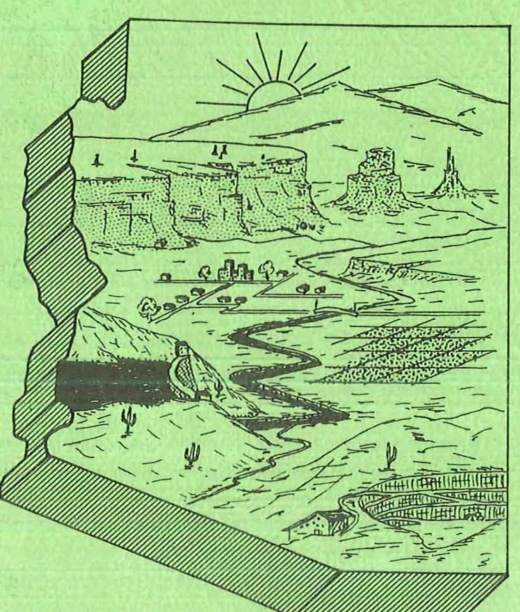
GL02964

STATE OF ARIZONA
BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY

Geological Survey Branch
Geothermal Group

Earth Science and Mineral Resources
in Arizona



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CONTENTS

COMPLIANCE WITH CONTRACTUAL REQUIREMENTS

The principal investigator, W. Richard Hahman, Sr., in accordance with Article I and Article A-I of Appendix A of DOE Contract Eg-77-S-02-4362 has devoted his full time, from February 1, 1978, through April 30, 1978, to the contract work. He plans to devote his full time to the contract work during the next quarter, May 1, 1978, through July 31, 1978. The principal investigator and the program are in compliance with the requirements of the contract.

REGISTERED PROFESSIONAL GEOLOGIST
OREGON
W. Richard Hahman, Sr.
No. 208

W. Richard Hahman, Sr.

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RESEARCH OBJECTIVES

The principal research objective of this program is the development of successful economic exploration tehcniques for the location, evaluation and development of low- to moderate-temperature geothermal resources for use by the general public and private industry. The development of such a program will require the close coordination of research in the three geoscience disciplines: geology, geophysics and geochemistry.

Current plans call for the complete development of three demonstration projects utilizing low- to moderate-temperature geothermal energy. The first two projects are somewhat experimental in that they must develop a successful, economic exploration and development program. The third demonstration project then must be brought on stream utilizing these cost-effective techniques.

While the detailed or site-specific exploration, evaluation and development programs are in progress, the reconnaissance exploration will continue to attempt to locate additional areas of interest over the entire state of Arizona. At present most data is confined to the Basin and Range physiographic province so that extensive exploration is necessary to identify potential geothermal resources which may exist in the Colorado Plateau region.

Another objective of this program is to compile and publish a more comprehensive geothermal energy resource map of the state of Arizona, 1:500,000 scale. This map will be produced through a joint effort by the U.S.G.S. Geotherm project, the National Oceanic and Atmospheric Administration and the Arizona Bureau of Geology and Mineral Technology, Geological Survey Branch. It is anticipated that the map will be available to the public in 1979.

Finally, the program is continuing to compile a reference library on all aspects of geothermal energy: exploration, development, evaluation, utilization, etc., for use by the public. The library is located at the Geological Survey Branch, Bureau of Geology and Mineral Technology, Tucson, Arizona.

INTRODUCTION AND REVIEW

The present Arizona geothermal energy program was initiated in response to prior geothermal research and reconnaissance programs conducted primarily under the aegis of the federal government. The initial program was extremely limited in scope, but expansion during the past year to six months has been both rapid and continuing. Early on the program was expanded to include the entire state of Arizona.

During the period covered by this report, February 1 to April 30, 1978, a third geologist, James C. Witcher, joined the professional staff, and William L. Weibel began as a half-time graduate assistant.

Two projects were completed during this quarter. The chapters in this report, Preliminary Map - Geothermal Energy Resources of Arizona by W. R. Hahman, Sr. and Thermal Gradient Anomalies in Southern Arizona by Salvatore Giardina, Jr. and J. N. Conley, detail the results. Following these are project reports on continuing phases of the overall program. All projects are continuing on schedule.

GEOTHERMAL GEOLOGY OF ARIZONA

by W. R. Hahman, Sr.

Introduction

The state of Arizona may be divided into two physiographic provinces: the Colorado Plateau in the northeast part of the state, and the Basin and Range in the southwest part of the state. There is a transition zone between the two provinces. The complex lithologies and overall structure of the Basin and Range province are the result of a long history of tectonic activity that commenced during Precambrian times, over one billion years ago. The physical features visible today, north and northwest trending mountain ranges and sediment-filled intermontane basins, are the result of complex tectonic activity that commenced approximately 14 million years ago and may continue in some places.

The Colorado Plateau, when compared to the Basin and Range, is tectonically stable. The land forms that characterize this province are broad plains, plateaus, buttes and mesas. These features have been formed by differential erosion of resistant and nonresistant sedimentary rocks.

Hydrothermal Geothermal Systems

In Arizona, indications of hydrothermal, geothermal systems are represented by natural thermal springs and drilled wells. Thermal springs and wells are widely distributed throughout the state but are most abundant in the Basin and Range and transition zone. The possible explanation for this relative concentration of geothermal phenomenon areas follows:

1) Deep circulation of meteoric water through the intense, complex fracture systems of the Basin and Range transition zones;

2) Igneous rock intrusions, again along fractures or zones of weakness, not exposed at the surface;

3) A combination of the prior two possibilities;

4) Heat generated by radiogenic decay of radioactive elements in igneous rocks;

5) Gerlach et al. (1975) have suggested the exothermic reaction resulting from the hydration of anhydrite in the evaporative sequences of sediments that occur in some of the intermontane basins.

The paucity of thermal springs and wells, especially wells, in the Arizona section of the Colorado Plateau could be the result of lack of observation. However, this paucity most likely is the result of the Plateau's relatively low heat flow (compared to the Basin and Range).

Hydrothermal resources suitable for electrical generation are expected to be encountered in several areas around the state. These favorable areas have been identified by use of geochemical thermometers indicating projected reservoir temperatures calculated from chemical analyses of water from wells and springs. The favorable areas are the San Bernardino valley, Clifton-Morenci-Safford, Springerville-St. Johns, Flagstaff, Phoenix, and the Hyder valley areas. Additional exploration is expected to locate other areas favorable for electrical generation from hydrothermal resources.

Hahman, Stone and Witcher (1978) in their preliminary map compilation of the geothermal energy resources of Arizona showed both high temperature and low to moderate temperature areas. Most of the favorable areas on this map are situated in the Basin and Range physiographic province. Preliminary investigations tend to indicate that low to moderate temperature geothermal energy will be available for use at most of the populated areas in the Arizona Basin and Range province. The current major uses of low to moderate temperature geothermal resources are in space heating, cooling and agribusiness.

Hot Dry Rock

Arizona has considerable potential for hot dry rock geothermal energy for use in electrical generation, space heating and cooling, agribusiness, etc.

Byerly and Stolt (1977) in their article on the Curie point isotherm in northern and central Arizona define a rather broad zone through central Arizona where the Curie point is less than 10 km and often less than 5 km below the land surface. The Curie point, that temperature at which magnetic materials lose their magnetic properties, of magnetite is 575°C. Therefore, if the Curie point is at 5 km, one might reasonably expect to have a temperature of approximately 575°C at that depth. The zone where the Curie point is within 5 km of the surface would be a much more favorable zone in which to look for hot dry rock and/or hydrothermal resources associated with young, concealed, silicic, igneous intrusive rocks than a section where the Curie point is at a depth of 20 or 30 km.

Conclusions

Arizona has considerable potential for geothermal energy resources. The geological manifestations of these resources are often very subtle. However, these geothermal resources, for both electric and nonelectric uses, can be located and developed through prudent, integrated programs involving geology, geophysics, and geochemistry.

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PRELIMINARY MAP - GEOTHERMAL ENERGY RESOURCES OF ARIZONA

by W. R. Hahman, Sr.

Background

During the first year of the Arizona DOE/DGE contract, an attempt was made to compile data relevant to geothermal energy in the state of Arizona. As part of this program the Arizona Oil and Gas Conservation Commission was funded to prepare a map, scale 1:1,000,000, constructed from their files and published reports, on the geothermal energy of Arizona. Another part of the program was the construction of a lineament map, scale 1:1,000,000, prepared from Landsat imagery by Dr. L. K. Lepley. Dr. Chandler Swanberg furnished the data contained in New Mexico Energy Institute Report No. 6 to the Arizona program. Therefore, the majority of the information had already been compiled when the U. S. Department of Energy, Division of Geothermal Energy, requested the publication of a preliminary map (Fig. 1) on the geothermal energy resources of the state.

The Arizona Bureau of Mines had published a map of the outcrops of Quaternary igneous rocks, scale 1:1,000,000, in 1962, and of cinder cones, scale 1:500,000, in 1969. In these two instances all that was necessary was an updating of the material.

Dr. Paul Damon and his associates of the Laboratory of Isotope Geochemistry, University of Arizona, Tucson, were kind enough to revise the 1962 map from their extensive age date files. Drafter Dan Dwyer revised the cinder cone map and drafted, registered and stripped the 10 plates for the printing company.

The cooperation of all parties associated with this map is gratefully acknowledged and greatly appreciated. Without the contributors' efforts, the map in its present form would have been impossible to construct.

Discussion

The following interpretative comments are preliminary in nature and should be treated as such.

The areas of favorable geothermal energy potential shown on the map appear concentrated in the southern half of the state. This concentration is apparent because of the greater population density and mineral exploration activity which has generated considerable knowledge of the Basin and Range physiographic province.

Dr. Chandler Swanberg et al. in NMEI Report No. 6, Figure 9, has computed the mean of observed temperatures for wells and springs from both the Colorado Plateau and the Basin and Range physiographic provinces of the southwestern United States. The mean temperature for the Colorado Plateau is 16.1°C and for the Basin and Range, 26.2°C. Therefore, any well or spring in the Colorado Plateau of Arizona having a temperature in excess of 20°C would be considered anomalous. In the Basin and Range of Arizona any well or spring having a temperature in excess of 30°C would be considered anomalous.

Dr. L. K. Lepley's lineament study presents some interesting conjectures when analyzed with the other data on the map. It does appear that the northeast (N 40° - 60°E) striking lineaments have a significant relationship with areas of high geothermal potential. Field observations in the volcanic field immediately west of Springerville, Arizona, tend to support the importance of this northeast direction. Cinder cones appear to be aligned along relic fissure vents striking N 40° - 45°E.

Another apparently important lineament direction is N 40° - 45°W. Favorable geothermal energy areas seem to occur in the vicinity of the intersections of the northeast and northwest lineaments. While this association could well be fortuitous, the geothermal anomalies could well result from more favorable ground preparation of the basement complex. These intersections could have numerous, deeply penetrating fractures extending considerable distances into the earth's crust. The ground water in the intermontane basins could easily circulate to great depths along these fractures, become heated and rise along these fractures. This action would cause a turnover of the water in the aquifers creating a convection cell or cells similar to the "one (?)" present in the Tucson Basin (Witcher, J.C., personal communication, 1978).

Conclusion

This map is the initial attempt to present the knowledge to date on the geothermal energy potential of the State of Arizona.

Thermal gradients calculated from single temperatures in shallow wells have the highest chances for error and may not extend to depth. However, these calculations do point out where the shallow depth hot water is located.

Water geochemical geothermometers are reasonably accurate at designating the minimum range for the geothermal reservoir temperatures. The reason it is the minimum temperature is that mixing of non-thermal water with thermal water often occurs prior to the water reaching the sample site.

Measured thermal gradients should be considered the most accurate. Temperature measurements, using a very accurate thermistor probe, are generally taken every five meters from the surface down. Approximately fifteen readings, over an extended time period, are taken at one downhole station if it is in air. Three readings are necessary per downhole station if there is fluid in the hole.

It should be noted that the configuration and areal extent of the potential geothermal energy resource areas shown on this map are conjectural. This map was prepared to furnish background information of investigative projects. The leasing of land and drilling for geothermal energy should only be undertaken after a thorough geological investigation.

References

Arizona Bureau of Mines, Outcrop of Quaternary igneous rocks, from Map of Outcrops of Tertiary and Quaternary rocks in Arizona, 1962.

Arizona Bureau of Mines, Correlation of Cinder Cones, from Geologic Map of Arizona, 1969.

Damon, P.E., Shafiqullah, M., and Lynch, D.J., Ages of volcanic fields determined by K-Ar dating at Laboratory of Isotope Geochemistry with support from N.S.F. Grant EAR 76-02590, U.S.G.S. Grant 14-08-0001-G-170 and the State of Arizona, January 1978.

Druitt, C.E. and Conley, J.N., Geothermal Areas, Arizona Oil & Gas Conservation Commission, August 1977.

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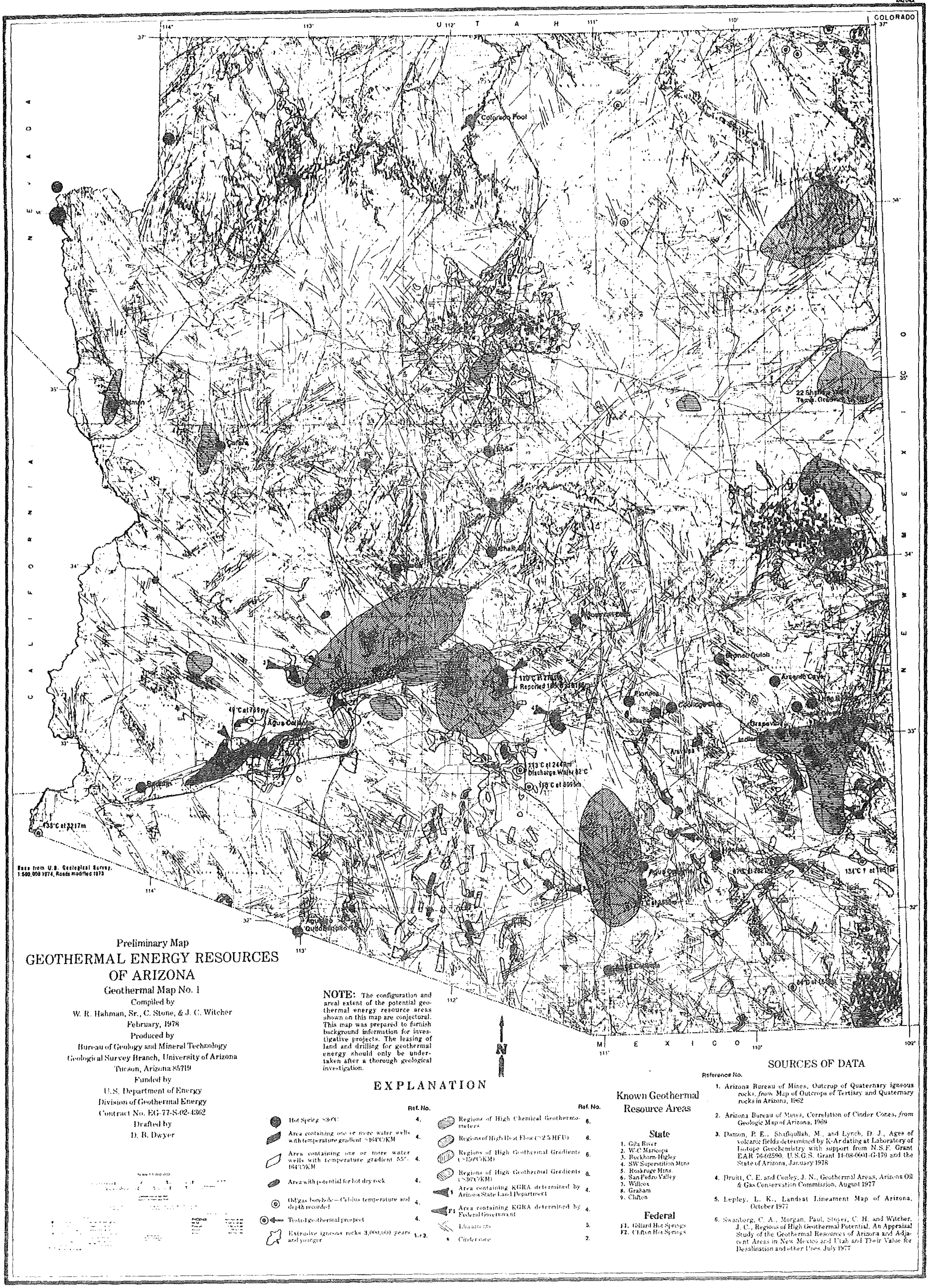
Swanberg, C.A., Morgan, Paul, Stoyer, C.H. and Witcher, J.C., Regions of High Geothermal Potential, An Appraisal Study of the Geothermal Resources of Arizona and Adjacent Areas in New Mexico and Utah and Their Value for Desalination and other Uses, NMEI Report No. 6, July, 1977.



U T A H
COLORADO
N E V A D A
C A L I F O R N I A
N E W M E X I C O
M E X I C O
Colorado Pool
Base from U.S. Geological Survey, 1:500,000 1974, Roads modified 1973
Preliminary Map
GEOTHERMAL ENERGY RESOURCES OF ARIZONA
Geothermal Map No. 1
Compiled by
W. R. Hahman, Sr., C. Stone, & J. C. Witcher
February, 1978
Produced by
Bureau of Geology and Mineral Technology
Geological Survey Branch, University of Arizona
Tucson, Arizona 85719
Funded by
U.S. Department of Energy
Division of Geothermal Energy
Contract No. EG-77-S-02-4362
Drafted by
D. B. Dwyer
NOTE: The configuration and areal extent of the potential geothermal energy resource areas shown on this map are conjectural. This map was prepared to furnish background information for investigative projects. The leasing of land and drilling for geothermal energy should only be undertaken after a thorough geological investigation.
EXPLANATION
Ref. No.
Area containing one or more water wells with temperature gradient 55°-164°C/KM 4.
Area with potential for hot dry rock 4.
Tested geothermal prospect 4.
Extrusive igneous rocks 3,000,000 years and younger 1, 3.
Regions of High Chemical Geothermometers 6.
Regions of High Geothermal Gradients 6.
Area containing KGRA determined by Arizona State Land Department 4.
Area containing KGRA determined by Federal Government 4.
Lineaments 5.
Cinder cone 2.
Known Geothermal Resource Areas
State
1. Gila River
2. W-C Maricopa
3. Buckhorn-Higley
4. SW Superstition Mtns
5. Roskruge Mtns.
6. San Pedro Valley
7. Willcox
8. Graham
9. Clifton
Federal
F1. Gillard Hot Springs
F2. Clifton Hot Springs
SOURCES OF DATA
Reference No.
1. Arizona Bureau of Mines, Outcrop of Quaternary igneous rocks, from Map of Outcrops of Tertiary and Quaternary rocks in Arizona, 1962
2. Arizona Bureau of Mines, Correlation of Cinder Cones, from Geologic Map of Arizona, 1969
3. Damon, P. E., Shafiqullah, M., and Lynch, D. J., Ages of volcanic fields determined by K-Ar dating at Laboratory of Isotope Geochemistry with support from N.S.F. Grant EAR 76-02590, U.S.G.S. Grant 14-08-0001-G-170 and the State of Arizona, January 1978
4. Druitt, C. E. and Conley, J. N., Geothermal Areas, Arizona Oil & Gas Conservation Commission, August 1977
5. Lepley, L. K., Landsat Lineament Map of Arizona, October 1977
6. Swanberg, C. A., Morgan, Paul, Stoyer, C. H. and Witcher, J. C., Regions of High Geothermal Potential, An Appraisal Study of the Geothermal Resources of Arizona and Adjacent Areas in New Mexico and Utah and Their Value for Desalination and other Uses, July 1977

(Fig. 1)

THERMAL GRADIENT ANOMALIES

IN

SOUTHERN ARIZONA

REPORT OF INVESTIGATION 6

BY

SALVATORE GIARDINA, JR., AND J. N. CONLEY

FEBRUARY 1978

ARIZONA OIL AND GAS CONSERVATION COMMISSION

PHOENIX, ARIZONA

ACKNOWLEDGMENT

This report of work was supported by funds provided by the U.S. Department of Energy, Division of Geothermal Energy, to the Bureau of Geology and Mineral Technology, Geological Survey Branch, University of Arizona, Tucson, Arizona 85719, Contract No. EG-77-S-02-4362.

ABSTRACT

A survey of the records of numerous thermally anomalous water wells in the southern portion of the Basin and Range province of Arizona indicate that most of these wells are less than 300 m deep. The temperature and depth data of most of these shallow wells produce abnormally high computed thermal gradients that are inconsistent with considerably lower gradients in deeper wells. Utilization of a method devised for an appraisal of shallow well data permits identification of the most attractive thermal gradient anomalies warranting additional data-gathering methods.

Water moving vertically from deep-heated crustal rock along faults and then moving horizontally into relatively shallow basin-fill deposits seems to be the most probable explanation for the irregular but widespread occurrence of thermal ground water in the study area. A significant number of these occurrences appear to have thermal gradients potentially adequate for non-electrical energy utilization.

INTRODUCTION

This report is based on a study of previously assembled temperature data abstracted from the records of numerous wells drilled for water and other Earth resources in Arizona. The study was undertaken to: 1) process and present the data in a format suitable for use by other workers; 2) identify thermal gradient anomalies potentially prospective for geothermal energy resources; and 3) present graphically the spatial relationship of identified thermal gradient anomalies to the thickness of middle and late Cenozoic alluvial deposits, faults, and geothermally anomalous localities and regions determined by previous studies.

DATA - TREATMENT AND INTERPRETATION

Literature Search. The initial phase of this study consisted of an intensive search of available published and unpublished subsurface temperature data reported in the records of wells drilled for water, oil, natural gas, helium, potash, and geothermal resources; and wells drilled for stratigraphic information in Arizona. Thermal gradients have been computed for more than 2,000 selected wells which are grouped by counties, arranged alphabetically, in table 2 in the appendix of this report.

With a few exceptions, the temperature and depth data of the wells drilled in the Colorado Plateau province of the State produced low thermal gradients in comparison with those of the Basin and Range province. In view of this fact and the paucity of temperature data in the Basin and Range portions of Mohave and Yavapai Counties, the study area is restricted to that portion of the State south of lat 34° N.

Data Quality. True geothermal gradients, representing the rate of temperature increase in the Earth with depth, require accurate temperature and depth measurements after establishment of thermal equilibrium. Most of the well completion records available lack these accurate measurements. The temperature gradients of this report have been calculated from the limited amount of data contained in the records and, therefore, are called thermal gradients.

In many instances these data are very incomplete. The records of most water wells reflect only a measurement of the temperature of the water at the wellhead and in many instances do not indicate the depth of the producing zone. Well perforations or open hole completions generally cover considerable intervals of water-bearing section. Consequently, the empirical value of the thermal gradients obtained under such conditions is apparent. In the case of no information as to the producing interval, it has been assumed that the highest recorded water temperature measured at the wellhead was produced from a zone at or near the total depth of the borehole. However, in the case of a dually completed well, this assumption may effect a conservatively low gradient if there is comingling of the water from the deep zone with that of cooler water from a shallower zone.

Data Interpretation. Computation of thermal gradients based on the reported water temperatures and depth data of numerous shallow wells frequently produce abnormally high values which invariably are not characteristic of in situ temperatures existing at greater depths. The computed gradients within the upper 300 m of alluvial deposits exhibit an extremely wide variation, generally ranging from 60°C/km at 300 m to over 1000°C/km within 10 m of the surface. Plots of the calculated thermal gradients of wells in each of the six counties of the study area (figs. 1-6) obviously show that the magnitude of the maximum calculated gradients decreases rapidly from the surface to depths of 300 to 500 m. The comparatively few deep wells do not exhibit a proportionately equal number of thermal gradients equal to or greater than 60°C/km, the value used in this study for the identification of thermal gradient anomalies. Maximum temperature profiles (fig. 8) of the six counties indicate that the elevated water temperatures found at shallow depths in numerous wells do not generally persist to depths below 150 m.

In order to identify thermal gradient anomalies based on the preponderance of relatively shallow well temperature data, a maximum gradient profile (G-D) has been constructed for each of the six counties (figs. 1-6). This profile generally demarcates the magnitude of the highest gradient values indicated by a plot at any given depth. Data plotting to the left of this profile may be considered to be anomalous. A maximum temperature profile (T-D) corresponding to the constructed maximum gradient profile is also shown. This profile may be interpreted as the limiting profile of the maximum expected temperatures corresponding to the maximum gradient profile. Data plotting to the right of the T-D profile may be considered to be anomalous.

Figure 7 illustrates the usefulness of T-D profiles in estimating whether similar non-equilibrium temperature data furnished by new wells are indicative of thermal anomalies exhibiting a specified (or required minimum) thermal gradient. A constructed desired gradient of 60°C/km is shown on the illustration as an example. It is apparent on the illustration that the temperatures of many wells completed at depths shallower than 250 m will exhibit gradients greater than 60°C/km. The gradient of most of these wells will invariably decrease with depth and the corresponding temperatures will plot to the left of the maximum temperature profile. The thermal gradients of most shallow water wells exhibit a decrease to values less than 60°C/km below depths of 250 m. Therefore, an estimate of whether a new temperature data point satisfies the desired gradient would require that it plot to the right of the T-D profile at depths less than 250 m or plot to the right of the constructed gradient line at depths greater than 250 m. The depth at which the constructed gradient line and the T-D profile intersect varies considerably, as shown on figures 1 through 6. This appraisal method was used in this report to identify potential energy-productive thermal anomalies based solely on well temperature and depth data.

Table 1 presents a statistical analysis of the thermal gradient data computed for 1,522 wells. It permits a comparison of the mean gradient (column X-1) of the total data set with the mean gradient (column X-2) of wells with depths greater than 300 m for each county of the study area. The resultant gradient values (column TG) calculated from a linear regression, relating temperature to depth of wells deeper than 300 m, represent the best fitting straight line through the temperature-depth data. These values may be considered to be the "normal" or average thermal gradient characteristic of each county, based on the quantity of data available. The average thermal gradients of wells deeper than 300 m for the six counties listed in table 1 is 34°C/km. The approximate average geothermal gradient in the Earth's crust is about 25°C/km (Am. Geol. Inst., 1972).

GEOLOGY

A detailed discussion of current theories pertaining to the geology, geohydrology, and geologic history of the southern portion of the Basin

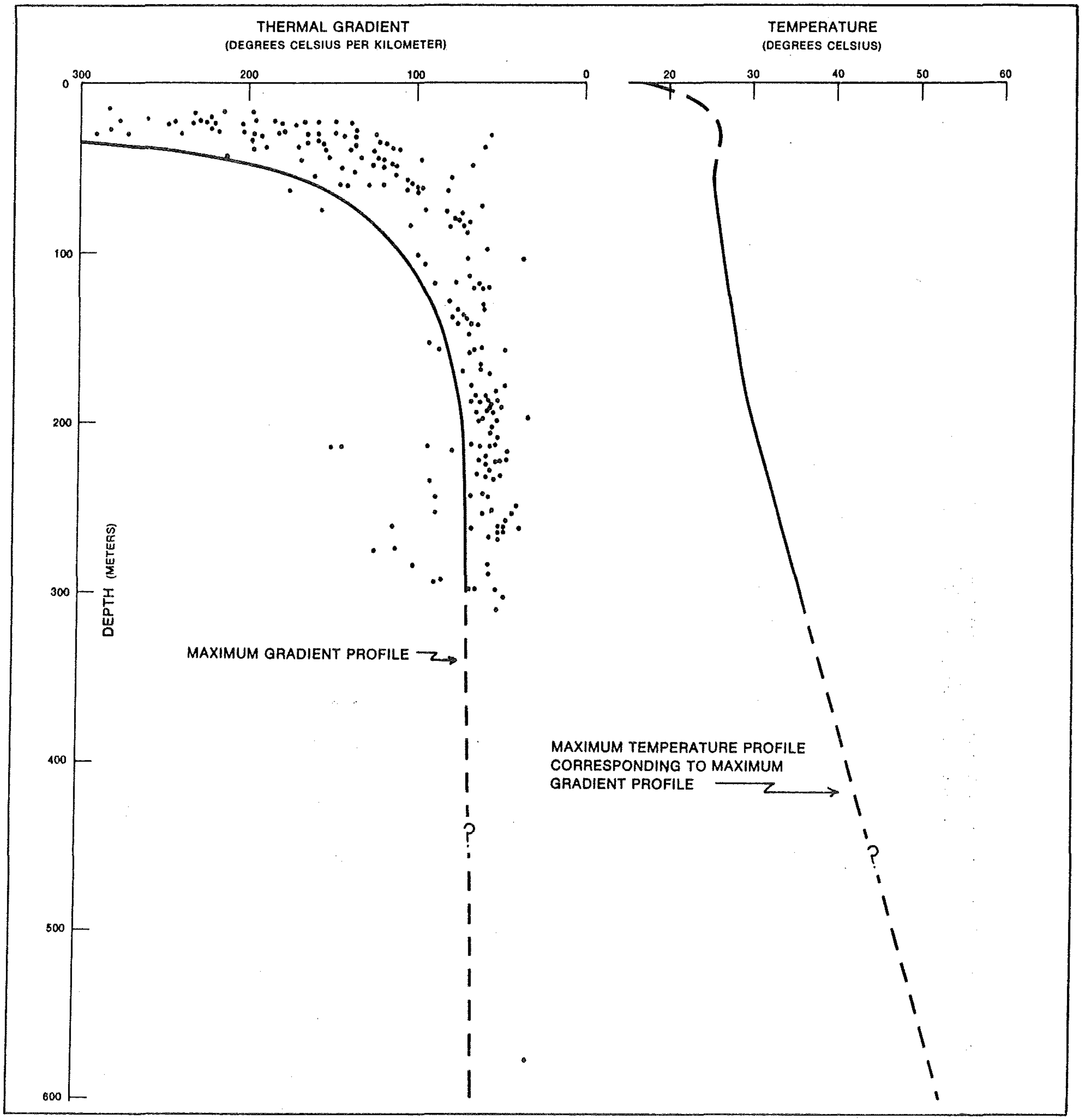


FIG. 1. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Cochise County.

