DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT
79-1129

DEEP DRILLING DATA, RAFT RIVER GEOTHERMAL AREA, IDAHO
RAFT RIVER GEOTHERMAL INJECTION WELL #6

T.15S., R.26E., sec. 25ad Elev. 4815'

By
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DISCUSSION

The southern Raft River Valley near Bridge, Idaho has long been known as a thermal area (Stearns and others, 1938). In 1971, an area southwest of Bridge was designated the Frazier Known Geothermal Resource Area (Frazier KGRA) by the U.S. Geological Survey (Godwin and others, 1971). A geochemical reconnaissance of thermal waters in Idaho by the U.S. Geological Survey (USGS) in 1972 (Young and Mitchell, 1973) indicated a reservoir temperature near 300°F (150°C) for the Raft River geothermal anomaly.

As a result of proposals by the Raft River Rural Electric Cooperative, the U.S. Energy Research and Development Administration (ERDA, now the U.S. Department of Energy, DOE) became interested in the Raft River Valley as a potential site for an experimental binary-fluid geothermal power plant. During the summer of 1973 the USGS, in cooperation with ERDA, began an integrated geological, geophysical, geochemical, and hydrological exploration program in southern Idaho. This program was designed to provide a scientific framework for the evaluation of a geothermal resource and to test the applicability of various geological, geophysical, geochemical, and hydrological techniques to the study of geothermal resources. Williams and others (1976) summarize the early results of this program.

In order to obtain the physical data necessary to evaluate these techniques, a drilling program was begun in the spring of 1974. Thirty-four auger holes were drilled to depths ranging from 25 ft (7 m) to 100 ft (30 m) (Crosthwaite, 1974), to measure the temperatures and flows of the near surface cold water aquifers. In cooperation with the Idaho Department of Water Administration, the USGS also drilled 5 continuously cored wells to depths ranging from 250 ft (76 m) to 1,423 ft (434 m) (Crosthwaite, 1976) in order to test geophysical interpretations of the subsurface geology and to provide hydrological, geological, and geochemical data on the shallow part of the geothermal system.

During the early stages of the USGS-ERDA integrated geothermal exploration program three petroleum test boreholes were being drilled in the Raft River Valley by Standard American Oil Company. Shortly after completion of the petroleum test boreholes and just prior to deep geothermal drilling by ERDA, Standard American Oil Co. provided the USGS with cuttings and well logs from the test boreholes (Oriel and others, 1978). The information from these boreholes was used for initial interpretation of geophysical data and of the deep subsurface geology of the Raft River basin.

The first Raft River geothermal exploration borehole (RRGE #1), drilled in early 1975 (Reynolds Electrical and Engineering Co., Inc., 1975; Covington, 1977a), initially confirmed the existance of hot water (295°F; 146°C) in quantities (600 gal/min; 38 L/sec artesian flow) suitable for a medium-temperature experimental binary-fluid geothermal power plant. Drilling of RRGE #2 (Reynolds Electrical and Engineering Co., Inc., 1976; Covington, 1977b) and RRGE #3 (Covington, 1977c; Covington, 1977d) followed in rapid succession with both producing more than 350 gal/min (22 L/sec) sustained artesian flow with temperatures above 295°F (146°C).

In early 1977, following a period of flow and injection testing, the fourth geothermal exploratory borehole (RRGE #4) was drilled (Covington, 1978). RRGE #4 was sited in order to test the effect of injection of geothermal fluids at intermediate depths (2,000-3,000 ft; 600-1,000 m) within the geothermal resource area.

It was determined that injection of the geothermal fluids should take place outside the main geothermal resource area; sites for Raft River geothermal injection boreholes (RRGI) six and seven were selected just south of the production area.

Drilling of RRGI #6, by Colorado Well Service, began on April 11, 1978, using drilling mud as the drilling fluid. Thirteen and three-eighths inch (34 cm) surface casing was installed at 1,682 ft (513 m) and drilling continued using drilling mud to 2,014 ft (614 m). Below 2,014 ft (614 m) water was used as the drilling fluid to a total depth of 3,872 ft (1,180 m), reached on April 29, 1978. Two cores were taken within the prospective injection zone between 2,979-3,009 ft (908-917 m) and 3,842-3,872 ft (1,171-1,180 m). Borehole geophysical logging and a preliminary flow test indicate approximately 50 gal/min (3 L/s) artesian flow with a maximum downhole temperature of 158°F (70°C).

