5	3.7	C43- 572.3	174.4	3.7
C43- 560.5	170.8	3.7	C43- 573.2	174.7	3.9
C43- 561.5	171.1	3.6	C43-1039.5	316.8	2.9

Mean 3.35

Standard Deviation 0.38

Location: 38° 26.04'N
75° 03.57'W

*...Units of K = mcal/cm-s-°C

TABLE A-XV

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C46
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C46- 739.5	225.4	3.3	C46- 752.7	229.4	4.2
C46- 740.5	225.7	3.3	C46- 753.5	229.7	4.3
C46- 741.5	226.0	3.3	C46- 754.0	229.8	4.2
C46- 742.5	226.3	3.6	C46- 966.5	294.6	2.3
C46- 743.5	226.6	3.1	C46- 967.5	294.9	2.4
C46- 745.5	227.2	3.5	C46- 968.5	295.2	3.1
C46- 746.5	227.5	3.8	C46- 969.0	295.4	3.7
C46- 747.5	227.8	3.7	C46- 970.3	295.7	2.6
C46- 748.5	228.1	3.9	C46- 971.3	296.1	2.6
C46- 749.5	228.4	3.7	C46- 973.3	296.7	3.2
C46- 750.5	228.8	4.3	C46- 974.3	297.0	3.7
C46- 751.5	229.1	4.4	C46- 975.3	297.3	2.9

Mean	3.46
Standard Deviation	0.61

Location: 38° 23.96'N
75° 34.49'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XVI

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C55

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
C55- 545.5	166.3	4.7	C55- 562.5	171.4	4.8
C55- 546.5	166.6	4.0	C55- 563.5	171.8	4.0
C55- 547.5	166.9	3.9	C55- 564.5	172.1	4.4
C55- 548.5	167.2	4.0	C55- 565.5	172.4	4.3
C55- 549.5	167.5	4.0	C55- 566.5	172.7	3.8
C55- 550.5	167.8	4.3	C55- 944.5	281.9	3.6
C55- 552.5	168.4	4.2	C55- 945.5	288.2	3.1
C55- 553.5	168.7	3.7	C55- 946.5	288.5	3.6
C55- 554.5	169.0	3.9	C55- 949.5	289.4	2.8
C55- 555.5	169.3	3.8	C55- 950.5	289.7	2.7
C55- 556.5	169.6	3.7	C55- 969.5	295.5	2.5
C55- 557.5	169.9	3.7	C55- 970.5	295.8	3.1
C55- 558.5	170.2	4.3	C55- 972.5	296.4	3.0
C55- 559.5	170.5	4.2	C55- 973.5	296.7	2.9
C55- 560.5	170.8	4.8	C55- 974.5	297.0	2.5
C55- 561.5	171.1	5.8			

Mean	3.81
Standard Deviation	0.74

Location: 37° 42.53'N
75° 42.85'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XVII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C59
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C59- 477.5	145.5	3.1	C59- 493.5	150.4	2.7
C59- 478.5	145.8	3.0	C59- 494.5	150.7	2.9
C59- 479.5	146.2	2.9	C59- 495.5	151.0	2.8
C59- 481.5	146.8	2.9	C59- 496.5	151.3	2.9
C59- 482.5	147.1	3.3	C59- 497.5	151.6	3.1
C59- 483.5	147.4	2.6	C59- 498.9	152.1	2.5
C59- 484.5	147.7	2.6	C59- 499.9	152.4	3.1
C59- 485.5	148.0	2.5	C59- 500.9	152.7	2.6
C59- 486.5	148.3	2.5	C59- 501.9	153.0	2.7
C59- 487.5	148.6	2.6	C59- 502.9	153.3	3.1
C59- 488.5	148.9	2.7	C59- 979.5	298.6	3.0
C59- 489.5	149.2	2.7	C59- 980.5	298.9	3.7
C59- 490.5	149.5	2.5	C59- 981.5	299.2	4.7
C59- 491.5	149.8	2.7	C59- 982.5	299.5	4.8
C59- 492.5	150.1	2.7	C59- 983.5	299.8	3.9

Mean 2.99
Standard Deviation 0.58

Location: 37° 53.02'N
76° 15.09'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XVIII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE C60
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]	Sample Name	Depth (m)	K [a]
C60- 918.5	280.0	4.8	C60- 924.7	281.8	4.0
C60- 919.5	280.3	5.5	C60- 925.9	282.2	4.5
C60- 920.5	280.6	3.6	C60- 926.9	282.5	4.2
C60- 921.7	280.8	4.3	C60- 927.9	282.8	4.5
C60- 922.7	281.2	4.3	C60- 928.9	283.1	3.7
C60- 923.7	281.5	3.1			

Mean 4.23
Standard Deviation 0.64

Location: 37° 03.98'N
76° 19.28'W

[a] Units of K = mcal/cm-s-°C

TABLE A-XIX

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE PM1

(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
PM1- 35.0	35.0	6.48	PM1-137.5	137.5	6.51
PM1- 42.5	42.5	6.72	PM1-140.0	140.0	5.35
PM1- 45.0	45.0	7.18	PM1-145.0	145.0	5.73
PM1- 47.5	47.5	5.57	PM1-147.5	147.5	6.19
PM1- 50.0	50.0	6.20	PM1-152.5	152.5	8.92
PM1- 50.0	50.0	6.59	PM1-155.0	155.0	6.81
PM1- 52.5	52.5	6.30	PM1-157.5	157.5	7.74
PM1- 55.0	55.0	5.76	PM1-160.0	160.0	6.47
PM1- 57.5	57.5	5.92	PM1-162.5	162.5	5.84
PM1- 60.0	60.0	6.41	PM1-165.0	165.0	6.24
PM1- 65.0	65.0	6.47	PM1-167.5	167.5	6.81
PM1- 70.0	70.0	6.34	PM1-167.5	167.5	5.84
PM1- 80.0	80.0	10.25	PM1-170.0	170.0	6.50
PM1- 82.5	82.5	7.98	PM1-172.5	172.5	6.03
PM1- 85.0	85.0	4.35	PM1-175.0	175.0	5.83
PM1- 90.0	90.0	6.63	PM1-177.5	177.5	5.57
PM1- 92.5	92.5	7.13	PM1-180.0	180.0	5.55
PM1- 95.0	95.0	6.52	PM1-182.5	182.5	5.20
PM1- 97.5	97.5	6.43	PM1-185.0	185.0	5.52
PM1-100.0	100.0	6.00	PM1-190.0	190.0	6.43
PM1-100.0	100.0	5.74	PM1-192.5	192.5	5.14
PM1-105.0	105.0	6.08	PM1-195.0	195.0	5.83
PM1-107.5	107.5	6.62	PM1-198.0	198.0	5.56
PM1-115.0	115.0	5.61	PM1-200.0	200.0	5.62
PM1-117.5	117.5	5.25	PM1-202.5	202.5	5.96
PM1-120.0	120.0	6.04	PM1-205.0	205.0	6.56
PM1-122.5	122.5	5.75	PM1-207.5	207.5	5.12
PM1-125.0	125.0	6.40	PM1-210.0	210.0	6.14
PM1-127.5	127.5	5.28	PM1-236.0	236.0	7.51
PM1-132.5	132.5	6.89	PM1-288.8	288.8	6.26
PM1-135.0	135.0	5.82			

Drilled in Palmetto granite

Mean	6.25
Standard Deviation	0.91

Location: 33°29'55" N
84°41'58" W

[a] Units of K = mcal/cm-s-°C

TABLE A-XX

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE EDI
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K [a]
ED1-606.9	185.0	9.57
ED1-615.2	187.5	9.22
ED1-623.4	190.0	9.61
ED1-631.6	192.5	8.63
ED1-639.8	195.0	9.09
ED1-656.2	200.0	8.99
ED1-664.4	202.5	9.19
ED1-672.6	205.0	9.17
ED1-705.4	214.7	9.29
ED1-713.6	217.5	8.75
ED1-730.0	222.5	9.19
ED1-738.2	225.0	9.50
ED1-754.6	230.0	9.38
ED1-762.8	232.5	9.20
ED1-772.4	235.4	9.26
ED1-779.2	237.5	8.98
ED1-787.4	240.0	9.33
ED1-795.6	242.5	8.88
ED1-803.8	245.0	9.15
ED1-812.0	247.5	9.32
ED1-820.2	250.0	9.42
ED1-828.4	252.5	9.05
ED1-853.0	260.0	9.21
ED1-869.4	265.0	8.95
ED1-885.5	269.9	9.19
ED1-894.0	272.5	9.25
ED1-910.9	277.6	9.37
ED1-926.8	282.5	8.87
ED1-934.0	284.7	8.96
ED1-943.2	287.5	9.40
ED1-951.4	290.0	9.20

Drilled in Cuffytown Creek granite

Mean	9.18
Standard Deviation	0.23

Location: 33°55'11"N
82°07'10"W

[a] Units of K = mcal/cm-s-°C

TABLE A-XXI

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE RL4
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
RL4- 213	65.0	8.13	RL4- 435	132.5	6.66
RL4- 221	67.5	7.46	RL4- 443	135.0	8.00
RL4- 229	70.0	6.01	RL4- 451	137.5	6.55
RL4- 238	72.5	7.31	RL4- 459	140.0	7.96
RL4- 246	75.0	6.18	RL4- 467	142.5	6.67
RL4- 254	77.5	6.25	RL4- 476	145.0	7.68
RL4- 262	80.0	6.28	RL4- 484	147.5	6.69
RL4- 270	82.5	6.41	RL4- 489	149.0	6.83
RL4- 279	85.0	6.36	RL4- 492	149.9	6.85
RL4- 287	87.5	6.05	RL4- 500	152.5	6.70
RL4- 295	90.0	5.75	RL4- 508	155.0	7.83
RL4- 303	92.5	6.21	RL4- 517	157.5	6.72
RL4- 312	95.0	7.19	RL4- 525	160.0	8.52
RL4- 320	97.5	6.86	RL4- 533	162.5	7.21
RL4- 328	100.0	6.82	RL4- 541	165.0	7.50
RL4- 336	102.5	6.79	RL4- 549	167.5	6.84
RL4- 344	105.0	6.24	RL4- 558	170.0	6.06
RL4- 351	107.5	6.34	RL4- 565	172.5	7.54
RL4- 361	110.0	6.86	RL4- 574	175.0	7.67
RL4- 369	112.5	6.86	RL4- 582	177.5	7.05
RL4- 377	115.0	7.20	RL4- 590	180.0	6.62
RL4- 385	117.5	5.81	RL4- 595	181.5	6.79
RL4- 394	120.0	6.08	RL4- 607	185.0	6.74
RL4- 402	122.5	5.48	RL4- 615	187.5	6.06
RL4- 410	125.0	6.97	RL4- 623	190.0	7.04
RL4- 418	127.5	6.81	RL4- 632	192.5	6.89
RL4- 426	130.0	8.16	RL4- 640	195.0	7.04

Drilled in Rolesville pluton

Mean	6.84
Standard Deviation	0.66

Location: 35°43'36" N
78°19'45" W

[a] Units of K = mcal/cm-s-°C

TABLE A-XXII

THERMAL CONDUCTIVITY VALUES FROM CORE OF DRILL HOLE SM2
(Samples are 2.680 cm in diameter by 1.270 cm thick)

Sample Name	Depth (m)	K[a]	Sample Name	Depth (m)	K[a]
SM2- 90	27.5	7.31	SM2- 435	132.5	8.68
SM2- 148	45.0	7.63	SM2- 451	137.5	6.99
SM2- 156	47.5	6.87	SM2- 476	145.0	7.81
SM2- 164	50.0	7.12	SM2- 484	147.5	7.49
SM2- 180	55.0	7.51	SM2- 492	150.0	7.17
SM2- 189	57.5	7.50	SM2- 508	155.0	7.19
SM2- 197	60.0	7.63	SM2- 517	157.5	7.25
SM2- 205	62.5	9.06	SM2- 533	162.5	8.46
SM2- 238	72.5	8.74	SM2- 541	165.0	8.61
SM2- 246	75.0	9.74	SM2- 549	167.5	7.82
SM2- 262	80.0	7.14	SM2- 566	172.5	7.58
SM2- 271	82.5	7.16	SM2- 574	175.0	8.30
SM2- 279	85.0	7.33	SM2- 590	180.0	8.09
SM2- 287	87.5	8.11	SM2- 607	185.0	8.62
SM2- 303	92.5	7.54	SM2- 615	187.5	7.87
SM2- 344	105.0	9.14	SM2- 632	192.5	7.48
SM2- 351	107.5	8.23	SM2- 640	195.0	7.92
SM2- 361	110.0	7.54	SM2- 648	197.5	7.20
SM2- 369	112.5	7.70	SM2- 664	202.0	7.73
SM2- 377	115.0	9.67	SM2- 673	205.0	7.40
SM2- 385	117.5	7.16	SM2- 681	207.5	7.60
SM2- 394	120.0	8.39	SM2- 689	210.0	6.58
SM2- 410	125.0	9.15			

Drilled in Siloam granite

Mean	7.85
Standard Deviation	0.74

Location: 33°28'41" N
83°11'35" W

[a] Units of K = mcal/cm-s-°C

APPENDIX B

CALIFORNIA

1. Long Valley

To help define the regional thermal setting of the Long Valley, California (Fig. B-1), four heat-flow holes were drilled in granitic rock outside the caldera and two within it. Thermal conductivities and lithologies of these holes are provided in Tables B-I through B-VI as presented in a preliminary report by Sass et al., 1974. Further information on temperature gradients for these wells is available in Sass et al., 1974. Access to these cores is possible through S. Peter Galanis, U.S. Geological Survey, Menlo Park.

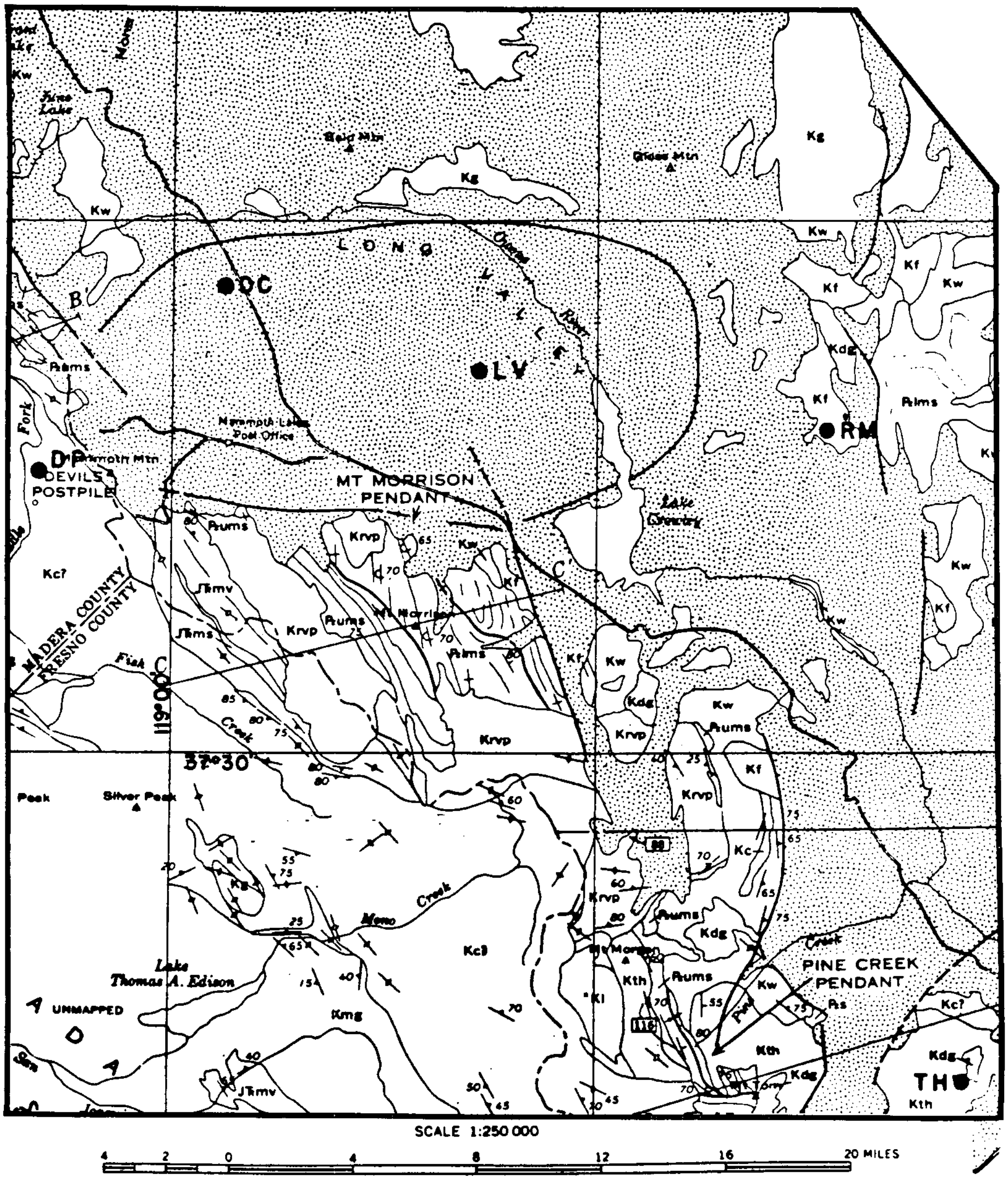

Fig. B-1. Geologic sketch map showing Long Valley, California.

TABLE B-I

CONDUCTIVITIES FROM DC-1

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
DMC-1	142.0 F	Trachyandesite	3.99	2.80	5.0
DMC-1	167.0 F	Trachyandesite	4.08	2.82	4.1
DMC-1	191.5 F	Trachyandesite	4.09	2.80	4.7
DMC-1	207.0 F	Trachyandesite	4.19	2.77	4.7
DMC-1	253.5 F	Trachyandesite	4.11	2.78	6.2
DMC-1	265.5 F	Trachyandesite	3.98	2.80	5.6
DMC-1	272.0 F	Trachyandesite	4.24	2.79	5.6
DMC-1	283.3 F	Trachyandesite	4.00	2.81	5.3
DMC-1	293.0 F	Trachyandesite	4.40	2.80	5.5
DMC-1	326.0 F	Trachyandesite	3.57	2.60	6.4
DMC-1	333.0 F	Trachyandesite	4.16	2.64	4.7
DMC-1	537.0 F	Clay	2.37		N.P.
DMC-1	540.0 F	Sand	1.89		N.P.
DMC-1	577.0 F	Sand	2.26		N.P.
DMC-1	594.0 F	Sand	2.02		N.P.
DMC-1	594.0 F	Sand	1.84		N.P.
DMC-1	603.0 F	Sand	1.40		N.P.
DMC-1	606.0 F	Pumice Sediment	1.47		N.P.
DMC-1	607.0 F	Pumice Sediment	1.30		N.P.
DMC-1	617.0 F	Pumice Sediment	2.04		N.P.
DMC-1	618.0 F	Sand	1.53		N.P.
DMC-1	625.0 F	Sand	1.73		N.P.
DMC-1	627.0 F	Pumice Tuff	1.11		N.P.
DMC-1	629.0 F	Pumice Tuff	1.67		N.P.
DMC-1	631.0 F	Pumice Tuff	1.55		N.P.
DMC-1	634.0 F	Pumice Tuff	1.47		N.P.
DMC-1	637.0 F	Pumice Tuff	0.95		N.P.

K - mcal/cm-s-°C

RHO - gm/cm^3

PHI - Porosity (%)

TABLE B-II

CONDUCTIVITIES FROM DP

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
DP-1	209.0 F	Granite	7.41	2.61	0.8
DP-1	232.0 F	Granite	7.34	2.62	1.0
DP-1	255.0 F	Granite	6.84	2.61	1.2
DP-1	277.0 F	Granite	7.28	2.62	0.8
DP-1	298.0 F	Granite	7.38	2.61	1.1
DP-1	323.0 F	Granite	6.94	2.61	1.0
DP-1	336.0 F	Granite	7.16	2.62	1.0
DP-1	359.0 F	Granite	8.00	2.62	0.9
DP-1	382.0 F	Granite	7.14	2.62	0.9
DP-1	406.0 F	Granite	7.12	2.62	0.8
DP-1	420.0 F	Granite	7.74	2.62	1.1
DP-1	439.0 F	Granite	7.46	2.62	0.9
DP-1	460.0 F	Granite	7.37	2.61	1.1
DP-1	480.0 F	Granite	7.58	2.60	1.2
DP-1	501.0 F	Granite	6.66	2.59	1.5
DP-1	521.0 F	Granite	8.26	2.62	1.2
DP-1	540.0 F	Granite	6.01	2.60	1.2
DP-1	560.0 F	Granite	7.04	2.60	1.1
DP-1	580.0 F	Granite	7.01	2.61	1.2
DP-1	600.0 F	Granite	8.14	2.60	1.1
DP-1	620.0 F	Granite	7.66	2.59	1.3
DP-1	639.0 F	Granite	7.58	2.59	1.1
DP-1	660.0 F	Granite	7.13	2.61	1.1
DP-1	682.0 F	Granite	8.43	2.59	1.4
DP-1	700.0 F	Granite	7.29	2.62	0.9
DP-1	720.0 F	Granite	6.95	2.61	1.0
DP-1	740.0 F	Granite	7.63	2.60	1.0
DP-1	760.0 F	Granite	7.08	2.60	1.0
DP-1	780.0 F	Granite	7.00	2.61	1.0
DP-1	800.0 F	Granite	7.24	2.61	1.0
DP-1	830.0 F	Granite	7.39	2.61	1.1

K - mcal/cm-s-°C

RHO - gm/cm^3

PHI - Porosity (%)

TABLE B-III

CONDUCTIVITIES FROM RM

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
RM-1	213.0 F	Granite	7.85	2.62	1.3
RM-1	213.0 F	Granite	8.08	2.62	0.8
RM-1	302.0 F	Granite	8.01	2.65	0.6
RM-1	302.0 F	Granite	8.16	2.65	0.4
RM-1	334.0 F	Granite	6.71	2.60	2.2
RM-1	334.0 F	Granite	7.08	2.60	1.6
RM-1	365.0 F	Granite	8.14	2.58	2.6
RM-1	365.0 F	Granite	7.69	2.58	1.9
RM-1	384.0 F	Dike	5.53	2.87	0.8
RM-1	384.0 F	Dike	5.53	2.87	0.4
RM-1	417.0 F	Granite	8.20	2.64	1.1
RM-1	417.0 F	Granite	7.90	2.65	0.6
RM-1	440.0 F	Granite	6.87	2.56	3.5
RM-1	440.0 F	Granite	6.91	2.56	2.0
RM-1	471.0 F	Granite	7.93	2.63	1.7
RM-1	471.0 F	Granite	7.72	2.63	0.9
RM-1	496.0 F	Granite	8.06	2.65	0.4
RM-1	506.0 F	Granite	7.87	2.65	0.4
RM-1	512.0 F	Granite	8.26	2.64	0.4
RM-1	525.0 F	Granite	8.21	2.65	0.3
RM-1	536.0 F	Granite	8.04	2.64	0.2
RM-1	546.0 F	Granite	7.90	2.64	0.2
RM-1	556.0 F	Granite	8.06	2.64	0.3
RM-1	565.0 F	Granite	7.73	2.63	0.5
RM-1	576.0 F	Granite	7.94	2.64	0.6
RM-1	590.0 F	Granite	8.22	2.64	0.2
RM-1	600.0 F	Granite	8.02	2.66	0.2
RM-1	610.0 F	Granite	8.14	2.71	0.2
RM-1	623.0 F	Granite	5.42	2.75	0.4
RM-1	632.0 F	Granite	7.85	2.65	0.3
RM-1	643.0 F	Granite	8.26	2.62	0.4
RM-1	652.5 F	Granite	9.50	2.33	0.2
RM-1	660.0 F	Granite	8.27	2.63	0.2
RM-1	670.0 F	Granite	8.36	2.63	0.2
RM-1	680.0 F	Granite	7.76	2.62	0.6
RM-1	687.0 F	Granite	8.46	2.63	0.3

K - mcal/cm-s-°C

RHO - gm/cm^3

PHI - Porosity (%)

TABLE B-IV

CONDUCTIVITIES FROM SM

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
SM-1	284.0 F	Granite	8.34	2.65	0.6
SM-1	328.0 F	Granite	7.76	2.67	1.2
SM-1	378.0 F	Granite	8.21	2.66	0.5
SM-1	416.0 F	Granite	7.84	2.68	0.4
SM-1	453.0 F	Granite	7.58	2.68	0.5
SM-1	504.0 F	Granite	7.45	2.64	0.4
SM-1	570.0 F	Granite	7.06	2.67	0.4
SM-1	649.0 F	Granite	7.90	2.68	0.4
SM-1	727.0 F	Granite	7.76	2.67	0.4
SM-1	795.0 F	Granite	7.66	2.67	0.5
SM-1	851.0 F	Granite	7.80	2.68	0.3
SM-1	893.0 F	Granite	7.48	2.67	0.3

TABLE B-V

CONDUCTIVITIES FROM TH

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
TH-1	431.0 F	Quartz Diorite	5.81	2.76	0.9
TH-1	443.0 F	Quartz Diorite	5.76	2.74	1.0
TH-1	452.0 F	Quartz Diorite	6.35	2.77	0.2
TH-1	460.0 F	Quartz Diorite	6.19	2.79	0.4
TH-1	470.0 F	Quartz Diorite	6.20	2.78	0.2
TH-1	480.0 F	Quartz Diorite	6.31	2.77	0.2
TH-1	490.0 F	Quartz Diorite	6.54	2.79	0.1
TH-1	500.0 F	Quartz Diorite	6.27	2.75	0.3
TH-1	510.0 F	Quartz Diorite	6.46	2.77	0.2
TH-1	520.0 F	Quartz Diorite	6.51	2.77	0.1
TH-1	530.0 F	Quartz Diorite	6.09	2.74	0.2
TH-1	557.0 F	Quartz Diorite	6.15	2.77	0.2
TH-1	567.0 F	Quartz Diorite	6.12	2.77	0.2
TH-1	576.0 F	Quartz Diorite	6.66	2.76	0.2
TH-1	587.0 F	Quartz Diorite	6.36	2.76	0.2
TH-1	597.0 F	Quartz Diorite	6.48	2.74	0.6
TH-1	606.0 F	Quartz Diorite	6.28	2.74	0.7
TH-1	619.0 F	Quartz Diorite	6.68	2.76	0.1

K - mcal/cm-s-°C

RHO - gm/cm^3

PHI - Porosity (%)

TABLE B-V1

CONDUCTIVITIES FROM LV

Hole ID	Depth	Sample Lithology	K Wet	RHO Wet	PHI
LVCH-1	475.7 F	Tuff. sand and clay	1.79		N.P.
LVCH-1	492.0 F	Tuff. sand and clay	2.13		N.P.
LVCH-1	522.0 F	Tuff. sand and clay	1.91		N.P.
LVCH-1	545.5 F	Tuff. sand and clay	2.04		N.P.
LVCH-1	553.5 F	Tuff. sand and clay	1.62		N.P.
LVCH-1	572.0 F	Tuff. sand and clay	1.10		N.P.
LVCH-1	576.0 F	Tuff. sand and clay	1.78		N.P.
LVCH-1	587.0 F	Tuff. sand and clay	2.46		N.P.
LVCH-1	606.5 F	Tuff. sand and clay	2.81		N.P.
LVCH-1	612.0 F	Tuff. sand and clay	1.87		N.P.
LVCH-1	625.0 F	Tuff. sand and clay	1.85		N.P.
LVCH-1	817.5 F	Tuff. sand and clay	1.69		N.P.
LVCH-1	822.5 F	Tuff. sand and clay	2.37		N.P.
LVCH-1	984.8 F	Tuff. sand and clay	1.69		N.P.