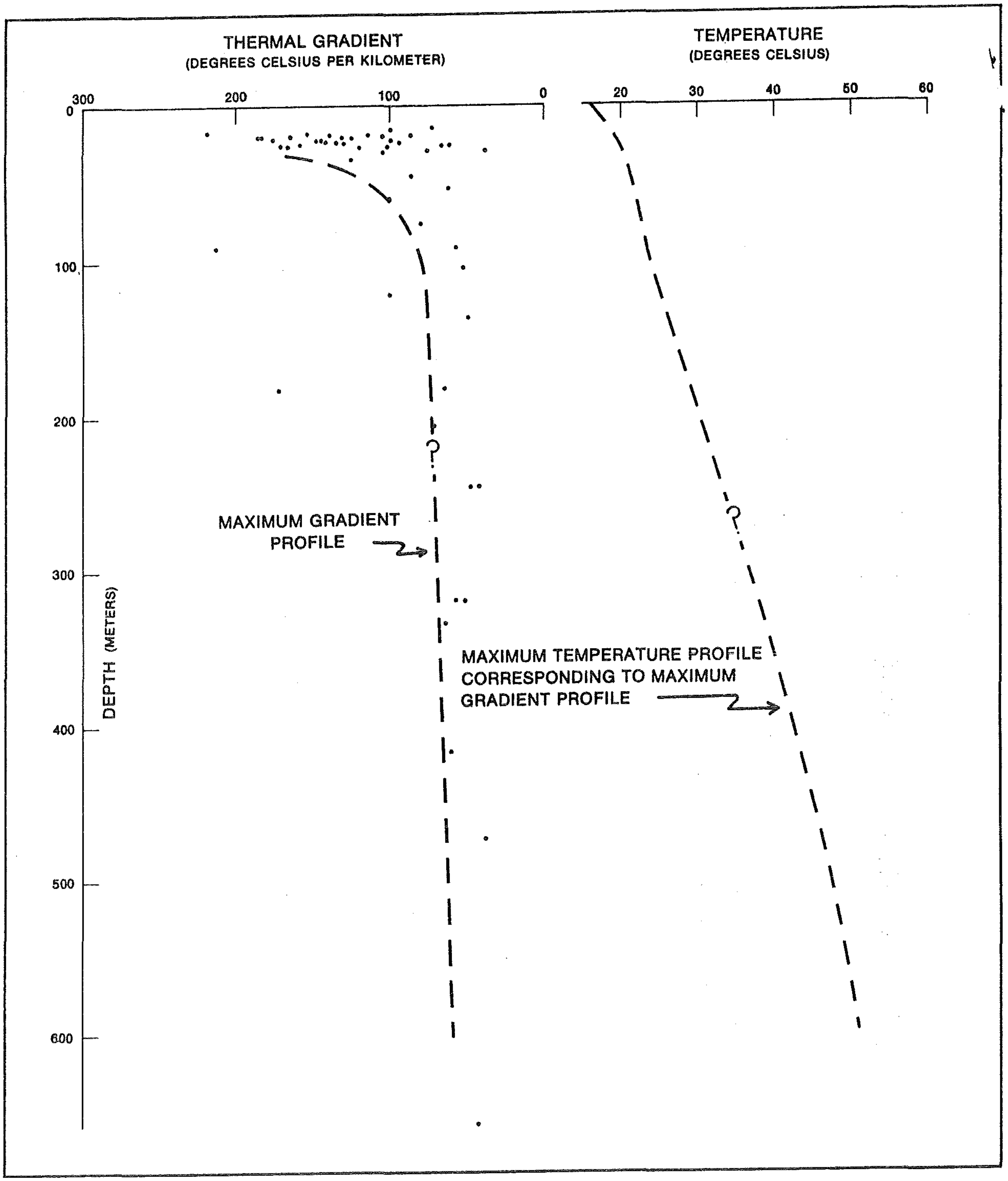


FIG. 2. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Graham County.

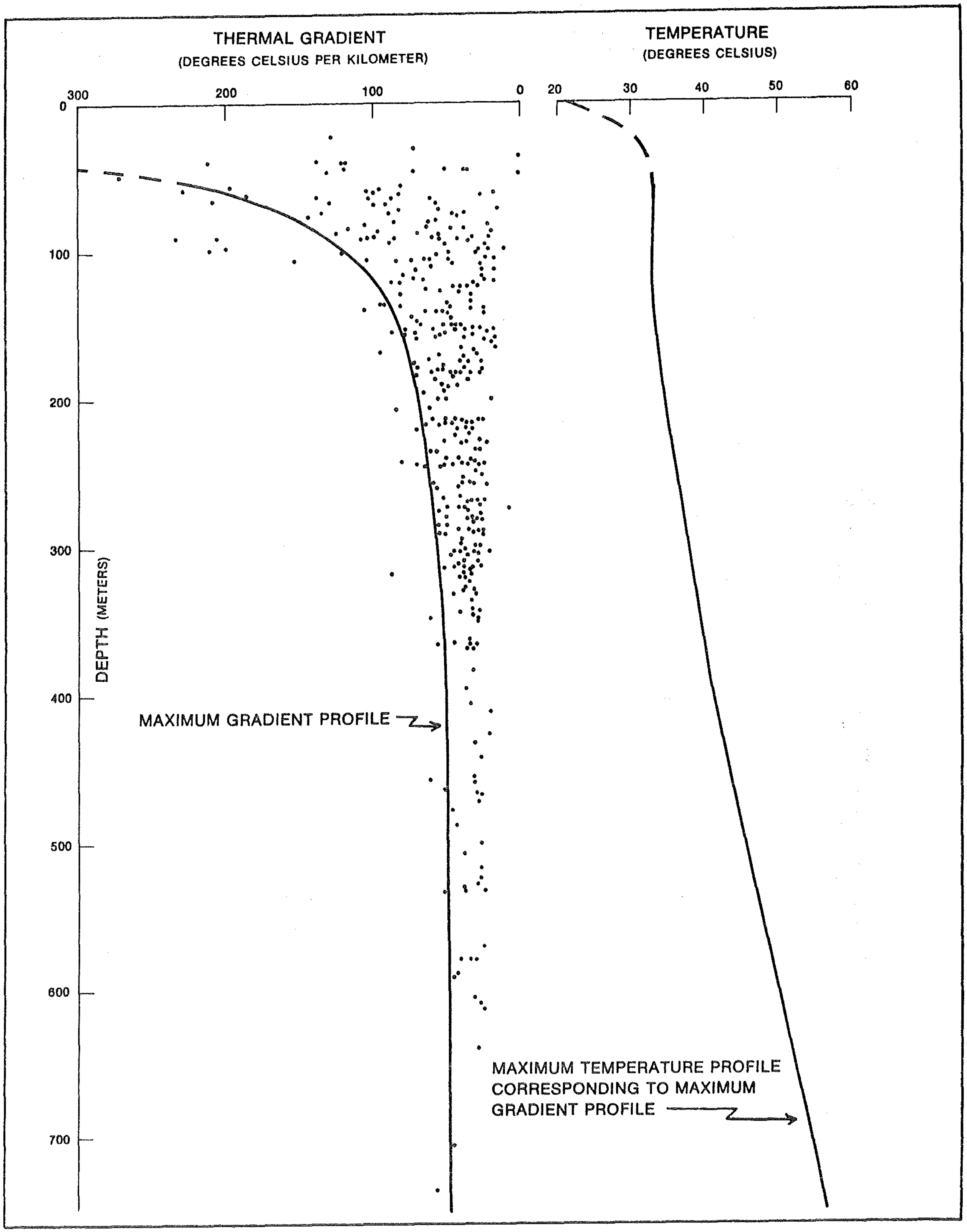


FIG. 3. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Maricopa County.

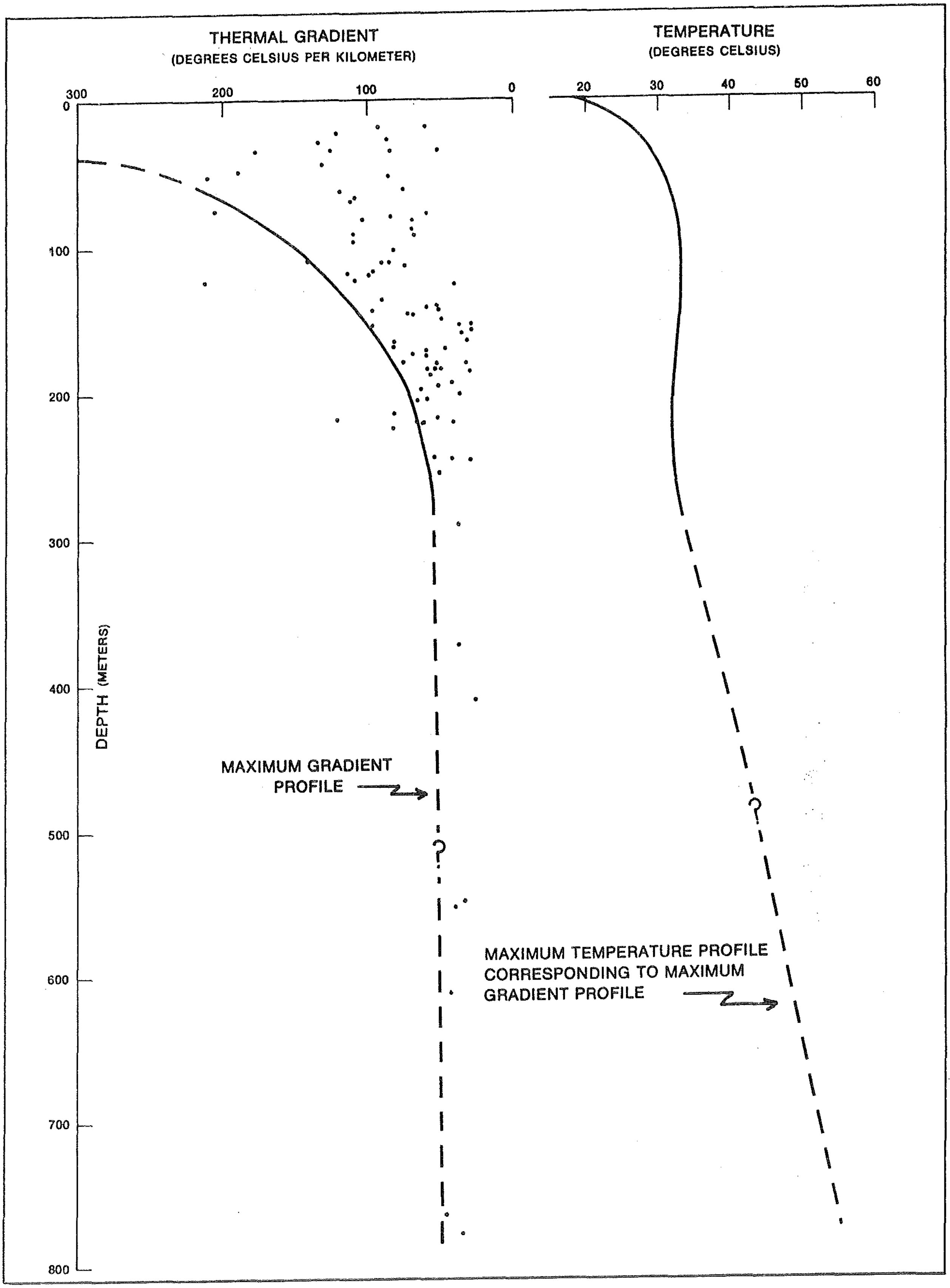


FIG. 4. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Pima County.

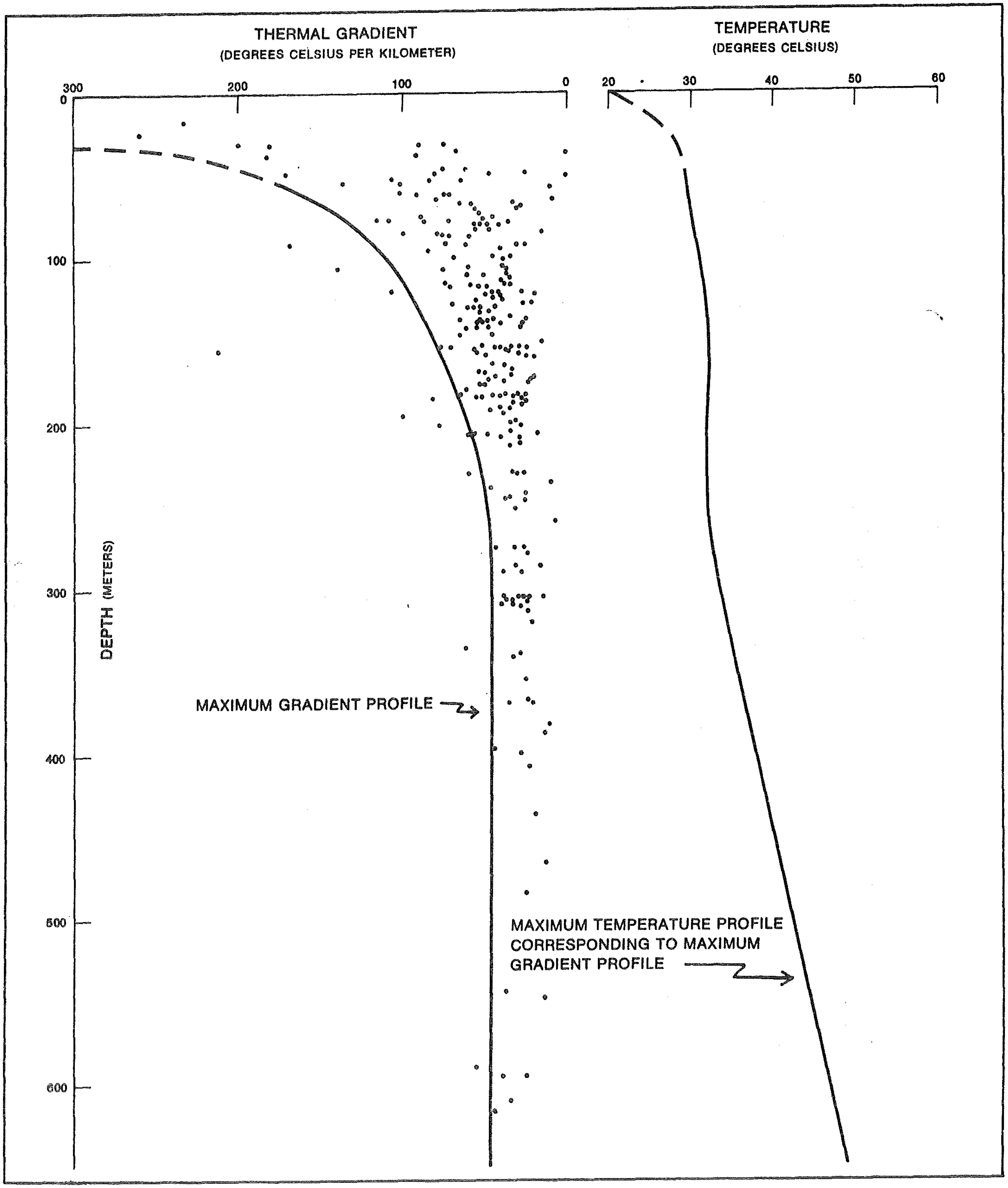


FIG. 5. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Pinal County.

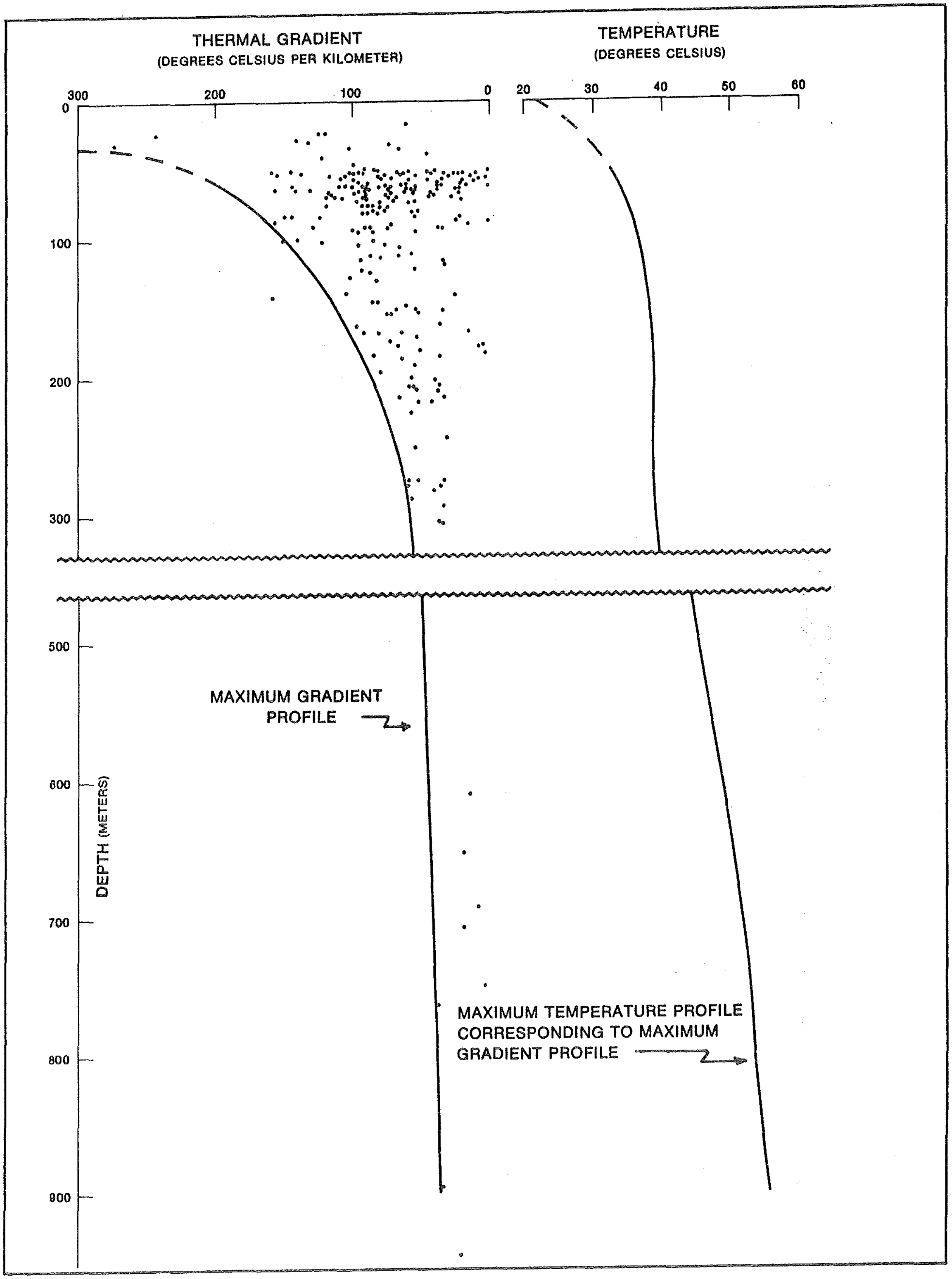


FIG. 6. — Maximum gradient and temperature profiles based on plot of calculated thermal gradient data of wells in Yuma County.

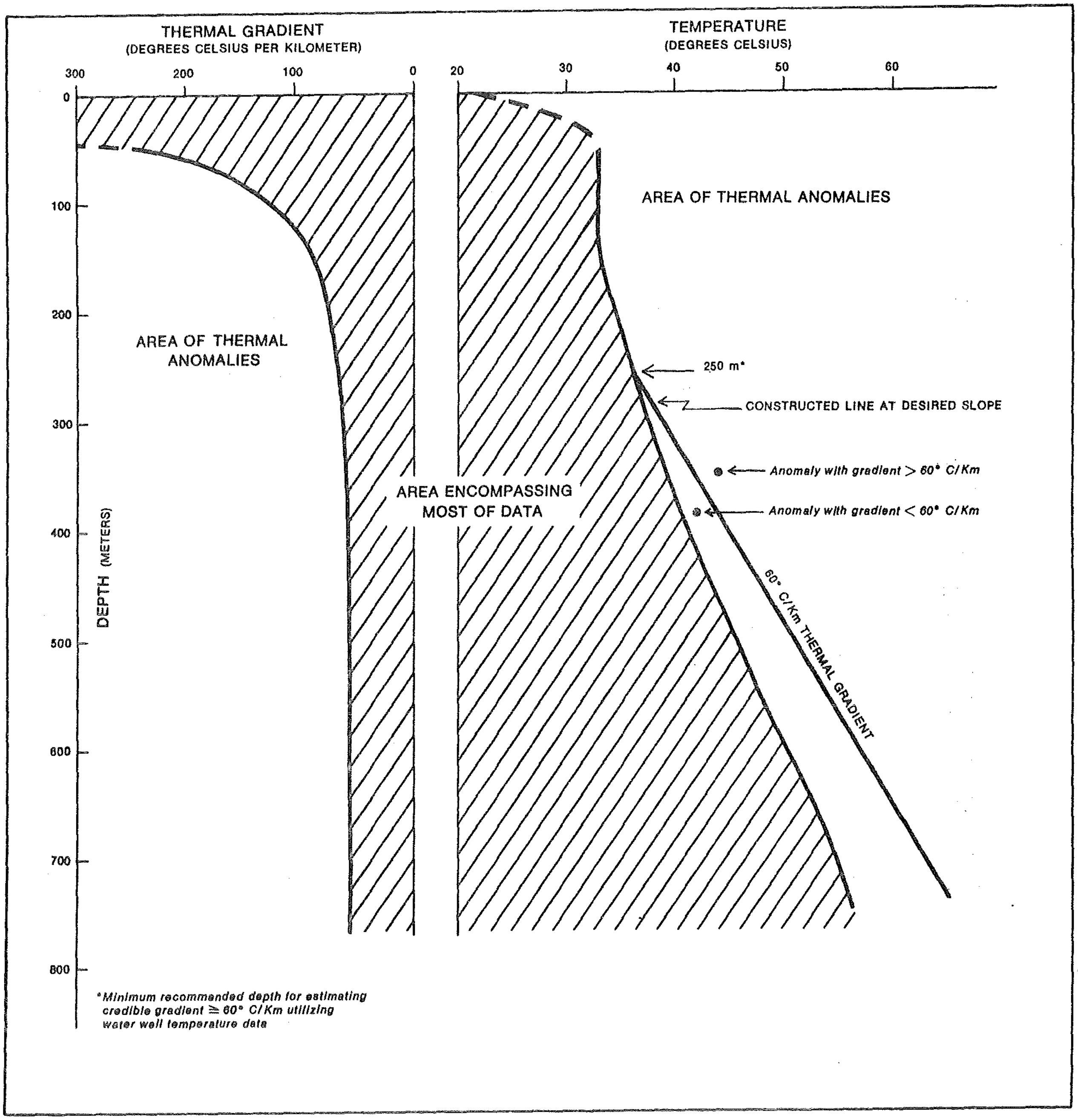


FIG. 7. — Thermal gradient and temperature profiles illustrating potential utilization in exploration for geothermal energy resources.

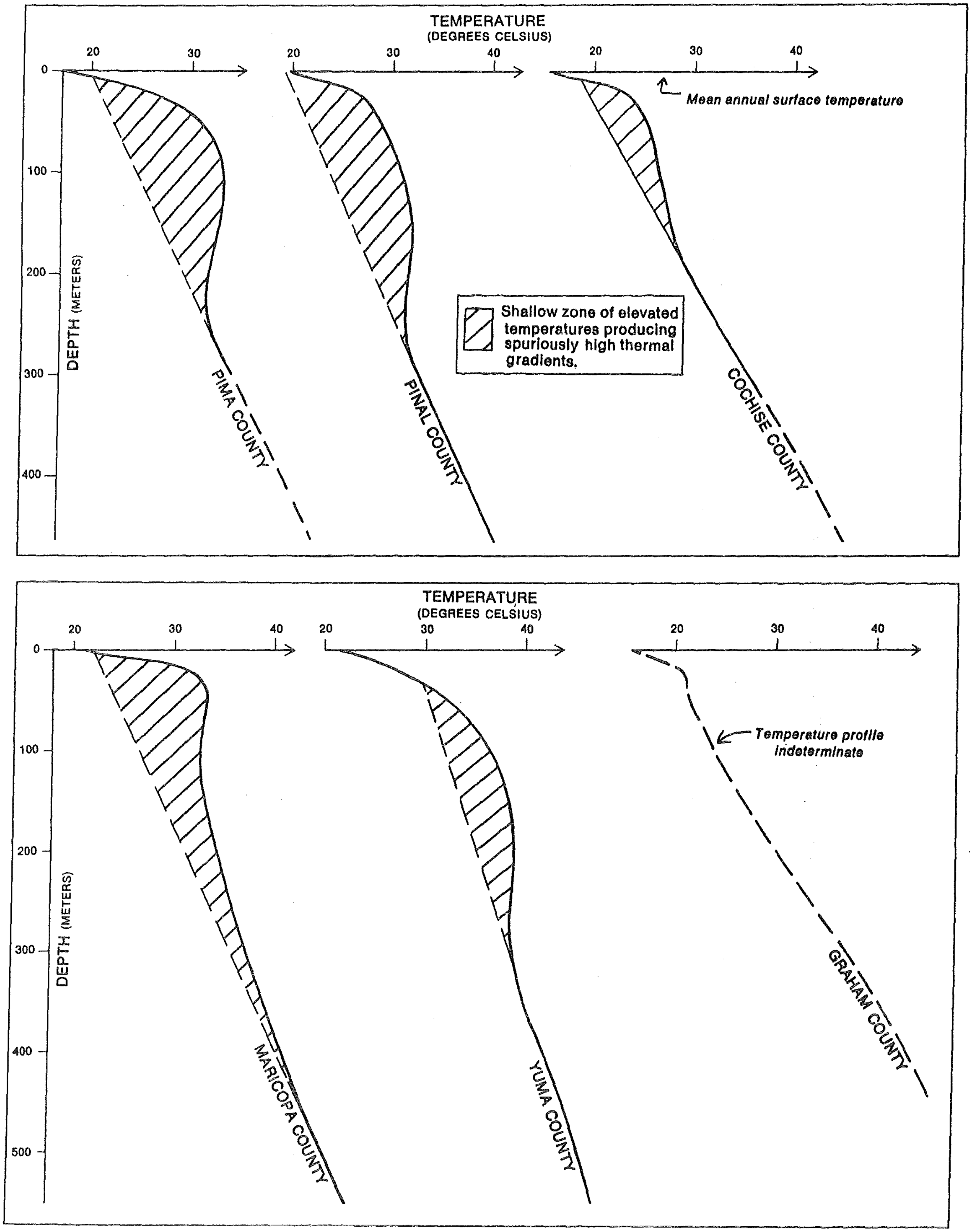


FIG. 8. — Maximum temperatures profiles in Basin and Range counties.

and Range province of Arizona is beyond the scope of this report. Structural disturbances resulting in faulting, flexing, erosion, deposition of sediments, and volcanic activity have taken place intermittently and with variable intensity throughout the geologic history of the region (Wilson and Moore, 1959). Most of the faulting occurred between 30 and 6 m.y. ago (Morrison, 1969, p. 43). The alternating mountains and valleys of the region are the result of large-scale faulting. The depression of some blocks and subsequent deposition of detritus derived from adjacent uplifted blocks produced the present day land forms.

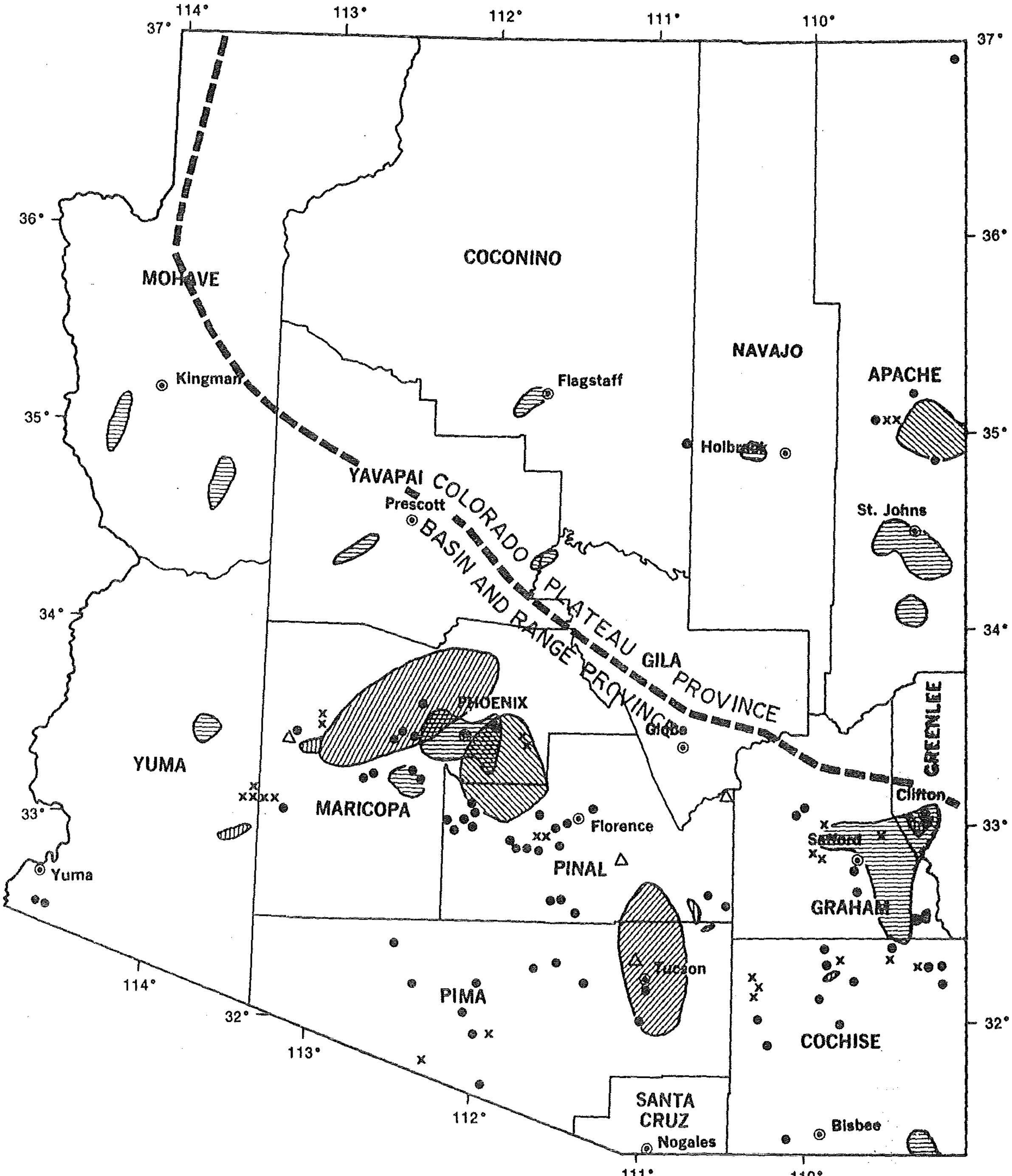
Most of the thermal water produced in the region is obtained from wells penetrating the Tertiary, Quaternary, and Recent alluvial fill in the structural basins. Deposition of the fill in the basins took place under widely varying conditions causing great discontinuity of the lenses of silt, sand, and gravel that constitute most of the section. A common exception to the irregular strata sequence of the older valley fill is the occurrence of variable thicknesses of lacustrine clay in the upper portion of the stratigraphic section in several basin areas. The apparent continuity from basin to basin in many cases exists only in the upper parts of the alluvial fill. Consequently, several basins, particularly east of the Santa Cruz basin, are structurally and hydrologically separate (Heindl and DeCook, 1952). Thick sequences of evaporites have been penetrated in several basins (Peirce, 1976).