DATA SUMMARY

Drilling period:	April 11	to	April 29, 1978
Total depth:	3,872 ft		1,180 m
Surface casing:	1,682 ft		513 m
Artesian flow:	50 gal/min		3 L/s
Maximum Temperature:	158°F		70°C
Top of Salt Lake Formation:	1,170 ft		357 m

CORE

Core #1 — 2,979-3,009 ft (908-917 m) Salt Lake Formation: Siltstone and fine-grained sandstone in alternating light and dark grayish-green laminae. The lighter laminae are calcareous sandstones while the darker laminae are noncalcareous siltstones. The laminae maintain a 20° dip throughout the core; carbonaceous material occurs between the laminae near the middle of the core. The few fractures and faults that can be seen are partly filled with calcite and dip 60°-90°.

Core #2 — 3,842-3,872 ft (1,171-1,180 m) Salt Lake Formation: Coarse-grained sandstone and gravel grading downward to fine-grained sandstone. Entire core is light gray green in color with bedding dips from 30° to 40°. A few fractures dipping 70° to 90° and partly filled with calcite can be seen. The sandstone is calcareous and consists of subangular to rounded clasts of quartz and minor rhyolite. The gravel is calcareous and contains rounded clasts of rhyolite, quartzite, and dolomite as much as 2 cm in diameter.

GEOPHYSICAL LOGS

Log	Date	Logged Interval feet	Logged Interval Meters
Temperature	4-30-78	1,660-3,782	506-1,153
Compensated Densilog/ Gamma	40-30-78	1,700-3,787	518-1,154
Compensated Neutron/ Gamma	4-16-78	100-2,017	30-615
Compensated Densilog Compensated Neutron	4-30-78	1,700-3,787	518-1,154
BHC Acoustilog	4-17-78	100-2,011	30-613
BHC Acoustilog	4-30-78	1,700-3,773	518-1,150
Dual Induction-Focused Log	4-30-78	1,700-3,782	518-1,153

Borehole geophysical logging by Dresser Atlas Wireline Services.

EXPLANATION

FAN ALLUVIUM (PLEISTOCENE): Medium to fine sand and gravels, moderately well sorted. Clasts are subangular to subrounded and composed of reddish-brown and gray rhyolitic lavas, metamorphic rocks, and limestones (Williams and others, 1976)

SALT LAKE FORMATION (TERTIARY): Gray to light-green, thin-bedded to massive, tuffaceous siltstones and sandstones with minor beds of conglomerate. In the western part of the Raft River Basin the formation is divided by a volcanic member at Jim Sage Mountain into upper and lower members (Williams and others, 1976)

Lithologic changes shown within, and the contact between, the fan alluvium and the Salt Lake formation are based solely on the well cuttings and may not correspond exactly to changes in the geophysical logs. Cuttings and core were examined and described in the office and lithologic breaks assigned without the use of geophysical logs. Sample depth control was maintained, through the use of a carbide lag, by Rocky Mountain Geo-Engineering. Borehole geophysical logging was carried out by Dresser Atlas Wireline Service. No adequate Caliper log was obtained for this well. The Gamma log used in this report above 1,700 ft (518 m) is from the Compensated Neutron log run on April 16, 1978: below 1,700 ft (518 m) the Gamma log is from the Compensated Densilog run on April 30, 1978.

