PRELIMINARY EVALUATION
GEOTHERMAL RESOURCE UTILIZATION
WILLIAMS AIR FORCE BASE, ARIZONA

Summary

A high potential exists for geothermal heating and cooling by utilizing low temperature fluids (70-140^{o}F) pumped from the shallow unconfined aquifer coupled with heat pump engineering. Power production from the deep geothermal reservoir would encounter several major problems and would require a major effort and expense in exploration, drilling and engineering.

Introduction

A significant geothermal reservoir has been identified immediately adjacent to, and probably beneath, the Williams Air Force Base (WAFB) near Chandler, Arizona. A program of upgrading and expanding facilities at the base is currently being implemented which will continue for several years. This program of building centralization and new construction provides an excellent opportunity to utilize an already identified geothermal resource for air conditioning, space heating, and possibly electric power generation. If successful such a program could displace a significant amount of fossil fuel usage.

Geologic Setting and Background Information

The geologic setting of the region will be reported in detail by other workers. The subject area is located on a large plain of Quaternary alluvium east of Phoenix and 15 miles southeast of the Superstition Mountains which have been carved from Tertiary Volcanics. Geologically the area lies within the transition zone between the southern Basin and Range and the Colorado Plateau provinces. The stratigraphy of the area as generalized from the two

Geothermal Kinetics deep geothermal tests is indicated in Figure 1. Approximately 1100 feet of alluvium overlies a 1000-foot sequence of siltstone which gradually increases in anhydrite content and becomes dominantly anhydrite at about 2300 feet. The evaporite sequences continues to approximately 3650 feet, and possibly thins to the north. Approximately 3000 feet of shales, sandstones and siltstones, and claystones continue from the base of the anhydrite to approximately 6600 feet where Tertiary tuffs are clearly identified and become dominant. Tuffs, interbedded with siltstones and probably reworked volcanics continues to approximately 9115 feet. A basic igneous rock first identified at 9115 continues to 10,050 feet. The interval from 10,050 to 10,440 feet appears to be an altered, fractured zone which may be a major conduit of the geothermal system. The deeper hole, P.R. #2, bottoms at 10,453 feet in what is identified as an acidic igneous rock.

A preliminary review of regional geophysical data, bouguer gravity and detail aeromagnetic data which extends south and east of WAFB, and discussions with Geothermal Kinetics, Inc. indicate a probable major north trending fault is located 0-2000 feet east of the Power Ranch wells. This feature appears to cut (Precambrian?) bedrock to the south in the San Tan Mountains, and may provide the fracture porosity and permeability important in localizing geothermal fluids. The major east-west trending gravity gradient indicates an east-west trending structure probably composed of several fault zones, which may be the dominant structural control.

Group Seven, Inc. (controlling interest in Geothermal Kinetics) believe the reservoir extends mainly east from the Power Ranch data, based on electrical, seismic and mercury geochemistry data. Their geochemical thermometry, using a 90-96% mixing model, suggests deep reservoir temperatures up to 240^{o}C. Very optimistically they envision a reservoir one mile thick, 14 square miles in size with temperatures to 200-235^{o}C. GKI reports extensive efforts in stimulating the existing wells to flow before flow finally terminated.

Preliminary Assessment

The three main options for geothermal utilization at WAFB are indicated in Table I. Option I has the highest probability for successful implementation, and would utilize 70-140^{o}F temperature waters pumped from the alluvium in conjunction with conventional heat pump technology. Production and injection wells could be sited conveniently on the base proper. Engineering requirements are important here but little or no exploration effort is required.

Option 2 would use higher temperature waters (180-220^{o}F) produced from considerable depth in the sandstone, siltstone sequence and would require completion in a porous, permeable horizon. Air conditioning or space heating could be achieved but no electric power generation would be possible. New wells could be drilled on WAFB property and completed for production from these units. The water quality from these units is not clearly known, but mixing with the evaporate sequence along fractures could give rise to high salinities (17,000-60,000 ppm total dissolved solids). Exploration prior to drilling might include slim hole drilling (2 to 4 holes approximately 2000-4000 feet deep) but blow-out prevention equipment might be required. Costs for two production and injection wells could range from $2-4,000,000.

Alternatively, some agreement might be negotiated with G.K.I. for production from those zones in P.R. #1 or #2. However high salinities would be expected and well stimulation would probably be required.

Option 3 would seek to achieve electric power generation from great depth. The high salinities (17,000-60,000 ppm t.d.s.), moderate temperatures (300-360^{o}F), great depth for fluid production and low flow rates indicated by two existing wells hold little promise for power production. This prospect would not be highly regarded by major geothermal developers. Although some potential does exist for higher temperatures, a major exploration effort requiring a large capital investment would be required to effectively site drill holes and prove power generation potential.