OCCURRENCE OF THERMAL GRADIENT ANOMALIES

Geographic Distribution. Most of the identified thermal gradient anomalies are located within a west-east corridor along the course of the Gila River from Yuma through Gila Bend and Phoenix to and beyond Safford and within basinal areas in northern Cochise County. Plate 1 shows the location of the anomalies with respect to the thickness of middle and late Cenozoic alluvial deposits. Approximately 87 percent of the anomalies occur in the uppermost 610 m of these deposits. Plate 2 shows the location with respect to anomalies tentatively outlined in an earlier study by the Oil and Gas Conservation Commission. Plate 3 shows the location with respect to faults shown on a map compiled by Wright (1971). Figure 9 shows the location with respect to the anomalous geothermal regions of Swanberg and others (1977).

All of the anomalies shown on the illustrations have thermal gradients equal to or greater than 60°C/km. To achieve a limited degree of grading, two categories of anomalies are symbolized. A primary grade has been assigned to anomalies based on multi-well control within a minimum radius of 2½ miles from the appropriate symbol. In a few instances an isolated single well with an exceptionally high gradient has been graded as primary. The secondary class consists of those anomalies based on: 1) an anomalous isolated single well, 2) an anomalous well surrounded by wells lacking any temperature data, and 3) an anomalous well surrounded by wells with thermal gradients lower than 60°C/km.

Sources of Heat. Specific parameters relating to the source of heat and the mode of occurrence of the identified thermal gradient anomalies remain speculative. However, a synthesis of conclusions derived from geology and geohydrology studies (Davidson, 1973; Gerlach and others, 1975;



EXPLANATION

NEW MEXICO ENERGY INSTITUTE REPORT NO. 006

ANOMALOUS GEOTHERMAL REGIONS

- High chemical geothermometers
- High heat flow (> 2.5 HFU)
- High geothermal gradients (> 150° C/Km)
- Moderate geothermal gradients (> 36° C/Km)
- △ Single point anomalies

ARIZONA OIL AND GAS CONSERVATION COMMISSION

GEOTHERMAL ANOMALIES – GRADIENTS > 60° C/Km

- x Multi-well control within a minimum radius of 2½ miles
- ● Single well control

FIG. 9. – Map showing location of geothermal anomalies of this report with respect to anomalous geothermal regions of Swanberg and others (1977).

Grose, 1977; Hayes, 1969; Hem, 1950; Loring, 1976; Muffler and White, 1974; and others) indicate that the most probable sources of the shallow heat concentrations found in the Basin and Range province may be summarized as follows:

1. Upward convection of thermal water along fault zones; primary source of heat not known but possibly due to heated shallow crust.

2. Heat generated by late Quaternary dikes and sills intruded into Cenozoic sediments.

3. Heat produced from the exothermic hydration of anhydrite within basins containing extensive evaporite deposits.

Thermal water is closely associated with major fault zones (Waring, 1915; Meinzer, 1924; White and Brannock, 1950; Wright, 1971; and others). Stearns and others (1937) believe that thermal springs throughout the entire Basin and Range province are closely associated with major fault lines. Hem (1950) suggests that the hot springs and wells in the Coolidge Dam area result from ground-water movement along faults in the Tertiary and Pleistocene valley-fill deposits. Evidence of minor displacements and folding within Pliocene and probably early Pleistocene sediments is not common in the Basin and Range province but has been described at several localities (Loring, 1976). Davidson (1973, pl. 1) maps numerous approximately located and inferred faults in late Cenozoic deposits within the interior portion of the Tucson basin. He states:

> The faults were formed in response to periodic depression of the basin with respect to the mountains ... The relative and periodic depressions of the basin were deduced to have extended from Oligocene to middle Pleistocene time, a period of at least 25 m.y.

Bouguer gravity anomaly maps (Davis, 1971; Davidson, 1973, pl. 5) show a system of intersecting faults in the Tucson basin. Similar fault systems can be interpreted in the Bouguer gravity maps of basins in Maricopa and Pinal Counties (U.S. Bur. Reclamation, 1976).

Large sections of the crustal rock were heated to high temperatures in the Basin and Range province during mid-Tertiary orogeny (Damon, 1966). The presence of numerous deep faults and the postulated existence of elevated shallow crustal temperature lead the authors to conclude that the primary mechanism effecting the thermal gradient anomalies identified in this study appears to be the transfer of the crustal heat by thermal water along fault zones into Tertiary, Quaternary, and Recent alluvial fill. In many basins the upper alluvial deposits exhibit a decrease of water temperature with depth, indicating local lateral migration of warm waters from fault zones which displace Pleistocene deposits, and/or mixing of warm waters at basin margins where hydraulic continuity of lower and upper aquifers provide a "channel" for heat transfer.

Outward horizontal movement of these waters from the source fault or faults could partially account for the location, irregular configuration, and areal extent of the thermal gradient anomalies mapped in this and other studies. Plummer and Sargent (1931) summarize work which indicates that the temperature of fluids in the subsurface decreases outward, away from fault zones. Reiter and Shearer (1978) state that "heated ground water moving horizontally from a distant thermal source may be present" in a well near Safford. Plate 2 of this report and figures 2 and 3 of a progress report prepared by Hahman (1978) show that areas with anomalously high temperature gradients range in areal extent from one or two sections to several townships. Superimposition of the thermally anomalous sites exhibiting gradient values equal to or greater than 60°C/km identified in in this study onto the anomalous areas shown on plate 2 and the thermal gradient value patterns shown on Hahman's figures certainly suggest outward horizontal movement of thermal water from one or more fault sources.

No evidence suggesting that the source of heat for some of the identified thermal gradient anomalies could be attributed to heat generated by late Quaternary dikes and sills intruded into Cenozoic sediments was noted in this study. However, Hahman (ibid) reports that igneous intrusives associated with Tertiary volcanics is most probably responsible for an anomaly observed at the north end of the White Tank Mountains in Maricopa County. A limited number of wells for which temperature and water-productive depth data were readily available indicate that the hydration of anhydrite may be the heat source for some wells, with anomalous thermal gradients, drilled in the deep interior portions of basins and completed in evaporite deposits.

CONCLUSIONS

Computed thermal gradients based on water well data provide a rapid and inexpensive geothermal reconnaissance tool. However, the preponderance of shallow well data produce numerous abnormally high gradients that are inconsistent with considerably lower gradients in deeper wells. Utilization of the method described in this study permits determination of thermal gradients that can be more confidently extrapolated to greater depths.

Thermal water moving vertically from deep-heated crustal rock along faults into Tertiary, Quaternary, and Recent sediments and then moving outward horizontally in these sediments from fault zones appears to be the most probable mechanism effecting the identified thermal gradient anomalies. A significant number of these anomalies appear to have thermal gradients potentially adequate for non-electrical energy uses.

Those portions of areally large anomalies exhibiting computed thermal gradients equal to or greater than 60°C/km below the shallow alluvial Cenozoic sediments generally exhibiting abnormally high gradients may be closest to the fault zones emitting thermal water. Localities containing such sites offer some degree of selectivity for initial geological, geophysical, and geochemical exploratory programs designed to evaluate the geothermal energy potential.

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APPENDIX

TABLE 1

STATISTICAL ANALYSIS OF THE TEMPERATURE DATA OF SELECTED WELLS DRILLED IN THE SOUTHERN PORTION OF THE BASIN AND RANGE PROVINCE

	ALL WELLS			WELLS >300 m				
COUNTY	X-1	S	n	X-2	S	TG	Ccf	n
Cochise	111	84	216	35	9	28	.95	13
Maricopa	49	36	522	32	9	36	.93	57*
Pima	84	81	97	35	7	34	.99	10
Pinal	54	53	419	23	8	33	.95	72
Yuma	69	45	268	28	12	37	.91	18

X Mean gradient, °C/km
S Standard deviation
n Number of data points
TG Thermal gradient calculated from slope of temperature versus depth regression equation, TG=1/slope(1000)
Ccf Correlation coefficient
* Wells >400 m

TABLE 2

EXPLANATION

NO.	Well identification number
LOCATION	Location, public land survey
MAT	Mean annual temperature, degrees Celsius (Druitt, 1976)
TEMP.	Reported temperature
°C	Degrees Celsius
	Type of measurement:
	20.0 Not reported but generally borehole or wellhead water sample
	20.0 C Calculated from drill stem test data
	20.0 D Drill stem test data
	20.0 E Estimated from drill stem test data
	20.0 G Geophysical log, recorded bottom-hole temperature Accuracy variable, depending upon method of measurement.
	20.0 P Bottom-hole pressure test data
	20.0 R Reservoir pressure test data
	20.0 T Temperature log
DEPTH (m)	Depth in meters at which temperature was measured, if known; otherwise, generally depth of deepest water-productive zone
TG °C/km	Thermal (geothermal) gradient, degrees Celsius per kilometer
A	Anomalous thermal gradient (°C/km = or $>$60)
DS NO.	Data source number

Factors used in converting data reported in degrees Fahrenheit and feet:

$°C = 5/9(°F-32°)$
$m = .305$ ft

Order of data presentation:

Township, range, section and quarter/quarter by counties in alphabetical order

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
APACHE COUNTY						
1	8N-29E- 7 SW NE	7.8	38.9 T	465	67	18
2	10N-24E- 4 SW NE	9.4	41.1 G	1399	23	18
3	10N-30E-27 SW NE	10.0	38.9 G	717	40	18
4	13N-25E-12 SE SE	11.7	34.4 G	1121	20	18
5	15N-25E-30 NW SE	12.8	32.2 D	1114	17	18
6	17N-26E- 3 SW NE	12.8	37.8 G	1153	22	18
7	17N-29E-27 NE NE	10.6	44.4 G	494	68 A	18
8	18N-25E-21 NE SE	12.8	26.7 G	160	87	18
9	-23 NE NW	12.8	33.3 G	314	65	18
			69.4 G	1053	54	18
10	19N-25E-11 NE NW	11.1	23.9 G	258	50	18
11	-25 C	11.7	26.7 G	284	53	18
12	-36 NE SW	11.7	26.1 G	230	63	18
13	19N-26E- 1 SW NE	11.1	27.2 G	328	49	18
14	- 2 NE SW	10.6	26.7 G	321	50	18
15	- 4 NW SE	10.6	46.7 G	365	99 A	18
16	- 5 SW NE	11.1	26.1 G	287	52	18
17	-12 NE SW	11.1	29.4 G	335	55	18
18	-14 SW SW	11.1	29.4 G	250	73	18
19	-21 NW SE	11.1	31.7 G	282	73	18
20	-26 SE NW	11.7	31.1 G	390	50	18
21	-27 NE NW	11.7	23.9 G	292	42	18
22	-28 NE SW	11.7	28.9 G	275	63	18
23	19N-27E- 1 SE NW	11.1	35.6 G	433	57	18
24	- 3 SW NE	11.1	26.1 G	390	38	18
25	- 4 W½ W½	11.1	32.2 G	322	66 A	18
			37.8 E	322	83 A	18
26	- 5 SE NW	11.1	29.4 G	336	54	18
			37.8 E	323	83 A	18
27	- 6 SW NE	11.1	22.2 G	323	34	18
			37.8 E	320	83 A	18
28	- 8 NE NE	11.1	32.2 G	339	62	18
29	- 9 NE NE	11.1	26.1 G	368	41	18
30	- 9 NE SW	11.1	38.3 G	895	30	18
31	-23 C E½	11.7	30.0 G	475	39	18
32	20N-26E- 9 NW NW	10.0	22.2 G	371	33	18
33	-21 SW SE	10.0	21.1 G	330	34	18
34	-27 NE SE	10.6	26.7 G	321	50	18
35	-28 SE SE	10.6	27.2 G	328	51	18
36	-31 SE NE	11.1	20.0 G	262	34	18

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
78	35N-22E- 2 NE SW	10.0	45.6 D	1870	19	18
79	35N-27E-31 NE NE	9.4	27.8 D	599	31	18
			28.9 D	695	28	18
80	35N-28E- 5 SW NW	10.0	45.0 G	924	38	18
81	-25 SE SE	10.0	44.4 G	914	38	18
82	35N-29E- 1 SE NE	8.3	46.1 G	1746	22	18
83	-15 NW NE	9.4	36.1 G	1036	26	18
84	-25 SW SW	9.4	41.1 G	1178	27	18
85	35N-30E- 3 NW NW	8.3	37.8 G	1294	23	18
86	- 4 NW NW	8.3	36.7 G	1211	23	18
87	- 5 SE NE	8.3	50.0 D	1392	30	18
88	- 5 SE NW	8.3	37.8 G	1258	23	18
89	- 6 SE NE	8.3	32.2 G	1305	18	18
90	- 6 SE SE	8.3	38.3 G	1403	21	18
91	- 8 SE NE	8.3	48.9 D	1466	28	18
92	-10 SW NW	7.8	42.8 G	1517	23	18
93	-14 NE NE	7.8	54.4 C	1572	30	18
94	-15 SE SW	8.3	36.7 G	1243	23	18
95	-35 SE NE	8.3	35.6 G	1209	23	18
96	36N-22E-14 NW NW	10.0	45.0 G	2040	17	18
97	36N-24E-23 SW NE	10.0	43.3 G	1745	19	18
98	36N-27E-30 SW NW	10.0	39.4 G	1051	28	18
99	-30 SE SW	10.0	38.9 G	1010	29	18
100	36N-28E- 3 NE NW	9.4	43.3 G	1188	29	18
101	- 6 NW NW	10.0	38.9 G	1326	22	18
102	36N-29E- 4 SE SE	9.4	36.1 G	920	29	18
103	-11 SE SW	8.9	35.0 D	976	27	18
			37.8 G	1188	24	18
104	-17 SW SW	8.9	40.0 G	1535	20	18
105	-23 SE NE	8.3	35.6 G	1677	16	18
106	-24 SE SE	8.3	41.1 G	1359	24	18
107	-25 SE NE	8.3	36.7 D	1249	23	18
			48.9 D	1470	28	18
108	-25 SE SE	8.3	35.6 G	1174	23	18
109	-32 SW SE	9.4	37.8 G	988	29	18
110	-36 SE NE	8.3	35.6 R	1144	24	18
111	36N-30E- 6 NW SW	9.4	40.6 D	1027	30	18
112	-19 SE SW	8.3	35.6 G	1425	19	18
113	-20 SE SE	8.9	37.8 C	1127	26	18
			37.8 G	1180	24	18

TABLE 2

EXPLANATION

NO.	Well identification number
LOCATION	Location, public land survey
MAT	Mean annual temperature, degrees Celsius (Druitt, 1976)
TEMP.	Reported temperature
°C	Degrees Celsius
	Type of measurement:
	20.0 Not reported but generally borehole or wellhead water sample
	20.0 C Calculated from drill stem test data
	20.0 D Drill stem test data
	20.0 E Estimated from drill stem test data
	20.0 G Geophysical log, recorded bottom-hole temperature Accuracy variable, depending upon method of measurement.
	20.0 P Bottom-hole pressure test data
	20.0 R Reservoir pressure test data
	20.0 T Temperature log
DEPTH (m)	Depth in meters at which temperature was measured, if known; otherwise, generally depth of deepest water-productive zone
TG °C/km	Thermal (geothermal) gradient, degrees Celsius per kilometer
A	Anomalous thermal gradient (°C/km = or > 60)
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Factors used in converting data reported in degrees Fahrenheit and feet:

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Township, range, section and quarter/quarter by counties in alphabetical order

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95	-35 SE NE	8.3	35.6 G	1209	23	18
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103	-11 SE SW	8.9	35.0 D	976	27	18
			37.8 G	1188	24	18
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105	-23 SE NE	8.3	35.6 G	1677	16	18
106	-24 SE SE	8.3	41.1 G	1359	24	18
107	-25 SE NE	8.3	36.7 D	1249	23	18
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109	-32 SW SE	9.4	37.8 G	988	29	18
110	-36 SE NE	8.3	35.6 R	1144	24	18
111	36N-30E- 6 NW SW	9.4	40.6 D	1027	30	18
112	-19 SE SW	8.3	35.6 G	1425	19	18
113	-20 SE SE	8.9	37.8 C	1127	26	18
			37.8 G	1180	24	18

37	-34	NW	SE	10.6	31.7	G	278	76	18
					34.4	G	763	31	18
38	-35	NW	NE	10.6	27.2	G	331	50	18
39	20N-27E- 7	SE	NW	10.0	28.3	G	344	53	18
40	-11	NE	SW	10.6	32.2	G	398	54	18
41	-15	SW	NE	10.6	32.8	G	379	59	18
42	-19	NE	SW	10.6	30.6	G	372	54	18
43	-25	SW	NE	10.6	26.7	G	421	38	18
44	-25	SE	NW	10.6	28.9	T	412	44	18
45	-25	SE	NW	10.6	37.8	C	414	66	18
46	-25	C	SW	10.6	28.9	G	439	42	18
47	-25	SE	SW	10.6	26.7	G	385	42	18
48	20N-27E-26	SW	NE	10.6	26.7	G	424	38	18
49	-26	NW	NW	10.6	28.3	G	522	34	18
50	-26	SE	SE	10.6	33.3	G	393	58	18
51	-30	NW	SE	10.6	32.2	G	386	56	18
52	-31	NE	SW	11.1	31.1	D	298	67	18
53	-32	NE	SW	11.1	32.2	G	332	64	18
54	-33	NE	SW	11.1	29.4	G	347	53	18
					29.4	E	337	54	18
55	-34	SW	NE	10.6	28.9	G	371	49	18
56	-36	NE	NE	10.6	27.8	G	352	49	18
57	-36	NE	NW	10.6	29.4	G	370	51	18
58	20N-28E-11	NW	SE	10.0	26.7	G	319	52	18
59	-13	NE	SW	10.0	26.7	G	362	46	18
60	-24	NE	SW	10.0	26.7	G	368	45	18
61	-25	SE	NW	10.0	26.7	G	386	43	18
62	-30	SE	NW	10.6	28.9	G	397	46	18
63	-30	SW	SW	10.6	37.8	G	364	75	18
64	-30	SW	SE	10.6	32.2	G	410	53	18
65	20N-29E-29	NW	SE	10.0	26.7	G	386	43	18
66	21N-26E-35	SE	NW	10.0	32.2	G	493	45	18
67	21N-28E-15	NE	SW	10.0	26.7	G	157	106	18
68	-21	NE	SW	10.0	37.8	G	282	99 A	18
69	-28	NE	NE	10.0	26.7	G	402	42	18
70	25N-25E-24			11.1	30.6	G	655	30	18
71	27N-22E-35?			9.4	28.9	G	218	89	18
72	- ?			9.4	27.2	G	202	88	18
73	- ?			9.4	27.8	G	205	90	18
74	27N-23E- 7			9.4	23.9	G	204	71	18
75	29N-24E-21	SE	NW	10.0	58.3	G	1387	35	18
76	31N-23E- 3	SW	NE	9.4	47.8	G	1758	22	18
77	-29?			9.4	27.8	G	810	23	18
114	-29	SE	SW	8.9	33.3	P	943	26	18
					36.7	G	995	28	18
115	-29	SE	SE	8.9	37.8	G	1116	26	18
116	-30	SE	NE	8.9	35.0	G	1179	22	18
117	-30	SE	SW	8.9	48.9	G	964	41	18
118	-30	SE	SE	8.9	36.1	G	1135	24	18
119	-31	SE	NE	8.3	34.4	G	1115	23	18
120	-31	SE	NW	8.3	36.7	G	1168	24	18
121	-31	NW	SE	8.3	35.0	G	1185	23	18
122	36N-30E-32	SE	NE	8.9	37.2	G	884	32	18
123	-32	SE	NW	8.3	34.4	G	999	26	18
124	-32	SE	SW	8.9	35.0	G	1179	22	18
125	-32	NW	SE	8.9	41.7	G	858	38	18
126	-32	SE	SE	8.3	36.7	G	1098	26	18
127	-33	SE	NW	8.9	41.7	G	1333	25	18
					43.3	E	1280	27	18
128	-33	NW	SW	8.9	33.9	G	1092	23	18
129	37N-25E- 4	NW	SE	10.6	40.0	G	1602	18	18
130	37N-27E- 8	SE	SE	10.6	41.7	G	1521	20	18
131	-23	SE	SE	10.6	40.6	G	1158	26	18
132	37N-28E-24	NE	SE	10.0	43.3	D	1145	29	18
133	-32	NW	NE	10.0	42.2	G	1203	27	18
134	37N-29E-12	NW	NE	10.0	48.9	D	1129	34	18
135	-16	NE	NE	10.0	31.7	G	1201	18	18
136	-16	NW	SE	10.0	42.8	G	1148	29	18
137	-22	NW	NW	10.0	38.9	G	1146	25	18
138	-33	SE	SE	10.0	37.8	G	1099	25	18
139	-35	NW	NW	10.0	37.8	D	1087	26	18
140	37N-30E-30	NE	SW	10.0	33.3	D	949	25	18
141	-34	NE	NE	10.0	43.3	G	1403	24	18
142	38N-23E-13	SW	SE	11.1	43.3	G	1694	19	18
143	38N-27E-20	SE	SE	10.0	50.0	D	1655	24	18
144	38N-29E-16	NE	SE	10.0	45.0	G	1355	26	18
145	38N-30E- 2	NW	NW	10.0	46.1	G	1520	24	18
146	-12	SE	NW	10.0	50.0	G	1467	27	18
147	-18	NW	NW	10.0	43.3	G	1639	20	18
148	-32	NE	SE	10.0	37.8	G	1343	21	18
149	39N-23E-12	SE	NW	11.1	51.1	D	1896	21	18
150	-12	NW	SE	11.1	51.1	G	1929	21	18
151	-24	NW	SW	11.1	50.0	G	1967	20	18
152	39N-24E- 7	SE	SE	11.1	47.2	D	1534	24	18
153	39N-25E-16	NW	NW	10.0	45.0	G	1838	19	18
154	-28	SE	NW	10.0	46.1	G	1721	21	18

APACHE COUNTY (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
155	39N-26E-19 NW SW	10.0	48.9 D	1720	23	18
156	39N-29E- 1 SE SE	10.0	52.2 D	2533	17	18
157	40N-24E- 8 NE SW	11.7	48.9 G	2011	18	18
158	40N-25E- 6 NE NE	11.7	48.9 G	2059	18	18
159	-11 NE SE	10.0	42.2 D	953	34	18
			60.0 D	1585	32	18
			68.9 D	1985	30	18
160	40N-26E-20 SE SE	10.0	52.2 D	1304	32	18
			70.0 D	1871	32	18
161	-30 NW NW	10.0	46.7 G	1987	18	18
162	40N-27E- 6 NW NW	11.1	45.0 G	2072	16	18
163	40N-28E- 1 SW SW	11.7	54.4 D	1720	25	18
164	- 2 SW SE	11.7	47.8 G	1630	22	18
165	- 6 NW SW	11.7	65.6 D	1922	28	18
			77.2 D	2178	30	18
166	- 9 NW NW	11.7	50.0 D	1575	24	18
167	-11 NE NE	11.7	48.9 G	1854	20	18
168	-11 NE NW	11.7	46.1 G	1769	19	18
169	-12 SW NW	11.7	48.9 R	1537	24	18
170	-16 SE NW	11.1	57.8 G	1932	24	18
171	-17 NW NE	11.1	46.1 G	1934	18	18
172	-18 NW NW	11.1	53.3 G	2109	20	18
173	40N-29E- 6 SW SW	12.2	54.4 G	1989	21	18
174	- 7 SE SE	11.7	50.0 G	1764	22	18
175	- 9 SE SW	12.2	50.6 G	1789	21	18
176	-15 NE SW	11.7	62.8 D	1488	34	18
			73.9 D	1750	36	18
177	-15 SW SW	11.7	48.9 D	1649	23	18
			57.8 G	2020	23	18
178	-16 SE NW	11.7	57.8 D	1754	26	18
179	-17 NE NE	11.7	51.7 G	1880	21	18
180	40N-29E-18 NE SE	11.7	47.8 G	1910	19	18
181	-21 SE NE	11.7	46.1 D	1558	22	18
			55.6 D	1830	24	18
182	-27 SW NE	11.7	51.1 G	2175	18	18
183	40N-30E- 2 NW SE	12.8	57.2 G	2205	20	18
184	- 3 NE NE	12.8	43.9 G	356	87 A	18
185	- ?	12.8	27.2 G	354	41	18
186	- 5 SW SW	12.8	52.2 G	1958	20	18

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
228	41N-30E-21 NE SW	13.3	36.7 D	1520	15	18
			61.1 D	1680	28	18
229	-23 SW SW	13.3	48.9 D	1624	22	18
230	-23 SE SW	13.3	52.2 G	2075	19	18
231	-23 NW SE	13.3	48.9 D	1776	20	18
232	-23 SE SE	13.3	50.0 D	1659	22	18
233	-30 NE NW	12.8	48.3 G	2024	18	18
234	-30 SW SE	12.8	49.4 G	2059	18	18
235	-36 NW SW	12.8	57.8 G	2134	21	18
236	41N-31E- 7 SE NE	13.3	21.7 G	142	59	18
237	- 7 SW SW	13.3	50.6 D	1703	22	18
238	-18 SE NE	13.3	26.7 G	128	105	18
239	-19 NW NW	12.8	26.7 G	211	66	18
240	-19 SW NW	12.8	48.9 G	1724	21	18
241	-19 SW SE	12.8	26.7 G	209	67	18
242	-33 SE SE	12.8	46.1 G	1764	19	18

APACHE COUNTY (Navajo Survey)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
243	4N- 7W-11 SW SW	8.9	35.6 G	724	37	18
244	6N- 6W-20 NW NW	8.9	30.0 G	854	25	18
245	6N- 7W-32 NE NE	8.9	34.4 G	846	30	18
246	6N-10W-14 SW NW	10.0	38.9 G	946	31	18
247	7N- 7W-15 SE SE	9.4	35.0 G	915	28	18
248	-26 NW NE	9.4	32.2 G	758	30	18
249	-32 NW SE	9.4	37.8 G	895	32	18
250	7N-10W- 1 NW NW	10.0	37.8 G	1049	27	18
251	-17 SE SE	10.0	40.6 G	1210	25	18
252	7N-11W	11.1	29.4 G	379	48	18

187	41N-22E-12	NW SW	11.1	51.1 D	852	47	18
188	41N-24E-16	NE NE	11.1	47.2 G	2063	17	18
189	41N-25E-16	NW SE	11.7	54.4 G	2018	21	18
190	-17	NE NE	11.1	60.0 D	1931	25	18
191	-20	NE NE	11.1	62.2 D	1993	26	18
192	-21	NW NE	11.1	54.4 G	2068	21	18
193	41N-26E-23	NW NW	11.7	56.1 G	1930	23	18
194	-28	SW SE	11.1	40.0 G	1462	20	18
				51.1 G	1958	20	18
195	-31	SW SW	11.1	53.3 G	1983	21	18
196	-33	SW SW	11.1	41.1 G	2015	15	18
197	41N-27E-22	NE NE	12.2	43.9 G	1908	17	18
198	41N-28E- 1	SW SW	13.3	37.8 G	1876	13	18
199	- 2	SW SW	13.3	46.1 D	1439	23	18
200	- 3	SE NW	12.8	56.7 G	1623	27	18
201	- 3	NE SW	12.8	61.1 D	1602	30	18
202	- 3	SW SW	12.8	41.1 G	1480	19	18
203	- 4	NE SE	12.8	46.7 R	1394	24	18
204	- 4	SW SE	12.8	43.3 G	1528	20	18
205	- 5	NW NE	12.8	47.8 G	1906	18	18
206	- 5	SE SE	12.8	45.0 G	1741	18	18
207	41N-28E- 9	NE NE	12.8	43.3 G	1576	19	18
208	- 9	NW NE	12.8	38.9 G	1523	17	18
209	- 9	SW NE	12.8	57.2 G	1979	22	18
210	- 9	NE NW	12.8	40.0 G	1590	17	18
211	-10	SW NE	12.8	43.3 D	1581	19	18
212	-11	SW NW	12.8	41.1 D	1455	19	18
213	-11	NE SW	12.8	42.8 R	1383	22	18
214	-22	SW NW	12.8	53.9 G	1800	23	18
215	-27	SE NW	12.8	48.3 G	1911	19	18
216	-31	SE SW	12.2	53.3 G	2329	18	18
217	41N-29E- 3	SE NE	13.3	54.4 E	1570	26	18
218	- 4	NE SE	13.3	48.9 G	1883	19	18
219	- 6	SE SE	13.3	50.0 G	1606	23	18
				54.4 G	1978	21	18
220	-22	NE NE	12.8	55.6 G	1924	22	18
221	-29	SE SE	12.8	49.4 G	2056	18	18
222	41N-30E-10	NW SW	13.3	61.7 G	1928	25	18
223	-11	SE NE	13.3	23.9 G	142	75	18
224	-13	SW NE	13.3	32.2 G	214	88	18
225	-13	SE SE	13.3	40.0 G	1650	16	18
226	-16	SW SW	13.3	71.7 G	2070	28	18
227	-16	SE SW	13.3	49.4 D	1666	22	18
				54.4 G	1749	24	18