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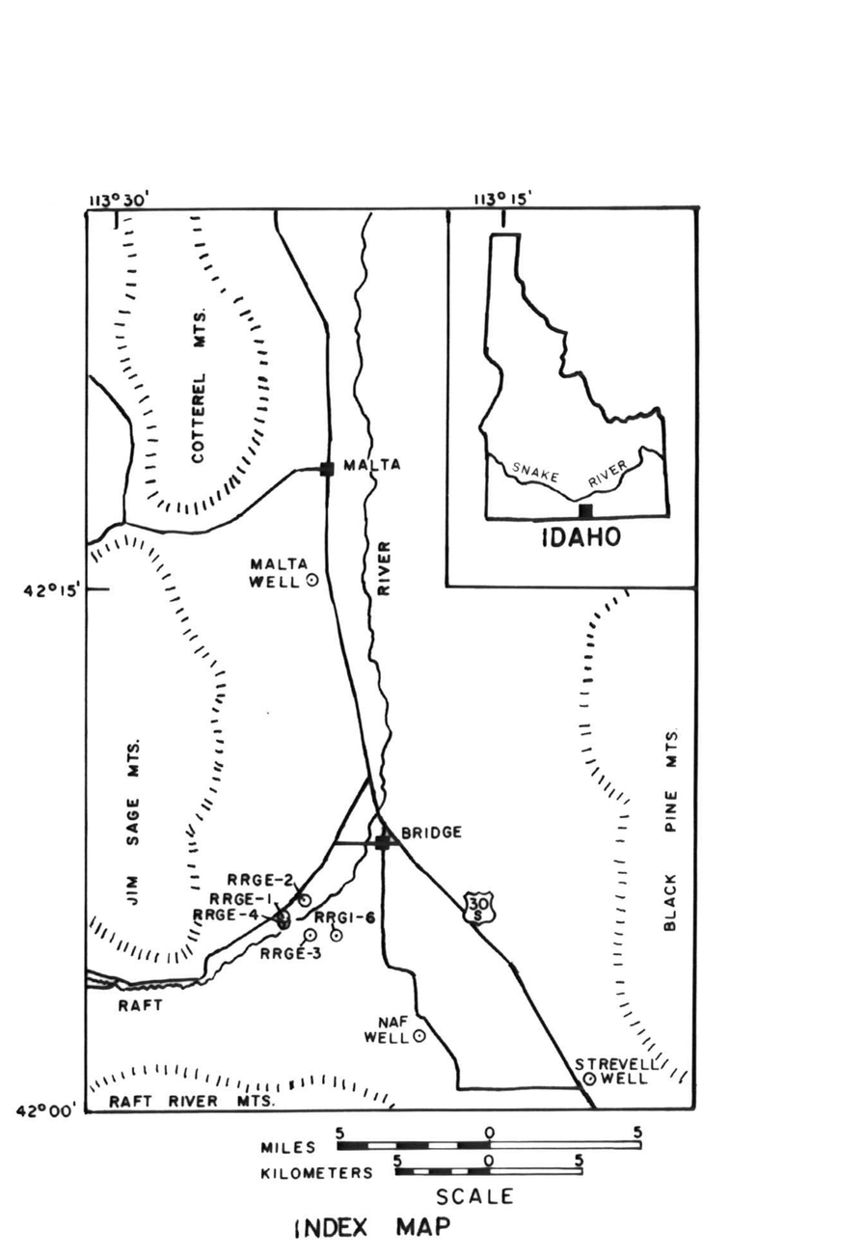
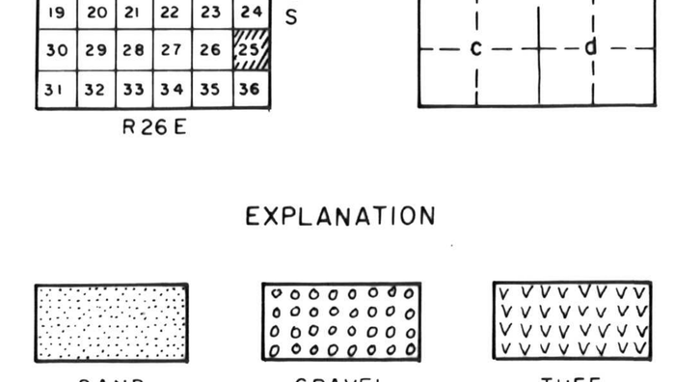