TABLE I
Geothermal Fluid Production Options

Option	Goal	Production Depths	Rock Type	Temp.	Water Quality
1	Space heating/ Air conditioning w. heat pump	300-1900' (400-460')	Qal-gravel valley fill	70-140^{o}F	fresh-<5,000ppm t.d.s.
2	Space heating/ Airconditioning w. heat pump	3700-6600' (4600'; 5200-5400')	Sandstone-siltstone (Tss)	180^{0}-220^{o}F	5,000-60,000ppm t.d.s
3	Electric Power Production	8000-10,500' (10,080-10,440')	Fractures in basic igneous rock or volcanic tuffs	300-360^{o}F	17,000-30,000 t.d.s

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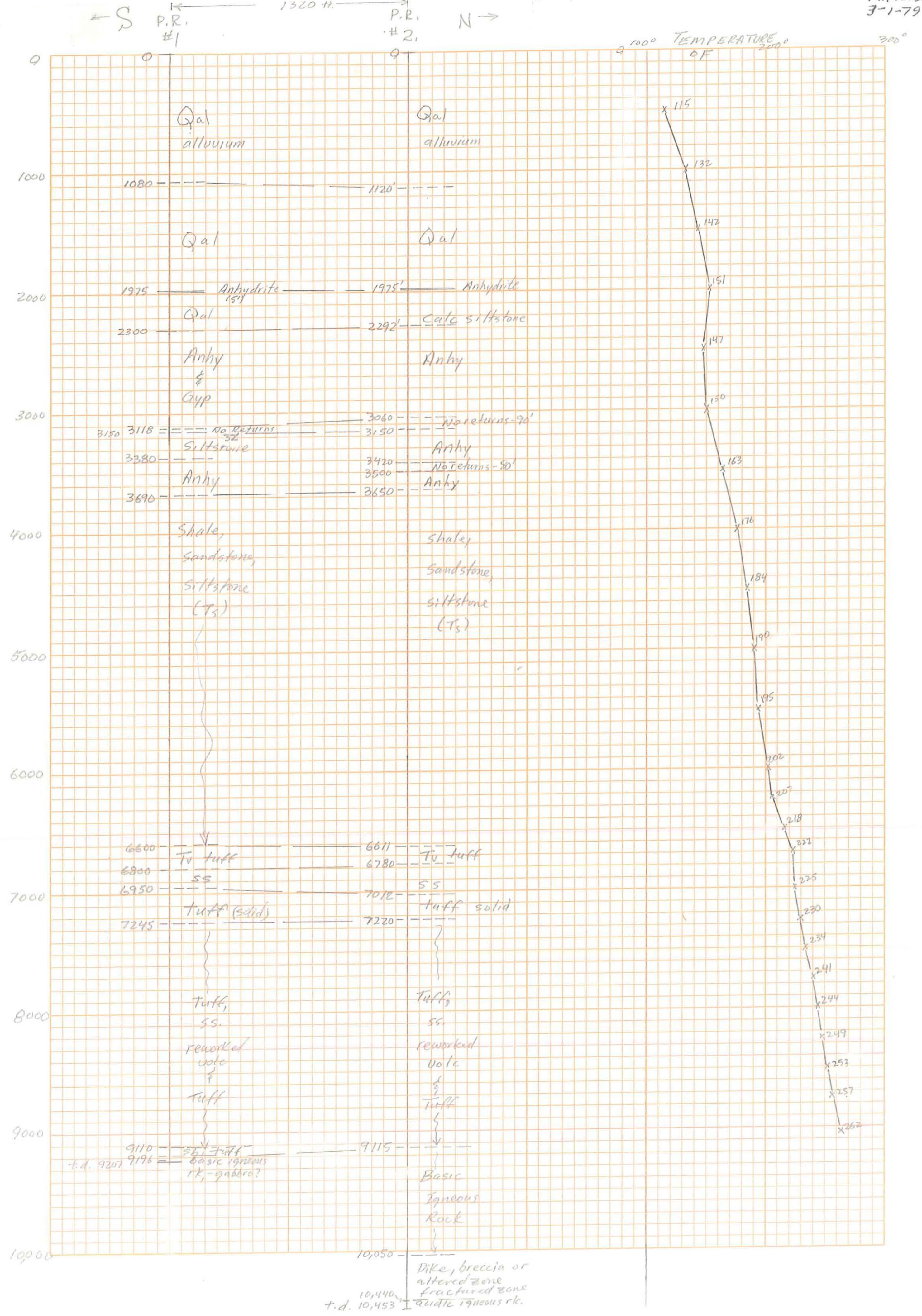

← S P.R. #1
1320 ft.
P.R. #2 N →
TEMPERATURE °F
100° 200° 300°
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
Qal alluvium
Qal alluvium
1080
1120'
Qal
Qal
1975
Anhydrite (15')
1975'
Anhydrite
Qal
2300
2292'
Calc siltstone
Anhy & Gyp
Anhy
3060
No returns-90'
3150 3118
No Returns 32
3150
Siltstone
Anhy
3380
3420
No returns-80'
3500
Anhy
3690
3650
Shale, Sandstone, Siltstone (Ts)
Shale, Sandstone, Siltstone (Ts)
6600
6611
Tv tuff
Tv tuff
6800
6780
SS
6950
7012
SS
tuff (solid)
tuff solid
7245
7220
Tuff, SS. reworked volc & Tuff
Tuff, SS. reworked volc & Tuff
9110
9115
SS, tuff
t.d. 9207 9196
Basic igneous rk, - gabbro?
Basic Igneous Rock
10,050
Dike, breccia or altered zone fractured zone acidic igneous rk.
10,440
t.d. 10,453
115
132
142
151
147
150
163
176
184
190
195
202
207
218
222
225
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234
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