COCHISE COUNTY

1	12S-23E- 2	NW NW	15.6	20.0	102	43	5
2	-11	NW NW	15.6	19.4	92.4	41	5
3	-13	NW NW	15.6	20.0	52.5	84	5
4	-13	NW SE	15.6	21.7	80.8	75	5
5	-13	SW SE	15.6	21.1	117	47	5
6	-14	NW NE	15.6	21.1	85.9	64	5
7	-14	NW SW	15.6	20.0	81.1	54	5
8	-24	NE SE	15.6	21.1	49.1	112	5
9	12S-24E- 2	SW SW	15.6	24.4	55.8	158	5
10	-17	NW SW	15.6	21.1	45.1	122	5
11	-18	NW NE	15.6	21.7	51.9	118	5
12	-28	NE NE	15.6	26.7	64.1	173 A	5
13	-29	SE SW	15.6	19.4	28.7	132	5
14	-31	NW NE	15.6	21.1	65.6	84	5
15	-31	NW NW	15.6	23.3	115	67	5
16	-31	NW SE	15.6	23.9	61.0	136	5
17	-32	SW SW	15.6	21.1	35.1	157	5
18	-33	NW SW	15.6	20.6	31.7	158	5
19	-34	NW NE	15.6	24.4	61.3	144	5
20	-35	SE SW	15.6	19.4	24.4	156	5
				23.3	61.0	126	5
21	12S-28E-22	SE SW	16.7	30.0	198	67 A	16
22	13S-19E-10	SW SE	17.2	19.0	31.1	58	21
23	-24	SW SW	16.7	22.0	21.4	248	21
24	13S-20E- 7	SE SE	17.2	31.0	134	103	21
25	13S-22E-33	NE SE	16.7	61.1 G	1612	28	18
26	13S-24E- 2	NE NW	15.6	20.0	40.0	110	5
27	- 2	NW SE	15.6	21.7	59.2	103	5
28	- 5	NW NE	15.6	22.2	67.1	98	5
29	- 5	NW NW	15.6	21.1	33.6	164	5
30	- 6	NW SE	15.6	20.6	40.3	124	5
31	13S-24E-10	NW SW	15.6	20.0	24.4	180	5
32	-15	SW NW	15.6	22.8	45.8	157	5
33	-23	NW NW	15.6	20.0	18.9	233 A	5
34	-23	NW NW	15.6	20.6	28.1	178	5
35	-23	SW SE	15.6	86.7 T	2028	35	18
36	-24	SW SE	15.6	26.7	20.1	552 A	5
37	-27	NW NE	15.6	20.0	36.0	122	5
38	-29	NE NE	16.1	20.6	30.5	148	5
39	-35	NW NE	15.6	20.6	24.4	205	5
40	-35	NW NE	15.6	19.4	24.4	156	5

COCHISE COUNTY (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
41	13S-25E- 3 SW SE	15.0	20.6	36.0	156	5
42	- 9 SE SE	15.6	24.4	30.5	289 A	5
43	-17 SW NE	15.6	23.9	30.5	272 A	5
44	-27 SW NE	15.6	21.7	27.5	222	5
45	-31 NE NW	15.6	20.0	22.6	195	5
46	-31 NE SW	15.6	32.8 G	577	30	18
47	-31 NE SW	15.6	31.7	244	66	5
48	-31 SW SW	15.6	21.1	24.1	228	5
49	-31 SW SE	15.6	21.7	31.1	196	5
50	13S-28E- 3 SW	16.1	37.2	244	86 A	16
51	- 4 SE SE	16.1	37.2	253	83 A	30
52	- 9 SW NW	15.6	31.7	214	75 A	30
53	13S-29E- 6 SW SW	16.1	31.1	255	59	30
54	-18 SE NW	16.1	28.3	262	47	30
55	-24 SW SE	16.1	41.7	294	87 A	30
56	13S-30E- 3 SE NW	16.7	33.3	262	63	30
57	-11 SW NW	16.7	32.2	290	53	30
58	-13 NE	16.7	31.1	232	62	22
59	-14 SE SE	16.7	32.2	284	55	30
60	-15 NE SE	16.1	35.0	297	64	30
61	13S-30E-23 SW NE	16.1	30.6	275	53	30
62	-23 NW	16.1	33.3	275	63	22
63	-25 NE	16.1	26.7	268	40	22
64	-26 NW	16.1	28.9	285	45	22
65	-27 SE NE	16.1	73.9	741	78 A	18
			134.4	1952	61	18
66	-30 SW NW	15.6	40.0	293	83 A	30
67	13S-31E-18 NE	16.7	28.3	186	62	22
68	-19 SW	16.7	27.8	256	43	22
69	-20 NE	16.7	28.3	180	64	22
70	-20 NW	16.7	28.9	171	71 A	22
71	-20 SE	16.7	28.9	195	63	22
72	-20 NE SE	16.7	28.9	188	65	30
73	-21 SE	16.7	26.7	168	60	22
74	13S-31E-28 NE	16.7	27.8	167	66	22
75	-28 NW	16.7	27.8	205	54	22
76	-28	16.7	27.2	191	55	22
77	-29 NE	16.1	26.1	188	53	22
78	-29 SE	16.1	27.2	232	48	22

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
122	14S-31E-25 NW SE	16.1	25.6	192	49	30
			26.7	192	55	30
123	-26 NW	16.1	27.2	224	50	22
124	-27 NW	15.6	28.3	226	56	22
125	14S-32E-19 NW	16.7	23.9	119	61	22
126	-19 SW	16.7	26.7	135	74	22
127	-19 SW	16.7	22.8	63.1	97	22
128	15S-20E- 8 NW SW	16.1	29.0	157	82 A	21
129	-10 SE NW	16.7	23.0	29.3	215 A	21
130	15S-24E-20 NE NW	16.1	22.2	24.7	247 A	5
131	-20 NE SW	16.1	23.3	30.5	236	5
132	-20 SE SW	16.1	22.2	30.2	202	5
133	-20 SW SE	16.1	23.3	61.0	118	5
134	-30 SW SE	16.1	22.8	122	55	5
135	15S-25E-15 SE SE	15.6	21.1	76.3	72	5
136	-25 SE NE	15.0	24.4	157	60	5
137	-25 SE SE	15.0	25.6	144	74	5
138	15S-25E-26 SE SE	15.0	26.1	139	80	5
139	-35 SE NE	15.0	26.7	214	55	5
140	15S-26E- 5 SE SW	15.0	23.9	143	62	5
141	- 6 NE SE	15.0	25.0	138	72	5
142	- 6 SE SE	15.0	25.0	140	71	5
143	-19 NE NW	15.0	22.2	104	69	5
144	-26 NW NW	14.4	24.4	107	93	5
145	-30 SE SW	15.0	25.6	159	67	5
146	15S-31E-24 NE NE	15.6	22.8	52.5	137	30
147	16S-19E-17 NW NE	15.0	20.6	22.9	245	16
148	-17 NW NE	15.0	21.0	45.8	131	21
149	16S-20E- 6 SW NE	15.6	20.0	36.3	121	21
150	- 6 SW NE	15.6	23.0	39.7	186	21
151	- 6 SW SE	15.6	21.0	38.7	140	21
152	-27 SW SE	16.1	20.0	22.0	268	21
153	-34 NE NW	16.1	19.0	22.9	127	21
154	-34 NE SE	16.1	30.0	305	46	21
155	16S-22E-15 SE NE	16.7	21.1	32.3	136	5
156	16S-23E-19 NE SW	16.7	26.1	172	55	5
157	16S-24E-36 NW NE	15.6	19.4	23.5	162	5
158	16S-25E- 1 NE NW	15.0	19.4	30.5	144	5
159	- 2 SE SW	15.0	21.1	31.7	192	5
160	- 9 NE NW	15.6	26.1	119	88	5

79	-31		SW	16.1	28.9	270	47	22
80	-31		SE	16.1	27.8	259	45	22
81	-33		NE	16.7	26.7	180	56	22
82	-33	SE	SW	16.7	26.7	223	45	30
83	-33		SE	16.7	27.2	210	50	22
84	-33	SE	SE	16.7	26.1	183	51	30
85	-33	SE	SE	16.7	26.7	214	47	30
86	14S-20E- 8	NW	SW	16.7	24.0	38.1	192 A	21
87	-28	NE	SE	16.7	22.0	25.0	212 A	21
88	-28	NE	SE	16.7	23.0	15.3	412 A	21
89	-34	NW	NW	16.7	28.0	75.0	151 A	21
90	-34	NE	SW	16.7	26.0	44.2	210 A	21
91	-34	SW	SW	16.7	21.0	19.8	217 A	21
92	14S-22E-31	NW	NE	16.1	21.7	48.8	115	5
93	14S-23E-36	NE	NW	16.1	19.4	24.4	135	5
94	14S-25E- 6	NE	NE	15.6	36.7	235	90 A	18
95	- 6	NW	SW	15.6	35.0	214	91 A	5
96	14S-26E-18	NE	SW	15.0	28.9	153	91 A	5
97	14S-30E-36	NE	NE	15.0	75.6 G	2312	26	18
98	14S-31E- 3		NW	16.1	26.7	191	55	22
99	- 3	SW	SW	16.1	26.1	218	46	30
100	- 4	NW	NE	16.1	26.7	223	48	30
101	- 7	SW	SW	15.6	28.9	232	57	16
102	-10		NE	16.1	26.7	184	58	22
103	-10	NW	SE	16.1	26.1	198	51	30
104	-11		SW	16.7	24.4	132	58	22
105	-13		SW	16.7	26.7	149	67	22
106	-14		NW	16.1	23.9	134	58	22
107	-14	NE	SE	16.1	27.2	214	52	30
108	14S-31E-15	NW	NW	16.1	25.6	251	38	30
109	-15		SW	16.1	28.3	221	55	22
110	-15	SE	SW	16.1	29.4	244	55	30
111	-17		NE	15.6	28.9	253	53	22
112	-21		NE	15.6	28.9	223	60	22
113	-21	SW	NW	15.6	32.2	217	76 A	30
114	-21		SE	15.6	29.4	244	57	22
115	-22		SE	16.1	28.3	235	52	22
116	-23		NW	16.1	28.9	215	60	22
117	-23		SW	16.1	28.3	229	53	22
118	-23		SE	16.1	26.7	189	56	22
119	14S-31E-24		NW	16.7	25.0	180	46	22
120	-25		NE	16.1	26.7	195	54	22
121	-25		SE	16.1	28.3	201	61	22
161	-15	NW	NE	15.0	25.0	168	60	5
162	-23	SE	NE	15.0	19.4	15.9	277	5
163	-24	SE	NE	15.0	22.8	122	64	5
164	16S-31E-10	NE	NE	15.0	54.4 G	1657	24	18
165	17S-20E- 4	NE	SE	15.6	31.0	311	50	21
166	- 9	NE	NE	15.6	31.0	302	51	21
167	-14	SW	SW	16.1	27.0	195	56	21
168	17S-21E-32	NE	NW	16.7	27.0	159	65	21
169	17S-24E-12	SE	SE	15.6	21.1	45.8	120	5
170	17S-25E- 3	NE	SE	15.6	21.7	17.7	345 A	5
171	- 7	NW	NW	15.6	21.1	23.8	231	5
172	- 9	SW	NW	15.6	21.7	39.7	154	5
173	-17	NW	NW	15.6	21.1	23.8	231	5
174	17S-25E-19	SW	SE	15.6	21.7	58.0	105	5
175	-23	NE	SE	15.0	20.6	22.9	245	5
176	-33	SW	NW	15.6	22.2	38.7	171	5
177	-35	SW	SW	15.0	21.7	44.5	151	5
178	17S-26E-10	NE	SE	15.0	26.7	198	59	5
179	-34	NE	SW	14.4	20.0	30.5	184	5
180	18S-21E- 5	NW	NW	16.7	22.0	82.4	64	21
181	- 6	NE	NE	16.1	27.0	18.3	596 A	21
182	- 6	NW	NE	16.1	20.0	31.7	123	21
183	- 7	SE	SE	16.1	26.0	192	52	21
184	-16	SW	SW	16.7	28.0	207	55	21
185	-28	SW	SW	16.7	21.0	37.2	116	21
186	-33	NE	SE	16.7	26.0	143	65	21
187	18S-25E- 9	NW	NW	15.6	21.7	59.5	103	5
188	-12	SE	SE	15.0	21.7	63.7	105	5
189	18S-26E-10	SW	SW	14.4	21.1	33.6	199	5
190	-11	NE	NW	14.4	19.4	30.5	164	5
191	-15	NW	NW	14.4	21.1	33.6	199	5
192	-16	NW	NW	15.0	20.0	36.6	137	5
193	-19	NE	NW	15.0	21.1	48.8	125	5
194	-28	SE	SE	14.4	20.0	24.4	230	5
195	-29	SE	SW	15.0	19.4	26.2	168	5
196	-32	NW	SE	15.0	19.4	24.4	180	5
197	-34	NW	NW	14.4	20.0	25.9	216	5
198	20S-20E-27	SE	SW	16.7	21.0	38.7	111	21
199	21S-19E- 1	SE	SE	16.1	22.0	54.9	107	21
200	21S-20E- 5	SW	NE	16.1	22.0	87.5	67	21
201	21S-21E-22	SE	SE	16.7	22.0	39.7	134	21
202	-27	NW	SW	16.7	21.0	45.8	94	21
203	-29	SW	SW	16.7	23.0	85.4	74	21

COCHISE COUNTY (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
204	21S-24E- 5 NE NE	16.1	48.9 G	964	34	18
205	- 5 NW SE	16.1	47.8 G	1069	30	18
206	21S-25E-25 SE NE	15.6	64.4 G	1511	32	18
207	22S-27E- 5 SE NW	15.0	53.9	1284	30	7
208	23S-22E-15 SW NE	16.7	21.0	73.2	59	21
209	-21 SE SW	16.7	25.0	16.8	494 A	21
210	-33 NW SW	16.7	24.0	122	60	21
211	-33 SW SW	16.7	21.0	56.4	76	21
212	-34 NW SW	16.7	24.0	50.3	145	21
213	24S-22E- 5 SW NE	16.7	22.0	99.1	53	21
214	- 8 SE NE	16.7	24.0	76.3	96	21
215	-17 NE SW	16.7	23.0	76.3	83	21
216	24S-31E- 2 NE SW	12.8	41.1 T	813	35	18

COCONINO COUNTY

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
1	14N-14E-30 SW NE	8.3	40.6 G	1162	28	18
2	17N- 6E- 6 SE SE	15.6	31.1 G	341	45	18
3	17N- 9E-11 SE NW	7.2	35.0 G	1197	24	18
4	18N-15E-28 NE NE	12.2	34.4 G	342	65	18
5	19S-10E-24 SE SW	10.0	54.4 C	1540	29	18
6	20N-10E-26 NW SE	10.0	33.3 G	1089	21	18
7	20N-11E-12 NE NW	11.1	27.8 G	1105	15	18
8	29N-14E-11 NW NW	11.1	60.0 D	2118	23	18
9	29N-15E- 6 NW NW	10.6	48.9 G	2135	18	18
10	37N-14E-28 N½ NE	11.7	61.1 G	2198	22	18
11	39N- 2E-32 NE NE	8.3	30.6 G	1181	10	18
12	28N- 1W-35 SW NE	9.4	42.2 G	642	51	18
			53.3 G	1081	41	18

GILA COUNTY

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
1	3S-15E-29 SE NW	17.2	43.3	45.8	570	10

GRAHAM COUNTY (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
42	7S-27E- 2 SW SW	16.1	35.6	91.5	213 A	10
43	- 4 NE SE	16.1	20.0	24.7	158	16
44	- 9 SE SE	16.1	20.0	21.0	186	16
45	-16 SW SW	16.7	21.1	35.1	125	16
46	-17 NE SW	16.7	19.4	21.7	124	16
47	-18 SW SE	16.7	20.0	22.6	146	16
48	-20 NE NE	16.7	21.1	25.9	170	16
49	-20 NE NW	16.7	20.6	24.7	158	16
50	8S-25E-12 NE NE	18.3	36.7	320	58	16
51	-12 SW NE	18.3	34.4	320	50	16
52	-12 SE NW	18.3	24.4	61.0	100 A	16
53	8S-26E- 7 SE NE	18.3	25.0	137	49	16
54	9S-26E- 5 NW NW	17.2	29.4	122	100 A	16
55	9S-28E-23 SW SW	17.8	23.9	76.3	80 A	16
56	9S-30E-11 SE SE	16.1	72.2	86.9	646 A	1
57	10S-28E-25 SE SE	17.8	36.0	474	38	26
58	-36 NE NE	17.2	42.2	418	60	18
59	11S-19E-10 SW SE	17.8	23.0	91.5	57	21
60	11S-24E-20 SW NW	15.6	21.1	105	52	5
61	-31 SW SE	15.6	20.0	26.5	66	5
62	11S-29E- 1 SE SW	17.2	28.9	183	64	30
63	-36 NW SW	17.2	32.2	207	72 A	30

GRAHAM COUNTY

1	4S-22E-13	SE NW	16.7	20.0	23.2	142	16
2	-13	SE SE	16.7	28.3	247	47	16
3	-35	NE NE	18.3	21.7	22.9	148 A	16
4	4S-23E-17		16.7	30.6	10.8	1287 A	10
5	-19	NW	17.2	27.8	247	43	16
6	5S-23E-11	NW NW	17.2	20.0	20.1	139	16
7	5S-24E- 7	NW NW	16.7	23.9	5.6	1286 A	16
8	-16	NW SW	16.7	48.3	183	173 A	18
9	-17	SE NE	16.7	48.3	183	173 A	26
10	-20	NE NW	17.2	20.6	20.1	169	16
11	-31	SE SE	17.8	21.1	23.2	142	16
12	6S-24E- 1	SW NE	17.2	20.0	18.3	153	16
13	- 2	NE SW	17.2	19.4	23.5	94	16
14	- 4	NW SW	17.2	47.7	18.0	1694 A	26
15	- 5	SW NE	17.8	20.6	19.5	136	16
16	-10	SE NE	17.8	19.4	16.2	99	16
17	-13	NW NE	17.8	58.9	1149	36	16
18	-23	SE NE	18.3	20.6	19.5	118	16
19	6S-25E- 7	NW NE	17.2	20.6	31.4	108	16
20	-22	SE NW	17.2	21.1	22.3	175	16
21	-23	SW SW	17.2	20.6	27.5	120	16
22	-32	SE NE	18.3	21.1	21.4	131	16
23	-36	NW SW	18.3	46.5	659	43	26
24	6S-27E-35	SW NE	15.6	24.4	15.9	553 A	16
25	6S-28E-31	NE NE	15.6	19.4	17.4	218	16
26	7S-23E- 1	SE NE	18.3	22.8	183	23	16
27	- 1	NE SW	18.3	21.7	24.4	139 A	16
28	7S-24E- 8	SW NW	18.3	22.2	45.8	85 A	16
29	- 8	NE SW	18.3	21.7	54.0	63	16
30	-17	SE NW	18.3	30.6	10.8	1139 A	16
31	-17	NW SW	18.3	20.0	27.1	63	16
32	-27	SE NE	18.3	20.0	19.8	86	16
33	-29	NW SE	17.8	21.1	25.3	130	16
34	-33	SE NE	17.8	20.6	27.5	102	16
35	-34	NW SW	17.8	20.0	23.5	94	16
36	7S-25E-11	NE SE	18.3	20.0	25.9	66	16
37	-12	SW SW	18.3	19.4	29.3	38	16
38	7S-26E- 6	NE NW	17.8	18.9	15.3	72	16
39	-13	SW SE	17.2	19.4	29.0	76	16
40	-24	NW NE	16.7	19.4	25.9	104	16
41	-31	NW SE	18.3	22.2	24.4	160 A	16

MARICOPA COUNTY - Townships North, Ranges East

1	1N- 1E- 2	NW NW	21.1	28.3	244	30	15
2	- 3	NW NE	21.1	29.4	183	46	15
3	- 4	NE NW	21.1	27.8	172	39	16
4	- 6	NE SE	21.1	25.6	131	34	16
5	- 9	NW NW	21.1	27.8	153	44	15
6	-10	SW SW	21.1	25.0	202	19	15
7	-17	NW NW	21.7	23.9	97.6	23	16
8	-19	NW NE	21.7	25.0	46.1	72	15
9	-23	SE SE	21.7	21.7	49.1	0	16
10	-33	NW SE	21.7	21.7	36.6	0	16
11	1N- 2E- 9	SW SE	21.1	34.5	592	23	26
12	1N- 4E- 1	NW NE	20.6	27.0	150	43	2
13	- 1	SE SW	20.6	32.0	259	44	2
14	-11	SW NE	20.6	27.0	166	39	2
15	-11	NE NW	20.6	36.0	320	48	2
16	-11	SE SW	20.6	29.0	177	47	2
17	-23	NW SE	20.6	26.0	128	42	16
18	-27	NE NE	20.6	26.0	46.1	117	16
19	-31	NE NE	21.1	23.0	46.1	41	16
20	1N- 5E- 2	NE NE	20.6	23.0	75.0	32	16
21	- 9	SW SE	20.6	26.0	214	25	16
22	-21	NW NE	20.6	26.0	124	44	16
23	-26	SE SE	20.6	23.0	110	22	16
24	-32	SW SW	20.6	22.0	46.4	30	16
25	-34	SE SE	20.6	23.0	120	20	16
26	1N- 6E- 3	NE SE	20.6	23.9	142	23	16
27	- 4	NW SE	20.6	22.2	85.4	19	16
28	- 9	NE NE	20.6	22.2	77.8	21	16
29	-10	SW SW	20.6	23.3	100	27	16
30	-15	SE NW	20.6	23.9	94.6	35	16
31	-21	SE SW	20.6	34.5	66.5	209 A	26
32	-22	NW NE	20.6	25.6	90.6	55	16
33	-23	SE NE	20.6	42.2	92.4	234 A	16
34	-23	NW SW	20.6	33.9	247	54	16
35	-23	SE SW	20.6	41.7	99.1	213 A	16
36	-23	NW SE	20.6	41.1	91.5	224 A	16
37	-24	SW NE	20.6	54.4	305	111 A	6
38	-26	SW NE	20.6	37.0	107	153 A	26
39	-35	NE NE	20.6	31.7	88.5	125	16
40	-35	NW NW	20.6	32.8	101	121	16
41	-36	NW SW	20.6	30.0	91.5	103	16

NO.	LOCATION MARICOPA COUNTY (Cont'd)	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
42	1N- 7E-21 NW SE	21.1	32.2	156	71	16
43	-23 SW NE	21.1	28.9	107	73	16
44	-36 NE SE	21.1	47.4 T	397	66 A	25
45	2N- 1E- 5 NE NW	20.6	27.2	187	35	15
46	- 8 SE SW	21.1	28.3	244	30	15
47	- 8 SE SE	21.1	28.3	183	39	15
48	- 9 SE SE	21.1	27.2	168	36	15
49	-13 SW SW	20.6	28.3	244	32	15
50	-14 SW SW	21.1	27.8	214	31	15
51	-15 NW NE	21.1	26.7	165	34	15
52	-15 NW SW	21.1	27.2	153	40	15
53	-17 SE SE	21.1	27.8	168	40	15
54	-20 SW SW	21.1	28.3	212	34	15
55	-20 NE SE	21.1	28.3	153	48	15
56	-20 SE SE	21.1	27.8	171	39	15
57	-21 NE NE	21.1	30.6	305	31	16
58	2N- 1E-23 SW SW	21.1	27.8	214	31	15
59	-26 NE SE	21.1	27.8	214	31	15
60	-28 NE NE	21.1	26.7	160	35	15
61	-29 NE NW	21.1	27.8	130	52	16
62	-29 NE SW	21.1	27.8	244	27	15
63	-30 NE SW	21.1	28.9	244	32	15
64	-30 SE SE	21.1	26.7	192	29	15
65	-32 NE SE	21.1	28.3	236	31	15
66	-33 SE SW	21.1	27.8	244	27	16
67	-34 NW NW	21.1	28.3	244	30	16
68	-34 SW NW	21.1	27.8	79.3	85	16
69	-35 SE SE	21.1	27.8	214	31	15
70	-36 NE SE	21.1	27.2	214	29	15
71	2N- 2E- 6 SW NE	21.1	40.0	580	33	26
72	- 8 NW NW	21.1	36.5	529	29	26
73	-17 SW NE	21.1	43.5	479	47	26
74	2N- 4E-11 NW SW	21.1	32.0	280	39	2
75	-11 SW SE	21.1	32.0	306	36	2
76	-12 SE NW	21.1	36.0	305	49	2
77	-13 NE SW	21.1	34.4	311	43	26
78	-22 SW SE	20.6	30.0	192	49	2
79	-25 NE NE	20.6	33.8	366	36	26
80	-25 NW NE	20.6	32.7	366	33	26
81	-25 SW NW	20.6	36.6	168	95 A	26
82	-25 SW SE	20.6	32.0	368	31	2

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
125	1N- 2W- 3 NW NE	21.7	30.6	231	39	16
126	- 3 NW NW	21.7	30.0	192	43	16
127	- 3 NW SW	21.7	31.1	309	30	16
128	- 3 NW SE	21.7	43.3	348	62 A	16
129	- 3 SW SE	21.7	49.0	549	50	26
130	- 8 NW NE	21.1	35.0	281	49	15
131	- 8 NW NW	21.1	36.1	259	58	16
132	- 8 SW SE	21.1	41.7	366	56	16
133	- 8 SE SE	21.1	44.4	515	45	25
134	- 9 NW SW	21.1	34.4	306	43	15
135	- 9 NW SE	21.1	28.9	92.1	85	16
136	-10 NW NW	21.7	26.7	108	46	16
137	-12 NW NW	21.7	25.6	160	24	16
138	1N- 2W-14 NW NE	21.7	26.7	91.8	54	16
139	-14 SE SE	21.7	26.7	108	46	16
140	-19 NW NW	21.1	31.1	73.8	136	16
141	-21 NW NW	21.1	26.1	61.0	82	16
142	-21 SW SE	21.1	36.1	277	54	26
143	-22 NW NE	21.7	27.8	88.5	69	16
144	-26 SE NW	21.7	31.7	282	35	15
145	-26 SW SW	21.7	26.7	62.5	80	16
146	-26 NW SE	21.7	33.3	153	76	16
147	-27 NE SW	21.7	26.7	50.9	98	16
148	-27 NW SW	21.7	25.6	75.0	52	16
149	-27 NE SE	21.7	26.7	37.8	132	16
150	-28 NW SE	21.7	25.0	72.0	46	15
151	-34 SW SW	21.7	25.6	65.6	59	16
152	1N- 4W-35 SW NE	21.7	40.0	607	30	26
153	1N- 8W- 6 NE NE	21.1	32.0	231	47	9
154	- 6 NW NW	21.1	32.0	183	60	9
155	- 7 NW SW	21.1	40.5	244	80 A	26
156	-19 NW NE	21.1	31.0	148	67	9
157	-19 SW NW	21.1	30.0	214	42	9
158	1N- 9W- 1 NW NW	21.1	33.5	468	26	26
159	- 6 SW SW	21.1	34.5	433	31	26
160	- 7 SW SW	21.1	35.0	519	27	26
161	- 7 SW SE	21.1	34.0	279	46	9
162	-11 NW NW	21.1	33.0	299	40	9
163	-13 NW NE	21.1	31.0	342	29	9
164	1N- 9W-17 NW SW	21.1	36.0	456	33	9
165	-20 NW NW	21.7	32.0	275	37	9

83	-35 NE NE	20.6	31.0	300	35	2
84	2N- 5E- 6 SW NE	21.1	30.0	153	58	2
85	3N- 1E- 7 NE NE	20.6	23.9	124	27	16
86	- 9 NW NE	20.0	27.8	244	32	16
87	-12 SE NE	20.0	27.2	140	51	15
88	-16 NW NE	20.6	26.7	214	29	15
89	-21 NW SW	20.6	23.9	154	21	16
90	-26 SE NE	20.6	28.9	214	39	16
91	-27 SW SW	20.6	23.9	138	24	15
92	-33 SE SE	20.6	26.1	58.0	95	16
93	-34 SE SE	20.6	27.2	244	27	15
94	-36 SE SE	20.6	26.1	183	30	15
95	3N- 2E- 4 NE SE	20.6	37.7	580	29	26
96	3N- 4E-21 NE NW	20.6	32.7	319	38	26
97	4N- 1E-13 NW SW	19.4	28.9	271	35	15
98	-15 NW SW	20.0	29.4	305	31	16
99	-15 SW SW	20.0	30.6	145	73	16
100	-23 NE NW	20.0	31.1	259	43	16
101	-24 NE NW	20.0	30.0	218	46	16
102	-27 NE NE	20.0	30.0	316	32	15
103	-33 NE SW	20.0	26.7	224	30	16
104	-34 NW NW	20.0	26.7	137	49	15
105	4N- 2E-23 NE SW	20.0	40.0	531	38	18