K - mcal/cm-s-°C

RHO - gm/cm^3

PHI - Porosity (%)

2. Randsburg

As part of a heat-flow study in the Randsburg, California, area,* 14 heat-flow holes were drilled within the Randsburg known geothermal resource area (KGRA), Fig. B-2. Thermal conductivity measurements for all and lithologic data for six of these wells are provided in Tables B-VII through B-XXVIII.

These data were obtained from the well bottoms. S. Peter Galanis can provide access to these cores at the U.S. Geological Survey (USGS), Menlo Park.

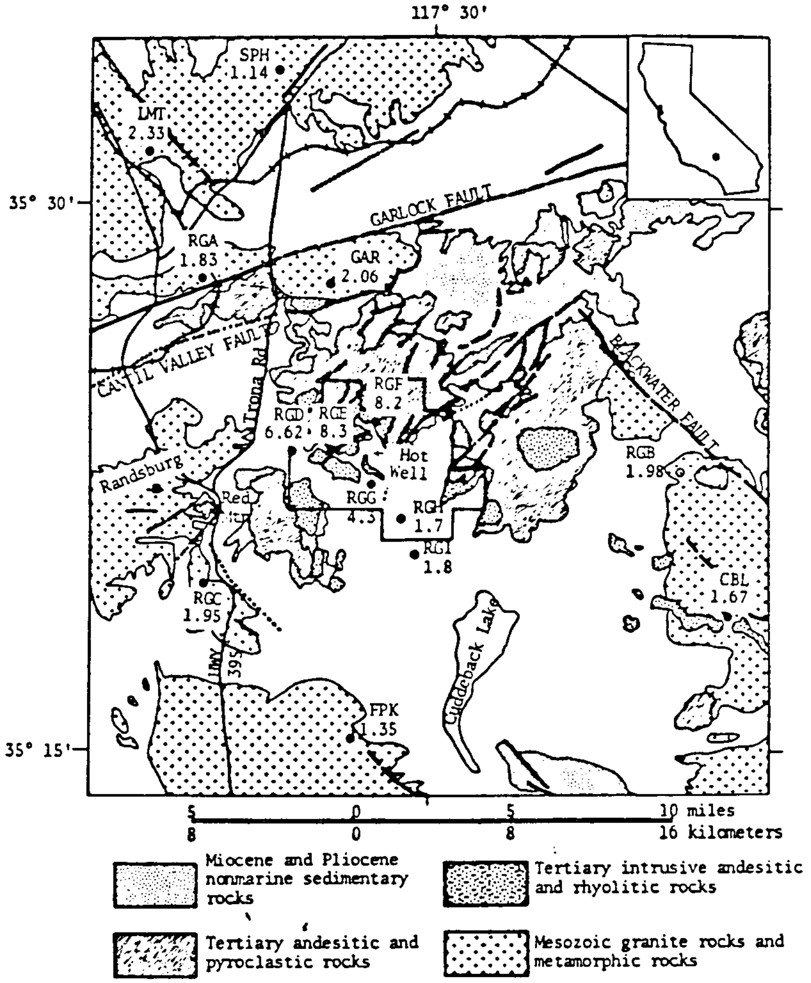

Fig. B-2. Geologic sketch map of Randsburg KGRA and environs. KGRA is outlined near center of map. Numbers are heat flows in heat-flow units (hfu). (Base map modified from Trona 2° sheet, Sass et al., 1978.) Inset shows location of Randsburg area.

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* More information on the heat flow in the Randsburg area can be found in Sass, J. S., Galanis, S. P., Jr., Marshall, B. V., Lachenbruch, A. H., Munroe, R. J., and Moses, T. H., Jr., 1978, Conductive Heat Flow in the Randsburg Area, California, USGS open-file report 78-756.

TABLE B-VII

PRINCIPAL ELEMENTS OF HEAT-FLOW CALCULATIONS FOR RANDSBURG KGRA

Locality	North Lat.	West Long.	Elev. (m)	Depth Range (m)	N	K (SE)[a]	Γ (°C/km) (SE)	q (hfu) (SE)
CBL 30S/43E-23aba	35°18.9'	117°20.2'	1146	46- 76	8	6.40 (0.10)	26.05 (0.09)	1.6 (0.03)
LMT 28S/41E-3bdd	35°31.8'	117°39.2'	1012	34-106	23	6.04 (.07)	37.95 (0.03)	2.33 (0.03)
GAR 28S/41E-35bca	37°27.8'	117°33.4'	1164	46-152	24	7.39 (0.10)	27.90 (0.03)	2.06 (0.03)
SPH 27S/41E-29caa	35°33.6'	117°35.1'	1006	30-101	14	7.14 (0.09)	15.97 (0.01)	1.14 (0.02)
FPK 31S/41E-12bbb	35°15.5'	117°32.3'	936	61-102	9	5.68 (0.15)	23.71 (0.07)	1.35 0.04)
RGA 28S/40E-25ccc	35°28.0'	117°37.6'	741	85-161	5	6.05 (0.21)	30.26 (0.02)	1.83 (0.06)
RGB 29S/43E-27ccc	35°22.8'	117°21.8'	1015	90-153	7	6.64 (0.14)	29.74 (0.02)	1.98 (0.04)
RGC 30S/41E-18bdc	35°19.6'	117°37.5'	1070	21-160	12	6.69 (0.19)	29.12 (0.04)	1.95 (0.06)
RGD 29S/41E-27bcb	35°23.2'	117°34.5'	1012	26-105	7	5.69 (0.22)	116.1 (0.1)	6.62 (0.25)
RGE 29S/41E-26bcb	35°23.2	117°33.4'	1021	33-103	5	6.85 (0.4)	120.6 (1.01)	8.3 (0.6)
RGF 29S/41E-24acc	35°23.9'	117°31.8'	1045	53-103	8	6.8 (0.5)	120.0 (0.1)	8.2 (0.6)
RGG 29S/41E-36bad	35°22.4'	117°32.0'	914	30-102	9	4.1 (0.3)	104.5 (0.0)	4.3 (0.3)
RGH 30S/42E-6abc	35°21.4	117°30.8'	828	24- 88	4	4.1 (1.0)	41.8 (1.0)	1.7 (0.4)
RGI 30S/42E-7daa	35°20.3'	117°30.4'	800	36-102	5	4.1 (1.0)	43.6 (0.1)	1.8 (0.4)

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[a] SE represents standard error.

TABLE B-VIII

SUMMARY OF LITHOLOGY, HEAT FLOW (q) AND POROSITY FOR RANDSBURG KGRA

Site	Rock	Porosity (%)	q (hfu)
CBL	Quartz monzonite	<1	1.67
LMT	Porphyritic granodiorite	<1	2.33
GAR	Quartz monzonite	<1	2.06
SPH	Granodiorite	<1	1.14
FPK	Granodiorite	<1	1.35
RGA	Diorite	<1	1.83
RGB	Quartz monzonite	<1	1.98
RGC	Granodiorite	<1	1.95
RGD	Andesite	<1 [a]	6.62
RGE	Altered rhyolite	4	8.3
RGF	Altered andesite	2	8.2
RGG	Andesite	5	4.3
RGH	Alluvium	20 [a]	1.7
RGI	Alluvium	20 [a]	1.8

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[a] Estimated quantities as no core or outcrop samples were available.

TABLE B-IX

THERMAL CONDUCTIVITIES FOR CBL

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s°C	W/m-K	gm/cm^3	(%)
Surface		8.11	3.39	2.57	1.0
0- 20	0- 6	6.79	2.84		
20- 35	6- 11	6.21	2.60		
35- 50	11- 15	6.65	2.78		
50- 65	15- 20	6.96	2.91		
65- 80	20- 24	6.81	2.85		
80- 95	24- 29	6.87	2.88		
95-110	29- 34	7.13	2.98		
110-125	34- 38	7.29	3.05		
125-140	38- 43	6.87	2.88		
140-155	43- 47	6.41	2.68		
155-170	47- 52	6.19	2.59		
170-185	52- 56	6.01	2.52		
185-200	56- 61	6.69	2.80		
200-215	61- 66	6.28	2.63		
215-230	66- 70	6.32	2.65		
230-245	70- 75	6.44	2.70		
245-260	75- 79	6.98	2.92		

TABLE B-X

THERMAL CONDUCTIVITIES FOR LMT

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm- s°C	W/m-K	gm/cm^3	(%)
Surface		6.94	2.91	2.67	0.8
0- 15	0- 5	5.88	2.46		
15- 35	5- 11	5.99	2.51		
35- 50	11- 15	6.53	2.73		
50- 65	15- 20	5.74	2.40		
65- 80	20- 24	6.32	2.65		
80- 95	24- 29	5.72	2.39		
95-110	29- 34	5.57	2.33		
110-125	34- 38	5.86	2.45		
125-140	38- 43	5.99	2.51		
140-155	43- 47	5.98	2.50		
155-170	47- 52	5.86	2.45		
170-185	52- 56	6.01	2.52		
185-200	56- 61	5.78	2.42		
200-215	61- 66	6.54	2.74		
215-230	66- 70	6.03	2.52		
230-245	70- 75	5.95	2.49		
245-260	75- 79	6.13	2.57		
260-275	79- 84	5.54	2.32		
275-290	84- 88	6.08	2.55		
290-305	88- 93	6.12	2.56		
305-320	93- 98	6.26	2.62		
320-335	98-102	7.27	3.04		
335-350	102-107	6.29	2.63		

TABLE B-XI

THERMAL CONDUCTIVITIES FOR GAR

Depth Range (ft)	Depth Range (m)	Conductivity mcal/cm-s-°C	Conductivity W/m-K	Density gm/cm^3	Porosity (%)
Surface		7.70	3.22	2.61	1.0
0- 20	0- 6	6.57	2.75		
20- 35	6- 11	6.70	2.80		
35- 50	11- 15	7.33	3.07		
50- 65	15- 20	8.23	3.45		
65- 80	20- 24	7.45	3.12		
80- 95	24- 29	7.30	3.06		
95-110	29- 34	7.04	2.95		
110-125	34- 38	7.42	3.11		
125-140	38- 43	7.46	3.12		
140-155	43- 47	7.65	3.20		
155-170	47- 52	7.37	3.09		
170-185	52- 56	6.55	2.74		
185-200	56- 61	7.40	3.10		
200-215	61- 66	7.71	3.23		
215-230	66- 70	7.09	2.97		
230-245	70- 75	6.47	2.71		
245-260	75- 79	6.78	2.84		
260-275	79- 84	7.79	3.26		
275-290	84- 88	7.10	3.08		
290-305	88- 93				
305-320	93- 98	7.60	3.18		
320-335	98-102	7.33	3.07		
335-350	102-107	6.53	2.73		
350-365	107-111	7.77	3.25		
365-380	111-116	7.48	3.13		
380-395	116-120	8.18	3.42		
395-410	120-125	7.67	3.21		
410-425	125-130	7.70	3.22		
425-440	130-134	7.92	3.32		
440-455	134-139	7.68	3.21		
455-470	139-143	7.32	3.06		
470-485	143-148	7.65	3.20		
485-500	148-152	8.01	3.35		

TABLE B-XII

THERMAL CONDUCTIVITIES FOR SPH

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
Surface		6.41	2.68	2.54	2.9
0- 20	0- 6	6.96	2.91		
20- 35	6- 11	7.04	2.95		
35- 50	11- 15				
50- 65	15- 20				
65- 80	20- 24				
80- 95	24- 29				
95-110	29- 34	7.49	3.14		
110-125	34- 38	7.45	3.12		
125-140	38- 43	7.45	3.12		
140-155	43- 47	7.32	3.06		
155-170	47- 52	7.50	3.14		
170-185	52- 56	6.89	2.88		
185-200	56- 61	6.99	2.93		
200-215	61- 66	7.05	2.95		
215-230	66- 70	6.54	2.74		
230-245	70- 75	6.71	2.81		
245-260	75- 79	7.44	3.11		
260-275	79- 84	7.28	3.05		
275-290	84- 88	6.87	2.88		
290-305	88- 93	7.11	2.98		

TABLE B-XIII

THERMAL CONDUCTIVITIES FOR FPK

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s°C	W/m-K	gm/cm^3	(%)
Surface		5.69	2.38	2.74	1.9
0- 20	0- 6	6.20	2.60		
25- 45	8- 14	6.28	2.63		
35- 50	11- 15	5.58	2.34		
45- 65	14- 20	6.10	2.55		
50- 65	15- 20	4.92	2.06		
65- 80	20- 24	6.05	2.53		
65- 85	20- 26	5.25	2.20		
80- 95	24- 29	5.02	2.10		
95-110	29- 34	5.54	2.32		
105-107	32- 33	6.59	2.76		
110-125	34- 38	5.83	2.44		
125.5	38.2	6.25	2.62	2.71	0.5
125.5-128	38.2- 39	5.23	2.19	2.81	0.6
127	38.7	6.36	2.66	2.73	0.4
125-140	38- 43	5.41	2.26		
140-155	43- 47	5.78	2.42		
155-170	47- 52	5.70	2.39		
170-185	52- 56	5.43	2.27		
185-200	56- 61	5.70	2.39		
200-215	61- 66	6.37	2.67		
215-230	66- 70	6.38	2.67		
230-245	70- 75	5.84	2.46		
245-260	75- 79	5.67	2.37		
260-275	79- 84	5.94	2.49		
275-290	84- 88	5.19	2.17		
290-305	88- 93	5.13	2.15		
305-320	93- 98	5.28	2.21		
320-335	98-102	5.58	2.34		

TABLE B-XIV

THERMAL CONDUCTIVITIES FOR RGA

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	5.12	2.15		
145-165	44- 50	5.65	2.37		
185-225	56- 68	5.29	2.22		
245-265	75- 81	5.85	2.45		
285-305	87- 93	6.27	2.62		
325-345	99-105	5.85	2.45		
385-405	117-123	6.83	2.86		
445-465	136-142	5.53	2.32		
496-501	151-153	5.65	2.36		
501-503	153-153	5.87	2.46		
501.5	152.9	5.79	2.42	2.85	0.3
503-508	153-155	6.29	2.64		
508-530	155-162	5.92	2.48		

TABLE B-XV

THERMAL CONDUCTIVITIES FOR RGB

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	6.72	2.81		
145-165	44- 50	6.43	2.69		
185-205	56- 62	5.45	2.28		
245-265	75- 81	6.95	2.91		
285-325	87- 99	6.56	2.75		
345-365	105-111	6.12	2.56		
385-405	117-123	7.19	3.01		
425-445	130-136	7.17	3.00		
496-501	151-153	6.80	2.85		
501-506	153-154	6.40	2.68		
511-530	156-162	6.37	2.67	2.85	0.3

TABLE B-XVI

THERMAL CONDUCTIVITIES FOR RGC

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	7.29	3.05		
145-165	44- 50	7.30	3.06		
185-205	56- 62	6.76	2.83		
245-265	75- 81	7.03	2.94		
285-305	87- 93	6.90	2.89		
345-365	105-111	6.51	2.73		
385-425	117-130	6.54	2.74		
445-465	136-142	5.24	2.19		
496.3	151.3	6.65	2.78	2.73	0.2
498.5	151.9	6.73	2.82	2.71	0.2
499.2	152.2	6.69	2.80	2.72	0.3
500-525	152-160	7.14	2.99		

TABLE B-XVII

THERMAL CONDUCTIVITIES FOR RGD

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	6.03	2.53		
145-165	44- 50	5.40	2.26		
185-205	56- 62	5.98	2.51		
245-265	75- 81	5.89	2.47		
300-302	91- 92	6.58	2.76		
306-308	93- 94	5.20	2.18		
325-345	99-105	5.00	2.10		

TABLE B-XVIII

THERMAL CONDUCTIVITIES FOR RGE

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	7.54	3.16		
145-165	44- 50	7.27	3.04		
185-205	56- 62	7.06	2.95		
245-265	75- 81	7.09	2.97		
299-301	91- 92	7.65	3.20		
301-306	92- 93	5.58	2.34		
304.1	92.7	8.15	3.41	2.61	2.6
305.7	93.2	6.74	2.82	2.56	5.2
306-308	93- 94	7.41	3.10		
325-345	99-105	7.46	3.12		

TABLE B-XIX

THERMAL CONDUCTIVITIES FOR RGD

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	6.49	2.72		
145-165	44- 50	4.62	1.93		
185-205	56- 62	6.45	2.70		
245-265	75- 81	6.50	2.72		
300-302	91- 92	6.79	2.84		
302.8	92.3	8.63	3.61	2.05	1.9
307.5	93.7	8.54	3.58	2.14	2.2
302-307	92- 94	6.84	2.86		
307-309	94- 94	6.94	2.90		
325-345	99-105	6.22	2.60		

TABLE B-XX

THERMAL CONDUCTIVITIES FOR RGG

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
85-105	26- 32	4.69	1.96		
145-165	44- 50	4.68	1.96		
185-205	56- 62	4.49	1.88		
245-265	75- 81	4.83	2.02		
299-301	91- 92	4.74	1.98		
301-305	92- 93	3.93	1.64		
305.1	93.0	4.33	1.81	2.40	5.4
308.7	94.1	4.68	1.96	2.40	5.8
310-312	94- 95	4.89	2.05		
325-345	99-105	3.36	1.41		

TABLE B-XXI

THERMAL CONDUCTIVITIES FOR RGH

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
84-104	26- 32	5.01	2.10		
144-164	44- 50	5.59	2.34		
184-204	56- 62	5.52	2.31		
244-264	74- 80	5.29	2.22		
300-320	91- 98	5.00	2.09		

TABLE B-XXII

THERMAL CONDUCTIVITIES FOR RGI

Depth Range		Conductivity		Density	Porosity
(ft)	(m)	mcal/cm-s-°C	W/m-K	gm/cm^3	(%)
80-100	24- 30	5.84	2.45		
140-160	43- 49	5.25	2.20		
200-220	61- 67	4.44	1.86		
240-260	73- 79	5.76	2.41		
300-320	91- 98	5.86	2.45		
320-340	98-104	5.47	2.29		

TABLE B-XXIII

Hole: RGD Location: Randsburg KGRA
Started: 2/24/78 Completed: 2/24/78 Drilled by: Clingan
Notes by: SPG Scale: 1 in. ▫ 50 ft

Graphic Column

Depth (ft)	Cored Interval	Rock Type	Alteration
0		Weathered light green porphyritic andesite (feldspar phenocrysts to 3 mm)	
45'		Clasts of red nonporphyritic to gray andesite, light green rhyolite, and white tuff	
125'		Dark red tuff in various states of alteration to red clay with clasts of altered porphyritic rhyolite and andesite	Intense alteration to white and red clays
145'			
165'		Clasts of light green to gray andesite and rhyolite in gray matrix	
185'		Clasts of light green to gray andesite and rhyolite in red clayey matrix	
225'		Clasts of light green to gray andesite and rhyolite in gray matrix	
245'		Clasts of light green to gray andesite and rhyolite in red clayey matrix	
	302'		
	306'		
345'			

TABLE B-XXIV

Hole: RGE Location: Randsburg KGRA
Started: 2/24/78 Completed: 2/25/78 Drilled by: Clingan
Notes by: SPG Scale: 1 in. = 50 ft

Graphic Column

Depth (ft)	Cored Interval	Rock Type	Alteration
0		Weathered tan porphyritic rhyolite	Trace to 5% pyrite (all altered to hematite and/or limonite)
85'		Light gray porphyritic rhyolite (feldspar phenocrysts as large as 3 mm)	Partial alteration of feldspar to white clay Trace to 5% pyrite
185'		Light gray porphyritic rhyolite (highly altered)	Nearly complete alteration of feldspar to white clay Trace to 5% pyrite
225'			
265'		Light gray porphyritic to nearly holocrystalline rhyolite (avg. grain size .5 to 3 mm)	Partial alteration of feldspars to white clay ≈3% pyrite veins calcite
	301' 306'		
345'			

TABLE B-XXV

Hole: RGF Location: Randsburg KGRA
Started: 2/25/78 Completed: 2/27/78 Drilled by: Clingan
Notes by: SPG Scale: 1 in. = 50 ft

Graphic Column

Depth (ft)	Cored Interval	Rock Type	Alteration
0 25'		Weathered tan porphyritic andesite (feldspar phenocrysts to 2 mm in aphanitic groundmass) and light gray porphyritic rhyolite	Trace of pyrite (all altered to hematite and/or limonite)
45'		Reddish-gray to gray porphyritic andesite	
85'		Light gray porphyritic rhyolite	
125'		Reddish-gray to dark gray porphyritic andesite minor light gray porphyritic rhyolite (fragments in the andesite)	
185'		Light green porphyritic rhyolite (feldspar phenocrysts to 6 mm) minor reddish gray andesite	Trace to 3% unaltered pyrite; partial alteration of feldspar to clay
265'		Light green porphyritic rhyolite and reddish-gray slightly prophyritic andesite	Mafic phenocrysts in andesite have been altered to chlorite and iron oxides Trace to 3% pyrite
285'		Light green porphyritic rhyolite	Partial alteration of feldspar to clay
300'	303'	Porphyritic rhyolite and porphyritic andesite	
	307'	Porphyritic andesite	Hornblende pheno crysts altered to chlorite and iron oxides. Feldspar altered to clay. 2 to 3% pyrite

TABLE B-XXVI

Hole: RGG Location: Randsburg KGRA

Started: 2/27/78 Completed: 2/28/78 Drilled by: Clingan

Notes by: SPG Scale: 1 in. = 50 ft

Graphic Column

Depth (ft)	Cored Interval	Rock Type	Alteration
0		Weathered tan porphyritic andesite	
15'		Brick-red porphyritic andesite (feldspar phenocrysts 6 to 8 mm long)	
100'			White felsite with 2% pyrite
145'		Brick-red porphyritic andesite with minor dark gray nonporphyritic andesite	
165'		Brick-red porphyritic andesite	
245'		Dark gray andesite with minor brick-red porphyritic andesite	Trace pyrite
285'	301' 310'	Brick-red porphyritic andesite (15% feldspar phenocrysts, 4 mm max. length) Minor dark gray andesite	

TABLE B-XXVII

Hole: RGH Location: Randsburg KGRA

Started: 2/28/78 Completed: 3/1/78 Drilled by: Clingan

Notes by: SPG Scale: 1 in. = 50 ft

Graphic Column

Depth (ft)	Cored Interval	Rock Type	Gravel Size	Alteration
0				
		Gravel, silt and clay	Max 45 mm	
			avg 10 mm	
24'		Gravel, silt and clay	Max 35 mm	
			avg 8 mm	
44'				
		Silt, clay and gravel	Max 15 mm	
64'			avg 3 mm	
		Silt, clay and gravel	Max 20 mm	
84'			avg 3 mm	
		Gravel, silt and clay	Max 20 mm	
			avg 8 mm	
124'				
		Gravel, silt and clay	Max 30 mm	
144'			avg 13 mm	
		Gravel, silt and clay	Max 30 mm	
164'			avg 12 mm	
		Gravel, silt and clay	Max 20 mm	
184'			avg 9 mm	
		Gravel, silt and clay	Max 17 mm	
			avg 6 mm	
224'				
		Gravel, silt and clay	Max 25 mm	
244'			avg 9 mm	
264'				
		Gravel, silt and clay	Max 18 mm	
280'			avg 9 mm	
		Gravel, silt and clay	Max 15 mm	
300'			avg 9 mm	
320'				

NOTE: Gravel-sized clasts composed of andesite and rhyolite

TABLE B-XXVIII

Hole: RGI Location: Randsburg KGRA
Started: 3/1/78 Completed: 3/1/78 Drilled by: Clingan
Notes by: SPG Scale: 1 in. = 50 ft

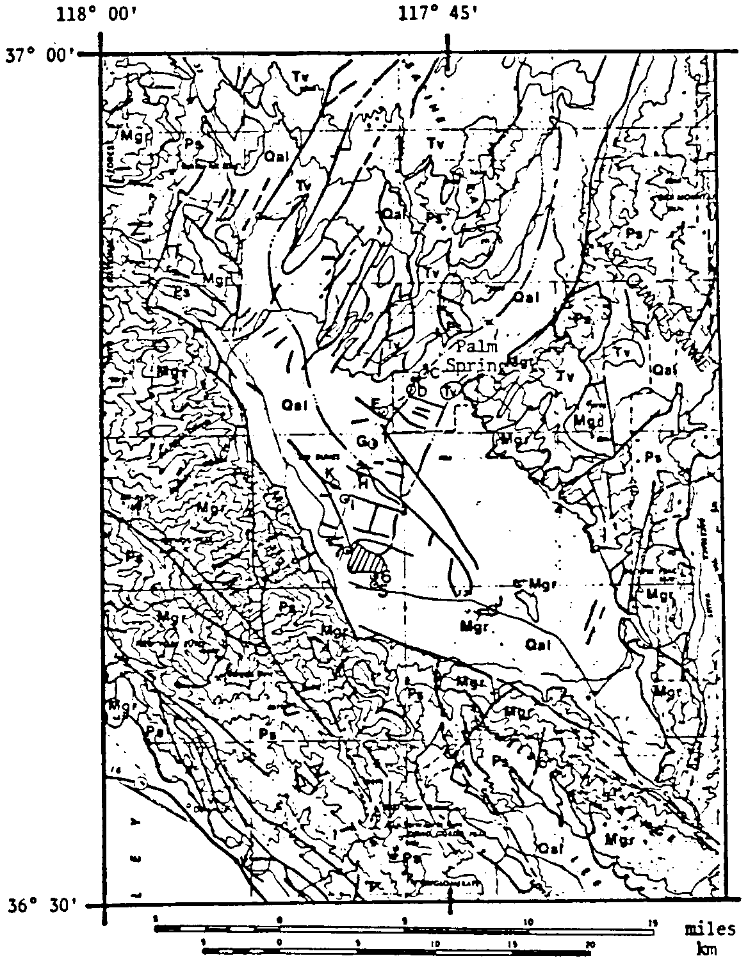
Graphic Column

Depth (ft)	Cored Interval	Rock Type	Gravel Size	Alteration
0				
		Gravel, silt and clay	Max 20 mm	
20'			avg 3 mm	
40'				
60'		Gravel, silt and clay	Max 20 mm	
			avg 7 mm	
80'				
		Gravel, silt and clay	Max 15 mm	
120'			avg 4 mm	
140'				
160'		Silt, clay and gravel	Max 20 mm	
			avg 10 mm	
180'				
		Gravel	Max 20 mm	
			avg 10 mm	
220'				
		Silt, clay and gravel	Max 20 mm	
240'			avg 5 mm	
		Silt, clay and gravel	Max 20 mm	
260'			avg 3 mm	
		Silt, clay and gravel	Max 10 mm	
280'			avg 4 mm	
		Silt, clay and gravel	Max 20 mm	
320'			avg 4 mm	

NOTE: Gravel-sized clasts composed of andesite and rhyolite

3. Saline Valley

Eight heat-flow holes were drilled in the Saline Valley of California. The well locations are shown on Fig. B-3. Ditch samples were collected every 6 m in each hole and 1 m of core was taken in four of the wells. Thermal conductivity values for the wells and lithologies are presented in Tables B-XXIX through B-XLII. Lithologies were determined using a 10X hand lens in the laboratory. A detailed report on the heat-flow study of the Saline Valley is available from the USGS, C. W. Mase et al., 1979. Contact S. Peter Galanis, USGS, Menlo Park for access to cores.