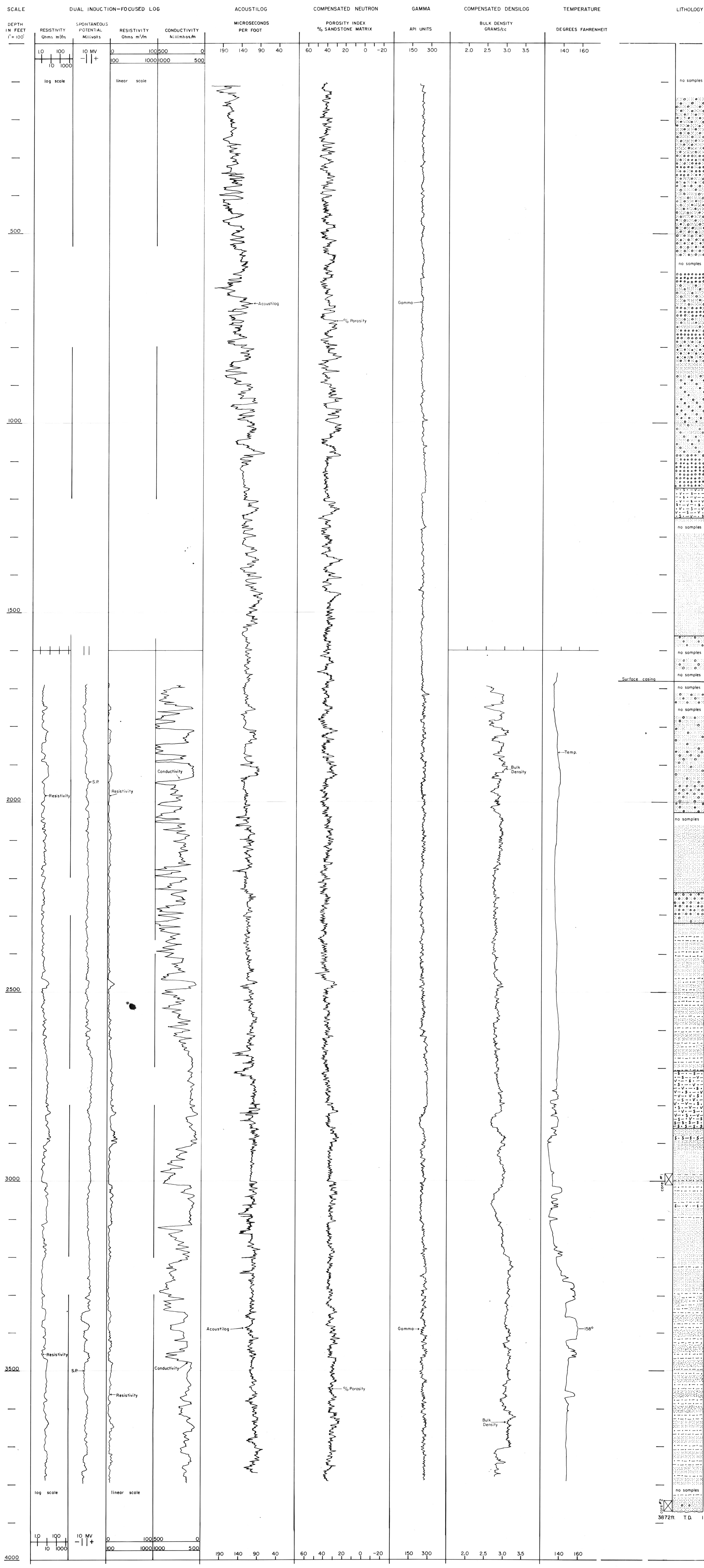
INDEX MAP

WELL-LOCATION SYSTEM

Idaho well numbers indicate the locations of wells within the official rectangular subdivisions of the public lands, with reference to the Boise baseline and meridian. The first two segments of a number designate the Township and Range (T. 15 S., R. 26 E.). The third segment is the section number, followed by two letters which indicate the quarter-section, and the 40-acre tract (sec. 25ad). Quarter sections are lettered a, b, c, and d in counterclockwise order from the northeast quarter. The 40-acre tracts are lettered in the same manner.



EXPLANATION



FAN ALLUVIUM

Sand and gravel: Poorly consolidated with minor amounts of calcareous cement in places. Sand; coarse, subangular to well rounded grains of quartz, schist, and rhyolite. Gravel; subangular to well rounded clasts of rhyolite and minor quartzite, quartz monzonite, schist and dolomite, as much as 1 cm in diameter. Gravel beds with clasts as much as 5 cm in diameter occur between 600-630 ft (183-192 m), and 1,080-1,170 ft (329-357 m)

SALT LAKE FORMATION

Siltstone: Light green in color, tuffaceous, partly silicified, and slightly calcareous in places. Trace of pyrite

Sandstone: Light greenish gray in color, medium to coarse grained and poorly consolidated. Grains are angular to subrounded and composed of 60-80 percent quartz and 20-40 percent rhyolite. The rhyolite clasts contain a green mineralization of the quartz phenocrysts and minor pyrite.

Sand and gravel: 60-80 percent sand, 20-40 percent gravel, poorly consolidated, minor calcareous cement and minor pyrite. Sand; medium to coarse, angular to subrounded grains of quartz and minor rhyolite. Gravel; subangular to well rounded clasts of quartzite and rhyolite as much as 1 cm in diameter

Sand: Light gray green in color, coarse grained and poorly consolidated. Grains are subangular to rounded quartz and minor rhyolite. Weak calcareous cement in places. Pyrite crystals throughout

Gravel: Poorly consolidated with a quartz sand matrix and weak calcareous cement. Clasts are subangular to rounded and composed of rhyolite and quartzite with minor schist and quartz monzonite as much as 7 mm in diameter

Siltstone and sandstone: Alternating beds with a trace of pyrite throughout and calcite flakes between 2660-2680 ft (811-817 m). Silt; white, light gray or light tan in color, calcareous and micaceous. Sand; medium to coarse grained, poorly consolidated subangular to subrounded grains of quartz and rhyolite

Siltstone: Light green in color, tuffaceous, and partly silicified. Trace of pyrite

Siltstone and sandstone: Alternating beds with a trace of pyrite, and occasional calcite flakes. Siltstone; light greenish gray in color, calcareous and micaceous. Sandstone; light gray to greenish gray in color, fine to coarse grained calcareous, with angular to subrounded grains of quartz and rhyolite

cm=in(2.54) m=ft(0.3048) km=mi(1.609) microseconds/m=microseconds/ft(0.3048) L/sec=gal/min(0.063) °C=5/9(°F-32)