Townships North, Ranges West

106	1N- 1W- 5 NW NW	21.7	28.9	221	33	16
107	- 8 NE NE	21.7	23.9	122	18	16
108	- 9 NW NE	21.7	23.3	63.1	25	16
109	-10 NW NE	21.7	22.8	97.0	11	16
110	-12 NE NE	21.7	23.9	107	21	16
111	-12 NE NW	21.7	25.6	123	32	16
112	-16 NW SE	21.7	50.0	458	62 A	26
113	-18 NE NW	21.7	41.1	508	38	15
114	-21 NW NE	21.7	25.6	92.7	42	16
115	-23 SE SW	21.7	22.8	61.0	18	16
116	-24 NW SW	21.7	22.8	73.8	15	16
117	-25 SE NE	21.7	23.9	99.1	22	16
118	-29 SE SE	21.7	24.4	166	16	16
119	-30 NE NW	21.7	24.4	73.8	37	16
120	-30 NW SE	21.7	28.3	145	46	16
121	1N- 2W- 1 NW NW	21.7	26.7	231	22	16
122	- 1 SW SW	21.7	45.5	580	41	26
123	- 2 NW NW	21.7	45.6	464	52	16
124	- 2 SW SW	21.7	48.5	549	49	26
166	-21 SW NW	21.1	32.0	315	35	9
167	-24 NE SW	21.1	29.0	305	26	9
168	-28 SW SW	21.7	36.0	345	41	9
169	-28 SW SE	21.7	31.0	314	30	9
170	-28 SE SE	21.7	29.0	304	24	9
171	-32 SW SW	21.7	32.0	301	34	9
172	-34 SW SE	21.7	29.0	258	28	9
173	1N-10W- 1 SW SW	21.1	31.0	280	35	9
174	- 1 SW SE	21.1	33.5	244	51	26
175	- 1 SE SE	21.1	36.0	613	24	26
176	2N- 1W- 2 SW NE	21.1	30.6	256	37	16
177	- 2 NW NW	21.1	27.8	235	29	16
178	- 2 NW NW	21.1	32.2	282	39	26
179	- 2 SW NW	21.1	53.9 G	985	33	18
180	- 2 SW SW	21.1	57.8 G	1365	27	18
181	- 3 NW NE	21.1	25.6	79.3	57	16
182	- 3 NW NW	21.1	24.4	121	27	16
183	- 3 SE SE	21.1	27.8	181	37	16
184	- 3 SE SE	21.1	27.8	183	37	16
185	- 4 NE SE	21.1	23.9	153	18	16
186	2N- 1W- 5 NW NW	21.1	30.0	157	57	16
187	- 6 NW NE	21.1	29.4	228	36	16
188	- 6 NW SE	21.1	35.0	218	64	15
189	- 7 NW NE	21.1	33.3	214	57	26
190	- 7 NW NW	21.1	30.6	228	42	15
191	- 7 NW SW	21.1	29.4	186	45	16
192	- 8 NW SE	21.1	27.2	176	35	16
193	- 9 SW NW	21.1	34.4	366	36	26
194	-10 NW NW	21.1	26.7	154	36	16
195	-12 SW SW	21.1	25.0	153	25	16
196	2N- 1W-14 NW SE	21.1	30.0	220	40	15
197	-17 NW NW	21.1	27.8	179	37	16
198	-18 SW NE	21.1	30.6	218	44	16
199	-18 NW NW	21.1	30.6	342	28	15
200	-18 NW SW	21.1	31.1	225	44	16
201	-19 NE NE	21.1	31.1	85.4	117	16
202	-19 NE NW	21.1	53.9	707	46	18
203	-19 NW NW	21.1	32.2	257	43	16
204	-19 NW SW	21.1	32.2	295	38	15
205	-19 NW SE	21.1	31.1	191	52	15
206	-20 SW NW	21.1	32.8	241	49	16
207	-21 NW NE	21.1	48.8	318	87 A	26
208	-21 SW SW	21.1	46.7	590	43	15
209	-24 SW SW	21.1	25.6	140	32	15

MARICOPA COUNTY - Townships North, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
210	2N- 1W-25 SW NW	21.1	26.1	168	30	16
211	-28 SW SE	21.1	25.6	181	25	15
212	-29 NW NW	21.1	28.9	244	32	16
213	-30 NE SW	21.7	31.1	172	55	15
214	-31 NW NW	21.7	39.4	641	28	26
215	2N- 2W- 1 NW NE	21.1	32.2	323	34	15
216	- 1 SW NE	21.1	32.2	217	51	16
217	- 1 NW NW	21.1	31.7	308	34	16
218	-10 SW SE	21.7	31.1	305	31	16
219	-11 NE NW	21.7	30.6	305	29	15
220	-11 NW NW	21.7	30.6	268	33	16
221	2N- 2W-12 NW NE	21.7	31.7	200	50	16
222	-14 NW NE	21.7	31.1	244	39	16
223	-14 SW NW	21.7	30.6	299	30	15
224	-15 NE NE	21.7	30.0	153	54	15
225	-24 NE NW	21.7	32.8	281	40	16
226	-24 NW NW	21.7	30.6	304	29	16
227	-24 NW SW	21.7	31.7	240	42	15
228	-24 NW SE	21.7	32.8	107	104	15
229	-25 NW NW	21.7	32.2	172	61	16
230	-25 NE SE	21.7	33.3	217	53	15
231	2N- 2W-27 NE NE	21.7	40.0	489	37	26
232	-27 NE NW	21.7	30.0	305	27	15
233	-27 SW SW	21.7	30.6	305	29	15
234	-28 NW NE	21.1	33.9	313	41	16
235	-33 NW NE	21.1	30.0	281	32	16
236	-33 NW SW	21.1	28.9	183	43	16
237	-34 NE NW	21.7	37.8	291	55	16
238	-36 SW NW	21.7	48.0	534	49	26
239	-36 NW SW	21.7	33.3	315	37	16
240	-36 NW SE	21.7	28.9	278	26	16
241	2N- 7W-14 NW SW	21.7	39.0	209	83 A	26
242	-26 NE NE	21.7	48.5	63.4	422 A	26
243	2N- 8W-17 NE SE	20.0	32.0	156	77	9
244	-31 NE NE	20.6	34.0	371	36	9
245	-31 NE NW	20.6	37.0	366	45	9
246	-32 NW NW	20.6	35.0	525	27	26
247	2N- 9W- 9 NW NE	20.6	35.0	470	31	26
248	- 9 NW SE	20.6	35.0	458	31	26

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
293	3N- 2W-25 NE NW	21.1	32.8	306	38	15
294	-35 NE NE	21.1	31.7	320	33	16
295	-35 NW NW	21.1	30.6	305	31	15
296	-36 NE NW	21.1	32.2	305	36	15
297	4N- 1W-15 NW NE	20.6	30.6	244	41	15
298	-19 NE NW	20.6	31.1	329	32	15
299	-19 NW NW	21.1	31.1	350	29	16
300	-19 SW NW	20.6	30.6	305	33	16
301	-20 SW NW	20.6	33.0	305	41	26
302	-20 SW SW	20.6	33.5	364	35	26
303	-21 NW NW	20.6	32.2	305	38	16
304	-27 NW SW	20.6	28.3	220	35	15
305	-28 NE NW	20.6	31.1	315	33	15
306	-29 NE NE	20.6	33.0	329	38	26
307	-29 NW NE	20.6	32.2	275	42	16
308	4N- 1W-30 SW SE	20.6	31.1	313	34	15
309	-32 NW NW	20.6	32.8	366	33	15
310	-34 NW SW	20.6	32.8	153	80	16
311	-34 NW SE	20.6	32.2	305	38	16
312	4N- 2W-25 NE NW	20.6	31.1	305	34	16
313	-26 NW SE	20.6	27.8	261	28	15
314	-26 SW SE	20.6	29.4	305	29	16
315	-26 SE SE	20.6	30.6	305	33	15
316	5N- 9W-25 SW SE	20.6	32.5	443	27	26
317	7N- 7W-17 SE NE	17.2	29.4	295	41	16
318	-17 SE SE	17.2	30.0	177	72	16
319	7N- 8W-32 SW SW	17.8	26.7	141	63	16
320	7N- 9W- 4 NW NW	17.8	33.8	503	32	26
321	- 4 NW SW	17.8	32.2	503	29	26
322	-11 NE NE	18.3	29.0	311	34	3
323	-15 SE SW	18.3	28.3	229	44	16
324	-22 SW NW	18.3	26.7	116	72	16
325	-32 NE NE	18.3	33.8	412	38	26
326	-32 NE NW	18.3	32.2	306	45	26
	Townships South, Ranges West					
327	1S- 4W- 5 NE NW	21.1	30.6	485	20	25
328	- 6 NW NW	21.1	41.1	482	41	25
329	- 9	21.1	24.4	76.3	43	16
330	1S- 6W-18 NW NW	21.1	35.0	407	34	26

249	-10	NW NE	20.6	35.0	458	31	26
250	-10	NW NW	20.0	35.0	397	38	26
251	-11	SE NE	20.0	28.0	119	67	9
252	-11	NW NW	20.0	35.0	458	33	26
253	-11	NW SW	20.0	35.0	459	33	26
254	-13	NE NW	20.0	33.0	184	71	9
255	-14	NW NW	20.0	33.0	467	28	26
256	2N-10W-16	NW NW	20.0	26.0	151	40	9
257	3N- 1W- 3	NW NW	20.6	31.7	160	69	15
258	- 6	SW NE	20.6	32.2	367	32	26
259	- 6	NE NW	20.6	30.6	305	33	15
260	- 7	NW NE	21.1	30.6	313	30	15
261	- 8	NW NE	20.6	31.7	366	30	15
262	- 9	NW NE	20.6	31.1	122	86	16
263	-11	NW NW	20.6	25.6	170	29	16
264	-15	NW NW	20.6	32.8	245	50	16
265	-15	NW NW	20.6	29.4	91.5	96	16
266	-15	NW SW	20.6	36.1	222	70 A	16
267	-19	NW NE	21.1	30.6	181	52	16
268	3N- 1W-22	NW NE	20.6	28.3	244	32	16
269	-25	NW NW	20.6	33.8	195	68	26
270	-26	NW SW	20.6	29.4	305	29	16
271	-27	NW NE	21.1	27.2	229	27	16
272	-27	NW SW	21.1	28.9	244	32	16
273	-28	NW NE	21.1	32.2	245	45	16
274	-29	SW NW	21.1	31.1	333	30	16
275	-31	NW NW	21.1	31.7	183	58	16
276	-32	NE NW	21.1	32.7	315	37	26
277	-32	NW SW	21.1	29.4	214	39	16
278	-32	SE SE	21.1	37.8 G	611	27	18
279	3N- 2W- 1	NE NE	21.1	30.0	305	29	15
280	- 1	NW NW	21.1	31.1	305	33	15
281	- 2	NE NW	21.1	30.0	307	29	15
282	-10	NW NW	21.1	29.4	305	27	15
283	-10	SW SE	21.1	34.0	468	28	26
284	-11	NE NW	21.1	30.6	304	31	16
285	-12	NE NE	21.1	28.9	224	35	15
286	-12	NE NW	21.1	29.4	305	27	15
287	-15	NE NE	21.1	32.2	307	36	16
288	-15	NW SE	21.1	41.6	738	28	26
289	-23	NE NE	21.1	33.3	315	39	16
290	-23	NE NW	21.1	30.6	305	31	15
291	-24	NW NE	21.1	31.1	275	36	15
292	-24	NW NW	21.1	32.2	201	55	16
331	1S- 8W- 4	NW NW	21.7	33.9	61.0	200	16
332	- 6	SW SW	21.7	29.0	217	34	9
333	-13	SE NW	21.7	25.6	71.7	54	16
334	-14	NW NE	21.7	27.8	59.5	103	16
335	-14	NW NE	21.7	28.0	68.6	92	9
336	-14	SE NE	21.7	27.2	216	25	16
337	1S- 9W- 1	SW SW	21.7	34.0	307	40	26
338	- 2	SW NW	21.7	28.0	112	56	9
339	- 5	SW SE	22.2	29.0	284	24	9
340	2S- 1W-18	NE SE	21.1	36.0	292	51	8
341	-19	NE NE	21.1	34.0	245	53	8
342	-19	NE NW	22.2	33.0	347	31	8
343	-20	NE NW	21.1	32.7	472	25	26
344	-20	NW SE	21.1	35.5	219	66 A	26
345	-28	NE SE	21.1	37.0	246	65 A	8
346	-29	NE NW	21.1	35.0	247	56	8
347	-29	NE SW	21.1	36.0	247	60	26
348	-29	NE SE	21.1	35.5	285	51	26
349	-30	NW SE	21.1	34.0	183	70	8
350	-32	SE NE	21.1	35.0	268	52	8
351	-33	NE NE	21.1	37.0	314	51	8
352	-33	SW SE	21.1	34.0	327	39	26
353	2S- 2W- 8	NE SW	21.1	29.0	185	43	8
354	- 8	NE SE	21.1	28.0	142	49	8
355	- 9	SE NW	21.1	28.0	249	28	8
356	- 9	NW SW	21.1	29.0	297	27	8
357	- 9	SE SW	21.1	29.0	157	50	8
358	-10	SW SW	21.1	29.0	229	34	8
359	-10	SE SE	21.1	29.0	305	26	8
360	-11	SW SW	21.7	29.0	305	24	8
361	-13	NE NE	21.7	32.0	188	55	8
362	-14	SE NE	21.1	32.0	303	36	8
363	2S- 2W-17	SE NE	21.1	31.0	306	32	8
364	-23	SW SW	21.1	33.0	385	31	26
365	-26	SW NE	21.1	32.0	336	32	8
366	-26	SW SW	21.1	35.0	314	44	26
367	-27	NW SW	21.1	35.0	322	43	26
368	-27	SW SW	21.1	37.0	287	55	26
369	-27	SE SW	21.1	36.0	331	45	8
370	-35	SW SE	21.1	32.0	316	34	8
371	-36	SW SE	21.1	32.0	267	41	8
372	2S- 4W-25	SW SW	21.1	36.0	261	57	23
373	-26	SE NE	21.1	34.0	156	83 A	23
374	-26	SE NW	21.1	34.0	183	70	23

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
MARICOPA COUNTY - Townships South, Ranges West (Continued)						
375	2S- 4W-26 SE NW	21.1	31.7	131	81	28
376	-31 NE SE	21.1	28.0	138	49	23
377	-32 SE NE	21.1	34.0	137	94 A	23
378	-32 NE SW	21.1	36.0	140	106 A	23
379	-33 SW NW	21.1	34.0	304	42	23
380	2S- 5W-35 SE NE	21.1	23.0	275	7	23
381	-35 NE NW	21.1	24.0	118	25	23
382	-36 NW SW	21.1	23.0	108	18	23
383	3S- 4W- 4 NE NW	21.1	32.0	76.3	143	23
384	- 4 SE NW	21.1	31.0	150	66	23
385	- 6 NE SW	21.1	24.0	162	18	23
386	- 7 NE NE	21.1	24.0	101	29	23
387	- 8 NE NW	21.1	26.0	124	40	23
388	- 8 NE SW	21.1	23.0	113	17	23
389	- 9 NE NW	21.1	31.0	149	66	23
390	- 9 NE SW	21.1	29.0	153	52	23
391	-14 NE NE	21.1	31.0	183	54	23
392	-15 SE NW	21.1	28.0	142	49	23
393	-15 NE SE	21.1	28.0	128	54	23
394	-16 NE SE	21.1	29.0	126	63	23
395	-17 SE NE	21.1	24.0	92.1	31	23
396	3S- 4W-19 NW NW	21.1	24.0	366	8	23
397	-21 NW NW	21.1	23.0	91.5	21	23
398	-22 SE SE	21.1	28.0	142	49	23
399	-22 SE SE	21.1	29.0	183	43	23
400	-23 NE NW	21.1	29.0	113	70	23
401	-23 NW NW	21.1	29.0	121	65	23
402	-28 NW NE	21.1	27.0	280	21	23
403	-28 SW NE	21.1	27.0	305	19	23
404	-28 NW SE	21.1	26.0	101	49	23
405	-33 NW NE	21.1	28.0	244	28	23
406	-33 SE NE	21.1	28.0	236	29	23
407	-33 SE NE	21.1	28.0	244	28	23
408	-33 NE SE	21.1	26.0	122	40	23
409	-33 SE SE	21.1	29.0	195	41	23
410	3S- 5W- 1 NE NE	21.1	23.0	149	13	23
411	-13 NE NW	21.1	24.0	307	9	23
412	3S- 9W- 7 SW NW	21.7	27.2	61.0	90	16

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
456	5S- 4W- 8 NW SE	21.1	26.0	41.2	119	23
457	- 9 SE SE	21.1	30.0	427	21	23
458	-10 NE NW	21.1	33.0	314	38	23
459	-10 NW SW	21.1	31.0	346	29	23
460	-18 SE NE	21.1	26.0	153	32	23
461	-19 SE SE	21.1	27.8	282	24	12
462	-31 SE NE	21.1	28.0	371	19	23
463	-31 NE SW	21.1	35.0	533	26	23
464	-31 NE SW	21.1	42.0	533	39	23
465	-31 NW SW	21.1	48.5	534	51	26
466	-32 SW NW	21.1	29.0	291	27	23
467	5S- 5W-18 SW SE	21.1	26.7	293	19	12
468	-18 SE SE	21.1	24.0	168	17	23
469	-18 SE SE	21.1	25.3	314	13	12
470	-22 SE SW	21.1	28.0	441	16	23
471	-23 SE SW	21.1	28.0	399	17	23
472	-24 NW NW	21.1	29.0	39.7	204	23
473	-24 SE SW	21.1	29.0	427	19	23
474	5S- 6W- 1 SE SW	21.1	25.0	275	14	23
475	- 2 NW NW	21.1	26.0	183	27	23
476	- 2 NW SE	21.1	24.0	130	22	23
477	- 3 SW NE	21.1	25.0	163	24	23
478	- 4 SE SE	21.1	28.0	214	32	23
479	- 6 SE NE	21.1	26.0	292	17	23
480	-11 SE SW	21.1	27.0	281	21	23
481	-12 SE SE	21.1	24.0	160	18	23
482	-13 SE NE	21.1	25.0	85.4	46	23
483	-34 SW SW	21.1	26.0	305	16	23
484	5S- 7W- 1 NE NE	21.7	31.0	214	43	23
485	- 1 NW NE	21.7	28.0	252	25	23
486	- 1 NE NW	21.7	27.0	214	25	23
487	5S- 9W-12 SW NE	22.2	25.0	45.8	61	27
488	-12 SW NE	22.2	33.0	188	57	26
489	5S-10W- 7 NW SW	22.2	28.3	47.3	129	27
490	-16 NW NE	22.2	25.0	22.0	127	27
491	-16 NW NW	22.2	45.6	387	60 A	27
492	-28 NW SE	22.2	24.4	31.7	69	27
493	-32 NE NE	22.2	23.3	34.2	32	16

413	4S- 4W- 3	NW NE	21.1	30.0	107	83	23
414	- 4	SE NW	21.1	26.0	96.4	51	23
415	- 9	NE NW	21.1	24.0	91.5	32	23
416	-15	SW NE	21.1	33.0	298	40	23
417	-15	NW SW	21.1	32.0	216	50	23
418	-15	SE SE	21.1	31.0	258	38	23
419	-18	NE NE	21.1	27.0	115	51	23
420	-22	NE SE	21.1	29.0	279	28	23
421	-22	SE SE	21.1	29.0	300	26	23
422	-27	NE SE	21.1	29.0	268	29	23
423	-27	SE SE	21.1	30.0	285	31	23
424	-32	NW NW	21.1	26.0	79.3	62	23
425	-34	NE NE	21.1	30.0	291	31	23
426	4S- 6W-27	SE NW	21.1	28.0	107	64	23
427	-28	NE SE	21.1	27.0	183	32	23
428	-29	NE NE	21.1	26.0	104	47	23
429	-29	NE NE	21.1	31.0	289	34	23
430	-29	NE SE	21.1	28.0	305	23	23
431	-31	SE SW	21.1	24.0	245	12	23
432	-36	SE NE	21.1	28.0	293	24	23
433	4S- 7W-16	NW SE	21.1	28.0	332	8	23
434	-16	SW SE	21.1	27.0	316	19	23
435	-21	SE NW	21.1	27.0	366	16	23
436	-21	NW SW	21.1	27.0	308	19	23
437	-34	SE SW	21.1	31.0	253	39	23
438	-34	SE SE	21.1	29.0	141	56	23
439	-35	SW SE	21.1	28.0	214	32	23
440	4S- 8W-26	SE NE	21.7	32.8	56.4	197 A	16
441	-26	SE SE	21.7	34.5	58.6	218 A	26
442	-27	SE SE	21.7	23.9	30.5	72	16
443	-27	SE SE	21.7	28.3	75.0	88	16
444	-34	SE SE	21.7	26.1	134	33	16
445	-35	SE NW	21.7	30.6	83.0	107	16
446	-35	NE SW	21.7	28.3	65.3	101	16
447	-35	NE SE	21.7	30.6	64.7	138	16
448	-35	NW SE	21.7	30.6	68.3	130	16
449	4S-10W- 3	NE SE	22.2	33.5	138	82 A	26
450	- 6	NW NW	22.2	36.7	305	48	27
451	- 6	NW NW	22.2	35.0	139	92 A	27
452	- 7	NW NW	22.2	35.0	196	65 A	27
453	-33	SE NW	22.2	25.6	195	17	16
454	5S- 4W- 3	SW NE	21.1	30.0	301	30	23
455	- 3	SE SW	21.1	30.0	257	35	23

494	6S- 4W- 5	NW NE	21.1	28.0	69.8	99	23
495	- 7	SW SW	21.1	27.0	72.0	82	23
496	-29	SW NE	21.1	31.0	92.1	107	23
497	6S- 5W- 2	SE NE	21.1	35.0	305	46	23
498	- 2	SE NW	21.1	38.0	300	56	23
499	- 3	NW SW	21.1	34.0	305	42	23
500	- 4	SW SE	21.1	34.0	324	40	23
501	- 6	SE SE	21.1	29.0	310	25	23
502	-23	SE SE	21.1	29.0	124	64	23
503	-25	NW NW	21.1	31.0	122	81	23
504	6S- 6W- 8	NW SE	21.7	24.0	90.3	25	23
505	- 9	SW NW	21.7	27.0	83.9	63	23
506	-18	SW SE	21.7	25.0	91.5	36	23
507	6S- 9W- 9	NE NE	22.2	26.7	56.1	80	16
508	7S- 4W- 3	NW NE	21.7	31.0	117	79	23
509	7S- 6W- 4	SE NE	21.7	29.0	273	27	23
510	- 4	SE SE	21.7	28.0	270	23	23
511	- 9	SE NE	21.7	29.0	290	25	23
512	- 9	SW SE	21.7	29.0	293	25	23
513	10S- 1W-36	SE NW	19.4	32.2	207	62	13

Townships South, Ranges East

514	1S- 6E- 1	NW NE	20.6	28.3	156	49	16
515	- 2	NW NE	20.6	28.9	86.9	96	16
516	-12	NE NE	20.6	27.8	175	41	16
517	-14	SE SW	20.6	27.2	107	62	16
518	-23	SE SW	20.6	25.6	61.0	82	16
519	-27	SE SE	20.6	47.2	592	45	20
520	1S- 7E- 4	SW NW	21.1	33.3	305	40	6
521	- 4	SW NW	21.1	40.6	336	58	6
522	- 7	SW NW	21.1	35.6	659	22	25
523	-11	SW SE	21.1	26.7	64.7	87	16
524	-16	SE SW	20.6	26.1	39.7	139	16
525	-33	NE NE	20.6	25.6	41.2	121	16
526	2S- 3E-27	NW SE	21.7	25.0	85.4	39	16
527	2S- 5E-13	SW SE	20.6	23.9	76.3	43	16
528	-27	SW NE	20.6	34.4	571	24	25
529	2S- 6E- 1	SE NE	20.6	65.6 G	2118	21	18
				120.0 G	2783	36	18
530	- 1	NE SE	20.6	46.7 T	950	27	18
				63.9 T	1458	30	18
				117.8 G	2768	35	18
531	- 5	SE NW	20.6	25.6	109	46	16

MARICOPA COUNTY - Townships South, Ranges East (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
532	2S- 6E- 9 SW SE	20.6	25.6	107	47	16
533	-11 NE NW	20.6	26.7	183	33	16
534	-15 NE SW	20.6	26.1	91.5	60	16
535	-17 SE NE	20.6	25.0	174	25	16
536	-24 SE SW	20.6	34.4	275	50	26
537	-27 SE SW	20.6	28.3	107	72	16
538	-36 SW SE	20.6	28.9	94.6	88	16
539	2S- 7E-11 SE SW	20.6	25.6	158	32	16
540	-19 NE NE	20.6	25.6	153	33	16
541	-22 NE SE	20.6	25.6	153	33	16
542	-27 SE NE	20.6	26.7	182	34	16
543	4S- 1E-26 NE NW	21.1	23.9	113	25	28

MOHAVE COUNTY

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
1	17N-18W-12 SW NW	19.6	33.5	306	45	26
2	26N-16W-22 SW SW	18.3	52.8 T	540	64	18
			75.6 T	1828	31	18
3	-28 NE NE	18.9	50.0 G	651	48	18
4	-30 SE SE	19.4	48.3 G	795	36	18
5	38N- 7W-17 SW SW	13.3	26.7	342	39	18
6	39N- 7W- 2 NE SE	12.8	41.7	1228	24	18

NAVAJO COUNTY (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
43	13N-21E-10 SE SW	11.1	15.0	127	31	17
44	-25 SW NW	10.8	15.0	61.0	69	17
45	-26 NE NE	10.8	15.0	91.5	46	17
46	-29 NW NW	10.6	16.0	214	25	17
47	-29 SE SE	10.6	15.5	205	24	17
48	-32 SW SW	10.6	16.5	244	24	17
49	-34 SW SW	10.6	15.5	49.4	99	17
50	14N-16E-34 SW NW	10.6	16.5	293	20	17
51	14N-18E-12 C NW	10.6	24.4 G	593	23	18
52	14N-19E-35 NE NE	10.6	31.1 G	1164	18	18
53	14N-20E-29 NW SE	11.1	35.0 G	1033	23	18
54	-30 NE SW	11.1	16.5	122	44	17
55	-33 NE SE	10.6	47.8 G	1138	33	18
56	14N-21E-30 SW NW	11.1	35.6 G	1155	21	18
57	14N-22E- 6 NE SE	11.7	40.0 G	1107	26	18
58	15N-16E-15 SE SE	10.3	25.5	275	55	17
59	-35 NE NE	10.0	16.5	279	23	17
60	15N-21E- 8 SE SE	11.7	16.5	122	39	17
61	-32 SW NE	11.4	17.0	131	43	17
62	-36 SW NW	11.7	18.0	104	61	17
63	15N-22E-10 NW SE	12.2	18.0	91.5	63	17
64	15N-23E- 3 NW NW	12.5	17.0	82.4	55	17
65	-17 NE SE	12.2	16.5	91.5	47	17
66	-34 NE NE	12.2	17.0	131	37	17
67	16N-16E- 1 SW SW	11.1	52.8 G	1278	33	18
68	16N-17E- 8 NE SW	11.7	17.0	188	28	17
69	-11 SW SE	11.7	17.0	168	32	17
70	16N-18E- 9 SW NE	11.7	44.4 G	1197	27	18
71	-28 SW SE	11.7	19.0	229	32	17
72	16N-19E- 4 NW NW	12.2	16.0	100	48	17
73	16N-20E- 5 SE NE	11.7	43.3 D	1135	28	18
74	16N-22E-14 SE NE	12.2	19.0	92.4	74	17
75	-16 SE NE	12.2	30.6 G	1031	18	18
76	-17 SW SW	12.2	16.0	158	24	17
77	16N-23E-15 NE NW	12.8	19.5	153	44	17
78	17N-19E- 2 SE SW	12.8	18.0	151	34	17
79	- 2 NW SE	12.8	18.0	47.3	110	17
80	-12 SW NE	12.5	18.0	158	35	17
81	-12 SW NW	12.5	16.0	198	18	17