Qal - Quaternary Alluvium. Includes fan, lacustrine, eolian, and calcareous rufa deposits.
Tv - Tertiary Volcanics. Predominantly Pliocene basalt.
Mgr - Mesozoic Granitics. Composed primarily of granodiorite and quartz monzonite.
Ps - Paleozoic sedimentary rocks. Includes limestone, dolomite, shale, and quartzite.

Fig. B-3. Geologic sketch map of Saline Valley. KGRA is outlined by dashed line. Geology and faults generalized from Mase et al., 1979.

TABLE B-XXIX

THERMAL CONDUCTIVITIES FOR SVC

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} $°C^{-1}$	ϕ_{corr} (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} $°C^{-1}$
26- 32	85-105	2.61	6.22	18	2.00	4.79
38- 44	125-145	2.49	5.95	18	1.93	4.61
62- 69	205-225	2.40	5.74	18	1.87	4.47
75- 81	245-265	2.16	5.17	18	1.72	4.10
87- 93	285-305	2.24	5.36	18	1.77	4.23
79- 80	258-264	(needle probe)			1.72	4.11

TABLE B-XXX

THERMAL CONDUCTIVITIES FOR SVD

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} $°C^{-1}$	ϕ_{corr} (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} $°C^{-1}$
24- 30	80-100	2.24	5.35	30	1.51	3.61
37- 43	120-140	1.91	4.55	30	1.35	3.23
49- 55	160-180	2.83	6.75	30	1.78	4.25
61- 67	200-220	2.98	7.13	30	1.85	4.41
73- 79	240-260	2.91	6.94	30	1.81	4.33
85- 91	280-300	2.84	6.78	30	1.78	4.26
98-104	320-340	2.88	6.87	30	1.80	4.30
110-116	360-380	3.08	7.35	30	1.89	4.51
127-128	418-420	2.30	5.49	30	1.54	3.68
79- 80	258-261	(needle probe)			1.86	4.45

TABLE B-XXXI

THERMAL CONDUCTIVITIES FOR SVE

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} $°C^{-1}$	ϕ corr (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} $°C^{-1}$
24- 30	80-100	2.33	5.56	30	1.55	3.71
37- 43	120-140	2.55	6.09	30	1.65	3.95
49- 55	160-180	2.89	6.90	30	1.81	4.31
61- 67	200-220	3.30	7.87	30	1.98	4.73
73- 79	240-260	3.23	7.72	30	1.95	4.66
85- 91	280-300	2.73	6.52	30	1.74	4.14

TABLE B-XXXII

THERMAL CONDUCTIVITIES FOR SVG

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} $°C^{-1}$	ϕ corr (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} $°C^{-1}$
26- 32	85-105	2.77	6.61	30	1.75	4.19
38- 44	125-145	3.07	7.33	30	1.88	4.50
50- 56	165-185	2.79	6.67	30	1.76	4.21
62- 69	205-225	2.86	6.83	30	1.79	4.28
75- 81	245-265	2.76	6.59	30	1.75	4.18
87- 93	285-305	2.30	5.49	30	1.54	3.68
99-105	325-345	2.62	6.25	30	1.69	4.03
111-117	365-385	2.46	5.89	30	1.61	3.85
122-128	400-420	2.29	5.48	30	1.53	3.67
134-140	440-460	2.68	6.39	30	1.71	4.09
146-152	480-500	2.66	6.36	30	1.70	4.07
152-154	500-504	2.72	6.51	30	1.73	4.13
78- 79	257-260	(needle probe)			1.82	4.35

TABLE B-XXXIII

THERMAL CONDUCTIVITIES FOR SVH

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} °C^{-1}	ϕ corr (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} °C^{-1}
24- 30	80-100	1.76	4.21	30	1.28	3.05
37- 43	120-140	2.39	5.70	30	1.58	3.78
49- 55	160-180	3.13	7.48	30	1.91	4.56
61- 67	200-220	2.62	6.27	30	1.69	4.03
73- 79	240-260	2.66	6.35	30	1.70	4.07
85- 91	280-300	2.87	6.85	30	1.80	4.29
98-104	320-340	2.65	6.32	30	1.70	4.06
110-116	360-380	2.81	6.71	30	1.77	4.23
122-128	400-420	2.91	6.96	30	1.81	4.33
134-140	440-460	2.76	6.60	30	1.75	4.18
146-152	480-500	3.00	7.15	30	1.85	4.43
78- 79	257-260	(needle probe)			1.76	4.21
139-140	457-459	(needle probe)			1.69	4.03

TABLE B-XXXIV

THERMAL CONDUCTIVITIES FOR SVI

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} °C^{-1}	ϕcorr (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} °C^{-1}
24- 30	80-100	2.69	6.43	30	1.72	4.10
37- 43	120-140	2.63	6.28	30	1.69	4.04
49- 55	160-180	2.48	5.92	30	1.62	3.88
61- 67	200-220	2.48	5.91	30	1.62	3.88
73- 79	240-260	2.72	6.49	30	1.73	4.13
85- 91	280-300	2.58	6.17	30	1.67	3.98
98-104	320-340	2.53	6.04	30	1.64	3.93
110-116	360-380	2.46	5.86	30	1.61	3.85
122-128	400-420	2.24	5.34	30	1.51	3.61
134-140	440-460	2.77	6.61	30	1.75	4.19
146-152	480-500	2.67	6.37	30	1.71	4.08
78- 79	257-259	(needle probe)			1.87	4.47
139-140	457-460	(needle probe)			1.71	4.09

TABLE B-XXXV

THERMAL CONDUCTIVITIES FOR SVJ

Depth Range (m)	(ft)	K_s W m^{-1} K^{-1}	K_s mcal cm^{-1} s^{-1} °C^{-1}	ϕ corr (%)	K_f W m^{-1} K^{-1}	K_f mcal cm^{-1} s^{-1} °C^{-1}
26- 32	85-105	2.36	5.62	30	1.57	3.74
38- 44	125-145	2.12	5.06	30	1.45	3.47

Tables B-XXIX through B-XXXV:

K_f = formation conductivity

K_s = solid component conductivity

$K_f = K_s^{(1-\phi)} \cdot K_w^{\phi}$, where K_w = conductivity of water; ϕ is fractured porosity.

TABLE B-XXXVI

LITHOLOGY FOR BOREHOLE SVC

Hole: SVC Location: Saline Valley

Started: 7/4/78 Completed: 7/11/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
		Calcareous tufa and silt	Hot spring and lake(?) deposits
20			
25			
		Gravel and silt	Fan deposit
50			
56			
		Calcareous tufa, silt, and gravel	Fan and reworked(?) hot spring deposits
69			
75			
	79 m to 80 m	Gravel and silt	Fan deposit
93 T.D.			

TABLE B-XXXVII

LITHOLOGY FOR BOREHOLE SVD

Hole: SVD Location: Saline Valley

Started: 7/1/78 Completed: 7/4/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
		Calcareous tufa and silt	Hot spring and fan deposits
25			
37			
50			
75			
		Gravel and silt	Fan deposit
100			
128 T.D.	126 m to 127 m		

TABLE B-XXXVIII

LITHOLOGY FOR BOREHOLE SVE

Hole: SVE Location: Saline Valley

Started: 7/12/78 Completed: 7/13/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
		Gravel and silt	Fan deposit
18			
		Calcareous tufa, gravel, and silt	Fan and reworked(?) hot spring deposits
43			
50			
75		Gravel and silt	Fan deposit
100			
116 T.D.			

TABLE B-XXXIX

LITHOLOGY FOR BOREHOLE SVG

Hole: SVG Location: Saline Valley

Started: 7/14/78 Completed: 7/15/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
25		Silt and clay	Lake deposit
50			
57			
75	79 m to 80 m		
100		Gravel and silt	Valley fill
125			
154 T.D.			

TABLE B-XL

LITHOLOGY FOR BOREHOLE SVH

Hole: SVH Location: Saline Valley

Started: 7/15/78 Completed: 7/16/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
25		Silt and clay	Lake deposit
50			
55			
75			
100		Gravel and silt	Valley fill
125			
152 T.D.			

TABLE B-XLI

LITHOLOGY FOR BOREHOLE SVI

Hole: SVI Location: Saline Valley

Started: 7/17/78 Completed: 7/17/78 Drilled by: Clingan

Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
25		Silt and clay	Lake deposit
50			
55			
75			
100		Gravel and silt	Valley fill
125			
	140 m to 141 m		
152 T.D.			

TABLE B-XLII

LITHOLOGY FOR BOREHOLE SVJ

Hole: SVJ Location: Saline Valley
Started: 7/18/78 Completed: 7/19/78 Drilled by: Clingan
Notes by: Galanis Scale: 1 in. = 25 m

Depth (m)	Graphic Column Cored Interval	Rock Type	
0			
		Gravel and silt	Fan deposit
25			
44 T.D.			

APPENDIX C

HAWAII GEOTHERMAL PROJECT

HGP - A Drill Hole

The site is at approximately altitude, and 200 ft north of the Pahoiki Bay Road, 0.6 miles southwest of the prehistoric cone of Puu Honuaula, and 0.23 miles south of the first vents of the 1955 eruption (Figs. C-1 and C-2).

Thin-section work and measurements of the physical properties of the rocks HGP-A drill hole are being completed. The following descriptions are based on hand identification.

Cuttings were taken every 10 ft starting at 1000 ft and every 5 ft through part of the interval. In the upper part of the hole, cutting samples were taken whenever return mud circulation was attained. All cores are highly fractured. Cores taken in the interval are listed in Table C-I.

TABLE C-I

CORED INTERVALS OF HGP-A

Core							Core Recovered
A	456	458	feet	below	rotary	table	2 ft
B	1057	1068	feet	below	rotary	table	1 ft
C	1412	1423	feet	below	rotary	table	2 ft
D	2230	2240	feet	below	rotary	table	10 ft
E	2876	2886	feet	below	rotary	table	10 ft
F	3666	3676	feet	below	rotary	table	10 ft
G	4447	4457	feet	below	rotary	table	10 ft
H	5396	5406	feet	below	rotary	table	10 ft
I	6029	6039	feet	below	rotary	table	10 ft
J	6446	6456	feet	below	rotary	table	10 ft

At and near the surface are normal olivine bearing tholeiitic basalts of Kilauea (aa and pahoehoe). Vesicularity ranged from 5 to 25%.

Core B is dark grey, dense basalt with a few pahoehoe-type vesicles (probably subaerial).

Core C is partly glassy and appears to be subaqueous pillow lava.

Top 3 ft of core E is fine-grained olivine bearing grey basalt with 3% pahoehoe-type vesicles 0.5 mm across. This grades into dense black tachylite, which makes up the lower 7 ft of the core. Fractures in this core are serpentinized--some showing slickensides and many with tiny pyrite cubes.

From 3682 to 3760 ft, the cuttings are sandy material with angular grains 1.5 mm in diameter. It appears to be hyaloclastite.

Below 3000 ft chlorite and pyrite are present in all cores. Pyrite abundance increases with depth. Zeolites and calcite are moderately abundant from 1200 to 4000 ft and decrease below that.

The top four inches of the last core shows a dense, dark grey basalt bounded by a contact perpendicular to the core axis. There is little effect of chilling at the contact.

All data are supplied by Paul Yuen of the University of Hawaii.

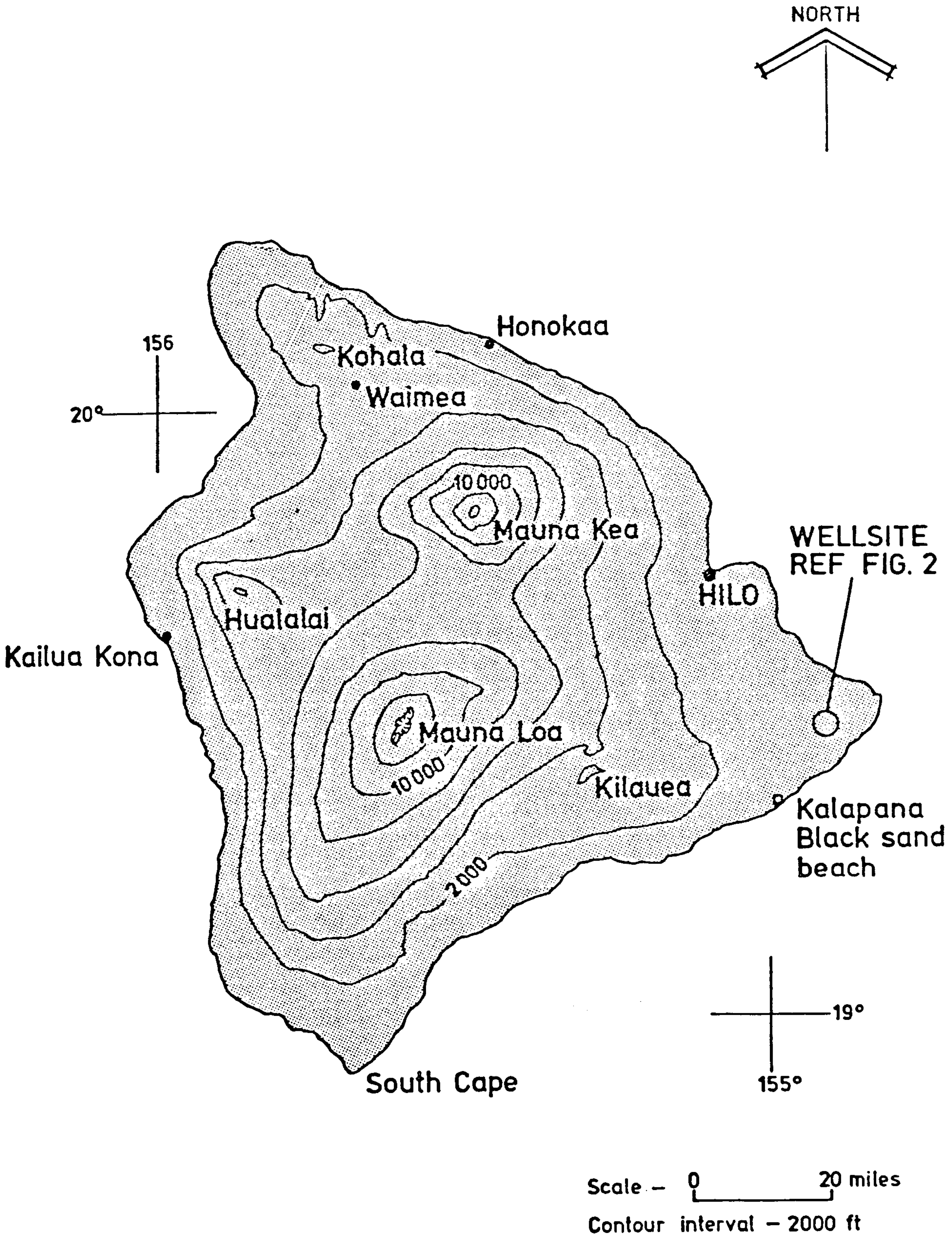


Fig. C-1. Map of Hawaii.

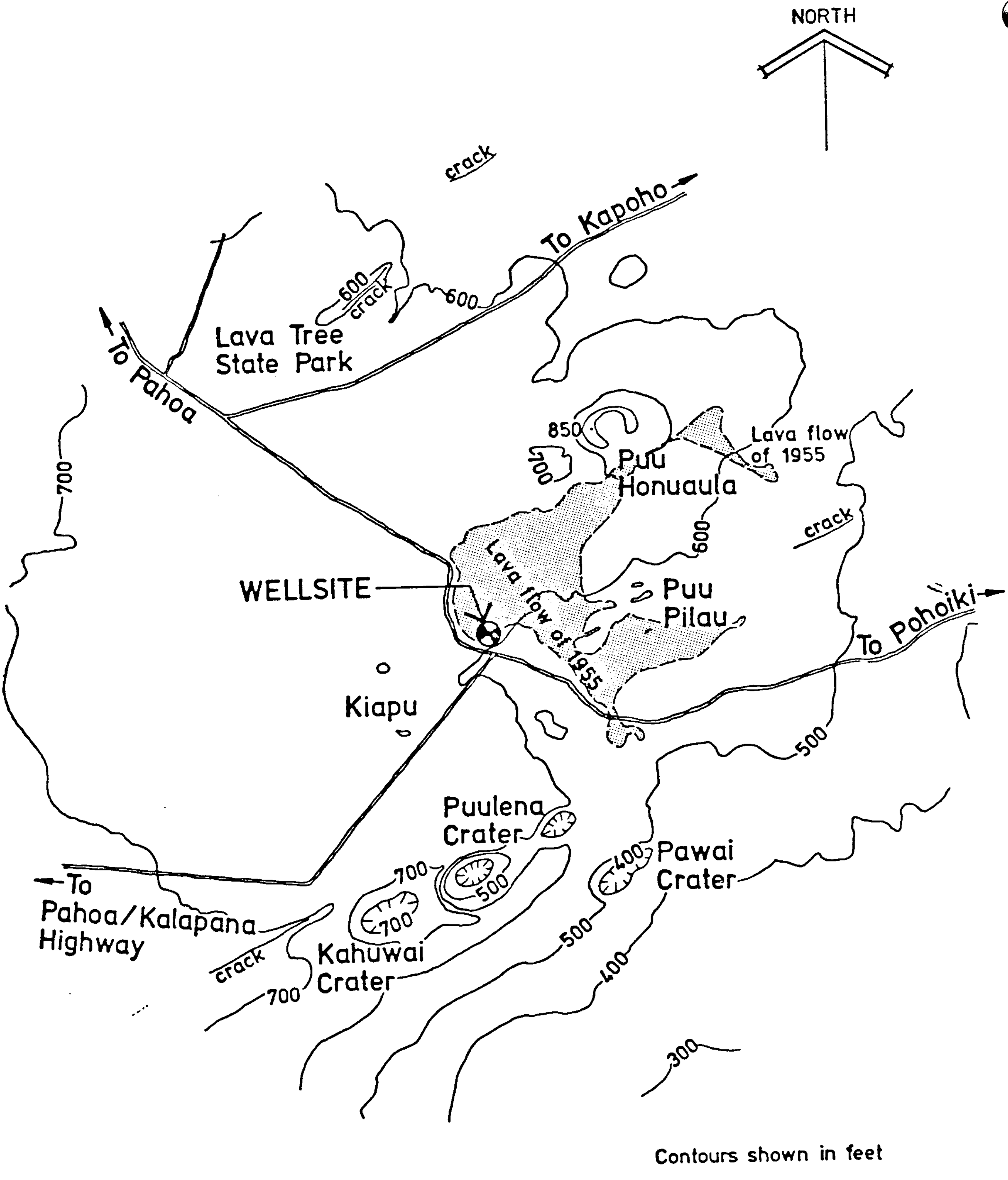


Fig. C-2. Hawaii geothermal project site location.

APPENDIX D

IDAHO

1. Raft River Geothermal Area

Five deep wells were drilled in the Raft River Valley near Bridge, Idaho, by the USGS from 1974 to 1979 (Fig. D-1). The USGS had previously drilled five continuously cored wells to depths of 76 m to 424 m in the same area (Crosthwaite, 1976). Further data from boreholes in the area have been supplied by Standard American Oil Company (Fig. D-2). The lithologic logs for the deep USGS wells and the Standard American Oil Company holes are summarized below. References for detailed lithologic logs and geophysical logs of these wells are provided.

RRGE No. 1: Location NW1/4 SW1/4 SE1/4 Sec 23 T15 S R26E
TD-1521 m

Cored Intervals

1	1364-1382 m	Celular silica, fractured and slickensided
2	1423-1426 m	Quartzite and graphitic schist
3	1520-1521 m	Gneissic, altered monzonite

Top of Formation (from cuttings)

Tertiary-Salt Lake Formation	137 m
Precambrian (?) Upper Narrows Schist	1397 m
Precambrian Elba Quartzite	1432 m
Precambrian Quartz Monzonite	1512 m

RRGE No. 2: Location NW1/4 NW1/4 Sec 23 T15S R26E
TD-1994 m

Cored Intervals

1	931-936 m	Tuffaceous, conglomeritic siltstone
2	1128-1132 m	ss + tuffaceous ss
3	1280-1283 m	Calcareous ss
4	1326-1328 m	Calcareous tuff, highly fractured
5	1459.5-1460 m	no core recovered; cutting 95% white quartzite
6	1993-1994 m	Gneissic gravity monzonite

Top of Formation (from cuttings)

Tertiary Salt Lake Formation	182 m
Precambrian Upper Narrows Schist	1420 m
Precambrian Elba Quartzite	1451 m
Precambrian Quartz Monzonite	1519 m

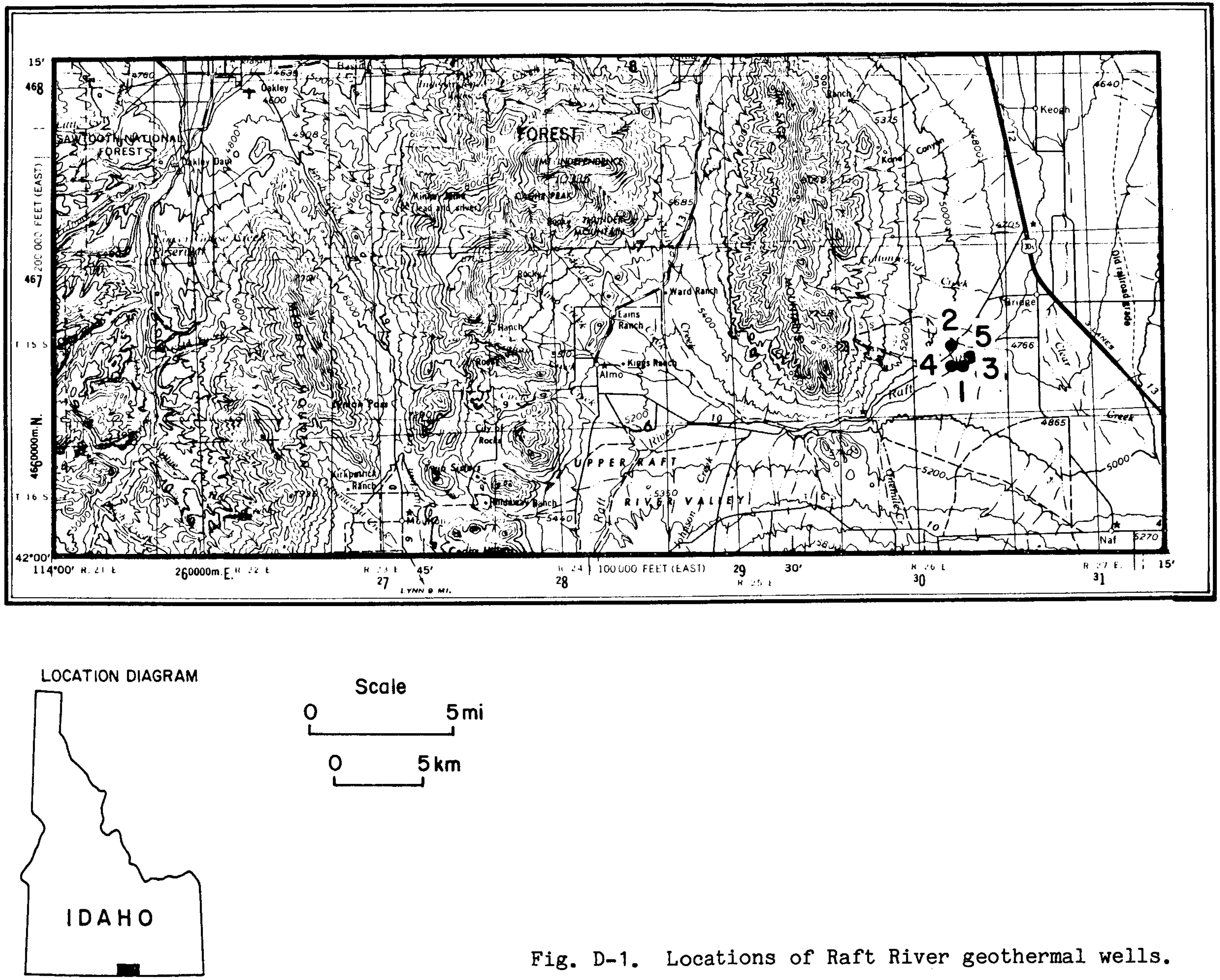


Fig. D-1. Locations of Raft River geothermal wells.

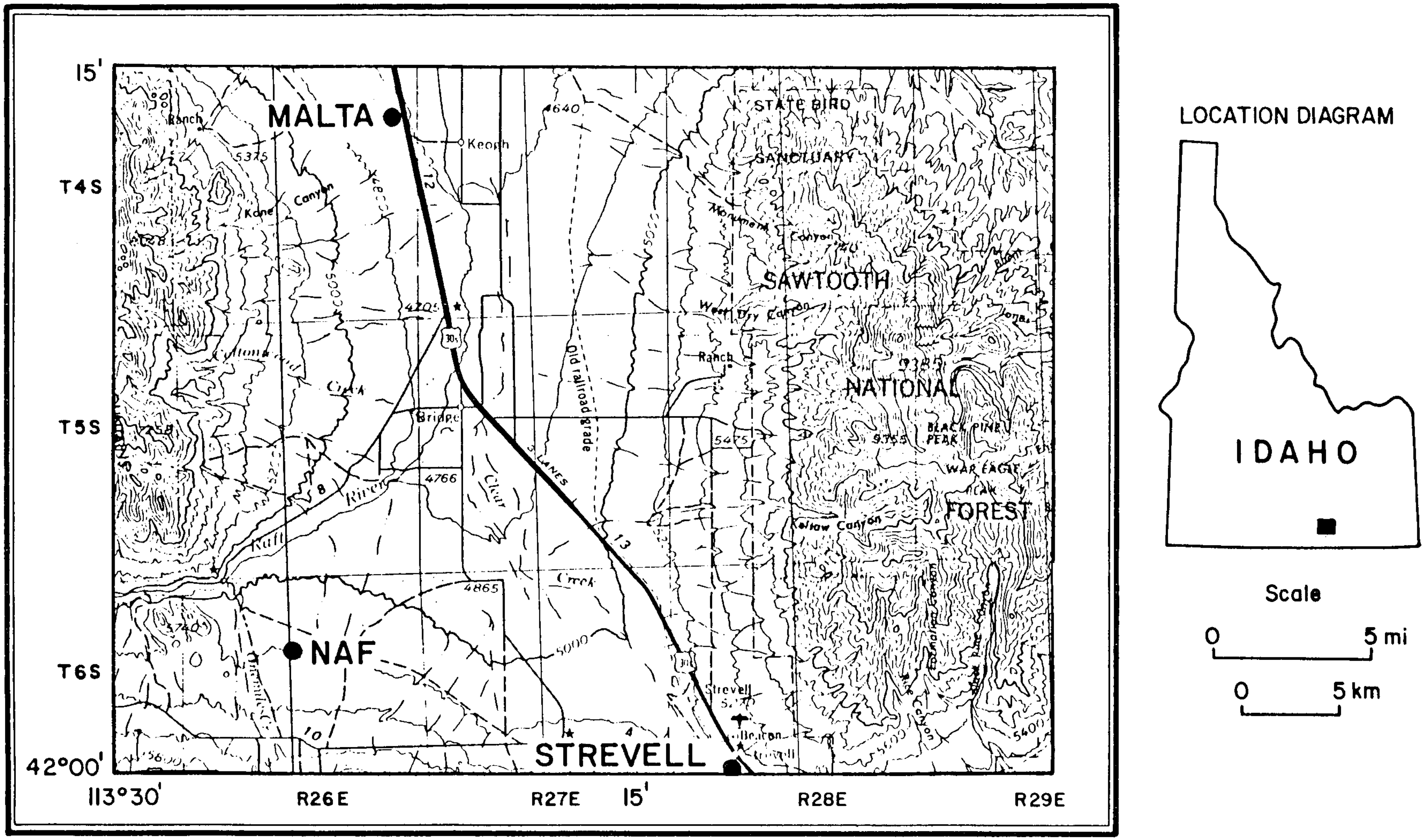


Fig. D-2. Standard American Oil Company petroleum test well locations in Raft River area, Idaho.

RRGE No. 3: Location SE1/4 NW1/4 Sec 25 T15S R26E
TD-1784 m

Cored Intervals

1	849-852 m	Alternating siltstone and sandstone
2	1020-1025 m	ss
3	1203-1208 m	Alternating siltstone and ss
4	1511-1517 m	Alternating siltstone and ss
5	1600-1603 m	Alternating siltstone and ss
6	1686-1686 m	Milky quartzite

Top of Formations (from cuttings)

Tertiary Salt Lake Formation	?
Precambrian Quartzite of Yost	1595 m
Precambrian Upper Narrows Schist	1646 m
Precambrian Elba Quartzite	1670 m
Precambrian Older Schist	1746 m
Precambrian Quartz Monzonite	1776 m

RRGE No. 4: Location SE1/4 SW1/4 Sec 23 T15S R26E
TD-866 m

Cored Intervals

1	577-582 m	Calcareous, tuffaceous ss
2	860-866 m	ss with thin interbedded siltstone

Hole bottom in Salt Lake Formation

RRGP No. 4: Well was re-entered on 22 September 1978; sidetrack A was drilled to 1649 n; sidetrack B bottomed at 1554 m. One core was taken in sidetrack B.

1409-1418 m Siltstone and fine ss becoming schist and then gneissic toward core bottom

Top of Formations (sidetrack A) (from cuttings)

Precambrian Quartzite of Yost	1399 m
Precambrian Upper Narrows Schist	1419 m
Precambrian Elba Quartzite	1451 m
Precambrian Quartz Monzonite	1539 m

RRGP No. 5: Location NW1/4 SE1/4 Sec 23 T15S R26E
TD-1497 m

Cored Intervals

1	1136-1141 m	Alternating, ss and siltstone, highly fractured

Top of Formations (from cuttings)

Tertiary Salt Lake Formation	271 m
Quartzite of Yost	1320 m
Schist of the Upper Narrows	1335 m
Elba Quartzite	1387 m
Older Schist	1475 m
Quartz Monzonite	1490 m

*Malta Borehole: Location SE1/4 NW1/4 Sec 1 T14S R26E
TD-2068 m

Top of Formations

Quartzite of Yost	1673 m
Unnamed dolomitic marble	1850 m
Schist of the Upper Narrows	1943 m

*NAF Borehole: Location SE1/4 SW1/4 Sec 9 T16S R27E

Top of Formations

Quaternary Raft Formation	113 m
Tertiary Salt Lake Formation	262 m

*Strevell Borehole: Location NE1/4 SW1/4 Sec 20 T16S R28E
TD-2128 m

Top of Formations

Tertiary Salt Lake Formation	158 m
Pennsylvania Oquirrh Formation	344 m
Ordovician-Fish Haven (?) Dolomite	686 m
Ordovician-Eureka Quartzite	917 m
Ordovician-Pogonip Group	1128 m
Cambrian-Quartzite of Clarks Basin	1144 m
Precambrian (?) Schist of Stevens Spring	1207 m
Precambrian Quartzite of Yost	1365 m
Precambrian Unnamed Dolomitic Marble	1481 m
Precambrian Schist of the Upper Narrows	1597 m

Logs and cuttings supplied by Standard American Oil Company.

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* Standard American Oil Co., Malta, NAF, and Strevell Petroleum Test Boreholes (apparently no core was taken in these holes), Oriel et al., 1978.

2. Boise State University

Cuttings for the following wells are accessible through James Applegate, Boise State University, Boise, Idaho.

RRGE No.1		110 ft - 5005 ft
RRGE No. 2		922 ft - 4217 ft damaged
RRGE No. 3A		4259 ft - 5870 ft
RRGE No. 3B		4950 ft - 5000 ft
RRGP No. 4		1980 ft - 5420 ft
RRGP No. 5	Leg 2:	3590 ft - 5110 ft
		70 ft - 4910 ft
RRGI No. 6		110 ft - 3840 ft
RR-INT No. 2		random samples
RR-INT No. 3		226 ft - 1355 ft random samples
RR-INT No. 5		random samples

Anschtz Corp.: Fed. 60-13 No. 1 Owyhee County, Idaho (Fig. D-3)	NE SW Sec 13 T5S RIE
Halbouty/J. J. James No. 1 Ada County, Idaho (Fig. D-4)	Sec 27 T4N R1W
Al Griffith - Gulf Minerals; Bostic Elmore County, Idaho (Fig. D-5)	1A SW SW Sec 25 T4S R8E

J. Applegate can also provide access to cores listed below:

RRGE No. 3	Core 1	2805 ft - 2815 ft part
	Core 2	Top and bottom samples
	Core 3	3973 ft - 4 ft
		3979 ft - 80 ft

Boise Front Wells, Idaho (Fig. D-6)

BSU, NE SE Sec 2 T3N R2E	15.3 ft - 534.4 ft
BSU No. 1, SE NE Sec 13 T3N R2E	215 ft - 224.6 ft
Hawkins No. 1, SW NW Sec 1 T3N R2E	random samples

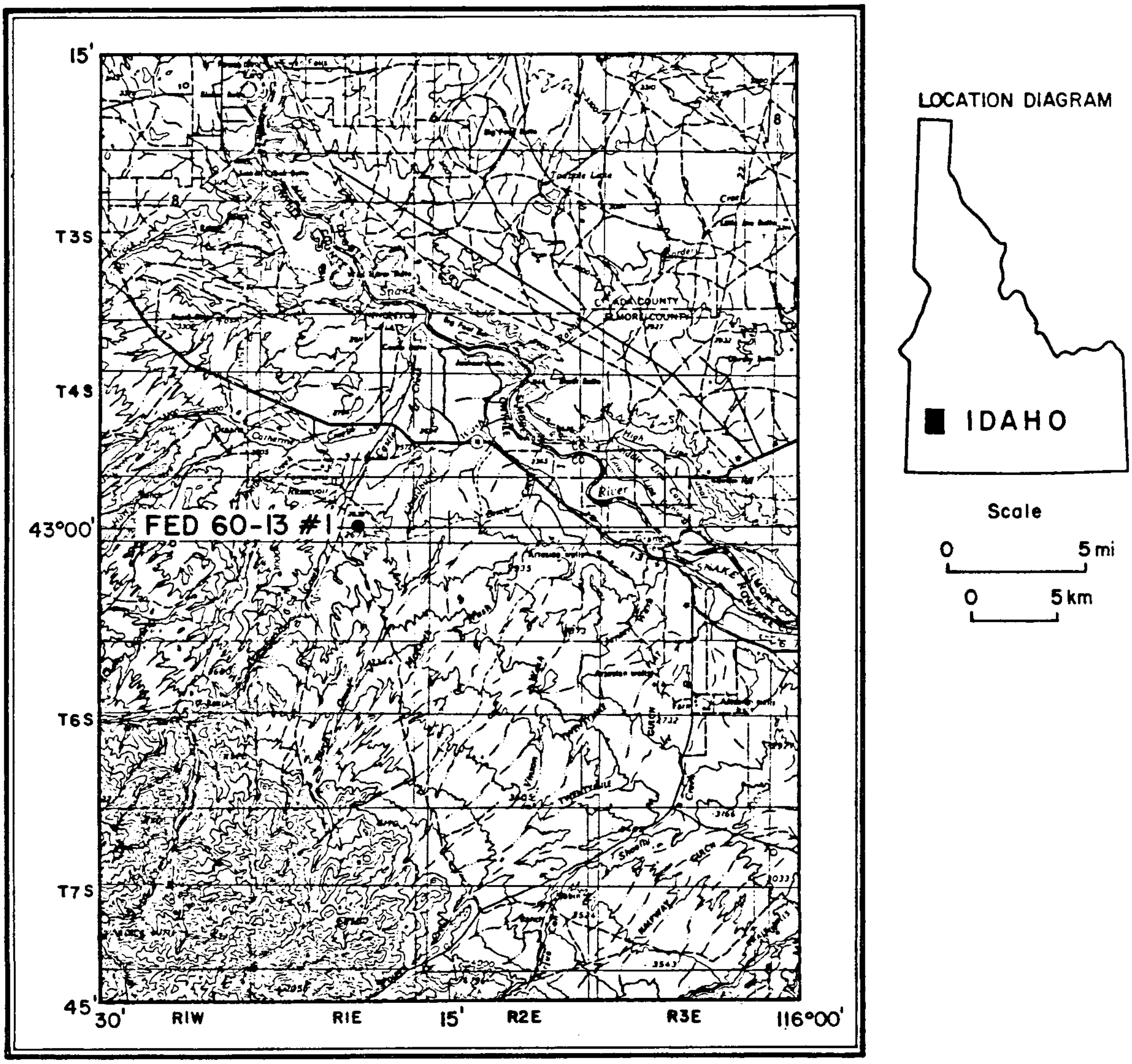

Fig. D-3. Location of Fed. 60-13 No. 1 geothermal well.

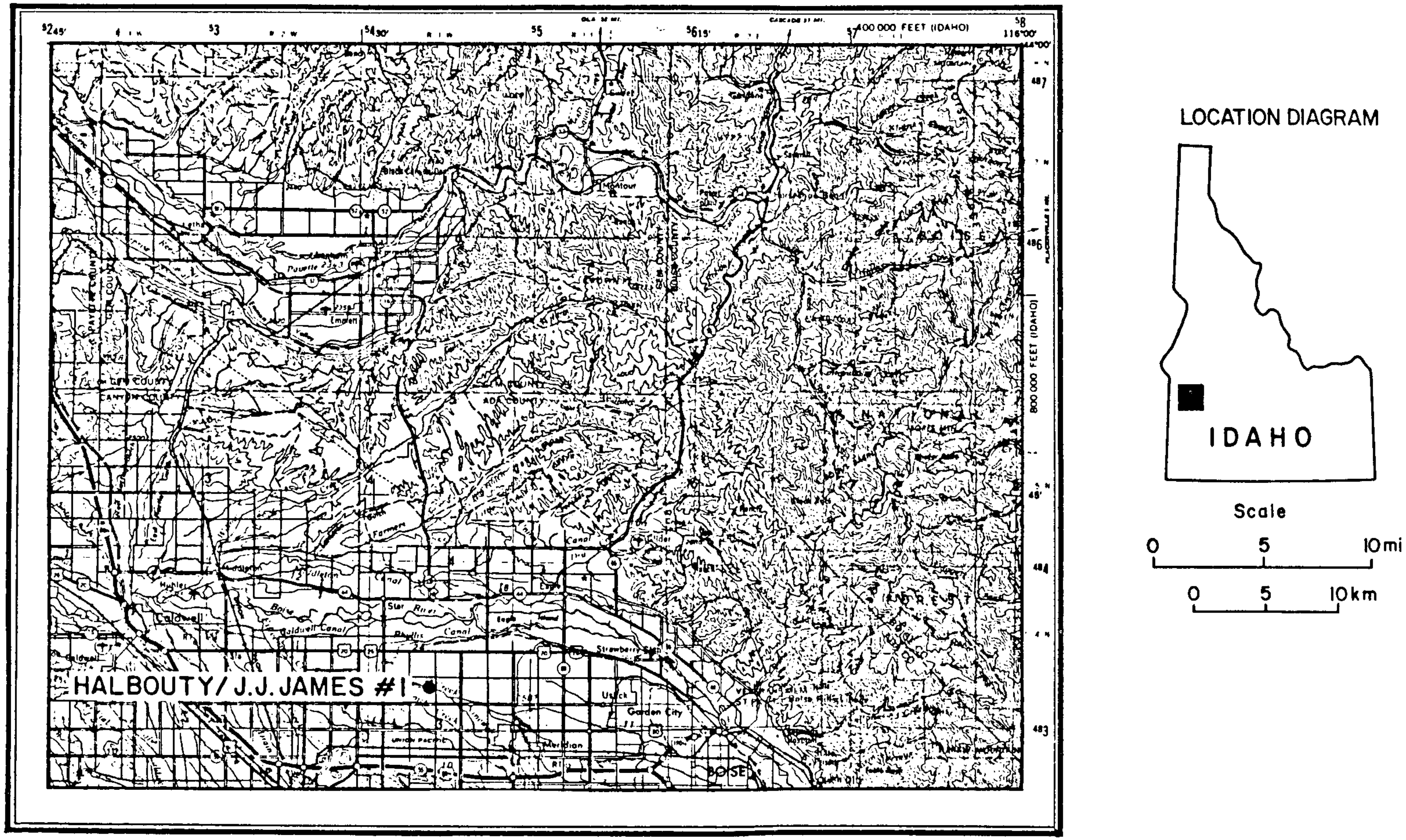

Fig. D-4. Location of Halbouty/J. J. James No. 1 geothermal well.

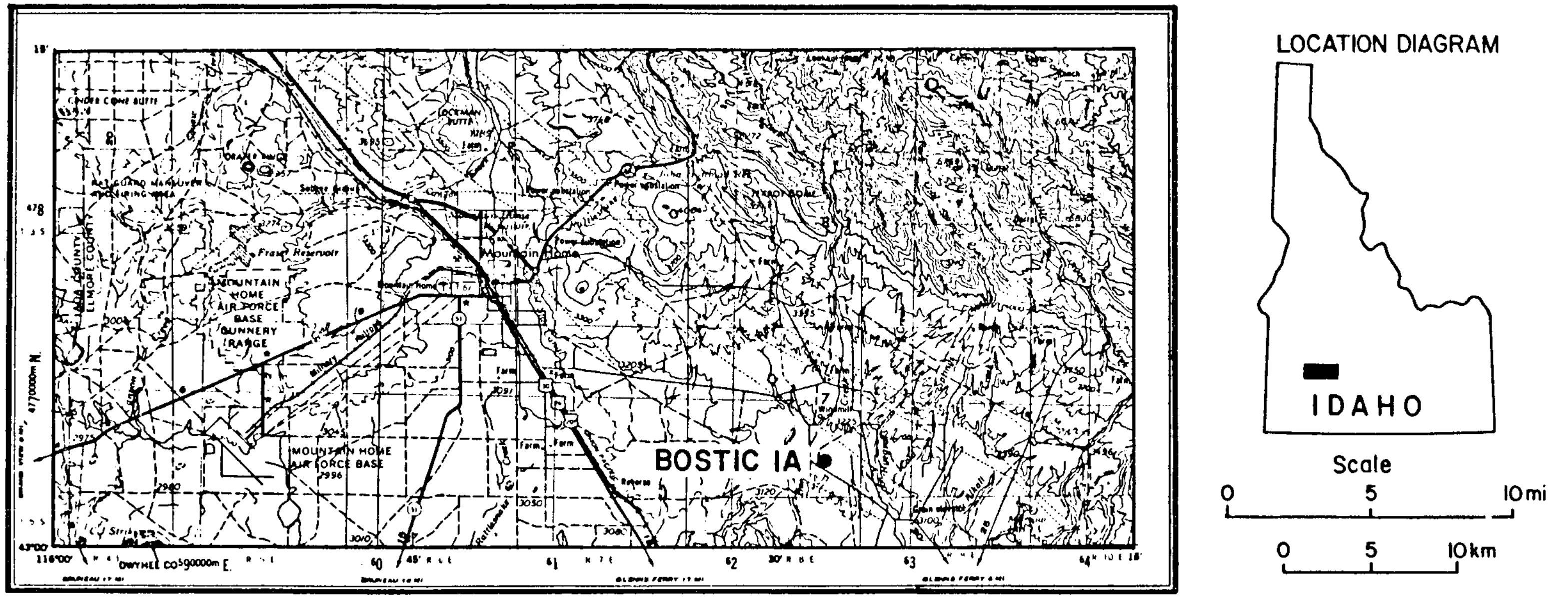

Fig. D-5. Location of Bostic 1A geothermal well.

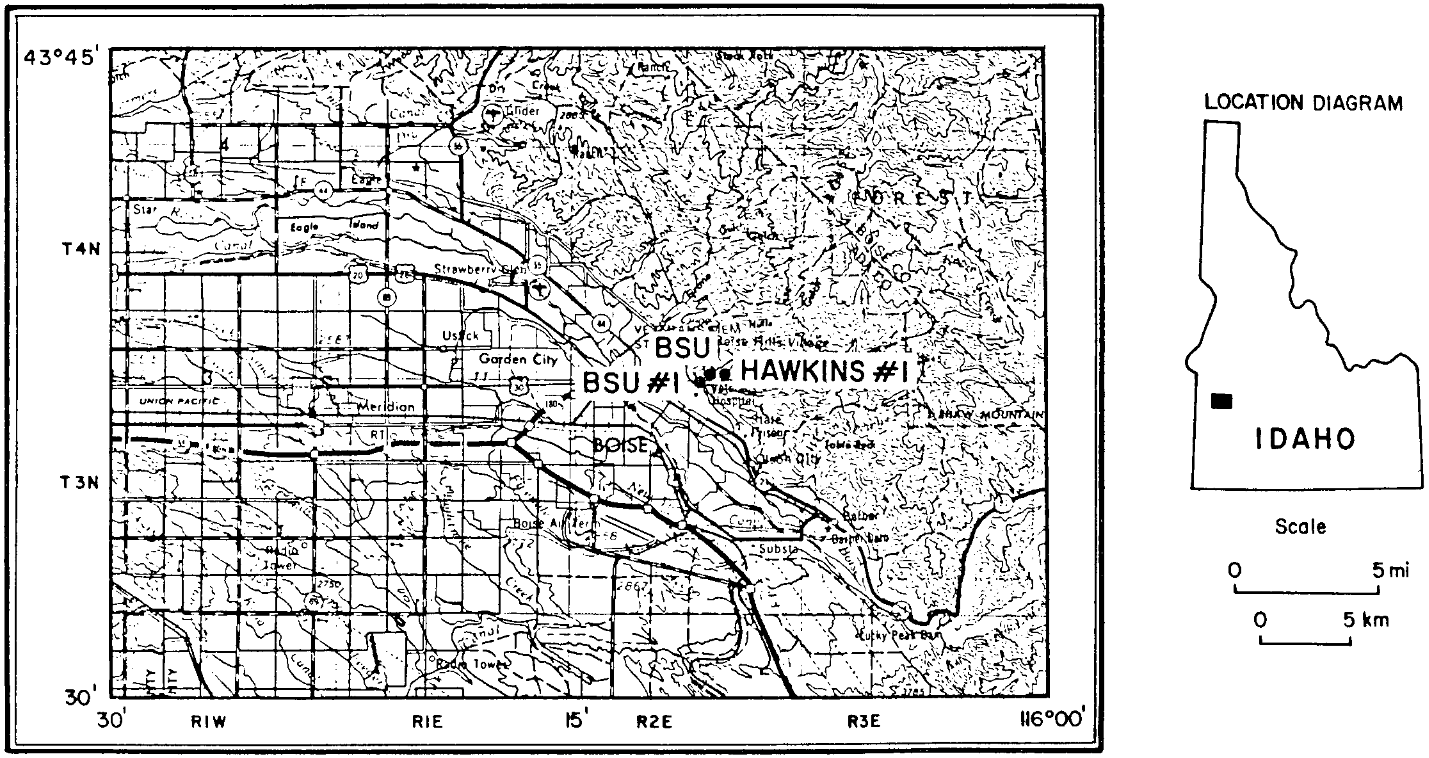

Fig. D-6. Boise Front well locations.

3. Butte County

A deep geothermal exploratory well (INEL-1) was drilled by the Department of Energy, Idaho, in NE NW Sec 1 T3N R29E, Butte County, Idaho (Fig. D-7). Total depth was 10 365 ft. Cored intervals are listed.

Core No.	Interval	Core Recovered
1	2340 - 2361	5 ft
2	2507 - 2518	8 ft
3	3661 - 3718	44 ft
4	4839 - 4878	39 ft
5	9810 - 9816	1 ft
6	10324 - 10330	1.5 ft
7	10330 - 10356	16 ft

Cuttings were also taken from this well. The hole penetrated a thick sequence of basalt, sediments, and rhyolite and bottomed in rhyodacite.

The cores of cuttings are on file at the University of Utah Research Institute (UURI) Geothermal Sample Library, Earth Science Laboratory, 2459 Major Street, Salt Lake City, Utah, 84108.

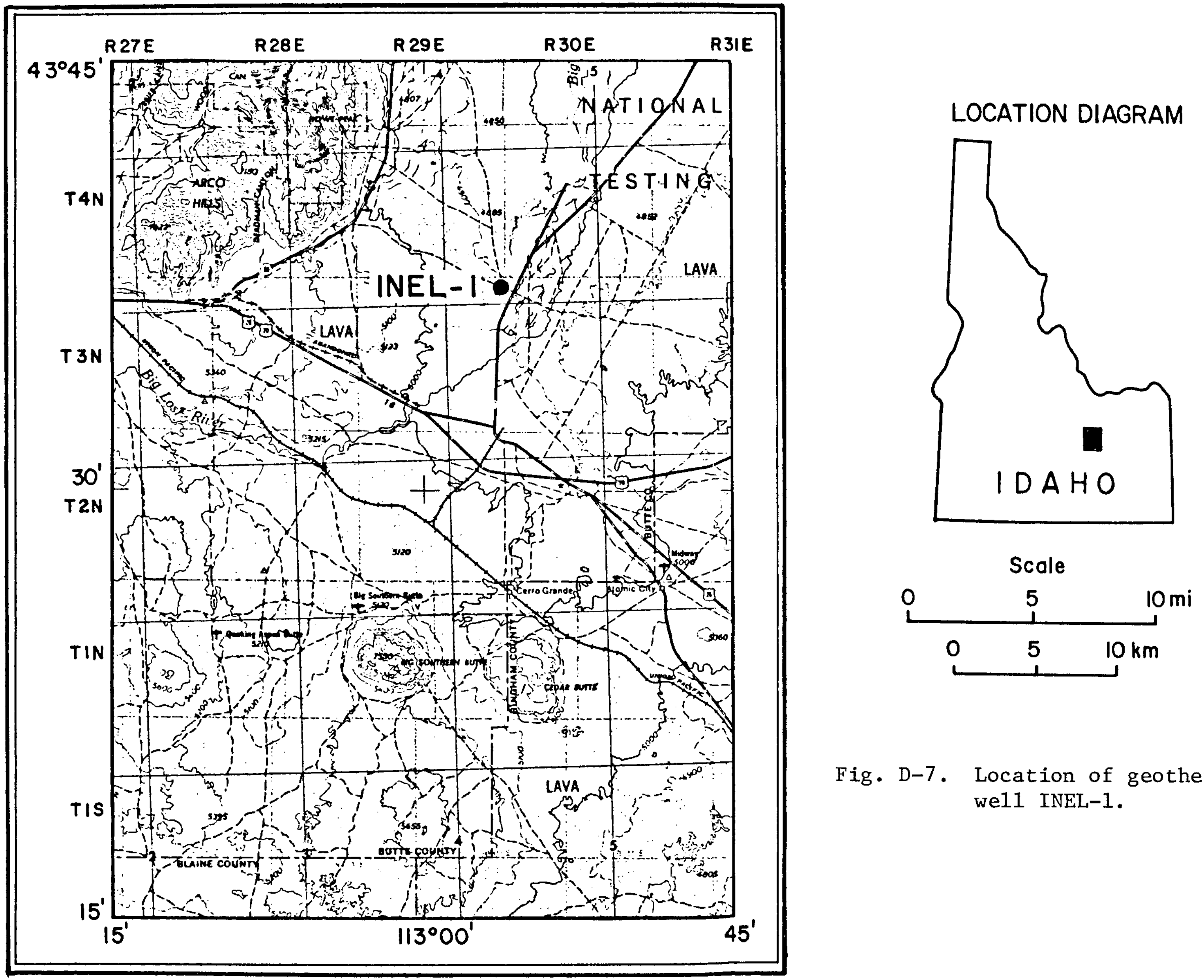

Fig. D-7. Location of geothermal well INEL-1.