NAVAJO COUNTY

1	8N-23E- 4	NW NE	8.9	14.0	83.9	61	17
2	- 4	NE NW	8.9	10.0	153	7	17
3	- 4	SW NW	8.9	13.4	76.3	59	17
4	- 4	SW NW	8.9	13.5	107	43	17
5	- 5	SE NW	9.4	13.0	95.2	38	17
6	- 5	SE SE	9.4	13.5	183	22	17
7	- 9	SW NE	8.3	15.0	55.5	121	17
8	-11	NW NE	8.3	12.0	58.0	64	17
9	9N-22E- 4	NE SW	9.4	15.0	214	26	17
10	-15	SW NW	9.4	14.5	203	25	17
11	-15	SW SE	9.4	15.0	216	26	17
12	-22	NW SE	9.4	13.5	36.6	112	17
13	-24	SW SW	9.4	14.0	31.4	146	17
14	-26	SE NE	9.4	10.0	19.8	30	17
15	9N-23E- 4	NW SE	9.4	15.0	276	20	17
16	- 5	SW SE	9.4	12.0	238	11	17
17	-32	SE SW	8.9	12.0	21.4	145	17
18	-32	NW SE	8.9	12.5	72.0	50	17
19	-32	SW SE	8.9	13.5	50.3	91	17
20	-32	SW SE	8.9	13.5	61.0	75	17
21	-34	NW NE	8.3	15.5	127	57	17
22	-34	NW NE	8.3	12.5	76.3	55	17
23	10N-20E- 8	NE SE	9.4	15.0	183	31	17
24	10N-21E- 3	SW SW	9.4	15.5	78.0	78	17
25	10N-21E-31	NE SE	9.4	33.3 G	1232	19	18
26	10N-22E-20	NE SE	10.0	16.0	183	33	17
27	11N-21E-17	NE NW	10.6	16.0	119	62	17
28	11N-23E- 3	NW NW	10.6	18.0	142	66	17
29	12N-15E-36	SE SE	9.4	12.0	183	14	17
30	12N-16E-24	NW NW	9.2	13.5	183	23	17
31	12N-17E-18	SE SE	8.9	18.9 G	519	19	18
32	12N-21E- 1	NW NW	10.8	14.5	107	53	17
33	-22	NW NW	10.3	16.5	64.1	97	17
34	12N-22E- 4	SE SW	10.8	17.0	79.3	103	17
35	-30	SW NW	10.3	17.5	71.7	100	17
36	-31	SW NW	10.3	18.0	107	72	17
37	12N-23E- 3	SW SW	11.1	16.0	114	43	17
38	-25	SW NE	10.0	45.0 G	1372	26	18
39	13N-17E- 5	NE SW	10.0	17.0	257	27	17
40	13N-18E- 6	NE SE	10.0	33.9 G	1111	22	18
41	13N-19E-27	SE SW	10.0	16.5	171	38	17
42	13N-20E-29	SW SW	10.6	17.0	160	40	17
82	-14	SE SW	12.5	14.0	67.1	22	17
83	-28	SW SW	12.5	16.0	85.4	41	17
84	17N-20E- 3	NW NW	12.8	17.0	153	27	17
85	- 5	SW SW	12.8	17.0	158	33	17
86	- 6	SW NE	12.8	17.0	123	42	17
87	- 8	SE NW	12.8	17.0	61.0	85	17
88	-10	NE SE	12.8	17.0	91.5	57	17
89	-11	NE SE	12.8	17.0	122	43	17
90	17N-23E- 1	SW NE	13.3	26.7 G	391	34	18
91	18N-19E- 8	SE SE	13.3	17.0	143	26	17
92	-16	SE NE	13.3	17.0	153	24	17
93	-16	NW NW	13.3	18.0	142	33	17
94	-16	SW NW	13.3	17.0	122	30	17
95	-16	NE SW	13.3	17.0	150	25	17
96	-16	NE SW	13.3	16.5	153	21	17
97	-16	NE SW	13.3	14.5	146	8	17
98	-16	NE SW	13.3	15.0	99.1	17	17
99	-16	SE SW	13.3	15.0	109	16	17
100	-16	NE SE	13.3	18.5	99.1	52	17
101	-16	SE SE	13.3	16.0	137	20	17
102	18N-19E-17	NE NE	13.3	16.0	153	18	17
103	-17	NE NE	13.3	18.0	153	31	17
104	-17	SE NE	13.3	17.5	130	32	17
105	-17	SE NE	13.3	16.0	153	18	17
106	-18	NE SE	13.3	14.5	68.6	17	17
107	-23	NW SE	13.3	17.0	168	22	17
108	-28	SE SW	13.3	16.0	76.3	35	17
109	-28	SE SE	12.8	17.0	137	31	17
110	-35	SE NE	12.8	16.0	137	20	17
111	18N-20E-30	SW SE	12.8	35.0 G	544	41	18
112	-31	SE SE	12.8	30.0 G	493	35	18
113	-33	NW SE	12.8	17.0	63.4	56	17
114	18N-23E-10	SE SE	13.3	18.0	30.5	154	17
115	-12	NW SW	13.3	15.0	48.8	35	17
116	19N-16E- 6	SE SW	13.3	14.5	86.0	14	17
117	-36	NW SE	13.3	17.0	186	20	17
118	19N-17E- 5	SE SE	13.9	18.0	207	20	17
119	-36	NE SE	12.8	39.4 G	1160	23	18
120	19N-22E-13	S½ SE	13.3	35.0 G	561	39	18
121	19N-23E- 9	SW NW	12.8	23.9 G	325	34	18
122	-16	NW SW	12.8	22.8 G	258	39	18
123	-26	NW SW	12.8	23.9 G	222	50	18
124	-34	NW NW	12.8	22.2 G	200	47	18

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
NAVAJO COUNTY (Continued)						
125	20N-15E-25 NE SE	12.8	41.7 G	1157	25	18
126	20N-21E-11 SE SW	13.3	30.6 G	523	33	18
127	26N-16E-15 NW NW	12.8	41.1 G	1806	16	18
128	28N-15E- 9 SW SE	11.7	50.0 G	2025	19	18
129	28N-17E-26 SE SW	10.6	26.7 G	299	54	18
130	29N-19E- 8 SE NE	10.0	48.9 G	2364	16	18
131	30N-17E-35 SW NE	10.0	50.0 G	2374	17	18
132	35N-18E-14 SW NW	9.4	33.0	1097	22	26
133	-16 NE NW	9.4	34.0	1078	23	26
134	-21	9.4	33.0	1079	22	26
135	36N-18E-20 C	10.0	43.3 G	1569	21	18
136	-26 NW NE	9.4	34.4 G	1089	23	18
137	-34 NE SW	9.4	34.0	1140	22	26
138	38N-19E-24 SE SW	10.6	55.6 D	2151	21	18
139	38N-21E-29 NE NW	10.0	51.7 G	2198	19	18
140	39N-21E-36 NE NW	11.1	48.9 G	2189	17	18
141	42N-18E-34 SW SE	9.4	47.8 G	1382	28	18
PIMA COUNTY - Townships South, Ranges West						
1	12S- 1W-25 SW SE	19.4	29.4	245	41	13
2	12S- 2W-21 NE SE	20.0	33.3	205	65 A	13
3	13S- 4W-10 NE NW	20.6	23.3	23.2	116	13
4	14S- 1W- 3 NE NE	19.4	28.9	180	53	13
5	-27 NW NW	19.4	33.3	143	97 A	13
6	14S- 4W- 9 NW SE	20.6	25.0	35.1	125	13
7	16S- 3W- 5 NE SW	20.6	27.8	246	29	13
8	17S- 1W-11 SW NW	19.4	28.9	110	86	13
9	17S- 3W- 9 NE NE	20.0	31.1	210	53	13
10	-36 NE NW	20.0	30.0	146	68	13
11	19S- 1W- 4 NE SE	19.4	26.1	78.4	85	13
12	19S- 2W- 2 SW NW	20.0	27.8	86.9	90	13
Townships South, Ranges East						
13	11S- 2E-21 SW NW	18.9	27.2	193	43	13
14	11S- 3E- 4 SE NE	19.4	27.8	102	82	13
15	11S- 4E-20 SW SE	19.4	23.9	51.9	87	13
16	11S- 5E- 2 SE SW	19.4	27.2	68.6	114	13

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
PIMA COUNTY - Townships South, Ranges East (Continued)						
58	16S- 1E-18 NW NW	19.4	26.7	142	51	13
59	-34 SW SE	18.9	30.0	116	96	13
60	16S- 2E- 6 NE NE	18.9	21.7	33.6	83	13
61	16S- 3E-10 NW SW	18.3	33.9	153	102 A	13
62	16S- 7E- 8 SE NE	17.2	30.0	244	52	13
63	16S-12E-26 NW SE	18.9	23.3	76.3	58	14
64	16S-13E-34 NE NE	18.9	32.2	220	60 A	26
65	16S-14E- 4 NE NW	18.9	40.0	523	40	31
66	-25 NW NW	18.3	31.1	254	50	31
67	-30 SW SW	18.9	23.3	61.0	72	16
68	16S-15E- 5 NE SW	18.3	45.6 G	905	31	18
			146.7 G	3834	33	18
69	-10 SW SW	18.3	40.6 G	914	24	18
70	17S- 2E-33 SW SE	18.9	31.1	135	90	13
71	17S- 3E- 8 NE SW	18.9	29.4	146	72	13
72	-24 SE SE	18.3	27.8	184	52	13
73	17S- 4E-25 SE NE	18.3	24.4	34.8	175	13
74	-25 SE NE	18.3	41.7	35.7	655 A	13
75	-25 NE SE	18.3	33.9	76.3	204 A	13
76	-26 SW NE	18.3	25.6	140	52	13
77	-27 NE NW	18.3	26.7	113	74	13
78	-30 NW SW	18.3	35.6	214	81 A	13
79	-34 NW NE	18.3	25.0	61.3	109	13
80	17S-10E-11	18.3	28.3 G	410	24	18
81	17S-13E-13 SE SW	18.9	36.5	547	32	26
82	18S- 1E- 7 SW NE	19.4	30.0	96.7	110	13
83	18S- 2E-29 SW NW	19.4	29.4	91.5	109	13
84	-31 NE NW	19.4	25.6	91.5	68	13
85	18S- 5E-24 NW NW	17.8	30.0	198	62	13
86	18S-18E-34 NW NW	15.0	41.7 G	777	34	18
87	19S- 1E- 5 NE SW	19.4	46.7	128	213 A	13
88	- 7 NW SE	19.4	45.6	218	120 A	13
89	-17 NE NE	19.4	29.4	171	58	13
90	-19 NE NE	19.4	30.0	290	37	13
91	19S- 3E-29 SW SW	18.9	31.1	165	74	13
92	-35 SE SE	18.9	29.4	187	56	13
93	19S-3½E- 1 NW NE	18.9	27.8	220	40	13
94	19S- 5E- 3 NW SE	18.3	28.9	184	58	13

17	11S-10E- 9	SE	SE	20.0	25.6	180	31	29
18	-12	SW	SW	19.4	25.0	153	37	29
19	-13	NE	NE	19.4	25.0	159	35	29
20	-24	NE	NE	19.4	23.9	153	29	29
21	11S-11E-16	SE	SW	19.4	24.4	164	30	29
22	-20	SW	SW	19.4	23.3	135	29	29
23	-34	SE	NE	19.4	23.9	156	29	29
24	11S-17E-24	NE	SW	17.8	27.0	48.8	189	21
25	11S-18E-15	SE	NE	18.3	20.0	33.6	51	21
26	12S- 2E-32	NE	NE	18.9	26.7	169	46	13
27	12S- 3E-23	SE	NE	18.9	27.2	80.8	103	13
28	12S-10E-29	NW	NE	19.4	25.6	88.5	70	29
29	-33	SE	SE	19.4	28.3	183	49	29
30	12S-12E-19	NW	SW	19.4	35.0	110	142 A	26
31	13S- 1E-27	NW	SE	18.9	24.4	81.7	67	13
32	13S- 3E- 2	NW	NW	18.9	30.6	119	98	13
33	13S- 4E-23	NE	NW	18.9	28.9	111	90	13
34	13S- 7E-21	SW	SE	18.9	32.2	178	75 A	13
35	13S- 8E-11	SE	NW	19.4	35.6	30.5	531 A	13
36	13S-13E-17	NE	SE	19.4	23.3	29.3	133	16
37	13S-14E-22	SE	SW	18.9	20.0	18.3	60	16
38	13S-15E-31	NE	NE	18.3	20.0	18.3	93	16
39	14S- 2E- 1	SW	NW	18.9	29.4	30.5	344 A	13
40	14S- 3E-31	SE	NW	18.3	23.9	42.7	131	13
41	-35	SE	SW	18.3	28.3	173	58	13
42	14S- 4E-28	SW	SE	18.3	32.8	220	66 A	13
43	14S- 7E- 7	NW	NW	18.9	30.6	203	58	13
44	14S-10E-20	SW	SW	18.9	26.7	19.8	394 A	13
45	-24	SE	SW	18.9	32.2	117	114	16
46	-25	NE	SW	18.9	32.2	122	109	29
47	14S-11E-33	SW	SW	19.4	30.6	217	52	29
48	14S-13E-25	NE	SE	19.4	33.3	168	83 A	26
49	14S-14E- 5	SE	SE	19.4	26.7	61.0	120	16
50	-16	NW	SW	18.9	35.0	372	43	26
51	15S- 1E-18	SE	NW	19.4	26.7	149	49	13
52	15S- 7E- 1	SE	NE	18.3	30.0	172	68	13
53	15S-10E-28	SE	SW	18.9	28.9	195	51	29
54	15S-11E-15	NW	NW	18.9	44.5	610	42	26
55	-35	NE	NW	18.9	27.2	141	59	14
56	15S-13E-23	NW	SW	18.9	23.9	125	40	14
57	15S-14E- 2	NE	SE	18.3	52.2	763	44	31
95	20S- 2E- 2	NW	NE	18.9	26.1	149	48	13
96	20S- 5E-15	NW	SW	17.8	36.1	223	82	13
97	-28	SW	NW	18.3	25.6	201	36	13

PINAL COUNTY

1	1S- 9E-36	SW	SE	21.7	32.2	153	69	16
2	1S-12E-33	SW	NE	20.0	53.3 G	1408	24	18
3	-34		NW	19.4	72.2 G	1808	29	18
4	2S-10E- 3	NW	NW	21.1	22.2	24.7	45	16
5	3S- 4E-25	SW	SE	21.7	22.2	47.6	11	16
6	3S- 5E-28	NW	SW	21.1	21.1	50.0	0	11
7	-29	SW	NW	21.1	21.1	53.1	0	11
8	-31	NW	NE	21.1	21.7	56.7	11	11
9	-34	NW	NW	21.1	22.2	48.2	23	11
10	3S- 6E-31	NW	NE	21.1	23.9	185	15	11
11	3S- 8E-36	NE	NE	21.1	25.0	155	25	16
12	4S- 2E-13	SW	SW	21.1	21.7	122	5	11
13	-23	SE	SE	21.1	33.0	305	39	26
14	-26	NW	NW	21.1	29.4	144	58	16
15	-26	SW	SE	21.1	30.0	229	39	16
16	4S- 3E- 2	NW	SW	21.1	36.0	155	96 A	26
17	-13	SE	SE	21.7	36.7	111	135 A	16
18	-34	SE	SE	21.1	24.4	91.5	36	11
19	-36	SW	NW	21.1	25.6	85.4	53	16
20	-36	SE	SE	21.1	26.7	62.5	90	16
21	4S- 4E- 1	SW	SW	21.7	25.0	134	25	11
22	-16	SE	SW	21.7	28.3	183	36	11
23	-16	SE	SE	21.7	29.4	183	42	11
24	-17	SE	SW	21.7	26.1	183	24	11
25	-19	SE	SE	21.7	28.9	230	31	11
26	-20	SE	NW	21.7	25.6	142	27	11
27	-20	SE	SE	21.7	33.0	342	33	26
28	-28	NE	SE	21.7	27.2	183	30	11
29	-28	SE	SE	21.7	30.6	156	57	16
30	-29	SE	SE	21.7	30.6	177	50	16
31	-31	SE	SE	21.1	26.1	185	27	16
32	-33	SE	NW	21.7	30.0	183	45	11
33	-33	SE	SE	21.7	27.2	184	30	16

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
PINAL COUNTY (Continued)						
34	4S- 5E- 3 SE SE	21.1	25.0	115	34	16
35	- 6 SW NW	21.7	24.4	76.3	35	11
36	-12 NE NE	21.1	22.2	76.3	14	11
37	4S- 6E- 3 NE NW	20.6	21.7	39.3	28	11
38	- 8 SE SE	21.1	23.3	76.3	29	16
39	-16 SE NE	21.1	26.1	140	36	11
40	4S- 7E-27 NW NW	21.1	37.0	140	114 A	26
41	4S- 9E- 5 NE NE	21.1	24.4	123	27	11
42	- 6 NE NE	21.1	24.4	141	23	11
43	-28 SW SW	20.6	21.1	77.5	6	11
44	-28 SW SW	20.6	21.1	77.5	6	16
45	-29 NW SW	20.6	22.8	102	22	16
46	4S-10E-14 NE NE	21.1	28.3	15.3	471 A	16
47	-32 NE NW	21.1	21.1	64.7	0	16
48	5S- 2E- 2 SW SE	21.1	32.5	290	39	26
49	- 2 SE SE	21.1	30.0	169	53	11
50	-11 SW SE	21.1	33.0	207	57	26
51	-21 NW NW	21.1	33.0	154	77 A	26
52	-22 NW NW	21.1	28.9	154	51	11
53	-24 SW SW	21.1	33.9	183	70 A	16
54	-25 SW SW	21.1	36.0	184	81 A	26
55	5S- 3E- 3 SE NW	21.1	25.0	16.8	232 A	16
56	-11 SE SW	21.7	25.0	214	15	16
57	-11 SE SE	21.7	25.0	116	28	16
58	-12 NE NE	21.7	36.0	107	134 A	26
59	-12 SE NE	21.7	25.6	366	11	16
60	-12 SE SE	21.7	25.6	107	36	16
61	5S- 3E-13 SE NE	21.7	26.1	153	29	16
62	-16 SW SW	21.1	25.0	153	25	16
63	-17 SW SW	21.1	29.4	305	28	16
64	-24 SE SE	21.1	26.1	153	33	16
65	-27 SE SE	21.1	24.4	183	18	16
66	-28 SW NW	21.1	25.6	183	25	11
67	-31 SW SW	21.1	32.2	239	46	16
68	-32 SW SW	21.1	27.8	380	18	16
69	-34 SW SW	21.1	27.2	465	13	11
70	-34 SE SE	21.1	25.6	122	37	11
71	-35 NE NE	21.1	25.0	178	22	16
72	-35 SE SE	21.1	26.1	451	11	16
73	-36 SE SE	21.1	26.1	340	15	16

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
118	5S- 8E-26 NW NW	20.6	25.0	78.1	56	11
119	-28 SE SW	20.6	52.0	61.0	515 A	26
120	-29 SE SE	20.6	25.0	61.0	72	16
121	-30 SE SW	21.1	25.0	61.0	64	11
122	-31 SE NE	21.1	26.7	121	46	16
123	-31 SE NW	21.1	26.1	63.1	79	16
124	-31 SW SE	21.1	25.0	173	23	11
125	-33 SE SW	20.6	27.2	146	45	16
126	-34 SE SE	20.6	26.7	64.1	95	16
127	-35 SE NE	20.6	25.6	68.3	73	16
128	-36 SE NE	20.6	27.2	153	43	11
129	5S- 9E-11 SE SW	20.6	21.7	244	5	11
130	-18 SE NW	20.6	33.5	121	107 A	26
131	-19 SE SE	20.6	22.8	83.9	26	11
132	-21 SE NE	20.6	26.1	156	35	16
133	-30 NW SW	20.6	28.3	107	72	11
134	-32 NE NE	20.6	28.9	183	45	16
135	5S-16E-31 SE NW	18.3	21.0	33.6	80	21
136	6S- 3E- 1 SE SE	21.1	25.0	80.8	48	11
137	- 3 SE SE	21.1	26.1	387	13	11
138	- 5 SW NW	21.1	27.8	198	34	16
139	- 6 SW SW	21.1	28.9	189	41	11
140	- 8 SW NW	21.1	28.3	366	20	16
141	- 9 SW NW	21.1	22.2	83.9	13	11
142	-23 SW SE	20.6	26.1	153	36	16
143	-24 SE NE	20.6	23.9	122	27	11
144	-25 SE SW	20.6	28.3	142	54	16
145	-29 NE NW	20.6	26.1	76.9	72	11
146	-35 SE NE	20.6	28.3	153	50	16
147	-35 SW NW	20.6	29.4	305	29	16
148	6S- 4E- 2 SE SE	21.1	27.8	154	44	16
149	- 3 SE SW	21.1	27.8	110	61	16
150	- 5 SE SE	21.1	26.1	122	41	16
151	- 6 SE NE	21.1	25.0	159	25	16
152	- 6 SE SE	21.1	28.3	368	20	11
153	- 7 SW SW	21.1	25.0	93.7	42	16
154	- 8 SW NW	21.1	28.3	137	53	16
155	- 9 SE SW	21.1	26.7	171	33	16
156	- 9 SE SE	21.1	28.9	125	62	11
157	-11 SE SW	21.1	27.8	116	58	16
158	-13 SE NE	21.1	27.2	97.5	63	11

74	5S- 4E- 3	SE	SE	21.7	28.9	128	56	16
75	- 4	SE	SE	21.7	27.8	243	25	16
76	- 5	SE	SE	21.7	26.7	275	18	16
77	- 8	SW	SE	21.7	33.0	398	28	26
78	- 8	SE	SE	21.1	26.7	305	18	16
79	-10	SE	NE	21.7	30.0	308	27	16
80	-10	SE	SW	21.7	30.0	336	25	16
81	-15	SE	NE	21.1	31.7	153	69	16
82	-21	SE	NW	21.7	26.1	185	24	11
83	-23	SE	NW	21.1	29.4	208	40	16
84	-23	SE	SE	21.1	27.2	210	29	16
85	-28	SE	SE	21.1	27.8	320	21	11
86	-33	SE	NE	21.1	26.7	169	33	16
87	5S- 5E-31	NE	NE	21.1	27.2	181	34	16
88	5S- 6E-27	SE	NE	21.7	26.1	153	29	11
89	5S- 7E- 9	NW	NE	21.1	25.6	113	40	11
90	-12	NW	NW	20.6	21.7	42.7	26	11
91	-13	SW	SW	20.6	25.6	107	47	16
92	-14	SE	NE	21.1	25.0	142	27	11
93	-15	SW	NW	21.1	30.0	76.9	116	16
94	-24	SE	NW	21.1	26.7	470	9	16
95	-24	SE	SW	21.1	25.0	101	39	16
96	-24	SE	SE	21.1	26.7	122	46	16
97	-25	SE	NE	21.1	54.4	592	56	11
98	5S- 7E-26	SW	SE	21.1	26.7	491	11	16
99	-27	SW	SE	21.1	24.4	76.3	43	11
100	-34	SW	NE	21.1	41.7	336	61 A	11
101	-34	SW	SE	21.1	28.3	53.7	134	16
102	-34	SE	SE	21.1	27.2	153	40	16
103	-36	SW	NE	21.1	54.0	156	211 A	26
104	5S- 8E- 2	NE	NE	20.6	22.8	70.2	31	11
105	-10	SW	SW	20.6	22.8	236	9	11
106	-12	SE	NE	20.6	25.0	67.1	66	16
107	-14	NE	SW	20.6	22.8	65.9	33	11
108	-14	NE	SW	20.6	22.8	151	15	11
109	-16	SW	SW	20.6	24.4	443	9	16
110	-17	NE	NW	20.6	23.3	128	21	11
111	-17	NW	NW	20.6	23.9	79.3	42	16
112	-19	SE	NE	20.6	25.0	97.6	45	11
113	-19	SW	SW	20.6	24.4	76.3	50	11
114	-20	SE	NE	20.6	24.4	48.8	78	11
115	-20	SE	NW	20.6	24.4	73.2	52	11
116	-25	NW	NW	20.6	25.6	124	40	16
117	-25	NW	NW	20.6	27.8	124	58	11
159	6S- 4E-14	SE	SW	21.1	28.3	229	31	16
160	-14	SE	SE	21.1	27.2	187	33	16
161	-15	SE	SW	21.1	27.2	131	47	16
162	-15	SE	SE	21.1	28.3	183	39	16
163	-16	SE	NE	21.1	28.9	305	26	16
164	-21	SE	SE	21.1	27.8	366	18	16
165	-24	SE	NE	21.1	27.2	116	53	16
166	-24	NE	NW	21.1	27.2	185	33	11
167	-25	SE	NE	21.1	27.2	306	20	16
168	-27	SE	SW	21.1	25.0	112	35	11
169	-27	SE	SE	21.1	28.3	316	23	16
170	-29	SE	SE	20.6	27.2	128	52	16
171	-31	SE	SE	20.6	27.2	181	36	16
172	-32	SE	SE	20.6	26.7	122	50	16
173	-34	SE	SE	20.6	28.3	372	21	16
174	-36	SE	NE	21.1	24.4	103	32	11
175	6S- 5E- 8	NE	SW	21.1	23.3	48.8	45	16
176	- 8	SW	SE	21.1	25.0	67.1	58	11
177	-12	NE	SE	21.1	27.2	23.5	260 A	11
178	-16	SE	SE	21.1	23.9	160	18	16
179	-17	SE	NE	21.1	24.4	45.8	72	11
180	-18	SW	SW	21.1	27.2	104	59	16
181	-18	SE	SE	21.1	30.0	275	32	16
182	-19	SE	SE	21.1	41.1 G	543	37	18
183	-21	SE	NE	21.1	24.4	37.5	88	11
184	-21	SE	NE	21.1	24.4	122	27	11
185	-23	SE	NE	21.1	20.6	36.0	0	11
186	-25	NW	NW	21.1	23.3	30.5	72	16
187	-30	SE	SE	21.1	28.3	308	23	11
188	-31	SE	SE	21.1	27.2	210	29	16
189	-36	NE	NE	21.1	23.3	34.8	63	11
190	6S- 6E- 5	NE	NE	21.1	28.9	153	51	16
191	- 7	SE	NW	21.1	33.5	207	60	26
192	- 7	SE	SE	21.1	23.9	66.5	42	11
193	- 8	SE	SE	21.1	26.7	244	23	11
194	- 9	SE	SE	21.1	29.4	183	45	16
195	-12	SE	SW	21.1	26.7	52.5	107	16
196	-13	SE	NE	21.1	28.3	214	34	16
197	-13	SE	SW	21.1	24.4	76.3	43	11
198	-13	SE	SE	21.1	29.4	85.4	97	16
199	-16	SE	SW	21.1	25.0	209	19	16
200	-16	SE	SE	21.1	25.0	108	36	11
201	-17	SE	SE	21.1	23.9	78.1	36	11
202	-20	SE	SE	21.1	23.9	45.8	61	11

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
PINAL COUNTY (Continued)						
203	6S- 6E-21 SE SE	21.1	26.7	31.1	180 A	16
204	-22 SE SE	21.1	27.2	246	25	16
205	-23 SE SE	21.1	23.9	92.1	30	11
206	-24 SE NE	21.1	29.4	48.8	170 A	16
207	-24 NE SE	21.1	25.0	140	28	16
208	-24 SE SE	21.1	24.4	53.4	62	11
209	-25 SE NE	21.1	26.7	91.5	61	16
210	-28 SE NE	21.1	24.4	206	16	11
211	-31 SW SE	21.1	23.9	31.1	90	11
212	-34 NW SW	21.1	25.6	71.4	63	11
213	6S- 7E- 1 NE NE	21.1	26.7	54.9	102	16
214	- 1 SE SW	21.1	27.8	36.6	183 A	16
215	- 1 SW SE	21.1	48.9	931	30	25
216	- 1 SE SE	21.1	28.3	137	53	11
217	- 2 SE NE	21.1	27.2	30.5	200 A	16
218	- 7 SE NW	21.1	25.0	83.6	47	11
219	- 9 SE SE	21.1	25.0	70.2	56	11
220	-11 SE NE	21.1	26.7	123	46	16
221	-13 SE SW	21.1	28.3	214	34	16
222	-14 SE NE	21.1	27.8	84.5	79	16
223	-16 SE SW	21.1	26.7	91.5	61	16
224	-16 SE SE	21.1	26.7	183	31	11
225	-17 SE SE	21.1	26.1	122	41	16
226	6S- 7E-18 SE NE	21.1	26.1	85.4	59	16
227	-18 SE SW	21.1	25.6	113	40	11
228	-19 SE NE	21.1	29.4	244	34	16
229	-19 SE NW	21.1	25.6	67.1	67	16
230	-21 NE SW	21.1	34.0	366	35	26
231	-22 SE NE	21.1	26.1	152	33	11
232	-25 SE SW	21.1	25.6	81.7	55	11
233	-25 SE SW	21.1	26.7	168	33	11
234	-27 SE SE	21.1	25.0	305	13	11
235	-31 NE NE	21.1	24.4	128	26	11
236	-32 NE NE	21.1	25.6	287	16	11
237	-34 NW NW	21.1	33.0	153	78 A	26
238	-35 SE NE	21.1	28.3	129	56	11
239	-35 SE NE	21.1	43.3	786	28	25
240	-36 SE NE	21.1	28.3	138	52	16

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
284	7S- 6E-31 SW SW	20.6	40.0	124	108 A	11
285	-31 SE SE	20.6	27.2	85.4	77	11
286	-32 SE SE	20.6	28.9	116	72	16
287	-33 SE SE	20.6	30.6	183	55	11
288	-34 SE NE	21.1	32.8	275	43	16
289	-34 SE SE	21.1	35.0	185	75	11
290	-35 SE NE	21.1	36.7	146	107 A	11
291	-36 SE SE	21.1	30.6	146	65	11
292	7S- 7E- 1 SW SE	21.1	28.9	546	14	11
293	- 1 SE SE	21.1	27.8	145	46	11
294	- 2 SE SE	21.1	27.8	153	44	11
295	- 3 SE SE	21.1	30.0	128	70	11
296	- 5 SW SE	21.1	25.6	61.0	74	11
297	- 6 SE SE	21.1	25.0	104	38	11
298	- 9 SE SE	21.1	28.3	183	39	11
299	-10 SE SE	21.1	29.4	153	54	16
300	-11 SE SW	21.1	30.0	137	65	16
301	7S- 7E-12 SW SW	21.1	27.8	137	49	16
302	-19 SW SE	21.1	25.6	61.0	74	11
303	-22 SE SE	21.1	29.4	244	34	11
304	-23 SE SE	21.1	27.8	97.6	69	16
305	-25 SE SE	21.1	28.3	275	26	16
306	-26 SE SE	21.1	29.4	244	34	11
307	-30 SE SW	21.1	27.2	116	53	16
308	-31 SE SE	21.1	33.9	366	35	11
309	-32 SE SW	21.1	29.4	437	19	11
310	-32 SE SE	21.1	32.8	483	24	11
311	-33 SE NE	21.1	26.1	187	27	11
312	-33 SE SE	21.1	26.7	123	46	16
313	-35 SE NE	21.1	30.0	285	31	11
314	-35 SE SE	21.1	27.2	244	25	16
315	-36 SE SE	21.1	28.3	182	40	16
316	7S- 8E- 1 SE SE	21.1	24.4	97.6	34	11
317	- 3 SE SE	21.1	26.7	61.6	91	16
318	- 4 SE SE	21.1	28.3	135	53	11
319	- 7 SE SE	21.1	28.3	214	34	16
320	- 8 SE SE	21.1	29.4	137	61	11
321	- 8 SE SW	21.1	82.2 G	1782	34	18
			106.7 G	2441	35	18
322	-10 SE SE	21.1	27.2	183	33	11
323	-15 SE SW	21.1	28.9	159	49	16