APPENDIX E

MARYSVILLE GEOTHERMAL WELL, HELENA, MONTANA

Well location: NW1/4 SW1/4 NE1/4 Sec 32 T12N R6W (Fig. E-1)

The 15 cores in this well are highly fractured into 1- to 12-in. pieces (Table E-I); however, they have been reconstructed. Cuttings were taken every 10 ft. A summary of the hole lithology is provided in Fig. E-II. Access to the cores and cuttings can be obtained through David Blackwell, Geophysics Department, Southern Methodist University, Dallas, TX 75275.

An extensive report on the studies of this hole titled "Marysville, Montana Geothermal Project Final Report," No. 2311-01410, U.S. ERDA, Sept. 1975, is also available from David Blackwell.

Brief lithologic summaries of the core descriptions are given below.

0 - 88.4 m	Hornfelsed Empire and possibly Spokane shales (tremolite and phlogopite in upper cores suggest metamorphosed dolomitic Empire shale, lack of these in lower cores indicates a transition to nondolomitic Spokane argillite).
88.4-121.9 m	Metamorphased dacite porphyry; this porphyry contains phenocrysts of plagioclase and biotite and possibly hornfels xenoliths of the Empire Fn; many plagioclase phenocrysts sericitized.
121.0-294.1 m	Empire and possibly Spokane formation.
294.1-1955 m	Empire Creek stock contact; granite porphyry with phenocrysts of orthoclase, plagioclase, quartz, and biotite; orthoclase and quarts make up the sugary groundmass; feldspars altered to Kaolinite, montmorillonite, and sericite; grain size increases with depth. The upper greenish-grey granite grades into a more equigranular pink granite at greater depth; alteration of feldspars decreases with depth though plug is still highly kaolinitized with minor nontmorillonite; fluorite veins present throughout.

TABLE E-I

CORED INTERVAL

Core No.	Interval	Core No.	Interval
1	99.1 - 102.1 m	9	848.0 - 849.2 m
2	132.9 - 135.9 m	10	1009.5 - 1010.7 m
3	177.0 - 180.1 m	11	1163.4 - 1165.9 m
4	280.7 - 283.8 m	12	1297.2 - 1299.7 m
5	303.9 - 306.9 m	13	1606.3 - 1608.1 m
6	464.5 - 466.4 m	14	1835.5 - 1837.6 m
7	590.1 - 593.3 m	15	1953.8 - 1955.0 m
8	699.5 - 701.0 m		

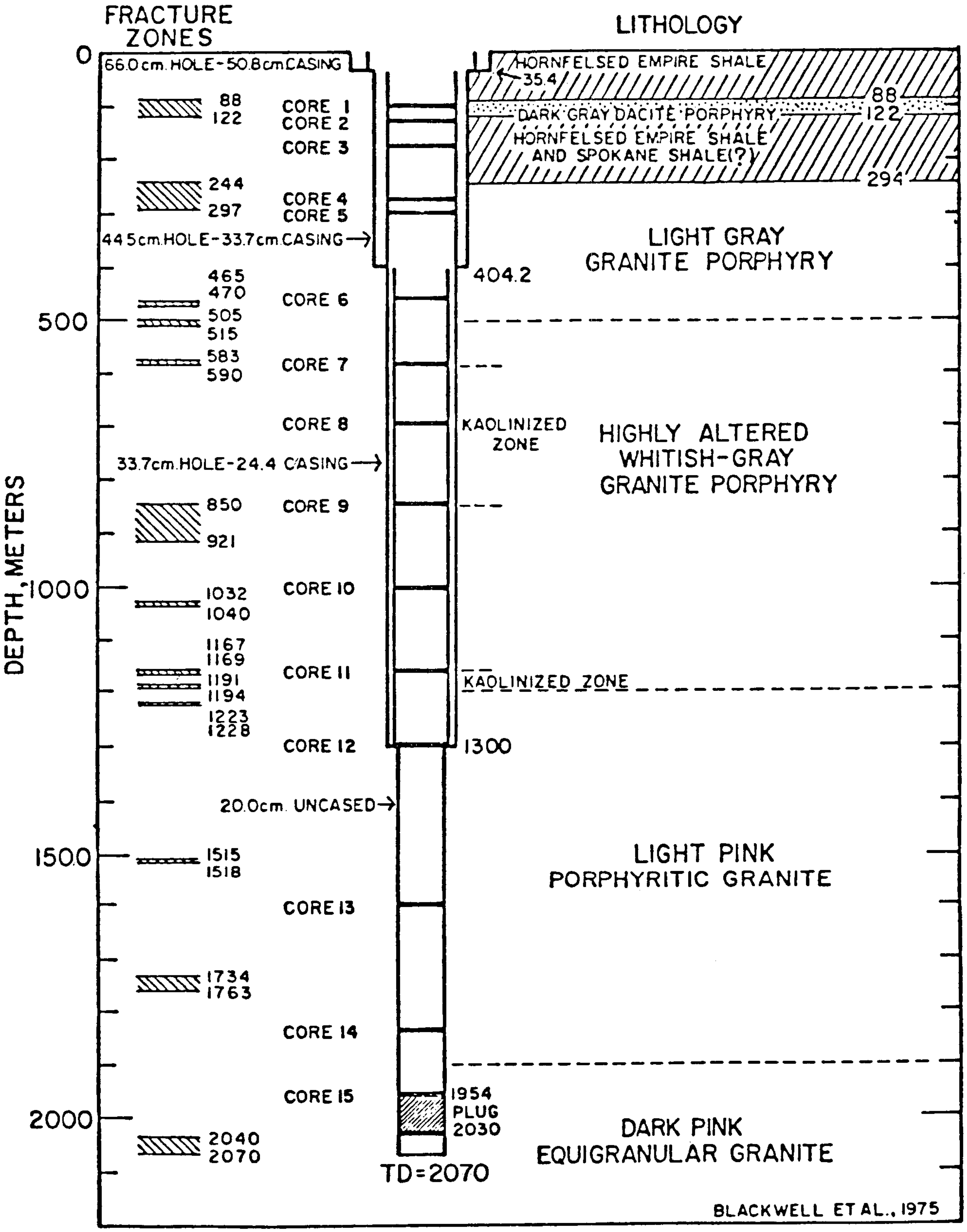

Fig. E-2. The Marysville, Montana, geothermal project: Final report, Battelle Pacific Northwest Laboratories. From McSpadden, 1975.

APPENDIX F

NEVADA

1. Buena Vista Valley

Core was taken in four holes near Kyle Hot Springs, Buena Vista Valley, Nevada (Fig. F-1). "Spot" cores were obtained for KY-1, drilled in carbonate, and KY-4 and -5, both drilled in alluvium. KY-3 was continuously cored in quartzite, but recovery was poor due to fracturing and weathering.

Conductivity values were made on chips and cores from these wells and are presented in Tables F-I through F-IV. All data were taken from Sass et al., 1976.

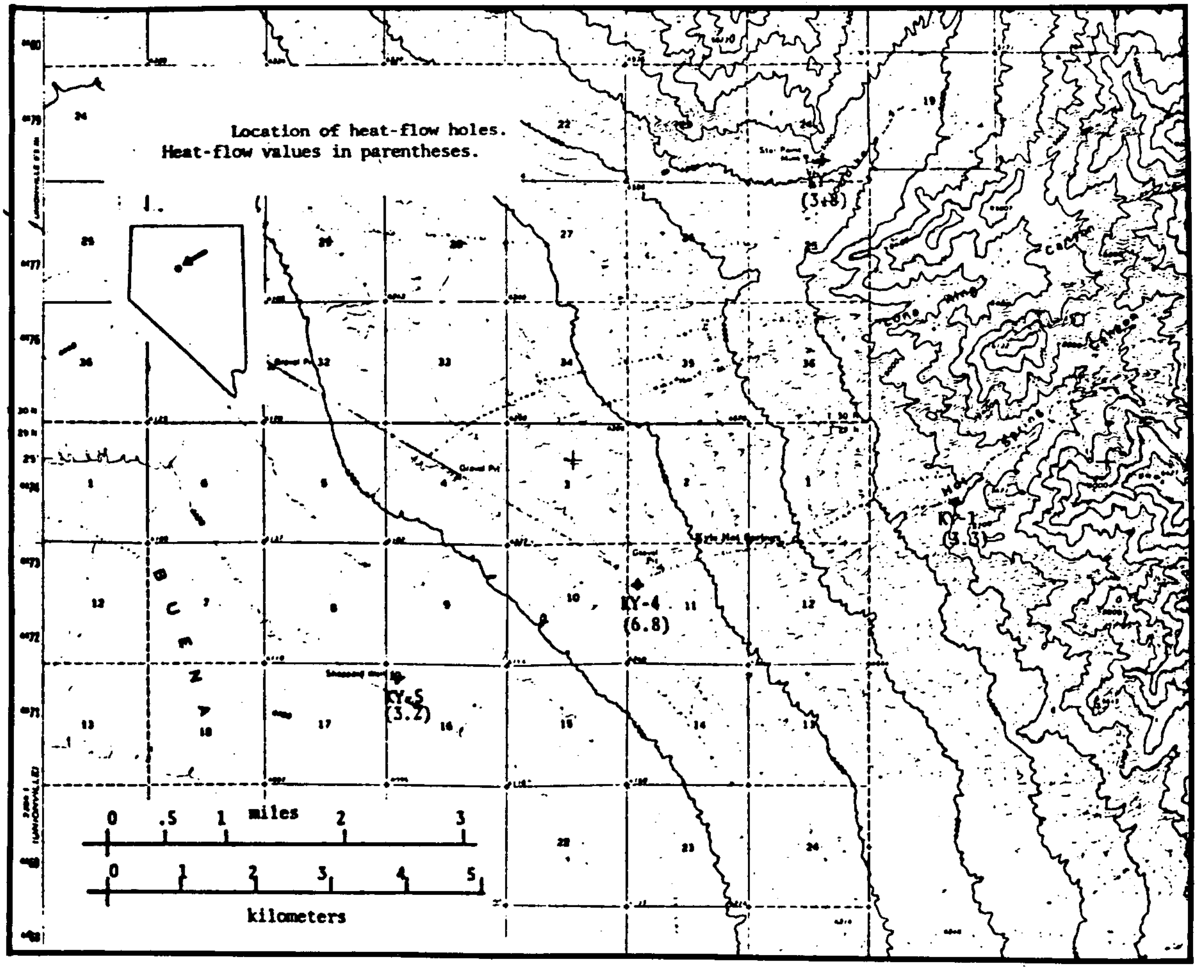

Fig. F-1. Location of Kyle Hot Springs, Buena Vista Valley, Nevada.

TABLE F-I

THERMAL CONDUCTIVITIES FOR HOLE KY-1

Depth (m)	K_f	K_s[a]	Porosity (%)
6.1		8.09	
12.2		8.25	
32.0	4.62 ± .20(7)[b]	8.97	35.7
48.8		8.69	
54.9		7.62	
62.0	8.38[c]	8.83	1.5
65.5		9.53	
85.3		8.32	
91.4		8.49	
93.0		8.80	

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[a] Conductivity of solid component using chips.

[b] Needle-probe measurements on core, number of determinations in parentheses.

[c] Divided-bar measurements on solid disks.

TABLE F-II

THERMAL CONDUCTIVITIES FOR HOLE KY-3

Depth (m)	K_f[a]	K_s[b]	Porosity (%)
4.6		15.86	
9.1		11.86	
13.7		15.61	
18.3		8.03	
22.9		9.72	
24.1	9.47		4
27.4		10.36	
32.0		11.53	
36.6		9.36	
41.1		11.43	
42.1	13.44		1
45.7		11.53	
50.3		11.46	
54.9		10.12	
55.8	11.01		1
59.4		9.28	
64.0		10.06	
68.6		9.50	
69.5	13.38		1
73.2		9.70	
77.7		15.71	
82.3		9.48	
86.9	10.05	12.61	1
91.4		15.49	
96.0		9.98	
100.6		13.22	
101.5	14.50		
105.2		10.53	

---

[a] Divided-bar measurements on solid disks.

[b] Conductivity of solid component using chips.

TABLE F-III

THERMAL CONDUCTIVITIES FOR HOLE KY-4

Depth (m)	K_f [a]	K_s [b]	Porosity (%)
6.1		7.99	
12.2		10.06	
18.3		9.76	
24.4		9.92	
30.5	4.60 ± .20(7)	8.86	35.5
36.6		7.50	
42.7		9.15	
48.8		8.06	
54.9		9.35	
61.0		9.76	
67.1		10.63	
79.2		8.33	
85.3		9.24	
91.4		8.10	
97.5		9.74	
103.6	5.22 ± .29(7)	9.24	30.3
109.7		8.78	
115.8		9.76	
121.9		10.52	
128.0		9.70	
134.1		9.96	
140.2	6.53 ± .38(8)	10.47	23.5
146.3		10.94	

---

[a] Needle-probe measurements on core, number of determinations in parentheses.

[b] Conductivity of solid component using chips.

TABLE F-IV

THERMAL CONDUCTIVITIES FOR HOLE KY-5

Depth (m)	K_f [a]	K_s [b]	Porosity (%)
6.1		5.03	
12.2		6.06	
18.3		7.55	
24.4		6.03	
30.5	3.86 ± .24(7)	6.64	34.8
36.6		5.33	
42.7		6.58	
48.8		5.65	
54.9		5.65	
56.4		3.81	
61.0		6.00	
67.1		4.73	
73.2		5.94	
79.3		6.20	
85.3	4.13 ± .42(5)	6.68	30.8
91.4		5.53	
97.5		4.35	
103.6		6.56	
109.7		7.11	
115.8		6.84	
121.9	3.28 ± .07(11)	7.18	47.9
128.0		6.75	
134.1		7.76	
140.2		6.86	
146.3		6.58	
152.4		7.22	

---

[a] Needle-probe measurements on core, number of determinations in parentheses.

[b] Conductivity of solid component using chips.

2. Buffalo Valley Hot Springs

Three heat-flow holes were drilled in Buffalo Valley, Nevada, near Buffalo Valley Hot Springs (Fig. F-2). Thermal conductivity data from these holes are provided with core lithologies below, Table F-V (Sass et al., 1976). Cores for these holes are stored at USGS, Menlo Park, and access can be obtained through Peter Galanis.

TABLE F-V

LITHOLOGY AND THERMAL CONDUCTIVITY FOR CONDUCTIVITY SAMPLES FROM BUFFALO VALLEY HEAT-FLOW HOLES

Hole No.	Depth (m)	Lithology [a]	K Mcal/cm-s-°C
1 (SW Sec 24 T29N R41E)	0 [b]	basalt ρ = 2.12, ϕ = 20.6	3.08
	0 [b]	basalt ρ = 2.69, ϕ = 7.8	4.10
	0 [b]	basalt ρ = 2.71, ϕ = 7.0	4.36
	67.7	silty sand	2.65
2 (SW Sec 22 T29N R41E)	92.6	clayey sand	2.36
	93.0	clayey sand	2.36
	113.7	gritty sand	2.52
	114.0	gritty sand	2.66
	114.3	gritty sand	2.54
3 (NW Sec 34 T30N R41E)	61.6	silty sand	2.62
	61.9	silty sand	2.42
	62.2	silty sand	2.34
	62.5	silty sand	2.36
	78.3	silty sand	2.39
	95.1	silty clay	2.70
	96.0	silty clay	2.59
	96.6	silty clay	3.38

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[a] For basalts, ρ = density g/cm^3, ϕ = apparent porosity %.

[b] Nearby outcrop samples of basalt flow intersected between 30 and 37 m.

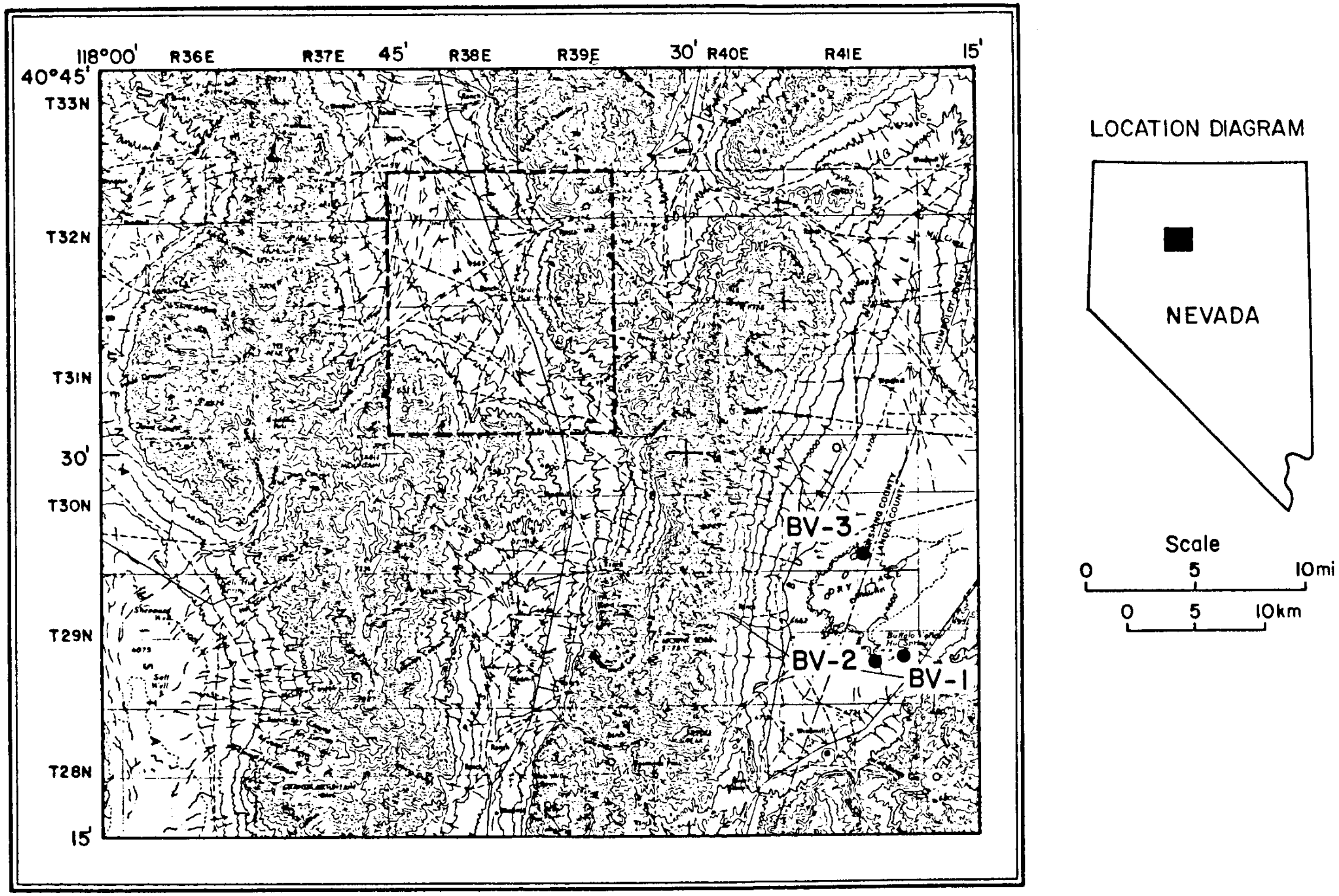

Fig. F-2. Approximate locations of Buffalo Valley geothermal wells.

3. Leach Hot Springs

Thirty-two drill holes were partially cored as part of a heat-flow study of the Leach Hot Springs area in Nevada (Fig. F-3). Lithologies of these holes were determined from drill cuttings (taken about every 5 m) and cores. Porosity measurements are also made on some of the cores. An attempt to correlate porosity with lithology was inconclusive, mainly because most cores contained a combination of the predominant lithologic units (clay sand ± gravel), and it was difficult to quantify lithology. Thermal conductivity measurements of the cores were made also, using a needle probe or, for competent rocks, with a divided bar and cylindrical disk.

Summaries of lithologies and thermal conductivity measurements for wells in the Leach Hot Springs area are presented in Tables F-VI through F-XV. More information on the heat-flow studies in the Leach Hot Springs area of Nevada is provided by Sass et al., 1976, and Ziagos et al., 1977. Cores for these wells are stored at the USGS, Menlo Park; access can be obtained through Peter Galanis.

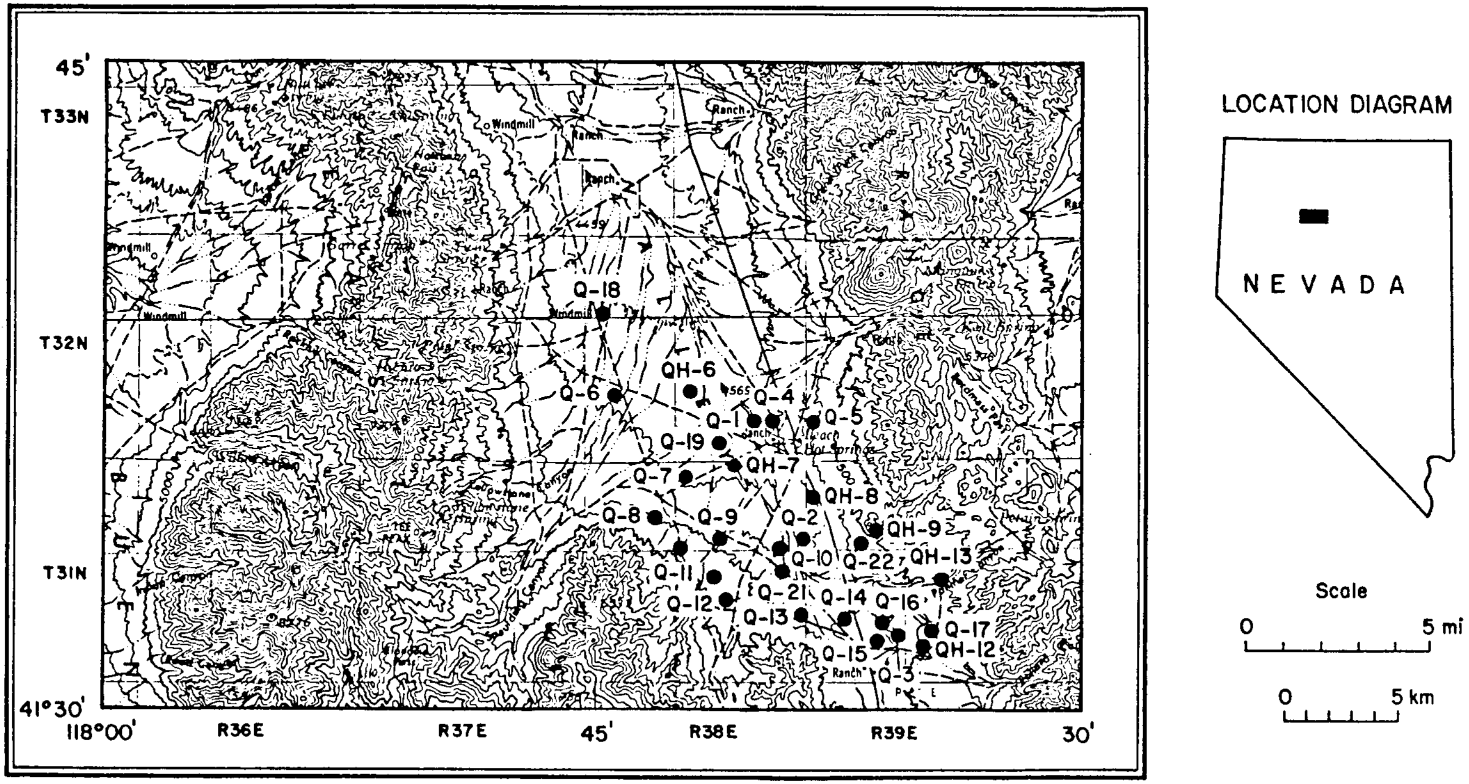

Fig. F-3. Approximate location of Leach Hot Springs geothermal well.

TABLE F-VI

POROSITY FROM CORES AND THERMAL CONDUCTIVITY FROM CORES AND CUTTINGS, GRASS VALLEY, NEVADA

Hole No.	Depth Interval (m)	Porosity [a] (%) ϕ		Thermal Conductivity (mcal/cm-s-°C) [b]			
		a	b	K_s	K_g a	K_g b	K_{np}
Q-4	51.8 - 53.3	36.0	41.8	5.56	3.38	3.12	3.49
Q-5	76.2 - 77.1		14.6	7.0		5.53	3.69
Q-6	57.0 - 58.5		23.7	6.22		4.37	4.12
Q-7	32.3 - 34.1	33.8		8.15	4.49		3.37
	57.9 - 59.4	24.5	28	6.3	4.36	4.13	4.17
Q-8	29.0 - 30.5	69.7		3.6	1.86		1.91
	64.6 - 66.1	57.4	48.1	4.46	2.29	2.55	3.01
	64.6 - 66.1	58.8	48.1	4.46	2.26	2.55	3.01
Q-9	48.8 - 50.3	42.0		10.05	4.39		3.49
Q-10	33.5 - 35.1	39.1	43.8	8.3	4.14	3.81	2.90
Q-12	46.3 - 47.9		26.0	8.3		5.23	4.39
	57.9 - 59.4	24.0		5.16	3.77		3.35
Q-13	85.3 - 86.9	29.5	36.8	7.1	4.40	3.91	4.38
Q-14	29.3 - 30.8	32.2		8.8	4.87		4.93
Q-15	29.0 - 30.5	67.3		5.03	2.13		2.45
	42.7 - 44.2	35.9	60.4	5.03	3.18	2.32	2.97
Q-16	48.8 - 50.3	27.9		7.01	4.47		3.16
	75.3 - 76.8		26.9	7.4		4.73	4.63
Q-17	33.5 - 35.1	29.9		8.6	5.00		4.06
Q-18	27.4 - 29.0	18.9	20.6	5.23	4.08	3.99	3.89
Q-19	24.4 - 25.9	46.8	21.4	6.09	3.06	4.45	4.03
Q-22	24.4 - 25.9	39.0	17.2	8.1	4.08	5.99	3.41

TABLE F-VI (cont)

Hole No.	Depth Interval (m)	Porosity [a] (%) ϕ		Thermal Conductivity (mcal/cm-s-°C) [b]			
		a	b	K_s	Kg a	b	K_{np}
QH-6	27.4 - 29.0	20.4	32.7	6.66	4.85	4.00	4.16
QH-7	34.4 - 36.0	36.0		5.6	3.40		3.43
	61.0 - 62.5	54.5	54.9	7.9	3.08	3.06	3.07
QH-8	34.4 - 36.0	54.9	46.8	7.0	2.89	3.3	3.35
	44.2 - 45.7	30.3		5.33	3.55		2.90
QH-11	39.6 - 41.1	59.6		4.14	2.17		2.31
	49.7 - 51.2	63.0	47.4	4.0	2.06	2.43	2.41
QH-12	39.6 - 41.1	54.1	54.9	6.4	2.81	2.78	2.77
QH-13	35.1 - 36.6	25.2		7.4	4.86		4.46

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[a] Porosity (ϕ) a) Lakewood; b) Menlo Park.

[b] Thermal conductivity: K_s, conductivity of solid component over the depth specified;

K_{np}, harmonic mean of needle-probe determinations (see Table F-VII);

Kg, $K_s^{(1-\phi)}. K_w^{\phi}$, where ϕ is fractional porosity; and

K_w, conductivity of liquid water at ≃15°C (≃1.4 mcal/cm s °C).

TABLE F-VII

THERMAL CONDUCTIVITY AND LITHOLOGIC DESCRIPTIONS OF CORES, LEACH HOT SPRINGS AREA, GRASS VALLEY, NEVADA

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
Q-4	51.82 - 52.34	51.90	3.84		Yellowish-brown, poorly sorted clayey sandstone.
		51.99	3.78		
		52.06	3.87		
		52.12	3.93 [a]		
		52.21	4.13		
		52.28	3.51 [a]		
		52.28	3.28 [a]		
		52.38	3.58		
		52.46	2.96		
		52.53	2.95 [a]		
		52.65	2.87		
		52.79	3.74 [a]		
				3.49 ± 0.13	
Q-5	61.87 - 62.48	61.92	4.52		Coarse gravel and pebbles (subangular) in silty, clayey matrix, poorly sorted.
	76.20 - 76.50	76.28	5.18		Poorly sorted gravelly, silty, buff-brown clay.
		76.30	2.87		
				3.69 ± 1.06	
Q-6	33.53 - 35.05	33.56	2.99		Large pebbles and cobbles (chert) with some gritty, pebbly, silty, clay.
		33.59	7.87		
				4.33 ± 1.95	
	57.00 - 58.52	57.06	3.34		Very tight conglomerate.
		57.08	4.56		
		57.11	4.78 [a]		
				4.12 ± 0.49	
Q-7	32.92 - 34.14	33.02	2.93		Sandy clay and fine gravel.
		33.20	2.83		
		33.33	2.68 [a]		
		33.43	4.41		
		33.52	3.87		
		33.69	4.40 [a]		
				3.37 ± 0.31	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
Q-7	57.91 - 59.44	57.97	3.63		Sandy, silty clay.
		58.02	3.81[a]		
		58.11	4.27		
		58.20	3.83[a]		
		58.35	5.06		
		58.51	4.03[a]		
		58.56	4.54		
		58.72	4.25		
				4.17 ± 0.16	
Q-8	28.96 - 32.00	28.96	1.87[a]		Light bluish-grey tuff with clear, flat glass shards--stratified.
		29.05	1.84		
		29.16	2.04		
		29.21	2.01[a]		
		29.39	2.07		
		29.54	2.07[a]		
		29.54	1.50[a]		
		29.84	1.75		
		29.97	2.25		
		30.56	2.15[a]		
		30.73	2.15		
		30.84	2.34		
		31.03	1.42		
		31.17	1.92[a]		
		31.17	1.43[a]		
		31.36	1.84		
		31.48	1.61[a]		
				1.86 ± 0.07	
	64.62 - 66.14	64.77	3.39		Yellowish-buff sandy, tuffaceous clay, some quartz grains.
		64.85	3.10[a]		
		64.95	3.92		
		65.03	2.85		
		65.14	2.66		
		65.36	3.06		
		65.47	3.24		
		65.65	3.23[a]		
		65.76	2.54		
		65.90	2.62[a]		
				3.01 ± 0.13	
Q-9	32.61 - 33.53	32.72	6.14		Sandy clay and gravel.
		32.79	3.81		
		32.85	4.64		
				4.68 ± 0.63	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C) K	<K>	Lithology
Q-9	48.77 - 50.29	48.77	3.97		Silty gravel, gravel, sandy clay.
		48.83	3.27		
		48.95	3.42		
		49.24	3.39[a]		
				3.49 ± 0.14	
Q-10	33.53 - 35.02	33.77	2.81		Reddish-brown clayey silt stone; very few pebbles.
		33.85	2.72[a]		
		33.85	2.66[a]		
		33.96	2.88		
		34.14	2.73[a]		
		34.20	2.90		
		34.33	3.28		
		34.47	3.36[a]		
				2.90 ± 0.09	
	48.77 - 50.29	49.01	4.27[a]		Sandy claystone.
		49.10	3.92[a]		
				4.09 ± 0.18	
Q-11	76.20 - 77.72	76.37	3.96		Clay and sandy clay with gravel.
		76.44	5.93		
		76.54	5.12		
				4.87 ± 0.59	
Q-12	46.33 - 47.85	46.37	3.07		Grit, clay, angular gravel.
		46.42	3.78		
		46.57	5.12		
		46.67	5.07		
		46.85	4.83		
		46.88	5.67		
				4.39 ± 0.45	
	57.91 - 59.44	58.02	2.92		Gritty, sandy clay.
		58.12	3.42[a]		
		58.18	3.84		
				3.35 ± 0.27	
Q-13	85.34 - 86.87	85.40	3.66		Gravelly clay.
		85.57	3.54		
		85.66	3.89[a]		
		85.73	4.60		
		85.82	5.41[a]		
		85.86	4.94		
		85.96	5.52		
				4.38 ± 0.31	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
Q-14	29.26 - 30.78	29.33	4.08		Gravelly, gritty, clayey.
		29.37	6.24 a		
				4.93 ± 1.03	
	46.63 - 47.55	46.66	5.21		Gravelly, sandy clay.

Q-15	28.96 - 30.48	28.96	2.26 a		Clay.
		29.01	2.41		
		29.09	2.47		
		29.10	2.57 a		
		29.15	1.90 a		
		29.20	4.23		
		29.25	2.44		
		29.30	2.34		
		29.34	2.41		
		29.37	1.86 a		
		29.42	2.54		
		29.50	2.67		
		29.53	2.46 a		
		29.53	2.45 a		
		29.57	3.15		
		29.62	2.46		
		29.69	2.33		
				2.58 ± 0.09	
	42.67 - 44.20	42.86	3.14 a		White siliceous tuff.
		42.91	2.99		
		43.00	2.75 a		
		43.08	3.10		
		43.13	3.09		
		43.66	2.98		
		43.70	2.77		
				2.97 ± 0.06	
Q-16	48.77 - 50.29	48.33	3.10		Clayey silt with pebbles and gravel.
		48.33	3.63		
		48.85	2.50		
		48.87	2.69		
		48.87	3.63		
		48.87	3.92		
				3.16 ± 0.24	
	66.45 - 67.97	66.47	4.43		Well-sorted, medium-grained, moderately rounded sand (lithic fragments pre dominant).
		66.50	3.03		
		66.57	2.78 a		
		66.57	4.74		

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
Q-16		66.60	3.64		
				3.57	
				± 0.37	
	75.29 - 76.81	75.35	4.72		0.5' gritty clay with pebbles; remainder gravel with no matrix.
		75.36	4.27		
		75.41	4.64		
		75.46	4.21[a]		
		75.54	5.01		
		75.56	4.54		
		75.56	5.22		
				4.63	
				± 0.14	
Q-17	33.53 - 35.05	33.63	3.55		Brown clay with sand and pebbles.
		33.70	3.48		
		33.71	4.39		
		33.85	5.29		
				4.06	
				± 0.39	
	65.53 - 67.06	65.59	4.61		Gravelly, cobbly, clay.

Q-18	28.35 - 29.87	28.46	3.30		Brown, clayey sand.
		28.62	4.38		
		28.69	4.04[a]		
		28.73	3.99		
				3.89	
				± 0.24	
	54.86 - 56.39	54.93	3.95		Brown, sandy clay.
		54.93	4.17		
		55.01	3.76		
		55.07	4.32		
		55.11	4.47		
				4.12	
				± 0.13	
Q-19	24.38 - 25.91	24.38	3.57[a]		Clay with fine-to-medium gravel.
		24.51	4.39		
		24.62	4.70[a]		
		24.72	3.95		
		24.82	2.89[a]		
		24.91	3.00		
		25.07	3.91		
		25.26	5.19		
		25.37	3.54[a]		
		25.45	5.74		
		25.50	5.79[a]		
				4.03	
				± 0.29	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
Q-21	24.69 - 25.91	24.77	4.09		Silty sandstone, abundant
		24.86	6.14		
		25.01	4.16		
				4.63 ± 0.57	
Q-22	24.38 - 25.91	24.46	3.15		Brown silty clay, scattered pebbles.
		24.55	3.44		
		24.63	3.11[a]		
		24.68	3.70		
		24.88	3.64		
		24.98	3.51[a]		
				3.41 ± 0.10	
QH-6	27.43 - 28.96	27.43	3.10[a]		Brown, sandy, silty clay.
		27.54	3.53		
		27.70	4.19		
		27.79	3.75[a]		
		27.79	4.54[a]		
		27.91	4.77		
		28.07	4.02[a]		
		28.13	4.73		
		28.19	5.10		
		28.40	4.58[a]		
		28.40	5.29[a]		
		28.50	4.00		
		28.61	3.65[a]		
				4.16 ± 0.19	
	41.15 - 42.67	41.21	3.22		Sandy clay with fine gravel.
		41.26	3.75		
		41.35	4.57		
		41.39	4.14		
		41.44	4.19		
				3.92 ± 0.24	
QH-7	34.44 - 35.97	34.55	2.97		Clay, fine-grained sand.
		34.82	2.89[a]		
		34.93	3.16		
		35.03	3.04[a]		
		35.08	4.39		
		35.21	3.95		
		35.31	4.66[a]		
		35.37	3.38		
		35.55	3.27[a]		
				3.43 ± 0.19	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C)		Lithology
			K	<K>	
QH-7	60.96 - 62.48	61.06	3.02		Clay with course sand.
		61.26	2.73[a]		
		61.37	3.02		
		61.57	2.82[a]		
		61.68	2.83		
		61.93	2.68[a]		
		62.04	3.72		
		62.22	3.47		
		62.31	3.73		
				3.07 ± 0.13	
QH-8	34.44 - 35.97	34.54	3.68		Medium-brown pebbly clay, subangular fragments of greenstone.
		34.62	4.23[a]		
		34.62	3.26[a]		
		34.81	4.19		
		34.90	2.80		
		35.08	2.83[a]		
		35.08	2.83[a]		
		35.17	3.48		
		35.28	3.50[a]		
				3.35 ± 0.18	
	44.20 - 45.72	44.25	3.13		Brown clay with pebbles and gravel.
		44.32	3.08		
		44.44	2.71[a]		
		44.50	3.00		
		44.63	2.98		
		44.77	2.24[a]		
		44.77	2.74[a]		
		44.92	3.07		
		45.02	3.01[a]		
		45.08	3.00		
		45.21	3.32		
		45.36	2.80[a]		
				2.90 ± 0.09	
QH-9	48.77 - 50.29	48.77	3.22[a]		Brown gritty clay with pebbles and gravel.
		48.79	3.89		
		48.83	3.47		
				3.51 ± 0.19	
QH-11	27.43 - 28.96	27.46	3.42		Mostly gravel, very wet and soft.
		27.52	4.45		
				3.87 ± 0.51	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C) K	<K>	Lithology
QH-11	39.62 - 41.15	39.62	2.40[a]		Brown and bluish-grey layered clayey sand.
		39.70	2.56		
		39.77	2.25[a]		
		39.98	2.16[a]		
		40.08	2.30		
		40.17	2.21[a]		
				2.31 ± 0.06	
	49.68 - 51.21	49.77	2.54		Brown clay.
		49.91	2.52		
		50.02	2.26		
		50.15	2.55		
		50.25	2.35[a]		
		50.35	2.28		
		50.45	2.58		
		50.63	2.33[a]		
		50.75	2.46		
		50.87	2.56		
		51.02	2.23		
		51.08	2.23[a]		
		51.08	2.36		
		51.16	2.60		
				2.46 ± 0.07	
QH-12	39.62 - 41.15	39.67	2.26		Fine sandstone, pebbles, brown siltstone.
		39.79	2.46		
		39.95	3.39[a]		
		40.08	2.25		
		40.13	2.85		
		40.26	3.48[a]		
		40.28	3.76		
		40.51	2.81		
		40.61	2.69[a]		
		40.64	2.81		
		40.76	2.91		
		40.84	2.63[a]		
		40.89	2.83		
		41.02	2.54[a]		
				2.77 ± 0.11	
QH-13	35.05 - 36.58	35.11	4.88		Reddish-brown claystone with abundant angular rock fragments.
		35.19	3.51		
		35.34	4.28		
		34.44	5.79[a]		
				4.46 ± 0.47	

TABLE F-VII (cont)

Hole No.	Cored Interval (m)	Sample Depth (m)	Thermal Conductivity (mcal/cm-s-°C) K	<K>	Lithology
QH-13	48.77 - 50.29	48.82	5.31		Brown silty clay with abundant angular pebbles.
		48.94	6.37		
		49.02	4.09		
				5.09 ± 0.66	

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[a] Conductivity measured with probe along axis of core.

TABLE F-VIII

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE Q-1, GRASS VALLEY, NEVADA

Well Location: T32N R38E Sec 26 SE 1/4 NW 1/4 NW 1/4

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
62.48 - 64.01	Tan clay and silt; small pebble-sized chert and quartzite clasts rare	62.73	3.86
		63.03	4.09
		63.31	3.48
121.92 - 123.44	Tan clay and silt; ± 20% medium sand	122.13	3.55
		122.22	3.84
123.44 - 124.97	Tan clay and silt; 2-5% very coarse sand; calcite cement	123.54	2.67
		123.75	3.38
		123.96	3.07
		124.15	3.38
167.64 - 168.07	Tan clay to very fine sand	167.79	3.33
		167.94	3.26
		168.01	3.56

TABLE F-IX

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE Q-2, GRASS VALLEY, NEVADA

Well Location: T31N R38E Sec 12 SE-SE-NE

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
62.48 - 62.84	Conglomerate; quartzite, chert, basalt, and metavolcanic clasts, average clast size 5-10 mm (maximum size 80 mm), poor sorting, 20-30% tan clay and silt matrix	62.79	6.22
62.84 - 63.63	Conglomerate; average clast size 2-6 mm (maximum size 30 mm), poor 50-60% tan clay and silt matrix	63.15 63.43	4.43 4.28
122.53 - 123.09	Tan clay and silt; 5-20% poorly sorted clasts of quartzite, chert, and metavolcanics	122.80 123.08	2.91 3.09
123.09 - 124.05	Conglomerate; quartzite, chert, and metavolcanic clasts, 60-70% tan silt and clay matrix	123.20	3.45
124.05 - 124.46	Tan clay to very coarse sand; 10-20% chert clasts (maximum size 10 mm), poor sorting	124.36	3.28
124.46 - 124.66	Conglomerate; average clast size 3-7 mm (maximum size 10 mm), clasts predominantly of chert, ± 50% tan clay to coarse sand matrix	124.66	3.85
124.66 - 125.22	Conglomerate; chert clasts predominate, average clast size 10-15 mm (maximum size 25 cm), poor sorting, ± 50% tan clay to coarse sand matrix	124.97 125.21	3.27 3.64

TABLE F-X

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE Q-3, GRASS VALLEY, NEVADA

Well Location: T31N R37E Sec 28 NW-NE-NE

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
64.62 - 65.99	Conglomerate; clasts subrounded to angular chert, average clast size 5-15 mm (maximum size 50 mm), poor sorting, 40-60% tan clay and silt matrix	64.83 65.07 65.26 65.59	4.31 5.02 4.75 4.95
128.02 - 128.63	Conglomerate; chert, quartzite and rhyolitic clasts as large as 30 mm; ± 50% tan clay to medium sand size matrix	128.14 128.47	3.21 5.17
128.63 - 129.11	Tan clay and silt; ± 5% coarse sand	128.78 129.05	2.88 3.24
129.11 - 129.74	Conglomerate	129.54	6.05
129.74 - 129.97	Tan clay and silt	129.88	3.50
129.97 - 130.63	Conglomerate	130.36	3.69
164.59 - 165.91	Conglomerate; clasts of chert, quartzite, and andesite, average clast size 1-5 mm (maximum size 70 mm), poor sorting	164.71 165.02 165.29 165.63 165.90	4.42 4.03 4.81 3.79 3.73

TABLE F-XI

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE QH-1, GRASS VALLEY, NEVADA

Well Location: T32N R38E Sec 36 Center of east line of NE-NE

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
58.22 - 58.46	Conglomerate; clasts subrounded to angular chert and quartzite, average clast size 10-30 mm, poor sorting, ± 30% light green clay and silt matrix	58.37	5.45
58.46 - 59.74	Light green silt and clay; pervasively sheared, moderately indurated, 1-5% subrounded to angular chert and quartzite clasts	58.77 59.10 59.59	4.18 3.85 3.20
119.48 - 119.88	Fine sand; poor sorting, clayey matrix	119.60	3.97
119.88 - 120.30	Medium-to-fine sand; poor sorting, clayey matrix		
120.30 - 121.31	Medium sand; poor sorting, clayey matrix	120.43 120.76	3.78 3.98
152.70 - 152.89	Brown silt and clay; poor sorting, 5-30% very coarse sand		
152.89 - 153.13	Brown silt and clay; 5-20% coarse pebble-sized chert and quartzite clasts	153.07	5.13
153.13 - 153.22	Brown silt and clay	153.19	4.61
153.22 - 154.23	Brown clay and coarse silt; thin indistinct interbeds with as much as 10% very coarse sand	153.38 153.56 154.23	4.40 2.98 4.13 [a]

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[a] Density: 2.32; porosity: 16.6%.

TABLE F-XII

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE QH-2, GRASS VALLEY, NEVADA

Well Location: T32N R37E Sec 19 SW-NE-SE

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
60.96 - 62.79	Light green clay and silt; thin indistinct coarse silt to very fine sand interbeds, evidence of minor shearing, trace of secondary pyrite along fractures	61.60	2.55
		61.78	2.61
		61.94	2.79
		61.96	2.75
		62.06	2.91
		62.36	2.77
		62.51	2.79
		62.73	2.79
121.92 - 122.41	Light green clay to coarse silt; 1-2% chert clasts, average clast size 2-6 mm	122.16	2.61
122.41 - 124.00	Light green clay to medium silt	122.53	2.90
		122.70	3.05
		122.90	2.46
152.70 - 154.53	Light green silt to very fine sand; evidence of minor shearing, trace of secondary calcite as veining	153.04	3.32
		153.22	2.92
		153.86	3.26
		154.14	3.48
		154.53	3.51 [a]

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[a] Density: 2.04; porosity: 27.1%.

TABLE F-XIII

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE QH-3, GRASS VALLEY, NEVADA

Well Location: T31N R38E Sec 14 SE-NW-NE

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
60.96 - 61.87	Conglomerate; clasts subrounded to angular quartzite, average clast size 15-25 mm (maximum size 65 mm), poor sorting, ± 20% tan silt and clay matrix	61.11 61.17	4.98 5.33
118.87 - 120.40	Conglomerate; clasts subrounded to angular quartzite, chert, and metavolcanics, maximum clast size 70-80 mm, 20-50% tan silt and clay matrix	119.02 119.18 119.36 119.48	3.81 5.59 3.11 4.32
152.70 - 152.86	Tan clay and silt; <10% pebble-sized clasts		
152.86 - 153.01	Conglomerate; average clast size 3-8 mm (maximum size 40 mm), ± 20% tan clay and silt matrix	152.89 152.98	4.70 4.90
153.01 - 153.40	Conglomerate; average clast size 20-40 mm (maximum 85 mm), predominantly chert, quartzite, and metavolcanic clasts, with some schistose and granitic fragments, ± 20% clay and silt matrix	153.19	3.60

TABLE F-XIV

THERMAL CONDUCTIVITY AND LITHOLOGY OF CORES FROM TEST HOLE QH-4, GRASS VALLEY, NEVADA

Well Location: T31N R38E Sec 22 NW 1/4 NE 1/4 SW 1/4

Core Depth (m)	Lithology	K Sample Depth (m)	K (mcal/cm-s-°C)
58.22 - 58.83	Conglomerate; chert and quartz-clasts predominate, ± 30% tan clay and silt matrix	58.43 58.49	4.01 4.06
58.83 - 59.15	Conglomerate; clasts subrounded to angular, 75% of clasts are chert and quartzite, remainder are metavolcanic and andesitic, ± 20% tan clay and silt matrix	59.04	4.22
59.15 - 59.45	Tan clay and silt; 2-5% very coarse sand	59.22	2.84
59.45 - 59.85	Tan clay and silt; 20-40% clasts as large as 20 mm	59.50 59.59	3.04 3.04
122.00 to 123.00	Conglomerate; quartzite, chert, and graywacke clasts as large as 100 mm, ± 10% brick-red clay matrix	122.59	4.19
154.53 - 156.06	Brick-red clay; high angle (80°) shear planes	154.69 154.96 155.51	2.68 2.94 2.80

TABLE F-XV

GENERALIZED LITHOLOGY OF GRASS VALLEY TEST HOLES, BASED ON EXAMINATION OF DRILL CUTTINGS

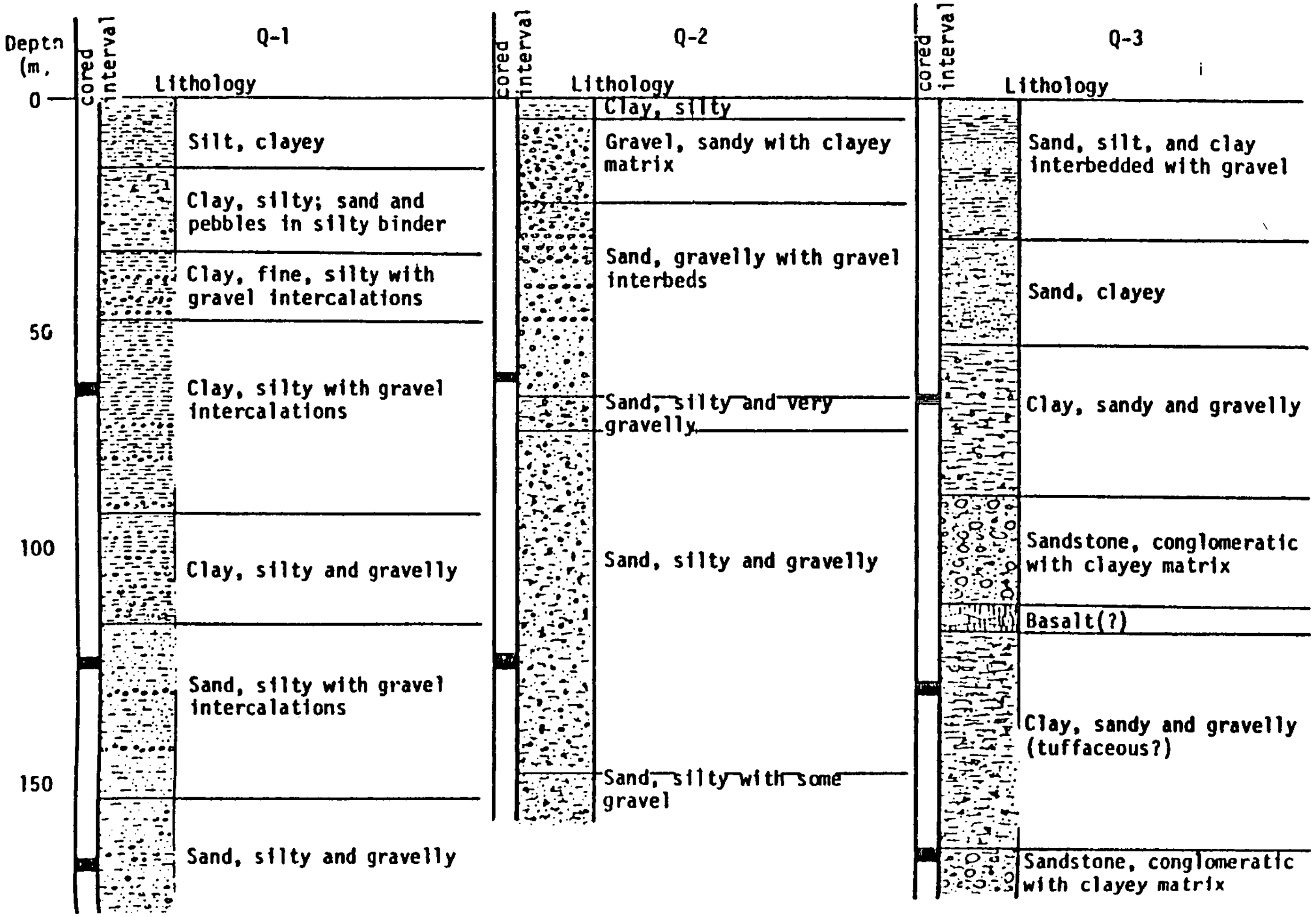


TABLE F-XV (cont)