241	6S- 8E- 2	NW	NW	20.6	26.1	111	50	11
242	- 2	SE	SE	20.6	28.9	76.3	109	11
243	- 3	NE	NE	20.6	26.7	122	50	11
244	- 3	SE	SE	20.6	27.8	140	51	11
245	- 4	SE	NE	21.1	25.6	114	39	11
246	- 6	SE	NE	21.1	48.0	783	34	26
247	- 6	SW	SE	21.1	71.7	824	61 A	10
248	- 8	SW	SE	21.1	27.8	76.9	87	11
249	-10	SE	NE	21.1	25.6	246	18	16
250	-10	SE	SE	21.1	27.2	137	45	16
251	-10	SE	SE	21.1	27.2	137	45	16
252	-18	SW	SW	21.1	27.2	165	37	16
253	-18	SE	SW	21.1	46.1 G	989	25	18
254	-18	SE	SE	21.1	26.1	120	42	11
255	6S- 8E-19	SE	NE	21.1	26.7	128	44	16
256	-23	NE	NE	21.1	24.4	198	17	16
257	-24	SE	NE	21.1	36.5	91.5	168 A	26
258	-25	NE	NE	21.1	26.7	153	37	11
259	-28	SE	NE	21.1	25.0	66.5	59	11
260	-28	SE	SW	21.1	27.2	61.0	100	11
261	-31	SE	SW	21.1	26.7	116	48	16
262	-32	SE	SW	21.1	27.2	85.4	71	16
263	-34	SW	NE	21.1	26.1	153	33	11
264	-34	SE	SW	21.1	27.8	140	48	16
265	-34	SE	SE	21.1	24.4	171	19	16
266	6S- 9E- 7	SE	SW	20.6	27.2	153	43	11
267	-19	NW	NW	20.6	26.1	153	36	11
268	6S-16E- 8	NW	SW	18.3	21.0	32.3	84	21
269	7S- 4E- 4	SE	SE	20.6	27.2	278	24	11
270	- 5	SW	SW	20.6	28.3	251	31	16
271	-13	NE	NW	20.6	27.2	294	22	16
272	-17	SW	SW	20.6	33.9	309	43	16
273	-25	SE	NE	20.6	25.6	122	41	11
274	7S- 5E- 5	SE	SE	21.1	30.6	212	45	11
275	- 6	SE	SE	21.1	26.7	202	28	16
276	- 7	SE	SE	21.1	26.7	261	21	16
277	-18	SE	SE	20.6	25.6	153	33	11
278	7S- 6E- 2	NE	SW	21.1	24.4	160	21	11
279	- 6	SW	SE	21.1	26.7	79.3	71	11
280	-11	SW	NE	21.1	27.8	90.6	74	11
281	-28	SE	SE	21.1	30.0	143	62	11
282	-29	SE	NE	21.1	28.3	163	44	11
283	-29	SE	SE	21.1	26.1	79.3	63	11
324	-16	SE	SW	21.1	29.4	174	48	11
325	-17	SE	SW	21.1	30.0	192	46	16
326	-17	SE	SE	21.1	30.0	176	51	16
327	-18	SE	SE	21.1	30.0	168	53	16
328	7S- 8E-19	SE	SW	21.1	28.3	184	39	11
329	-19	SE	SE	21.1	29.4	115	72	16
330	-20	SE	SE	21.1	28.9	94.6	82	16
331	-21	SE	SW	21.1	29.4	156	53	16
332	-21	SE	SE	21.1	28.3	193	37	16
333	-22	SE	NE	21.1	29.4	305	27	16
334	-22	SE	SW	21.1	28.3	171	42	16
335	-23	SW	SW	21.1	30.6	183	52	16
336	-25	SW	SW	21.1	35.0 G	589	24	18
337	-26	SE	SW	21.1	28.9	367	21	16
338	-27	SE	SW	21.1	30.0	165	54	11
339	-27	SE	SE	21.1	30.6	339	28	16
340	7S- 8E-28	SE	SW	21.1	31.1	206	49	11
341	-28	SE	SE	21.1	30.0	183	49	11
342	-29	SE	SW	21.1	27.8	258	26	16
343	-30	SE	SW	21.1	27.2	229	27	16
344	-31	SE	SW	21.1	25.6	153	29	16
345	-31	SE	SE	21.1	26.7	305	18	16
346	-32	SE	SW	21.1	27.2	183	33	16
347	-32	SE	SE	21.1	26.7	246	23	16
348	-33	SE	SW	21.1	25.6	157	29	16
349	-33	SE	SE	21.1	28.9	290	27	16
350	-34	SE	SW	21.1	28.3	313	23	11
351	-34	SE	SE	21.1	27.8	174	39	16
352	7S-15E- 4	NE	NW	18.9	24.0	128	40	21
353	7S-16E-26	SE	SE	18.3	23.0	35.4	133	21
354	-36	SE	SW	18.3	27.0	45.8	190	21
355	8S- 4E-23	SE	SW	20.6	31.1	59.8	176 A	13
356	8S- 5E- 1			20.6	26.7	69.5	88	16
357	-12	NW	NE	20.6	27.2	70.2	94	13
358	-12	NW	NE	20.6	27.2	73.2	90	13
359	-12	NW	NE	20.6	26.7	69.5	88	13
360	8S- 6E- 2	SE	NE	20.6	30.6	183	55	11
361	- 3	SE	NE	20.6	31.1	244	43	11
362	- 3	SE	SE	20.6	32.2	278	42	16
363	-10	SE	NE	20.6	27.8	210	34	11
364	-12	SE	NE	20.6	27.8	244	30	11
365	-13	SE	NE	20.6	29.4	275	32	16
366	-14	SE	SE	20.6	28.9	229	36	11

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
PINAL COUNTY (Continued)						
367	8S- 6E-23 SE SE	20.6	29.4	336	26	16
368	-26 SE SE	20.6	28.9	459	18	11
369	-32 SW NE	20.6	27.8	183	39	16
370	-32 SW SW	20.6	26.7	122	50	16
371	-33 NW NE	20.6	30.0	130	72	11
372	-35 SE SE	20.6	25.6	235	21	11
373	8S- 7E- 2 SE SE	20.6	27.2	306	22	16
374	- 3 SE NE	21.1	27.2	156	39	11
375	- 4 SE SE	21.1	27.2	321	19	16
376	- 9 SE NE	21.1	25.0	127	31	11
377	- 9 SE NE	21.1	43.5	641	35	26
378	- 9 SE SE	21.1	26.7	116	48	11
379	-10 SE NE	21.1	28.9	299	26	16
380	-11 SE SW	21.1	27.8	458	15	16
381	-11 SE SE	21.1	27.8	305	22	16
382	-12 SE NE	21.1	31.7	301	35	16
383	-12 SE SW	21.1	28.3	285	25	16
384	8S- 7E-13 SE NE	21.1	26.1	215	23	16
385	-13 SE SE	21.1	28.3	183	39	11
386	-14 SE SE	21.1	26.7	189	30	16
387	-15 SE SE	21.1	26.7	107	52	16
388	-16 SE SE	21.1	26.7	214	26	16
389	-17 SE SW	20.6	28.9	244	34	11
390	-18 SE NE	20.6	26.7	244	25	16
391	-19 SE NE	20.6	26.7	244	25	16
392	-19 SE SE	20.6	26.1	244	23	16
393	-21 SE SE	20.6	26.7	518	12	16
394	-23 SE NE	20.6	26.7	490	12	16
395	8S- 7E-26 SE NE	20.6	26.1	214	26	16
396	-27 SE SW	20.6	26.7	183	33	16
397	-27 SE SE	20.6	26.7	316	19	16
398	-28 SE SW	20.6	27.2	231	29	16
399	-29 SE SW	20.6	27.2	338	20	16
400	-29 SE SE	20.6	28.9	305	27	16
401	-33 SE SE	20.6	26.1	342	16	16
402	-34 SE NE	20.6	27.2	303	22	16
403	-35 SE NE	20.6	26.7	263	23	16
404	-35 SE SE	20.6	27.2	183	36	11
447	9S- 7E-26 SE SE	20.6	26.7	416	15	16
448	-27 SE NE	20.6	27.8	204	35	11
449	-28 SE SE	20.6	27.8	183	39	11
450	-34 SE NE	20.6	40.6 G	610	33	18
451	9S- 8E- 6 SE NE	20.6	28.3	168	46	16
452	- 8 SE SE	20.6	26.7	383	16	16
453	- 9 SE SE	20.6	28.3	245	31	11
454	-10 SE SE	20.6	26.7	305	20	16
455	-15 SE SE	20.6	28.9	323	26	16
456	-18 SE NE	20.6	26.1	177	31	16
457	-20 SE NE	20.6	27.2	153	43	11
458	-21 SE SW	20.6	27.8	392	18	16
459	-22 SE SE	20.6	26.7	183	33	11
460	-23 SE SE	20.6	26.7	153	40	16
461	9S- 8E-25 SE SE	20.6	27.8	271	27	11
462	-29 SE SW	20.6	28.3	342	23	16
463	-30 SE SE	20.6	29.4	361	24	16
464	-32 NE NE	20.6	27.8	168	43	16
465	-32 SE SE	20.6	37.2	153	109 A	16
466	-33 SW SW	20.6	34.0	162	83 A	26
467	-33 SE SE	20.6	28.9	171	49	16
468	-34 SE NE	20.6	27.8	160	45	16
469	-36 SE SE	20.6	27.8	253	28	16
470	9S-16E- 2 NE NW	18.3	38.0	397	50	21
471	9S-17E-10 SW SE	18.3	32.0	25.9	529 A	21
472	-24 SE SE	18.3	31.0	265	48	21
473	10S- 4E-16 NW SE	19.4	25.6	59.2	105	13
474	-33 SW SE	19.4	27.2	66.5	117	13
475	10S- 6E-11 SE SE	20.0	28.9	183	49	16
476	10S- 7E- 6 NE NE	20.0	30.6	214	50	16
477	10S- 9E- 6 SE NE	20.6	26.1	174	32	11
478	- 8 SE SE	20.6	25.6	123	41	16
479	-13 SW SW	20.0	25.0	122	41	16
480	-13 SE SE	20.0	25.0	122	41	11
481	-14 NE SW	20.0	34.0	244	63 A	26
482	-23 SE SE	20.0	26.7	159	42	16
483	10S-10E-15 SW NE	19.4	42.2	595	38	31
484	10S-17E- 5 SW NW	18.3	26.0	214	36	21
485	-15 NW NW	18.3	22.0	86.9	43	21
486	10S-18E- 3 NE NW	18.3	41.0	84.5	269 A	21

405	8S- 8E- 1 SE SE	21.1	29.4	364	23	16
406	- 2 NW SE	21.1	47.2 G	616	42	18
			75.6 D	2657	29	18
			110.0 G	3101	21	18
407	- 4 SE SE	21.1	27.2	305	20	16
408	- 5 SE SE	21.1	26.7	107	52	16
409	- 7 SE SW	21.1	27.8	153	44	11
410	- 9 SW SE	21.1	27.8	153	44	11
411	-10 SE SW	21.1	27.2	153	40	11
412	8S- 8E-17 SW SE	21.1	26.7	198	28	16
413	-18 SE SE	21.1	29.4	216	38	16
414	-19 SE SE	21.1	25.6	214	21	16
415	-27 SE SW	21.1	26.7	153	37	16
416	-28 SE SW	21.1	27.2	120	51	16
417	-29 SW NW	21.1	26.1	107	47	11
418	-31 SE NE	20.6	26.7	201	30	11
419	-32 SE SE	20.6	27.2	112	59	16
420	8S- 9E- 7 SE NE	21.1	35.0	421	34	26
421	- 7 SE SE	21.1	27.8	73.2	92	16
422	-18 SE SW	21.1	33.3	130	94	16
423	-18 SE SE	21.1	32.2	244	45	16
424	8S-17E-15 SE	18.3	23.3 G	629	8	18
425	-29 SE SE	18.3	23.0	30.5	154	21
426	-32 NE SE	18.3	42.0	453	52	21
427	-36 SW NE	18.3	24.0	130	44	21
428	9S- 2E-25 SE NW	20.0	25.0	18.3	273	13
429	9S- 3E-14 NW NW	20.0	26.7	131	51	13
430	9S- 4E- 4 NE NE	20.0	27.2	169	43	13
431	-15 SW SW	20.0	29.4	101	93	13
432	-15 SW SW	20.0	30.0	209	48	13
433	-15 NE SW	20.0	26.7	107	63	13
434	-15 SE SW	20.0	26.7	214	31	13
435	9S- 6E-24 SE SE	20.0	26.7	336	20	16
436	9S- 7E- 1 SE SE	20.6	26.1	193	29	11
437	- 2 SE SE	20.6	26.7	474	13	16
438	- 3 SE NE	20.6	26.1	305	18	16
439	- 4 SE NE	20.6	25.6	378	13	16
440	-11 SE SE	20.6	26.7	244	25	16
441	-14 SE NE	20.6	26.7	183	33	11
442	-14 SE SE	20.6	25.6	189	26	16
443	-16 SE SE	20.6	25.0	244	18	16
444	-18 SE NE	20.6	28.9	366	23	11
445	-19 SE SE	20.6	26.1	183	30	11
446	-26 SE NE	20.6	27.8	605	12	16

SANTA CRUZ COUNTY

1	20S-13E-32 SW NW	18.3	20.0	25.6	66	16

YAVAPAI COUNTY

1	8N- 9W-32 NE NE	18.3	34.0	412	38	3
2	10N-10W- 3 SE NE	18.9	71.1 G	1731	30	18
3	- 3 SE NE	18.9	51.7 G	1168	28	18
4	15N- 5E-36 NE SW	15.6	20.0	36.6	120	24
5	-36 SW SW	15.6	20.6	48.8	102	24
6	16N- 4E-15 SE SE	15.6	20.6	54.9	91	24
7	-26 SW SE	15.6	21.7	88.5	69	24
8	18N- 5E-34 NE NW	11.1	32.2 G	364	58	18
9	-34 SW NW	11.1	31.1 G	347	58	18

YUMA COUNTY - Townships North, Ranges West

1	5N-12W- 6 NE SW	19.4	23.3	73.2	53	16
2	-30 SW SE	19.4	26.7	53.1	137	16
3	-30 SE SE	19.4	26.1	122	55	16
4	-31 NE NE	19.4	26.0	80.8	82	3
5	-32 SE NE	19.4	24.4	41.2	121	16
6	5N-13W- 2 NE NW	20.0	26.7	91.5	73	16
7	- 2 NE SE	20.0	27.8	104	75	16
8	- 4 NW SW	20.0	26.7	107	63	16
9	-14 NW SW	20.0	22.2	30.5	72	16
10	-15 NE NW	20.0	27.8	202	39	16
11	-15 NE SW	20.0	22.2	61.0	36	16
12	-16 SE NE	20.0	24.4	45.8	96	16
13	-21 SW SE	20.0	25.0	168	30	16
14	5N-15W- 6 NE NW	20.6	30.0	278	34	4
15	- 6 SW NW	20.6	30.0	293	32	4
16	-18 SE SE	20.6	31.0	305	34	4
17	-29 NE SE	20.6	34.0	251	53	4
18	-32 SE SE	21.1	32.0	373	29	4

YUMA COUNTY - Townships North, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
19	5N-16W-25 SW SE	21.1	32.5	443	26	26
20	6N-12W-13 SW SE	19.4	36.7	366	47	16
21	-13 SE SE	19.4	37.7	365	50	26
22	-18 SE SW	19.4	33.3	275	51	16
23	-19 SW NE	19.4	23.3	63.1	62	16
24	-19 NW SE	19.4	30.6	305	37	16
25	-22 SE NE	19.4	34.0	288	51	26
26	-31 NW NW	19.4	36.0	279	59	26
27	6N-16W-33 NE NE	21.1	28.0	214	32	4
28	7N-17W-23 NE SW	21.1	25.0	28.1	139	4
29	-26 SW NW	21.1	27.0	24.4	242	4
30	7N-19W-24 NE NW	21.7	51.1 G	763	39	18
31	8N-13W-20 SW SW	20.0	27.2 G	414	17	18

Townships South, Ranges West

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
32	3S-11W-25 NW SE	22.2	48.9 G	401	67 A	18
33	4S-11W- 2 NW NW	22.2	39.0	162	104 A	26
34	- 2 SW NW	22.2	37.8	162	96	27
35	- 5 NW NW	22.2	44.5	142	157 A	26
36	-11 NW NE	22.2	37.8	184	85	27
37	-11 NE NW	22.2	37.2	168	89	27
38	-12 NW NE	22.2	38.0	375	42	26
39	-12 NW NW	22.2	35.0	127	101	26
40	-16 NW NW	22.2	30.0	153	51	27
41	-21 NW NE	22.2	32.2	419	24	27
42	5S-11W- 1 SW SE	22.8	31.7	275	32	27
43	- 4 NW NE	22.8	30.0	111	65	27
44	-11 NE SW	22.8	36.7	214	65	27
45	-12 NW SW	22.8	31.1	30.5	272 A	27
46	5S-12W- 4 SW NW	22.2	31.1	113	79	27
47	- 4 NW SW	22.2	30.0	94.6	82	27
48	- 5 NE NE	22.2	31.1	218	41	27
49	- 5 NE NE	22.2	30.6	101	83	16
50	- 9 NW NW	22.2	31.1	171	52	27
51	-15 SW NW	22.2	33.3	154	72	16
52	-15 NE SW	22.2	33.9	145	81	27
53	-15 NW SW	22.2	34.0	145	81	26
54	-15 SW SW	22.2	34.4	145	84	16

Townships South, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
96	8S-22W-31 NW SE	22.2	23.5	62.5	21	19
97	-32 NW SW	22.2	22.8	57.6	10	19
98	-32 SW SW	22.2	23.2	62.2	16	19
99	-32 SE SW	22.2	23.4	61.0	20	19
100	-33 SE NE	22.2	22.6	56.7	7	19
101	-33 NE SW	22.2	22.9	54.9	13	19
102	-33 NW SW	22.2	22.6	58.0	7	19
103	-33 SW SW	22.2	23.3	58.0	19	19
104	-34 SE NE	22.2	22.5	183	2	19
105	-35 NE SW	22.2	23.3	178	6	19
106	-35 NE SW	22.2	31.1 G	610	15	18
107	-35 SW SW	22.2	22.8	177	3	19
108	-35 NE SE	22.2	23.3	53.4	21	19
109	8S-23W-12 SE SW	22.2	23.2	52.2	19	19
110	-21 NE SW	22.2	26.7	62.5	72	19
111	-21 NE SW	22.2	27.2	73.2	68	19
112	-26 NE SW	22.2	23.1	53.1	17	19
113	-26 SE SW	22.2	23.5	52.8	25	19
114	-26 NW SE	22.2	23.2	61.0	16	19
115	-26 SE SE	22.2	23.4	59.8	20	19
116	-29 NE SE	22.2	28.6	90.0	71	19
117	-32 NW SE	22.2	27.4	51.9	100	19
118	-33 NW SW	22.2	29.9	66.9	115	19
119	-33 SE SW	22.2	27.8	61.0	92	19
120	-35 NE NE	22.8	25.0	59.5	37	19
121	-35 SE NE	22.8	25.0	52.2	42	19
122	-35 NE SW	22.8	26.1	56.7	58	19
123	9S-21W- 2 SW NW	22.2	36.4	90.9	156 A	19
124	- 3 SE SW	22.2	28.9	79.3	84	19
125	- 4 SW NW	22.2	26.7	84.8	53	19
126	- 5 SW NW	22.2	25.6	79.0	43	19
127	- 6 NW NW	22.2	24.3	79.0	27	19
128	- 7 NE NE	22.2	25.3	91.5	34	19
129	- 8 NE NE	22.2	27.8	58.9	95	19
130	- 9 SE SW	22.2	28.6	61.3	104	19
131	-12 NW SE	22.2	31.9	104	93	19
132	-13 SW SW	22.2	34.5	102	121	19
133	9S-21W-14 SW NE	22.2	31.4	93.0	99	19
134	-14 NE NW	22.2	33.9	82.7	141	19
135	-16 SE NE	22.2	30.0	91.2	86	19

405	8S- 8E- 1 SE SE	21.1	29.4	364	23	16
406	- 2 NW SE	21.1	47.2 G	616	42	18
			75.6 D	2657	29	18
			110.0 G	3101	21	18
407	- 4 SE SE	21.1	27.2	305	20	16
408	- 5 SE SE	21.1	26.7	107	52	16
409	- 7 SE SW	21.1	27.8	153	44	11
410	- 9 SW SE	21.1	27.8	153	44	11
411	-10 SE SW	21.1	27.2	153	40	11
412	8S- 8E-17 SW SE	21.1	26.7	198	28	16
413	-18 SE SE	21.1	29.4	216	38	16
414	-19 SE SE	21.1	25.6	214	21	16
415	-27 SE SW	21.1	26.7	153	37	16
416	-28 SE SW	21.1	27.2	120	51	16
417	-29 SW NW	21.1	26.1	107	47	11
418	-31 SE NE	20.6	26.7	201	30	11
419	-32 SE SE	20.6	27.2	112	59	16
420	8S- 9E- 7 SE NE	21.1	35.0	421	34	26
421	- 7 SE SE	21.1	27.8	73.2	92	16
422	-18 SE SW	21.1	33.3	130	94	16
423	-18 SE SE	21.1	32.2	244	45	16
424	8S-17E-15 SE	18.3	23.3 G	629	8	18
425	-29 SE SE	18.3	23.0	30.5	154	21
426	-32 NE SE	18.3	42.0	453	52	21
427	-36 SW NE	18.3	24.0	130	44	21
428	9S- 2E-25 SE NW	20.0	25.0	18.3	273	13
429	9S- 3E-14 NW NW	20.0	26.7	131	51	13
430	9S- 4E- 4 NE NE	20.0	27.2	169	43	13
431	-15 SW SW	20.0	29.4	101	93	13
432	-15 SW SW	20.0	30.0	209	48	13
433	-15 NE SW	20.0	26.7	107	63	13
434	-15 SE SW	20.0	26.7	214	31	13
435	9S- 6E-24 SE SE	20.0	26.7	336	20	16
436	9S- 7E- 1 SE SE	20.6	26.1	193	29	11
437	- 2 SE SE	20.6	26.7	474	13	16
438	- 3 SE NE	20.6	26.1	305	18	16
439	- 4 SE NE	20.6	25.6	378	13	16
440	-11 SE SE	20.6	26.7	244	25	16
441	-14 SE NE	20.6	26.7	183	33	11
442	-14 SE SE	20.6	25.6	189	26	16
443	-16 SE SE	20.6	25.0	244	18	16
444	-18 SE NE	20.6	28.9	366	23	11
445	-19 SE SE	20.6	26.1	183	30	11
446	-26 SE NE	20.6	27.8	605	12	16

SANTA CRUZ COUNTY

1	20S-13E-32 SW NW	18.3	20.0	25.6	66	16

YAVAPAI COUNTY

1	8N- 9W-32 NE NE	18.3	34.0	412	38	3
2	10N-10W- 3 SE NE	18.9	71.1 G	1731	30	18
3	- 3 SE NE	18.9	51.7 G	1168	28	18
4	15N- 5E-36 NE SW	15.6	20.0	36.6	120	24
5	-36 SW SW	15.6	20.6	48.8	102	24
6	16N- 4E-15 SE SE	15.6	20.6	54.9	91	24
7	-26 SW SE	15.6	21.7	88.5	69	24
8	18N- 5E-34 NE NW	11.1	32.2 G	364	58	18
9	-34 SW NW	11.1	31.1 G	347	58	18

YUMA COUNTY - Townships North, Ranges West

1	5N-12W- 6 NE SW	19.4	23.3	73.2	53	16
2	-30 SW SE	19.4	26.7	53.1	137	16
3	-30 SE SE	19.4	26.1	122	55	16
4	-31 NE NE	19.4	26.0	80.8	82	3
5	-32 SE NE	19.4	24.4	41.2	121	16
6	5N-13W- 2 NE NW	20.0	26.7	91.5	73	16
7	- 2 NE SE	20.0	27.8	104	75	16
8	- 4 NW SW	20.0	26.7	107	63	16
9	-14 NW SW	20.0	22.2	30.5	72	16
10	-15 NE NW	20.0	27.8	202	39	16
11	-15 NE SW	20.0	22.2	61.0	36	16
12	-16 SE NE	20.0	24.4	45.8	96	16
13	-21 SW SE	20.0	25.0	168	30	16
14	5N-15W- 6 NE NW	20.6	30.0	278	34	4
15	- 6 SW NW	20.6	30.0	293	32	4
16	-18 SE SE	20.6	31.0	305	34	4
17	-29 NE SE	20.6	34.0	251	53	4
18	-32 SE SE	21.1	32.0	373	29	4

YUMA COUNTY - Townships North, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
19	5N-16W-25 SW SE	21.1	32.5	443	26	26
20	6N-12W-13 SW SE	19.4	36.7	366	47	16
21	-13 SE SE	19.4	37.7	365	50	26
22	-18 SE SW	19.4	33.3	275	51	16
23	-19 SW NE	19.4	23.3	63.1	62	16
24	-19 NW SE	19.4	30.6	305	37	16
25	-22 SE NE	19.4	34.0	288	51	26
26	-31 NW NW	19.4	36.0	279	59	26
27	6N-16W-33 NE NE	21.1	28.0	214	32	4
28	7N-17W-23 NE SW	21.1	25.0	28.1	139	4
29	-26 SW NW	21.1	27.0	24.4	242	4
30	7N-19W-24 NE NW	21.7	51.1 G	763	39	18
31	8N-13W-20 SW SW	20.0	27.2 G	414	17	18

Townships South, Ranges West

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
32	3S-11W-25 NW SE	22.2	48.9 G	401	67 A	18
33	4S-11W- 2 NW NW	22.2	39.0	162	104 A	26
34	- 2 SW NW	22.2	37.8	162	96	27
35	- 5 NW NW	22.2	44.5	142	157 A	26
36	-11 NW NE	22.2	37.8	184	85	27
37	-11 NE NW	22.2	37.2	168	89	27
38	-12 NW NE	22.2	38.0	375	42	26
39	-12 NW NW	22.2	35.0	127	101	26
40	-16 NW NW	22.2	30.0	153	51	27
41	-21 NW NE	22.2	32.2	419	24	27
42	5S-11W- 1 SW SE	22.8	31.7	275	32	27
43	- 4 NW NE	22.8	30.0	111	65	27
44	-11 NE SW	22.8	36.7	214	65	27
45	-12 NW SW	22.8	31.1	30.5	272 A	27
46	5S-12W- 4 SW NW	22.2	31.1	113	79	27
47	- 4 NW SW	22.2	30.0	94.6	82	27
48	- 5 NE NE	22.2	31.1	218	41	27
49	- 5 NE NE	22.2	30.6	101	83	16
50	- 9 NW NW	22.2	31.1	171	52	27
51	-15 SW NW	22.2	33.3	154	72	16
52	-15 NE SW	22.2	33.9	145	81	27
53	-15 NW SW	22.2	34.0	145	81	26
54	-15 SW SW	22.2	34.4	145	84	16

Townships South, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
96	8S-22W-31 NW SE	22.2	23.5	62.5	21	19
97	-32 NW SW	22.2	22.8	57.6	10	19
98	-32 SW SW	22.2	23.2	62.2	16	19
99	-32 SE SW	22.2	23.4	61.0	20	19
100	-33 SE NE	22.2	22.6	56.7	7	19
101	-33 NE SW	22.2	22.9	54.9	13	19
102	-33 NW SW	22.2	22.6	58.0	7	19
103	-33 SW SW	22.2	23.3	58.0	19	19
104	-34 SE NE	22.2	22.5	183	2	19
105	-35 NE SW	22.2	23.3	178	6	19
106	-35 NE SW	22.2	31.1 G	610	15	18
107	-35 SW SW	22.2	22.8	177	3	19
108	-35 NE SE	22.2	23.3	53.4	21	19
109	8S-23W-12 SE SW	22.2	23.2	52.2	19	19
110	-21 NE SW	22.2	26.7	62.5	72	19
111	-21 NE SW	22.2	27.2	73.2	68	19
112	-26 NE SW	22.2	23.1	53.1	17	19
113	-26 SE SW	22.2	23.5	52.8	25	19
114	-26 NW SE	22.2	23.2	61.0	16	19
115	-26 SE SE	22.2	23.4	59.8	20	19
116	-29 NE SE	22.2	28.6	90.0	71	19
117	-32 NW SE	22.2	27.4	51.9	100	19
118	-33 NW SW	22.2	29.9	66.9	115	19
119	-33 SE SW	22.2	27.8	61.0	92	19
120	-35 NE NE	22.8	25.0	59.5	37	19
121	-35 SE NE	22.8	25.0	52.2	42	19
122	-35 NE SW	22.8	26.1	56.7	58	19
123	9S-21W- 2 SW NW	22.2	36.4	90.9	156 A	19
124	- 3 SE SW	22.2	28.9	79.3	84	19
125	- 4 SW NW	22.2	26.7	84.8	53	19
126	- 5 SW NW	22.2	25.6	79.0	43	19
127	- 6 NW NW	22.2	24.3	79.0	27	19
128	- 7 NE NE	22.2	25.3	91.5	34	19
129	- 8 NE NE	22.2	27.8	58.9	95	19
130	- 9 SE SW	22.2	28.6	61.3	104	19
131	-12 NW SE	22.2	31.9	104	93	19
132	-13 SW SW	22.2	34.5	102	121	19
133	9S-21W-14 SW NE	22.2	31.4	93.0	99	19
134	-14 NE NW	22.2	33.9	82.7	141	19
135	-16 SE NE	22.2	30.0	91.2	86	19

405	8S- 8E- 1 SE SE	21.1	29.4	364	23	16
406	- 2 NW SE	21.1	47.2 G	616	42	18
			75.6 D	2657	29	18
			110.0 G	3101	21	18
407	- 4 SE SE	21.1	27.2	305	20	16
408	- 5 SE SE	21.1	26.7	107	52	16
409	- 7 SE SW	21.1	27.8	153	44	11
410	- 9 SW SE	21.1	27.8	153	44	11
411	-10 SE SW	21.1	27.2	153	40	11
412	8S- 8E-17 SW SE	21.1	26.7	198	28	16
413	-18 SE SE	21.1	29.4	216	38	16
414	-19 SE SE	21.1	25.6	214	21	16
415	-27 SE SW	21.1	26.7	153	37	16
416	-28 SE SW	21.1	27.2	120	51	16
417	-29 SW NW	21.1	26.1	107	47	11
418	-31 SE NE	20.6	26.7	201	30	11
419	-32 SE SE	20.6	27.2	112	59	16
420	8S- 9E- 7 SE NE	21.1	35.0	421	34	26
421	- 7 SE SE	21.1	27.8	73.2	92	16
422	-18 SE SW	21.1	33.3	130	94	16
423	-18 SE SE	21.1	32.2	244	45	16
424	8S-17E-15 SE	18.3	23.3 G	629	8	18
425	-29 SE SE	18.3	23.0	30.5	154	21
426	-32 NE SE	18.3	42.0	453	52	21
427	-36 SW NE	18.3	24.0	130	44	21
428	9S- 2E-25 SE NW	20.0	25.0	18.3	273	13
429	9S- 3E-14 NW NW	20.0	26.7	131	51	13
430	9S- 4E- 4 NE NE	20.0	27.2	169	43	13
431	-15 SW SW	20.0	29.4	101	93	13
432	-15 SW SW	20.0	30.0	209	48	13
433	-15 NE SW	20.0	26.7	107	63	13
434	-15 SE SW	20.0	26.7	214	31	13
435	9S- 6E-24 SE SE	20.0	26.7	336	20	16
436	9S- 7E- 1 SE SE	20.6	26.1	193	29	11
437	- 2 SE SE	20.6	26.7	474	13	16
438	- 3 SE NE	20.6	26.1	305	18	16
439	- 4 SE NE	20.6	25.6	378	13	16
440	-11 SE SE	20.6	26.7	244	25	16
441	-14 SE NE	20.6	26.7	183	33	11
442	-14 SE SE	20.6	25.6	189	26	16
443	-16 SE SE	20.6	25.0	244	18	16
444	-18 SE NE	20.6	28.9	366	23	11
445	-19 SE SE	20.6	26.1	183	30	11
446	-26 SE NE	20.6	27.8	605	12	16