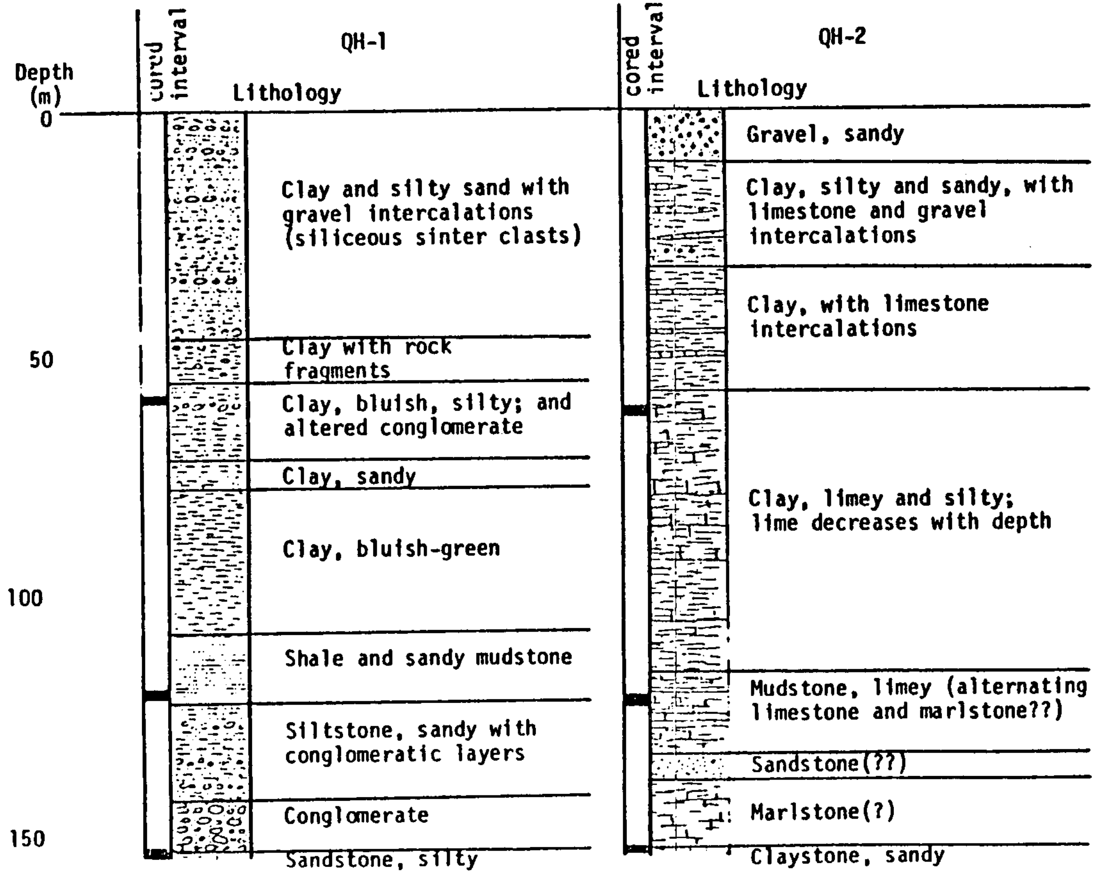
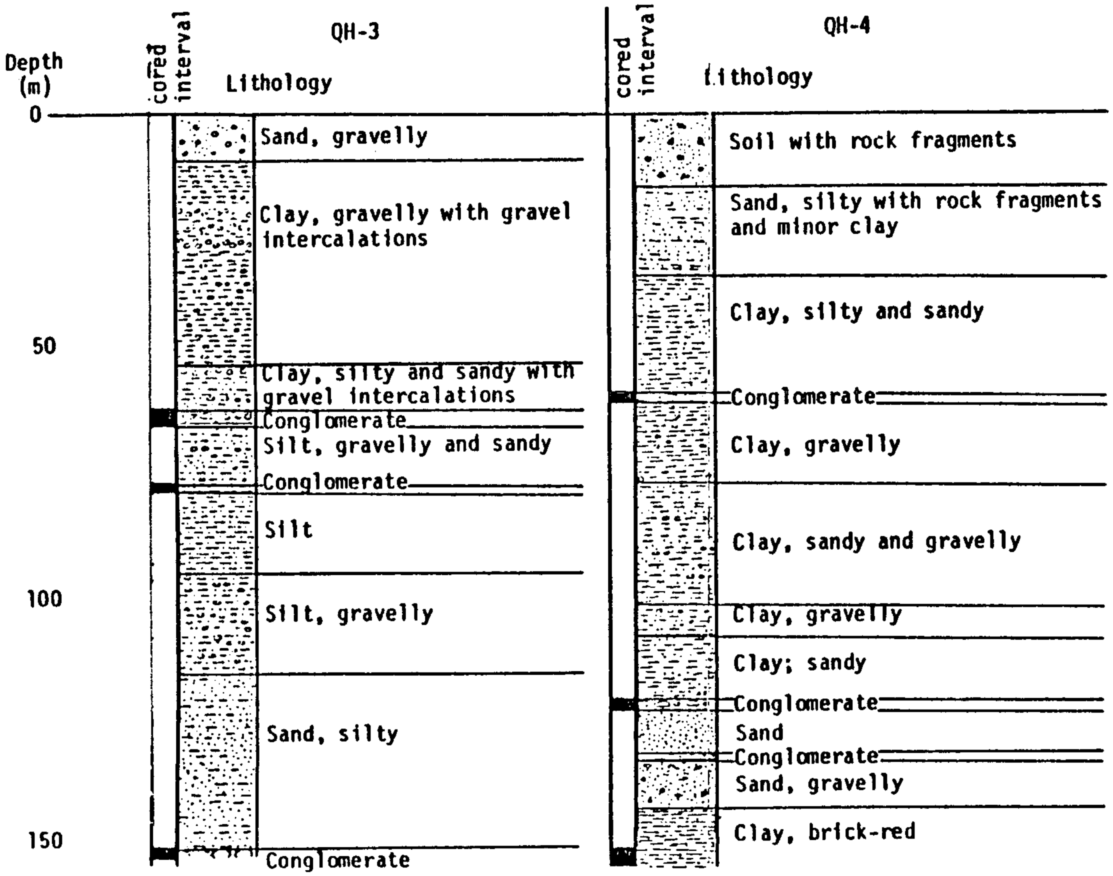


TABLE F-XV (cont)



APPENDIX G

REDSTONE, NEW HAMPSHIRE

Well Location: North Conway, New Hampshire (Fig. G-1)

The well was drilled through 3000 ft of crystalline rock. Presently, the 3000 ft of 2-7/8-in. diam core is stored in the basement of James Hall, University of New Hampshire, Dept. of Earth Science, Durham, NH 93824. Access can be obtained through Glenn Stewart at the above address.

A report describing the petrography in detail and the general geology and geophysical work done on the hole is available from the National Technical Information Service, U.S. Dept. of Commerce, Springfield, VA 22161, under Hoag, R. B., and Stewart, G. W., 1977, "Preliminary petrographic and geophysical interpretations of the exploratory geothermal drill hole and core, Redstone, New Hampshire," COO-2720-1, 121 p. A summary of the petrography of the hole is provided on the following pages (Table G-I).

Major rock type descriptions

Green phase of Conway Granite: medium-grained hypidiomorphic rock of altered green microperthite, smokey quartz, hastingsite, biotite, and minor plagioclase.

Red phase of Conway Granite: coarse-grained hypidiomorphic rock of microperthite, smokey quartz, biotite, minor plagioclase and amphibole.

Albany quartz syenite: varies from dark blue-grey, pastel olive-green, light grey-green to grey-pink; color due to feldspars (mainly orthoclase mantled by K feldspar) hastingsite is the principal dark mineral.

Hastingsite-biotite granite: in bottom 200 ft of hole; dark minerals mostly in clots; main feldspar is microperthite.

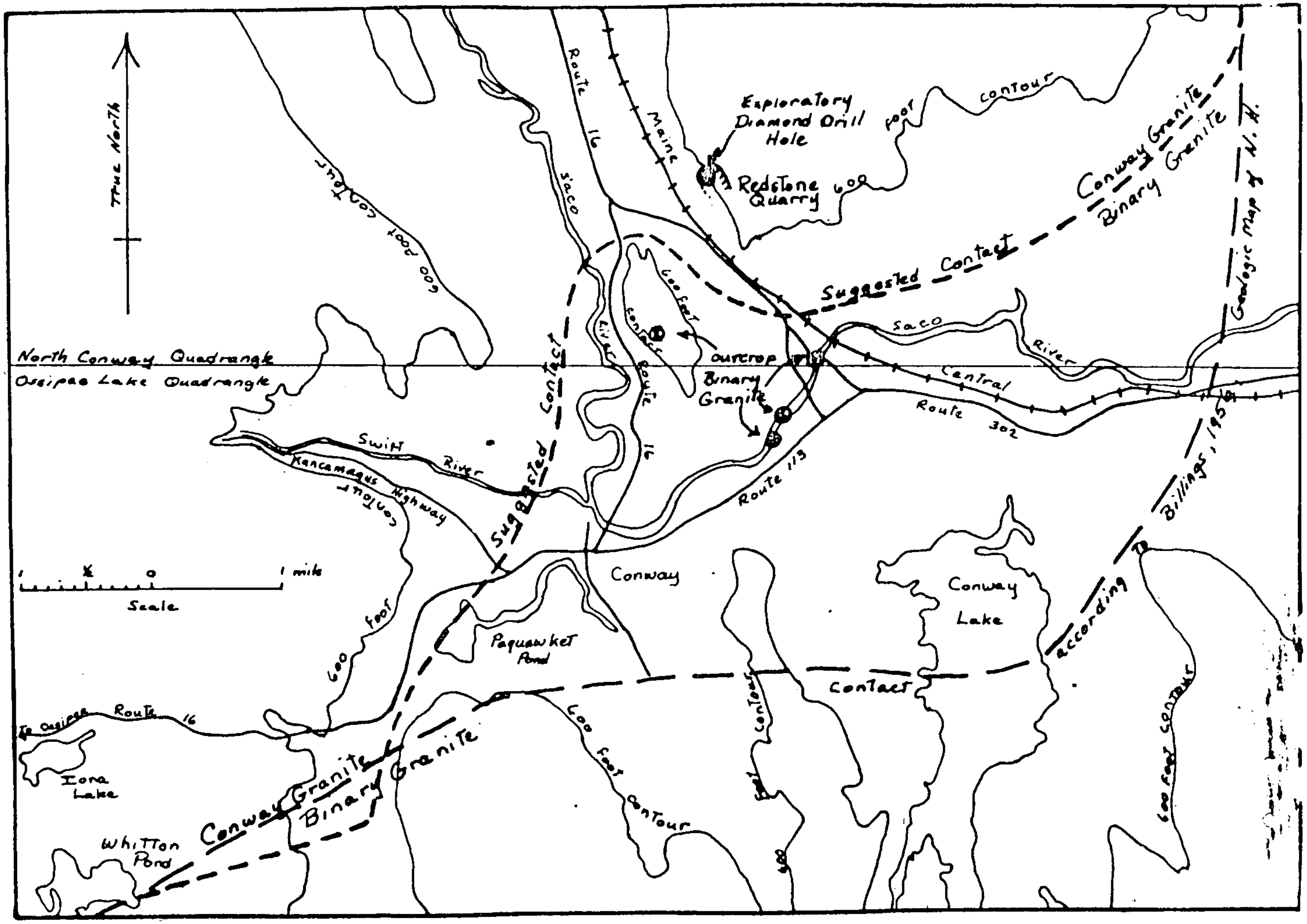


Fig. G-1. Location map of exploratory geothermal well, North Conway, New Hampshire.

TABLE G-I

PRELIMINARY PETROGRAPHIC AND GEOPHYSICAL INTERPRETATIONS OF THE EXPLORATORY GEOTHERMAL DRILL HOLE AND CORE, REDSTONE, NEW HAMPSHIRE

	GREEN PHASE	Medium-grained green granite, abundant weathering
		Alteration
100'-		Green to buff medium-grained granite with numerous fractures
	Brecciated zone fine-grained grunge	
200'-		
	Fine-grained granite	Green to buff medium-grained granite, alternating colors, some fractures
300'-		
	Fine-grained granite	
400'-		
		Altered zone
		Buff medium grained granite
500'-		
		Altered zone
600'-		
		Buff medium-grained granite
700'-		
		Altered zone
		Pink to buff
800'-		
		Medium-grained granite
900'-		Buff to green medium-grained granite
1000'-		Coarse-grained granite

TABLE G-I (cont)

1000'-		Coarse-grained granite
		Albany
		Quartz
		Syenite
1100'-		
	RED PHASE	
		Coarse-grained granite
1200'-		
		Gold fine-grained granite
	Fine-grained granite	
1300'-	Shear-mush	
		Coarse-grained granite
	Alteration	
	Microlite cavities	
1400'-	Shear-mush	
		Mottled quartz syenite
		Buff
1500'-		
	Shear-mush	Coarse-grained granite
	Abundant broken crys	
	tals and brushy area	
1600'-	Mottled quartz syenite	
		Lamp Dike
1700'-		Pink coarse-grained granite
		Lamp Dike
		Red coarse-grained granite
		Alteration
1800'-		
	Mottled quartz syenite	
		Red to pink
1900'-	Fine-grained granite	coarse-grained granite
		Lamp Dike
		Pink coarse-grained granite
2000'-		Lamp Dike

TABLE G-I (cont)

2000'-		Lamp Dike
	Zones of finer granite	
		Coarse-grained granite
2100'-		
	Inclusion - mafic	
	Dark fine-grained rock	
2200'-		Dark coarse-grained rock
	Fine-grained granite	Coarse-grained granite
2300'-		
		Syenite
		Coarse-grained granite
		Lamp Dike
2400'-		Coarse-grained granite with zones of syenite
		Syenite with mixed zones of coarse-grained granite
	Pegmatitic zone	
		Syenite
2500'-		
	Finer-grained area	
	Dark gray syenite	
		Lamp Dike
		Pink-grey syenite
2600'-		
	Aplite dike	
	Aplite dike	
2700'-	Aplite dike	Pink-grey syenite
	Dark inclusion	
	Grayer, finer-grained syenite	
	Granitic dike	
2800'-		
	Aplite	
	Fracture zone	Grey, medium to fine-grained granite
2900'-		
	Altered zone	
3000'-		

APPENDIX H

FENTON HILL HOT DRY ROCK PROJECT, JEMEZ MOUNTAINS, NEW MEXICO

Well Locations: Two wells, EE-1 and GT-2 (Fig. H-1), were drilled within 100 m of each other to depths of about 3000 m and 2700 m, respectively. Two cores were taken in EE-1; twenty cores and cuttings every 10 ft were taken from GT-2. A third well, EE-2, is being drilled at the time of publication. Total expected depth is about 14 000 feet. Available core descriptions are presented. Detailed descriptions of the EE-1 cores and the GT-2 Precambrian cores are available in Laughlin and Eddy, 1977, "Petrography and Geochemistry of Precambrian Rocks from GT-2 and EE-1", Los Alamos Scientific Laboratory report LA-6930-MS, obtainable upon request from A. W. Laughlin, MS 983 LASL, Los Alamos, NM 87545. Core access is also available through A. W. Laughlin.

Core summaries of GT-2 and EE-1 are given in Tables H-I and H-II, respectively. Core summary of EE-2 is given in Table H-III.

TABLE H-I

CORE SUMMARY OF GT-2

Core No.	Depth (m) (ft)	Recovery (%)	Lithology	Recovered Core Pieces (%)
1	633-639 (2078-2098)	25	Clay, limestone fragments	100
2	685-688 (2248-2258)	<10	Shale, limestone fragments	100
3	776-786 (2547-2580)	26	Leucocratic monzogranite gneiss	80
4	739-792 (2590-2600)	70	Leucocratic monzogranite gneiss	75
5	863-867 (2831-2844)	29	Leucocratic syenogranite gneiss	80
6	867-871 (2844-2857)	23	Leucocratic monzogranite gneiss	60
7	960-970 (3151-3182)	23	Biotite-granodiorite gneiss	75
8	1056-1059 (3464-3476)	16	Leucocratic monzogranite gneiss	60
9	1127-1129 (3694-3705)	100	Leucocratic monzogranite gneiss, granodiorite gneiss, pegmatite	50
10	1304-1306 (4278-4285)	100[a]	Leucocratic monzogranite gneiss, pegmatite	55
11	1491-1493 (4892-4897)	100[a]	Leucocratic monzogranite gneiss, leucocratic granodiorite gneiss, minor biotite-tonalite gneiss	70
12	1498-1500 (4915-4921)	100	Leucocratic monzogranite gneiss	55
13	1595-1597 (5234-5240)	50	Biotite-granodiorite gneiss, tonalite gneiss	30
14	1672.4-1674.1 (5487-5492.5)	100a	Leucocratic monzogranite gneiss, thin folia of magnetite	60
15	1723-1725 (5654-5660)	100	Hornblende-biotite schist	60

TABLE H-I (cont)

Core No.	Depth (m) (ft)	Recovery (%)	Lithology	Recovered Core Pieces (%)
16	1823-1825 (5980-5986)	100 100	Hornblende-biotite-plagioclase schist, amphibolite, granite gneiss, biotite-granodiorite gneiss	45
17	1875-1876 (6150-6156)	67	Leucocratic granite gneiss, granodiorite gneiss	40
18	1876-1878 (6156-6162)	100	Granodiorite gneiss	80
19	1934-1935 (6344-6350)	17	Leucocratic monzogranite gneiss	0
20	1935-1937	≃ 0	Chips of granite gneiss and schist	one bag chips
21	2041-2042 (6695-6701)	0		
22	2165-2165.2 (7102-7103.7)	100[a]	Biotite-tonalite gneiss and monzogranite gneiss	50
23	2413-2413.6 (7918-7918.6)	100[a]	Leucocratic monzogranite gneiss	0
24	2614-2617 (8577-8578)	70	Biotite granodiorite, pegmatite	30
25	2901-2904 (9519-9527)	50	Biotite granodiorite, monzogranite gneiss	50
26	2904-2907 (9527-9537)	50	Biotite granodiorite	25
27	2928-2929 (9607-9609)	75	Biotite-granodiorite gneiss	80
28[b]	2672.8-2674.0 (8769-8773)	52[a]	Biotite-granodiorite	75
29[b]	2713.3-2714.9 (8902-8907)	89[c]	Biotite-granodiorite	50

---

[a] Christensen diamond bit.

[b] L 2 B Redrill.

[c] Smith combination stratopax and chiseltooth.

TABLE H-II

CORE SUMMARY OF EE-1

Core No.	Depth (m) (ft)	Recovery (%)	Lithology	Recovered Core Pieces (%)
1	2095-2099 (6874-6886)	25	Leucocratic monzogranite gneiss	25
2	3011-3012 (9877-9881)	17[a]	Leucocratic granodiorite	0

---

[a] Diamond Cores.

TABLE H-III

SUMMARY OF CORE NO. 1, EE-2

Drill Hole: EE-2

Date: 11/10/79

Coring interval: 3577.4 to 3579.4 m (11,737.6 to 11,743.6 ft)

Length of recovered core: 1.44 m (4.72 ft)

SUMMARY OF CORE NO. 2, EE-2

Drill Hole: EE-2

Date: 11/27/79

Coring interval: 3916 to 3918.5 m (12,848 to 12,856 ft)

Length of recovered core: 2.22 m (7.29 ft)

BRIEF DESCRIPTION OF CORE NO. 1, EE-2*

The dominant rock type is a biotite granodiorite gneiss (BGG). Quartz, plagioclase, biotite, K-feldspar, minor epidote, and zircon are the dominant minerals. The gneissic banding is well developed with segregation bands of biotite up to 6 mm wide.

A fine-grained granodioritic rock cuts the BGG in two of the core pieces. Fractures are absent in most pieces of the core. Few of the fractures present are sealed.

BRIEF DESCRIPTION OF CORE No. 2, EE-2 *

Core No. 2 is composed of two units, a dark-colored (mesocratic) metavolcanic (or possibly a metamorphosed shallow intrusive) member and a light-colored (leucocratic) granitic member. This light-colored member intrudes the dark-colored member.

Mineralogy

The mesocratic member is a fine-grained rock composed of plagioclase biotite (approximately 30-50%), quartz, epidote, magnetite, and minor sulfides.

The leucocratic member is coarse-grained, composed of plagioclase microcline, quartz, biotite (approximately 10%), sphene, minor epidote, magnetite, zircon, and apatite.

Xenoliths of the mesocratic member are present in the leucocratic member and have been altered by the intrusion of the leucocratic member. These mesocratic xenoliths have essentially the same mineralogy as the undisturbed mesocratic member except for the presence of abundant sphene.

Megascopic View

The majority of this core is composed of the mesocratic member and the altered mesocratic unit (about 80%) while the remainder (20%) is composed of the leucocratic member.

Samples Nos. 11 through 14, 20, and 21 (approximately 22% of the entire core) are mostly composed of the undisturbed mesocratic member. These samples are thought to be representative of the country rock.

The rest of the samples are intruded by veins, stringers, and small dikes of the leucocratic member and show signs of alteration.

Altered, mesocratic xenoliths (greater than 5 cm in length) are well displayed in samples Nos. 3-10 and Nos. 28-30. The sphene (up to 1.0 mm across) in these xenoliths is invariably surrounded by coarse quartz and feldspar grains and these sphene-quartz-feldspar segregations are set in a matrix of biotite and plagioclase giving the xenoliths a "salt and pepper" appearance.

Fractures

Closed fractures with no apparent calcite fillings are present and appear to be more abundant than in Core No. 1. Fractures cut across both the mesocratic and leucocratic members, indicating no apparent lithologic control. The majority of the fractures occur in the "undisturbed" mesocratic (country rock) samples (11-14 and 20-21).

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* R. Laney, personal communication.

APPENDIX I

SOUTHEASTERN OREGON

To extend the regional heat-flow coverage into southeastern Oregon (Fig. I-1), 17 new heat-flow holes were drilled in this part of the Basin and Range. The available data on lithology, porosity, and thermal conductivity for these wells are summarized in Tables H-I through H-XIII. Details on the heat-flow survey for which this data were taken are available in Sass et al., 1976, USGS open-file report 76-217. Contact S. Peter Galanis, Menlo Park, for access to cores for these holes.

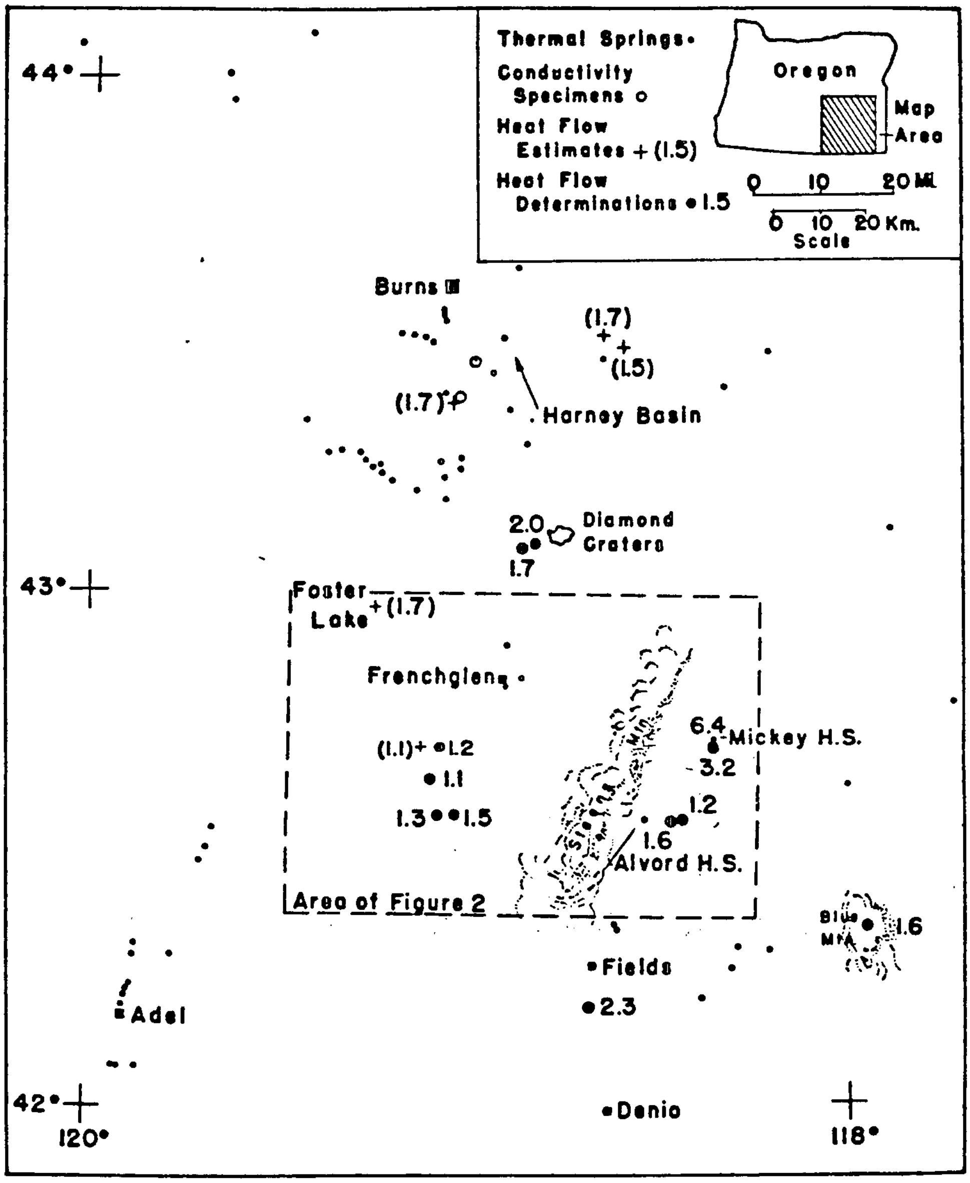

Fig. I-1. Distribution of thermal springs and heat flow in southeastern Oregon.

TABLE I-I

TEMPERATURE GRADIENTS AND HEAT FLOWS FROM SOUTHEASTERN OREGON

Locality	Well No.	N. Lat.	W. Long.	Elev. (m)	Depth Range (m)	Gradient (°C/km)	N[1]	<K>[2] (mcal/cm sec °C)	q[3] (HFU)
Blue Mountain	FU 1	42° 19'	117° 54'	1704	37 - 100	93 ± 3	20[4]	4.15 ± 0.11[5]	3.9 ± 0.2
					130 - 250	70.1 ± 0.3			2.9 ± 0.1
					250 - 300	58.9 ± 0.8			2.4 ± 0.1
					300 - 350	49.0 ± 0.4			2.0 ± 0.1
					350 - 400	38.1 ± 0.3			1.58 ± 0.04
					400 - 565	40.6 ± 0.2			1.69 ± 0.05
							Adopted value		(1.6)
Burns area	S1[6]	43° 22'	119° 02'	1266	50 - 190	81 ± 1		2.1[7]	(1.7)
	S2[6]	43° 28'	118° 35'	1262	60 - 183	69.5 ± 0.5		2.1[7]	(1.5)
	S3[6]	43° 30'	118° 39'	1255	40 - 203	82 ± 1		2.1[7]	(1.7)
Catlow Valley	1	42° 32'	119° 02'	1390	55.8 - 59.4	74.2 ± 0.6	3	1.97 ± 0.07	1.46 ± 0.05
					89.3 - 92.3	61.6 ± 0.7	3	2.26 ± 0.04	1.39 ± 0.03
					35 - 90	71.4 ± 0.3	6	2.10 ± 0.07	1.50 ± 0.05
							Best value		1.5
	2	42° 32'	119° 05'	1390	50 - 95	60.9 ± 0.2	6	2.08 ± 0.04	1.27 ± 0.02
	3	42° 37'	119° 04'	1390	65 - 93	52.0 ± 0.3	4	2.06 ± 0.13	1.07 ± 0.07
	4	42° 42'	119° 04'	1390	68.0 - 70.7	48.8 ± 0.6	4	2.28 ± 0.08	1.11 ± 0.04
					87.7 - 90.8	51.5 ± 0.4	4	2.43 ± 0.03	1.25 ± 0.02
					65 - 91	50.1 ± 0.1	8	2.35 ± 0.05	1.18 ± 0.03
							Best value		1.2
	5	42° 42'	119° 06'	1390	45 - 90	51	0	2.2[8]	(1.1)
Diamond Craters	MR-1	43° 05'	118° 49'	1262	56.4 - 64.0	89 ± 1	4	2.19 ± 0.17	1.95 ± 0.15
					40 - 91	96.0 ± 0.6	4	2.19 ± 0.17	2.10 ± 0.16
							Best value		2.0
	MR-2	43° 05'	118° 51'	1260	57.9 - 62.5	65 ± 2	4	2.37 ± 0.04	1.54 ± 0.05
					89.3 - 92.0	83 ± 3	4	2.19 ± 0.06	1.82 ± 0.08
					60 - 100	74.2 ± 0.8	8	2.28 ± 0.05	1.69 ± 0.04
							Best value		1.7
Foster Lake	BLM	42° 58'	119° 15'	1530	61 - 107	78 ± 2		2.2[9]	(1.7)
Alvord Valley (Mickey Hot Springs)	AD-1	42° 32'	118° 28'	1220	54.9 - 61.0	73.9 ± 0.02	7	2.06 ± 0.02	1.52 ± 0.02
					88.4 - 95.7	78.6 ± 0.3	9	2.03 ± 0.02	1.60 ± 0.02
					55 - 96	75.8 ± 0.3	16	2.04 ± 0.02	1.55 ± 0.02
							Best value		1.55
	AD-2[10]	42° 32'	118° 26'	1220	59 - 96	58.5 ± 0.3	19	2.13 ± 0.03	1.25 ± 0.02
	MH-1[12]	42° 40'	118° 22'	1225	40 - 51	146.2 ± 0.6	6	2.21 ± 0.03[11]	3.2 ± 0.1
	MH-2	42° 40'	118° 21'	1235	10 - 30	294.9 ± 0.8			
					30 - 35	255 ± 2			
					10 - 35	289.2 ± 0.8		2.21[13]	6.4

---

[1] N, number of thermal conductivity determinations.

[2] <K>, harmonic mean thermal conductivity.

[3] q, heat flow = gradient x <K>, 1 HFU = 10^{-6} cal/cm^2 sec = 41.8 mw/m^2.

[4] No systematic variation of conductivity with depth (see Table II).

[5] Measurements were made on chips; this is the upper limit based on no porosity.

[6] Temperature profiles published by Sass and Munroe, 1973.

[7] Mean of saturated conductivities (Table III).

[8] No core recovered; <K> is average from other holes in Catlow Valley.

[9] No core from hole; <K> is mean conductivity of tuffaceous sediments in other parts of the region.

[10] 1.8 km SW of Mickey Hot Springs.

[11] Cored interval was below bottom of casing and not accessible for temperature measurements.

[12] ~1 km W of Mickey Hot Springs.

[13] No core recovered; <K> is from MH-1.

TABLE I-II

THERMAL CONDUCTIVITY MEASUREMENTS ON COMPOSITE SAMPLES OF DRILL CUTTINGS AND GENERALIZED LITHOLOGIC DESCRIPTION FOR STANDARD BLUE MOUNTAIN FEDERAL UNIT NO. 1

Depth Range (m)	Description	K[a] (mcal/cm-s-°C)
16 - 40	Basalt (0 to 10% vesicles), tan and gray vitric tuff, black and brown volcanic glass, woody fragments.	4.05
52 - 70		4.25
70 - 100	Gray tuffaceous material, black and brown volcanic glass, varying but sometimes abundant amounts of white mica.	4.39
113 - 137		6.14
137 - 162		4.67
174 - 192		3.83
204 - 222		3.56
235 - 253		3.57
265 - 283		3.46
298 - 314		4.09
326 - 344		3.85
357 - 375		4.31
387 - 405	Basalt (0 to 10% vesicles), black and brown volcanic glass, pea-green earthy amygdules, minor woody fragments, varying amounts of white mica, cuttings from the zone 472-613 m have slickensides	4.23
411 - 436		4.40
448 - 466		4.30
478 - 497		4.26
509 - 527		4.29
540 - 558		3.85
570 - 588		4.70
594 - 613		4.11

$\langle K \rangle = 4.15 \pm 0.11$

---

[a] Conductivity measured on chips assuming zero porosity.

TABLE I-III

THERMAL CONDUCTIVITIES OF SOME SEDIMENTARY ROCKS FROM THE HARNEY BASIN

Location	Description	K_d[a] (mcal/cm-s-°C)	K_s[b] (mcal/cm-s-°C)	K_s/K_d	Apparent porosity[c] (ϕ)
Dog Mountain	Grey palagonitic tuff outcrop 1000' W of SE corner	0.94	1.98	2.1	0.23
	S8, T25S, R31E (Dog Mountain 15' quad)	0.84	1.93	2.3	0.26
	Harney Formation (?)				
Wrights Point	Buff tuffaceous palagonitic sediment from roadcut	1.1	2.4	2.2	0.25
	1800' W, 250' N of SE corner S34, T24S, R31E	0.93	2.2	2.4	0.28
	(Lawen 15' quad) Harney Formation (?)				

---

a Conductivity of shelf-dried specimen. Pores in clay minerals, zeolites, etc., probably retain some water.

b Conductivity of water-saturated specimen.

c Porosity, calculated assuming geometric mean conductivity $K_r = K_m^{(1-\phi)} \cdot K_f^{\phi})$. ϕ is fractional porosity; K_m is matrix conductivity; K_f is fluid conductivity. Assumption is that K_d represents all pores filled with air; K_s, all pores filled with water; $K_w \simeq 1.5$; $K_a \simeq 0.063$. From geometric mean, $\phi = \log (K_s/K_d)/\log (K_w/K_a)$.

TABLE I-IV

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE CV-1, CATLOW VALLEY, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay to very coarse sand, tan		
	18.30			
20-				
		Clay and silt, tan, minor clasts (maximum size 20 mm)		
	36.60			
40-				
		Clay and silt, tan, minor medium sand		
60-				
	61.87	Clay and silt, tan, moderate induration, massive bedding,	62.14	1.88
	65.53	irregularly shaped carbonaceous clots, rare rounded clasts	62.42	2.11
		of white, fine-grained, siliceous rock (maximum size 3 mm)	262.66	1.94
		Tan clay and silt		
80-				
	89.31	Tan clay and silt, moderate induration, massive bedding,	89.46	2.28
	89.97	molds of plant(?) parts	89.58	2.31
			89.68	2.18
100-				

$\langle K \rangle = 2.10 \pm 0.07$

TABLE I-V

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE CV-2, CATLOW VALLEY, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan, 3% ± clasts (maximum size 7.0 mm)		
20-				
	27.45			
40-				
		Clay and silt, pale green, 3% ± very coarse sand (1.2 mm)		
60-				
80-				
			95.91	1.94
	95.40	Silt and clay, pale green, massive bedding	96.31	2.14
	98.30		96.67	2.06
100-			97.53	2.21
			97.94	2.04
			98.24	2.13
			<K> = 2.08 ± 0.04	

TABLE I-VI

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE CV-3, CATLOW VALLEY, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
20-				
		Clay and silt to very coarse sand (maximum size 1.8 mm), tan, rare pebble-sized clasts (maximum size 8.0 mm)		
40-				
60-				
80-				
			92.64	2.17
	92.35	Clay and silt, tan, 30-40% fine sand,	92.94	1.74
	94.79	massive bedding	93.26	2.17
100-			93.52	2.25
			<K> = 2.06 ± 0.13	

TABLE I-VII

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE CV-4, CATLOW VALLEY, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
20-				
		Clay and silt, tan, 3-30% fine to very coarse sand (Maximum size 1.5 mm)		
40-				
60-				
			68.72	2.35
	68.58	Clay and silt, tan, 5-10% fine to very coarse sand,	68.85	2.41
	69.25	moderate induration, massive bedding	69.04	2.35
			69.13	2.04
		Clay and silt, tan, 3-30% fine to very coarse sand		
80-		(1.5 mm)		
	82.30			
		Clay and silt to very coarse sand (1.5 mm), brown	89.96	2.50
	89.31	Clay and silt, brown, 40-50% fine to very coarse sand,	90.01	2.34
	90.58	moderate induration, massive bedding	90.32	2.45
			90.52	2.45
100-				

<K> = 2.35 ± 0.06

TABLE I-VIII

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE MR-1, DIAMOND CRATERS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan, 10% subrounded clasts of basalt (maximum size 2 mm)		
	12.20			
20-		Silt to medium sand, gray, 10% clasts of basalt (minor porphyritic andesite)		
40-				
			59.16	2.05
		58.83 to 59.82-m clay and silt, brown	59.31	1.92
60-	58.83 60.43	59.82 to 59.97-m conglomerate; clasts of rounded vesicular basalt, average clast size 10 mm (maximum size 50 mm), 30% ± brown clay to fine sand matrix	59.60	2.16
		59.97 to 60.43-m conglomerate; same as above but with 50-60% matrix	60.13	2.80
80-		Clay to medium sand, gray, 10% basalt clasts		
	87.80			
	93.00	Conglomerate		
100-				

<K> = 2.19 ± 0.17

TABLE I-IX

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE MR-2, DIAMOND CRATERS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay to medium sand (maximum size .7 mm), tan		
	15.24			
20-				
		Clay to medium sand, brown, some coarse clasts (maximum size 4 mm)		
40-				
			59.25	2.28
	58.83	Silt, brown, massive bedding, moderate induration	59.55	2.44
60-	60.20		59.87	2.44
			60.10	2.33
80-				
			89.61	2.30
	89.31	Silt, brown, massive bedding, moderate induration	89.82	2.26
	92.35		90.16	2.03
			90.28	2.18
100-				

<K> = 2.28 ± 0.05

TABLE I-X

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE AD-1, SOUTH OF MICKEY HOT SPRINGS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan, 5% medium sand		
	11.89			
20-				
		Clay and silt, pale green with black layers, 0-3% medium sand		
40-				
			56.28	2.01
			56.45	2.02
	55.78	Clay and silt, pale green, minor iron oxide stain, massive bedding	56.76	2.09
	57.46		56.91	2.02
60-			57.16	2.04
			57.32	2.08
			57.50	2.19
80-				
			92.81	2.04
			93.12	2.02
			93.52	2.01
	92.66		93.83	2.18
	95.71	Clay and silt, pale green, 3% iron oxide stain, massive bedding	94.30	2.00
100-			94.63	1.97
			94.86	2.05
			95.15	2.01
			95.56	1.98

<K> = 2.-4 ± 0.02

TABLE I-XI

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE AD-2, SOUTH OF MICKEY HOT SPRINGS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan, 5% ± medium sand (0.3 mm)		
	10.06			
20-				
40-				
			58.30	2.00
			65.64	2.19
			66.08	2.27
	58.22		66.46	2.25
	58.37		67.07	2.25
60-			69.90	1.96
			71.40	1.93
	65.73	Clay and silt, pale green, 3% irregular patches of iron oxide stain, massive bedding	74.23	2.24
	67.72		74.67	2.26
			75.06	2.09
	74.07		75.33	2.03
	75.44		77.15	2.24
80-			79.25	2.30
	83.21		83.21	1.97
			92.66	2.31
	94.49	Clay and silt, pale green, minor iron oxide stain, massive bedding	94.64	1.99
	96.27		95.06	2.04
100-			95.71	2.16
			96.17	2.22

$\langle K \rangle = 2.13 \pm 0.03$

TABLE I-XII

LITHOLOGY FROM CORES AND CUTTINGS AND THERMAL CONDUCTIVITY OF CORES FROM HOLE MH-1, MICKEY HOT SPRINGS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan		
	6.10			
		Clay and silt, gray		
	15.24			
20-		Clay and fine sand, pale green, 5% clasts (average size 1-3 mm)		
	21.34			
		Clay and fine sand, pale green, 10-15% clasts of subangular to surrounded basalt, andesit tuffaceous sediment, and volcanic glass (average size 1-3 mm)		
40-				
	54.86		59.28	2.27
	58.83		59.48	2.38
60-	61.57	Clay and silt, pale green, massive bedding, moderate induration	59.82	2.16
			60.03	2.13
			60.25	2.14
			60.41	2.23
80-				
100-				

<K> = 2.21 ±0.04

TABLE I-XIII

LITHOLOGY (BASED ON EXAMINATION OF DRILL CUTTINGS) OF HOLE MH-2, MICKEY HOT SPRINGS, OREGON

Depth (m)	Cored Interval	Lithology	K sample depth (m)	K (mcal/cm-s-°C)
0-				
		Clay and silt, tan		
	4.60			
		Clay and sand, pale green and black		
20-				
	27.40			
		Clay and sand, 20-90% sand-sized volcanic clasts		
	36.90			
40-				
		Basalt?		

APPENDIX J

CLUBHOUSE CORNERS, CHARLESTON, SOUTH CAROLINA

A 792-m continuously cored test hole was drilled directly over a gravity and magnetic high about 41 km WNW of Charleston, South Carolina (Fig. J-1). The hole penetrated 750 m of Cenezoic and Upper Cretaceous sedimentary rocks and bottomed in 42 m of amygdaloidal basalts; 70% of the core was recovered in the sediments and 100% in the basalts. Thermal conductivity determinations from the core are presented in Table J-I. Information on the heat-flow study with which this hole was associated is provided in Ziagos, Sass, and Munroe, 1976, "Heat Flow Near Charleston, South Carolina," USGS open-file report 76-148. Access to these cores is possible through S. Peter Galanis, USGS, Menlo Park.

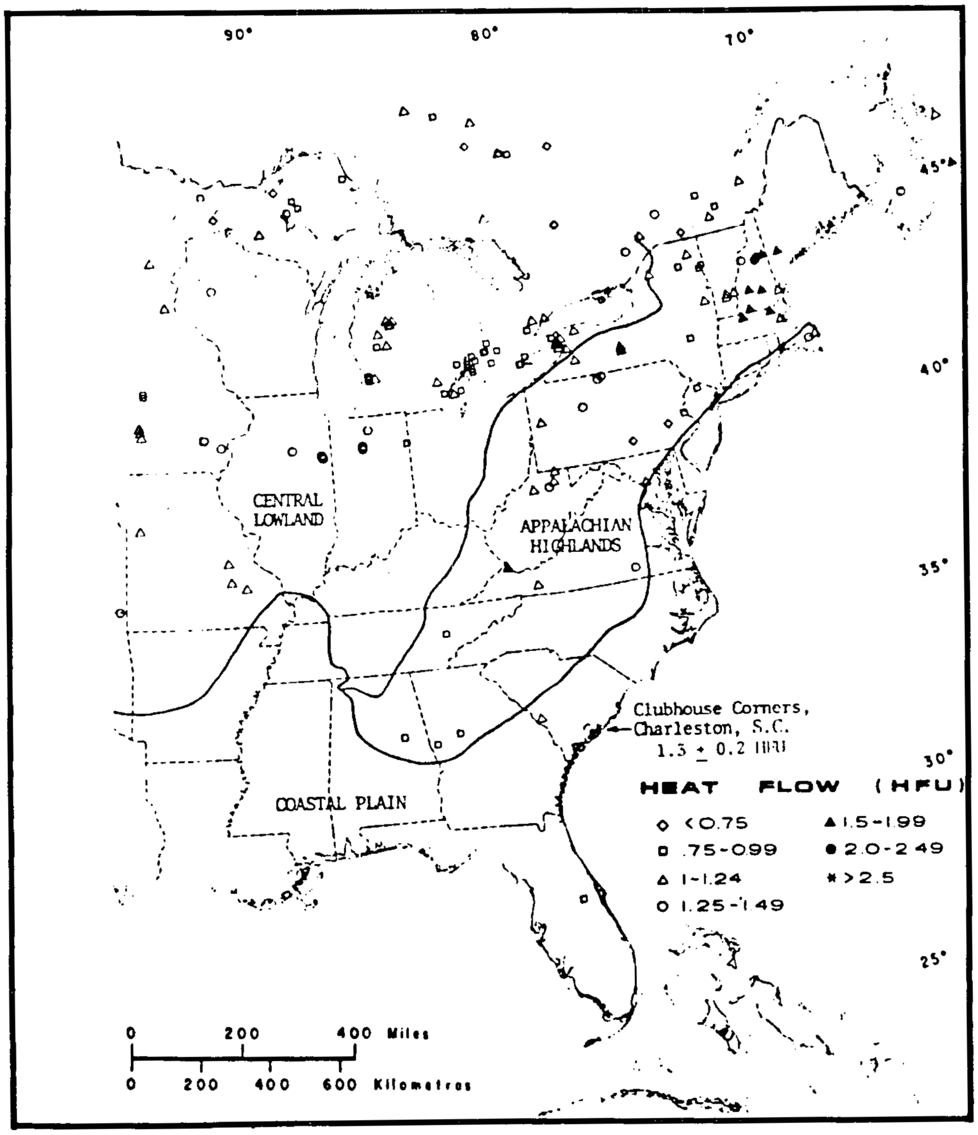

Fig. J-1. Heat-flow values in the eastern U.S. and adjoining regions of southern Canada.

TABLE J-I

THERMAL CONDUCTIVITY AND DENSITY OF WATER-SATURATED CORE AND APPARENT POROSITY (100 X [WET WEIGHT-DRY WEIGHT]/WET WEIGHT)

CLUBHOUSE CORNERS, SOUTH CAROLINA

Depth (m)	Thermal Conductivity Mcal/cm-s-°C	Density g/cm	Apparent Porosity (%)
15.7	3.94		
30.9	3.90		
47.1	3.52		
62.8	3.11		
70.4	4.19		
91.7	3.49		
106.2	2.94		
122.2	3.57		
135.6	6.53(ax)	2.67	5.8
	6.96	2.21	7.1
153.6	3.87		
164.6	10,89(ax)	2.65	0.4
	10.38	2.62	1.6
185.9	3.69		
198.3			
217.6	3.28		
213.3	2.86		
	2.72	1.79	49.1
243.8	7.85	2.56	5.8
258.0	4.34		
272.2	3.74		
296.1	5.54		
302.7	7.81	2.50	8.5
305.1	5.50		
321.6	5.53		
332.8	5.90		
343.5	8.14	2.59	4.1
350.8	5.95		
367.6	7.20		
374.0	5.60		
383.1	5.64		
397.8	4.77		
415.4	11.20	2.63	1.2
418.8	5.11		
426.7	7.69	2.41	8.3
428.9	5.33		
435.3	5.52		
442.9	3.83		
452.3	3.49		
458.4	3.55		
462.7	3.30		
469.1	2.90		
	5.48	2.20	28.6
473.4	3.54		
476.4	6.43		
480.1	5.55(ax)		

(ax) Conductivity measured along axis of core;all other measurement perpendicular to core axis.

TABLE J-I (cont)

Depth (m)	Thermal Conductivity Mcal/cm-s-°C	Density g/cm	Apparent Porosity (%)
	5.69		
483.1	5.37		
487.1	6.82		
504.1	5.37		
518.3	3.92		
524.6			
533.4	3.18		
533.6	9.07	2.61	3.6
541.2			
543.3	2.60		
567.5	2.97		
581.9	3.05		
585.1	4.45		
594.4	6.20		
602.0	5.69		
606.9	3.29		
608.1	5.06		
610.5	3.19		
616.6			
627.3	2.38		
632.5			
637.2	4.51		
655.2	5.84		
673.2	2.71		
675.4	5.30		
675.7	5.59		
683.1	3.68		
702.0	4.04		
716.1	3.44		
722.7	3.19		
729.1	3.71		
732.1	3.42		
748.6	8.14		
754.1			
757.4	3.16	2.26	7.3
760.5	4.21		
760.5	4.26		
760.5	4.30	2.71	0.7
763.5	4.18	2.80	0.8
766.3	4.27	2.82	0.5
769.6	4.58	2.88	0.4
772.7	4.47	2.89	0.7
774.5	4.63		
774.5	4.59		
774.5	4.62	2.89	0.2
776.0	4.51	2.87	0.9
778.8	4.63	2.89	0.8
781.8	4.73	2.91	0.4
785.2	3.33	2.41	5.1
787.9	4.11	2.70	1.0

REFERENCES

Burke, R. J. S., et al., 1969, The Litho-Porosity Crossplot, The Log Analyst, p. 25.

Costain, J. K., Glover, L., and Sinha, A. K., 1979, Evaluation and targeting of geothermal energy resources in the southeastern United States, Virginia Polytechnic Institute and State University, SPI and SU-5648-5, prepared for the U.S. Department of Energy.

Covington, H. R., 1977a, Deep drilling data, Raft River Geothermal Area, Idaho, Raft River Geothermal Exploration Well No. 1, USGS open-file report 77-226.

Covington, H. R., 1977b, Deep drilling data, Raft River Geothermal Area, Idaho, Raft River Geothermal Exploration Well No. 2, USGS open-file report 77-243.

Covington, H. R., 1977c, Deep drilling data, Raft River Geothermal Area, Idaho, Raft River Geothermal Exploration Well No. 2, Sidetrack-C, USGS open-file report 77-883.

Covington, H. R., 1977c, Deep drilling data, Raft River Geothermal Area, Idaho, Raft River Geothermal Exploration Well No. 3, USGS open-file report 77-616.

Covington, H. R., 1977d, Deep drilling data, Raft River Geothermal Area, Idaho, Raft River Geothermal Exploration Well No. 4, USGS open-file report 78-91.

Covington, H. R., 1978, Deep drilling - River Geothermal Production Well No. 4, USGS open-file report 79-692.

Covington, H. R., 1978, Deep drilling - River Geothermal Production Well No. 5, USGS open-file report 79-382.

Crosthwaite, E. G., 1976, Basic data from five core holes in the Raft River geothermal area, Cassia County, Idaho, USGS open-file report 76-665, p. 12.

Doherty, D. J., 1979, Drilling data from exploration well 2-2A, NW1/4, Sec. 15, T15N, R31E, Idaho National Engineering Laboratory, Butte County, Idaho, USGS open-file report 79-851.

Duba, A., 1978, Rock properties related to assessment methods, Lawrence Livermore Laboratory report, DOE contract W-7405-Eng.-48.

Laughlin, A. W., and Eddy, A., 1977, Petrography and geochemistry of Precambrian rocks from GT-2 and EE-1, Los Alamos Scientific Laboratory report LA-6930-MS.

Mase, C. W., Galanis, S. P., and Munroe, R. J., 1979, Near surface heat flow in Saline Valley, California, USGS open-file report 79-1136.

McSpadden, William R., 1975, The Marysville, Montana Geothermal Project - Final Report, Battelle Pacific Northwest laboratories research report.

Oriel, S. S., Williams, P. L., Covington, H. R., Keys, W. S., and Shaver, K. C., 1978, Deep drilling data, Raft River Geothermal Area, Idaho, Standard American Oil Co., Malta, NAF, and Strevell Petroleum Test Boreholes, USGS open-file report 78-361.

Rigby, F. A., and Reardon, P., 1979, Benefit/cost analysis for research in geothermal log interpretation, Los Alamos Scientific Laboratory report LA-7922-MS.

Sanyal, S. K., Wells, L. ., and Bickham, R. E., Geothermal well log interpretation State of the Art, Los Alamos Scientific Laboratory report LA-8211-MS.

Sass, J., Lachenbruch, A., and Munroe, R., 1974, Thermal data from heat flow Test Wells near Long Valley, California, USGS open-file report.

Sass, J. H., Galanis, S. P., Jr., Munroe, R. J., and Urban, T. C., 1976, Heat flow data from southeastern Oregon, USGS open-file report No. 76-217, p. 52.

Sass, J., Olmsted, F., Sorey, M., Wollenberg, H., Lachenbruch, A., Munroe, R., and Galanis, S., 1976, Geothermal data from test wells drilled in Grass Valley and Buffalo Valley, Nevada, USGS open-file report 76-85.

Sass, J. H., Wollenberg, H. A., Somma, D. E., and Ziagos, J. P., 1976, Heat flow near Kyle Hot Springs, Buena Vista Valley, Nevada, USGS open-file report 76-862, p. 16.

Sass, J. H., Ziagos, J., Wollenberg, H., Munroe, R., Somma, D., and Lachenbruch, A., 1977, Application of heat flow techniques to geothermal exploration, Leach Hot Springs Area, Grass Valley, Nevada, USGS open-file report 77-762.

Sass, J. H., Galanis, S. P., Jr., Marshall, B. V., Lachenbruch, A. H., Munroe, R. J., and Moses, T. H., Jr., 1978, Conductive heat flow in the Randsburg area, California, USGS open-file report 78-756, p. 45.

Ziagos, J. P., Sass, J. H., and Munroe, R. J., 1976, Heat flow near Charleston, South Carolina, USGS open-file report 76-148, p. 21.

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