SANTA CRUZ COUNTY

1	20S-13E-32 SW NW	18.3	20.0	25.6	66	16

YAVAPAI COUNTY

1	8N- 9W-32 NE NE	18.3	34.0	412	38	3
2	10N-10W- 3 SE NE	18.9	71.1 G	1731	30	18
3	- 3 SE NE	18.9	51.7 G	1168	28	18
4	15N- 5E-36 NE SW	15.6	20.0	36.6	120	24
5	-36 SW SW	15.6	20.6	48.8	102	24
6	16N- 4E-15 SE SE	15.6	20.6	54.9	91	24
7	-26 SW SE	15.6	21.7	88.5	69	24
8	18N- 5E-34 NE NW	11.1	32.2 G	364	58	18
9	-34 SW NW	11.1	31.1 G	347	58	18

YUMA COUNTY - Townships North, Ranges West

1	5N-12W- 6 NE SW	19.4	23.3	73.2	53	16
2	-30 SW SE	19.4	26.7	53.1	137	16
3	-30 SE SE	19.4	26.1	122	55	16
4	-31 NE NE	19.4	26.0	80.8	82	3
5	-32 SE NE	19.4	24.4	41.2	121	16
6	5N-13W- 2 NE NW	20.0	26.7	91.5	73	16
7	- 2 NE SE	20.0	27.8	104	75	16
8	- 4 NW SW	20.0	26.7	107	63	16
9	-14 NW SW	20.0	22.2	30.5	72	16
10	-15 NE NW	20.0	27.8	202	39	16
11	-15 NE SW	20.0	22.2	61.0	36	16
12	-16 SE NE	20.0	24.4	45.8	96	16
13	-21 SW SE	20.0	25.0	168	30	16
14	5N-15W- 6 NE NW	20.6	30.0	278	34	4
15	- 6 SW NW	20.6	30.0	293	32	4
16	-18 SE SE	20.6	31.0	305	34	4
17	-29 NE SE	20.6	34.0	251	53	4
18	-32 SE SE	21.1	32.0	373	29	4

YUMA COUNTY - Townships North, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
19	5N-16W-25 SW SE	21.1	32.5	443	26	26
20	6N-12W-13 SW SE	19.4	36.7	366	47	16
21	-13 SE SE	19.4	37.7	365	50	26
22	-18 SE SW	19.4	33.3	275	51	16
23	-19 SW NE	19.4	23.3	63.1	62	16
24	-19 NW SE	19.4	30.6	305	37	16
25	-22 SE NE	19.4	34.0	288	51	26
26	-31 NW NW	19.4	36.0	279	59	26
27	6N-16W-33 NE NE	21.1	28.0	214	32	4
28	7N-17W-23 NE SW	21.1	25.0	28.1	139	4
29	-26 SW NW	21.1	27.0	24.4	242	4
30	7N-19W-24 NE NW	21.7	51.1 G	763	39	18
31	8N-13W-20 SW SW	20.0	27.2 G	414	17	18

Townships South, Ranges West

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
32	3S-11W-25 NW SE	22.2	48.9 G	401	67 A	18
33	4S-11W- 2 NW NW	22.2	39.0	162	104 A	26
34	- 2 SW NW	22.2	37.8	162	96	27
35	- 5 NW NW	22.2	44.5	142	157 A	26
36	-11 NW NE	22.2	37.8	184	85	27
37	-11 NE NW	22.2	37.2	168	89	27
38	-12 NW NE	22.2	38.0	375	42	26
39	-12 NW NW	22.2	35.0	127	101	26
40	-16 NW NW	22.2	30.0	153	51	27
41	-21 NW NE	22.2	32.2	419	24	27
42	5S-11W- 1 SW SE	22.8	31.7	275	32	27
43	- 4 NW NE	22.8	30.0	111	65	27
44	-11 NE SW	22.8	36.7	214	65	27
45	-12 NW SW	22.8	31.1	30.5	272 A	27
46	5S-12W- 4 SW NW	22.2	31.1	113	79	27
47	- 4 NW SW	22.2	30.0	94.6	82	27
48	- 5 NE NE	22.2	31.1	218	41	27
49	- 5 NE NE	22.2	30.6	101	83	16
50	- 9 NW NW	22.2	31.1	171	52	27
51	-15 SW NW	22.2	33.3	154	72	16
52	-15 NE SW	22.2	33.9	145	81	27
53	-15 NW SW	22.2	34.0	145	81	26
54	-15 SW SW	22.2	34.4	145	84	16

Townships South, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
96	8S-22W-31 NW SE	22.2	23.5	62.5	21	19
97	-32 NW SW	22.2	22.8	57.6	10	19
98	-32 SW SW	22.2	23.2	62.2	16	19
99	-32 SE SW	22.2	23.4	61.0	20	19
100	-33 SE NE	22.2	22.6	56.7	7	19
101	-33 NE SW	22.2	22.9	54.9	13	19
102	-33 NW SW	22.2	22.6	58.0	7	19
103	-33 SW SW	22.2	23.3	58.0	19	19
104	-34 SE NE	22.2	22.5	183	2	19
105	-35 NE SW	22.2	23.3	178	6	19
106	-35 NE SW	22.2	31.1 G	610	15	18
107	-35 SW SW	22.2	22.8	177	3	19
108	-35 NE SE	22.2	23.3	53.4	21	19
109	8S-23W-12 SE SW	22.2	23.2	52.2	19	19
110	-21 NE SW	22.2	26.7	62.5	72	19
111	-21 NE SW	22.2	27.2	73.2	68	19
112	-26 NE SW	22.2	23.1	53.1	17	19
113	-26 SE SW	22.2	23.5	52.8	25	19
114	-26 NW SE	22.2	23.2	61.0	16	19
115	-26 SE SE	22.2	23.4	59.8	20	19
116	-29 NE SE	22.2	28.6	90.0	71	19
117	-32 NW SE	22.2	27.4	51.9	100	19
118	-33 NW SW	22.2	29.9	66.9	115	19
119	-33 SE SW	22.2	27.8	61.0	92	19
120	-35 NE NE	22.8	25.0	59.5	37	19
121	-35 SE NE	22.8	25.0	52.2	42	19
122	-35 NE SW	22.8	26.1	56.7	58	19
123	9S-21W- 2 SW NW	22.2	36.4	90.9	156 A	19
124	- 3 SE SW	22.2	28.9	79.3	84	19
125	- 4 SW NW	22.2	26.7	84.8	53	19
126	- 5 SW NW	22.2	25.6	79.0	43	19
127	- 6 NW NW	22.2	24.3	79.0	27	19
128	- 7 NE NE	22.2	25.3	91.5	34	19
129	- 8 NE NE	22.2	27.8	58.9	95	19
130	- 9 SE SW	22.2	28.6	61.3	104	19
131	-12 NW SE	22.2	31.9	104	93	19
132	-13 SW SW	22.2	34.5	102	121	19
133	9S-21W-14 SW NE	22.2	31.4	93.0	99	19
134	-14 NE NW	22.2	33.9	82.7	141	19
135	-16 SE NE	22.2	30.0	91.2	86	19

55	5S-12W-16	NE	NE	22.2	33.5	122	93	26
					32.2	191	52	27
56	-16	NW	NE	22.2	37.8	196	80	27
57	-16	NW	NE	22.2	32.8	130	82	16
58	-16	SW	NE	22.2	33.3	282	39	16
59	-16	SE	NE	22.2	33.3	154	72	27
60	-16	NE	NW	22.2	35.0	226	57	27
61	-16	NW	NW	22.2	37.0	100	148 A	26
					36.7	139	104	27
62	-21	NE	NE	22.2	33.9	177	66	27
63	-21	NW	NW	22.2	34.0	187	63	26
64	-21	NW	NW	22.2	32.8	114	93	27
65	5S-12W-22	NW	NW	22.2	34.4	174	70	16
66	-28	NE	NE	22.2	33.3	218	51	16
67	-33	SE	SW	22.2	31.1	75.3	118	27
68	-35	NW	NW	22.2	31.1	148	60	16
69	5S-22W-13	SE	NW	22.2	26.7	50.0	90	19
70	6S-12W- 3	NE	NW	22.2	29.4	244	30	16
71	- 7	SE	SE	22.2	27.8	162	35	27
72	-17	NE	NW	22.2	26.7	81.1	55	27
73	-17	NE	SE	22.2	24.4	62.8	35	27
74	-17	NW	SE	22.2	23.9	53.4	32	16
75	-17	NW	SE	22.2	23.9	53.4	32	27
76	-18	NE	SE	22.2	25.0	23.5	119	16
77	-18	SE	SE	22.2	24.4	35.4	62	27
78	-19	NE	NE	22.2	23.9	38.1	45	27
79	-24	NW	SE	22.2	26.7	12.2	369 A	27
80	6S-13W-33	SE	SE	21.7	24.4	22.9	118	27
81	6S-21W-34	NW	SE	21.1	33.3	82.7	148	19
82	7S-11W-27	SE	SW	22.8	31.7	180	49	27
83	-27	SE	SE	22.8	34.4	207	56	27
84	-36	NE	SE	22.2	35.5	167	80	26
85	7S-12W-13	NW	NW	22.2	33.3	201	55	27
86	-14	SW	SE	22.2	33.5	155	73	26
87	-19	SW	SW	22.2	33.5	207	55	26
88	-24	SE	NW	22.2	32.2	151	66	27
89	7S-13W-16	NE	NE	22.8	57.2 G	1681	20	18
90	7S-14W- 1	SW	NW	21.7	25.6	29.9	130	27
91	- 2	NE	NE	21.7	24.4	29.9	90	27
92	8S-21W-32	SW	SW	22.2	25.6	140	24	19
93	8S-22W-15	NE	SE	22.2	34.4 G	571	21	18
94	-25	NE	SE	22.2	23.3	60.1	18	19
95	-31	SW	NW	22.2	24.3	61.0	34	19
136	-17	SE	SW	22.2	28.3	110	55	19
137	-18	SE	SE	22.2	27.2	94.6	53	19
138	-19	SW	SW	22.2	27.2	67.1	75	19
139	-20	NE	NE	22.2	28.9	90.6	74	19
140	-21	NE	NW	22.2	29.2	72.9	96	19
141	-21	SW	SE	22.2	30.3	91.2	89	19
142	-23	NW	NE	22.2	32.5	83.5	123	19
143	9S-22W- 4	SW	NE	22.2	24.2	50.9	39	19
144	- 4	NW	SE	22.2	24.4	59.0	37	19
145	- 5	NW	NW	22.2	23.9	55.3	31	19
146	- 6	SE	NE	22.2	23.9	51.5	33	19
147	- 9	NW	NW	22.2	23.6	72.3	19	19
148	-11	NW	NW	22.2	23.6	66.5	21	19
149	-17	SW	SE	22.2	25.0	66.5	42	19
150	-18	SE	SE	22.2	27.8	54.0	104	19
151	-23	NE	NE	22.2	25.6	80.8	42	19
152	-24	NW	NE	22.2	25.6	52.8	64	19
153	-24	NW	NW	22.2	26.3	79.3	52	19
154	9S-22W-28	NW	SW	22.2	35.6 G	707	19	18
155	-29	NW	NW	22.2	24.9	66.6	41	19
156	9S-23W- 1	NE	SW	21.7	25.3	64.1	56	19
157	- 3	SW	SE	21.7	27.8	61.9	99	19
158	- 4	NW	SW	21.7	28.1	70.2	91	19
159	- 5	NE	NE	21.7	30.6	63.9	139	19
160	- 5	SE	SW	21.7	27.7	56.1	107	19
161	- 5	SE	SE	21.7	29.0	51.4	142	19
162	- 8	SW	SE	22.2	25.1	54.5	53	19
163	- 8	SE	SE	22.2	26.8	64.8	71	19
164	9S-23W-17	NW	NE	22.2	27.3	51.9	98	19
165	-17	SW	SE	22.2	26.4	54.5	77	19
166	-20	NE	NW	22.2	27.2	58.6	85	19
167	-20	SE	NW	22.2	27.9	50.9	112	19
168	-20	SE	SW	22.2	26.7	73.2	61	19
169	-21	SE	NW	22.2	24.2	63.9	31	19
170	-23	SE	NE	22.2	26.1	51.9	75	19
171	-23	SW	SE	22.2	27.2	51.9	96	19
172	-24	NE	NE	22.2	26.1	53.4	73	19
173	-28	SW	NE	21.7	25.6	61.7	63	19
174	9S-23W-29	NE	NE	21.7	25.4	67.3	55	19
175	-29	NW	NW	21.7	27.5	64.7	90	19
176	-29	NE	SW	21.7	26.4	65.1	72	19
177	-30	SE	SW	21.7	27.8	64.5	95	19
178	-30	NW	SW	21.7	27.2	61.9	89	19

YUMA COUNTY - Townships South, Ranges West (Continued)

NO.	LOCATION	MAT °C	TEMP. °C	DEPTH (m)	TG °C/km	DS NO.
179	9S-23W-30 NW SW	21.7	26.9	58.9	88	19
180	-30 NE SE	21.7	27.3	76.3	73	19
181	-31 SE NE	21.7	28.0	70.1	90	19
182	-32 NE NW	21.7	27.7	78.6	76	19
183	-35 SW SW	21.7	26.7	72.6	69	19
184	-36 SE NW	21.7	25.1	51.9	66	19
185	-36 SW SW	21.7	25.4	60.9	61	19
186	9S-24W- 2 NE NE	21.7	25.6	50.3	78	19
187	- 8 NE NW	21.7	25.0 G	750	4	18
188	-19 SE NW	21.7	22.1	53.4	7	19
189	-36 NE NE	21.7	28.3	75.5	87	19
190	-36 SE NE	21.7	28.3	185	36	19
191	-36 NE SW	21.7	26.5	67.1	72	19
192	10S-22W- 7 SE NE	21.7	27.7	75.5	79	19
193	10S-23W- 3 NE NE	21.7	26.1	56.1	78	19
194	- 4 SE NE	21.7	27.3	57.3	98	19
195	- 6 NW NW	21.7	27.3	64.1	87	19
196	- 7 NW NW	21.7	26.6	61.9	79	19
197	- 9 NE NE	21.7	25.1	52.0	65	19
198	-11 SW SW	21.7	25.6	118	33	19
199	-11 SW SE	21.7	29.7	151	53	19
200	-12 NW NE	21.7	32.8	209	53	19
201	-12 SE NW	21.7	29.2	207	36	19
202	-12 SE NW	21.7	29.2	210	36	19
203	-13 SW SE	21.7	30.6	62.2	143	19
204	10S-23W-14 NE NE	21.7	32.3	167	63	19
205	-18 SW SW	21.7	28.2	66.9	97	19
206	-20 SW SW	21.7	29.4	67.1	115	19
207	-21 NW NE	21.7	28.8	80.5	88	19
208	-22 NW NE	21.7	28.3	60.7	109	19
209	-23 NW NE	21.7	27.8	69.2	88	19
210	-23 NW SW	21.7	28.6	75.6	91	19
211	-28 SW SW	21.7	34.2	70.2	178 A	19
212	-28 SE SW	21.7	31.0	58.0	160	19
213	-29 NE SW	21.7	29.7	63.1	127	19
214	-29 SE SE	21.7	30.3	75.6	114	19
215	-31 NW NW	21.7	29.2	70.2	107	19
216	-36 SE SE	21.7	33.9	64.4	189 A	19
217	10S-24W- 1 SE NW	21.7	28.0	54.2	116	19
218	- 1 SE SW	21.7	26.7	52.5	95	19
260	11S-25W- 2 NW NW	21.7	23.2	64.1	23	19
261	- 3 NE SE	21.7	21.1	61.6	0	19
262	-12 SW NW	21.7	22.8	59.5	18	19
263	12S-21W-14 NE SE	21.7	31.5	112	88	19
264	-17 NW SW	21.7	35.4	88.5	155	19
265	-25 SE NE	21.7	32.5	124	87	19
266	12S-22W- 6 NE SE	21.7	29.8	51.3	158	19
267	- 9 NE NW	21.7	35.6	100	139	19
268	13S-20W- 2 NW NE	21.7	37.6	274	58	19

219	- 1 NE SE	21.7	27.6	66.3	89	19
220	- 1 SW SE	21.7	27.4	72.7	78	19
221	- 5 SE SE	21.7	24.2	57.3	44	19
222	- 6 SW NW	21.7	21.5	50.7	0	10
223	- 7 SW SW	21.7	23.3	55.1	29	19
224	-12 SW NE	21.7	26.1	54.9	80	19
225	-12 SW NW	21.7	25.8	54.3	76	19
226	-12 SE SW	21.7	25.8	50.6	81	19
227	-12 NE SE	21.7	25.2	64.7	54	19
228	-12 SE SE	21.7	25.0	62.7	53	19
229	10S-24W-13 SE NE	21.7	26.1	63.6	69	19
230	-13 NW NW	21.7	25.7	56.4	71	19
231	-13 SW NW	21.7	24.7	52.1	58	19
232	-14 SE SE	21.7	26.4	51.9	91	19
233	-15 SW SE	21.7	23.9	50.5	44	19
234	-23 SE SE	21.7	26.3	61.0	75	19
235	-24 NW SW	21.7	51.7 G	1835	16	18
236	-30 NE NW	21.7	21.8	56.4	2	19
237	-32 SE SE	21.7	25.8	66.8	61	19
238	10S-25W- 1 NW NW	21.7	21.7	86.9	0	19
239	-14 NE NE	21.7	23.7	86.6	23	19
240	-23 SE NE	21.7	23.6	57.0	33	19
241	-26 NE NW	21.7	23.5	85.4	21	19
242	-35 NW NW	21.7	37.8 G	896	18	18
243	-35 NE SW	21.7	23.1	89.4	16	19
244	-36 SW SW	21.7	22.6	51.0	18	19
245	11S-21W- 4 SE SE	21.7	33.3	91.1	127	19
246	11S-22W-13 SW NE	21.7	30.0	63.6	131	19
247	-23 NE SE	21.7	30.6	94.6	94	19
248	-24 NE NW	21.7	30.0	70.5	118	19
249	11S-23W-12 SE SE	21.7	29.7	52.6	152	19
250	-34 NW NW	21.7	31.6	63.6	156	19
251	11S-24W- 2 NW NE	21.7	25.0	91.5	36	19
252	- 2 NW NW	21.7	25.6	115	34	19
253	- 8 SW NE	21.7	42.2 G	945	22	18
			137.8 G	3219	36	18
25[illegible]	- 9 SE SE	21.7	26.4	69.7	67	19
255	11S-24W-10 SE SW	21.7	26.8	70.2	73	19
256	-10 SE SE	21.7	29.5	70.2	111	19
257	-11 SE NW	21.7	26.7	69.8	72	19
258	-11 SE SW	21.7	26.7	151	33	19
259	-23 SW NW	21.7	27.7	75.6	79	19

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17. Mann, L. J., 1976, Ground-water reservoirs and water use in southern Navajo County, Arizona: Ariz. Water Comm. Bull. 10.

18. Oil and Gas Conservation Commission, 1977, Well record files: Oil & Gas Conserv. Comm.

219	- 1 NE SE	21.7	27.6		66.3	89	19
220	- 1 SW SE	21.7	27.4		72.7	78	19
221	- 5 SE SE	21.7	24.2		57.3	44	19
222	- 6 SW NW	21.7	21.5		50.7	0	10
223	- 7 SW SW	21.7	23.3		55.1	29	19
224	-12 SW NE	21.7	26.1		54.9	80	19
225	-12 SW NW	21.7	25.8		54.3	76	19
226	-12 SE SW	21.7	25.8		50.6	81	19
227	-12 NE SE	21.7	25.2		64.7	54	19
228	-12 SE SE	21.7	25.0		62.7	53	19
229	10S-24W-13 SE NE	21.7	26.1		63.6	69	19
230	-13 NW NW	21.7	25.7		56.4	71	19
231	-13 SW NW	21.7	24.7		52.1	58	19
232	-14 SE SE	21.7	26.4		51.9	91	19
233	-15 SW SE	21.7	23.9		50.5	44	19
234	-23 SE SE	21.7	26.3		61.0	75	19
235	-24 NW SW	21.7	51.7	G	1835	16	18
236	-30 NE NW	21.7	21.8		56.4	2	19
237	-32 SE SE	21.7	25.8		66.8	61	19
238	10S-25W- 1 NW NW	21.7	21.7		86.9	0	19
239	-14 NE NE	21.7	23.7		86.6	23	19
240	-23 SE NE	21.7	23.6		57.0	33	19
241	-26 NE NW	21.7	23.5		85.4	21	19
242	-35 NW NW	21.7	37.8	G	896	18	18
243	-35 NE SW	21.7	23.1		89.4	16	19
244	-36 SW SW	21.7	22.6		51.0	18	19
245	11S-21W- 4 SE SE	21.7	33.3		91.1	127	19
246	11S-22W-13 SW NE	21.7	30.0		63.6	131	19
247	-23 NE SE	21.7	30.6		94.6	94	19
248	-24 NE NW	21.7	30.0		70.5	118	19
249	11S-23W-12 SE SE	21.7	29.7		52.6	152	19
250	-34 NW NW	21.7	31.6		63.6	156	19
251	11S-24W- 2 NW NE	21.7	25.0		91.5	36	19
252	- 2 NW NW	21.7	25.6		115	34	19
253	- 8 SW NE	21.7	42.2	G	945	22	18
			137.8	G	3219	36	18
[illegible]	- 9 SE SE	21.7	26.4		69.7	67	19
255	11S-24W-10 SE SW	21.7	26.8		70.2	73	19
256	-10 SE SE	21.7	29.5		70.2	111	19
257	-11 SE NW	21.7	26.7		69.8	72	19
258	-11 SE SW	21.7	26.7		151	33	19
259	-23 SW NW	21.7	27.7		75.6	79	19

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221	- 5	SE	SE	21.7	24.2		57.3	44	19
222	- 6	SW	NW	21.7	21.5		50.7	0	10
223	- 7	SW	SW	21.7	23.3		55.1	29	19
224	-12	SW	NE	21.7	26.1		54.9	80	19
225	-12	SW	NW	21.7	25.8		54.3	76	19
226	-12	SE	SW	21.7	25.8		50.6	81	19
227	-12	NE	SE	21.7	25.2		64.7	54	19
228	-12	SE	SE	21.7	25.0		62.7	53	19
229	10S-24W-13	SE	NE	21.7	26.1		63.6	69	19
230	-13	NW	NW	21.7	25.7		56.4	71	19
231	-13	SW	NW	21.7	24.7		52.1	58	19
232	-14	SE	SE	21.7	26.4		51.9	91	19
233	-15	SW	SE	21.7	23.9		50.5	44	19
234	-23	SE	SE	21.7	26.3		61.0	75	19
235	-24	NW	SW	21.7	51.7	G	1835	16	18
236	-30	NE	NW	21.7	21.8		56.4	2	19
237	-32	SE	SE	21.7	25.8		66.8	61	19
238	10S-25W- 1	NW	NW	21.7	21.7		86.9	0	19
239	-14	NE	NE	21.7	23.7		86.6	23	19
240	-23	SE	NE	21.7	23.6		57.0	33	19
241	-26	NE	NW	21.7	23.5		85.4	21	19
242	-35	NW	NW	21.7	37.8	G	896	18	18
243	-35	NE	SW	21.7	23.1		89.4	16	19
244	-36	SW	SW	21.7	22.6		51.0	18	19
245	11S-21W- 4	SE	SE	21.7	33.3		91.1	127	19
246	11S-22W-13	SW	NE	21.7	30.0		63.6	131	19
247	-23	NE	SE	21.7	30.6		94.6	94	19
248	-24	NE	NW	21.7	30.0		70.5	118	19
249	11S-23W-12	SE	SE	21.7	29.7		52.6	152	19
250	-34	NW	NW	21.7	31.6		63.6	156	19
251	11S-24W- 2	NW	NE	21.7	25.0		91.5	36	19
252	- 2	NW	NW	21.7	25.6		115	34	19
253	- 8	SW	NE	21.7	42.2	G	945	22	18
					137.8	G	3219	36	18
254	- 9	SE	SE	21.7	26.4		69.7	67	19
255	11S-24W-10	SE	SW	21.7	26.8		70.2	73	19
256	-10	SE	SE	21.7	29.5		70.2	111	19
257	-11	SE	NW	21.7	26.7		69.8	72	19
258	-11	SE	SW	21.7	26.7		151	33	19
259	-23	SW	NW	21.7	27.7		75.6	79	19

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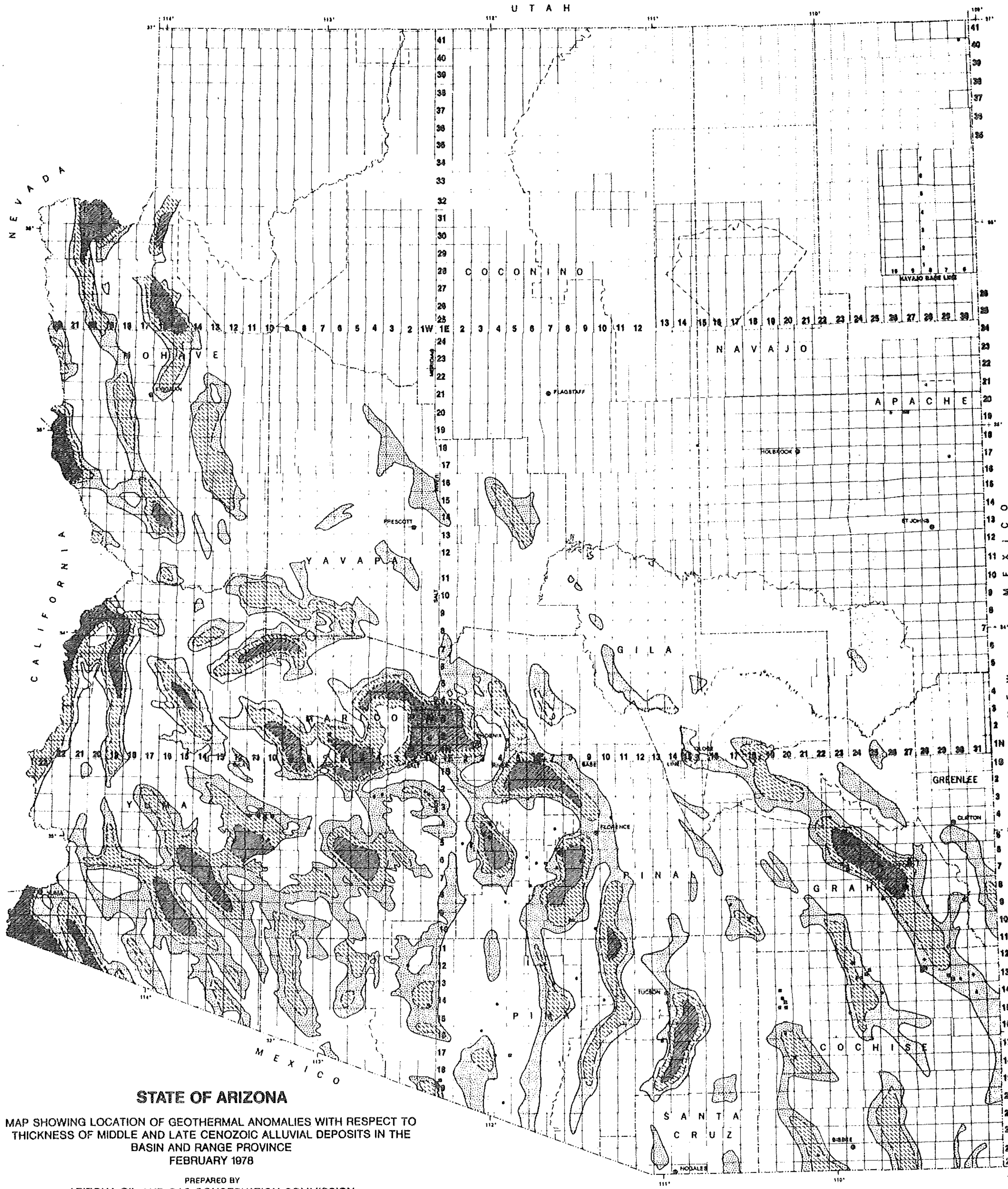
ARIZONA OIL AND GAS CONSERVATION COMMISSION
JOHN BANNISTER, EXECUTIVE SECRETARY

PLATE 1



STATE OF ARIZONA

MAP SHOWING LOCATION OF GEOTHERMAL ANOMALIES WITH RESPECT TO THICKNESS OF MIDDLE AND LATE CENOZOIC ALLUVIAL DEPOSITS IN THE BASIN AND RANGE PROVINCE
FEBRUARY 1978

PREPARED BY
ARIZONA OIL AND GAS CONSERVATION COMMISSION

SCALE
10 0 10 20 30 40 MILES

U S GEOLOGICAL SURVEY BASE, 1974
LAMBERT CONFORMAL PROJECTION
STANDARD PARALLELS 29° and 45°

EXPLANATION

Geothermal anomalies — gradients ≥ 60° C/km

- Multi-well control within a minimum radius of 2½ miles
- Single well control

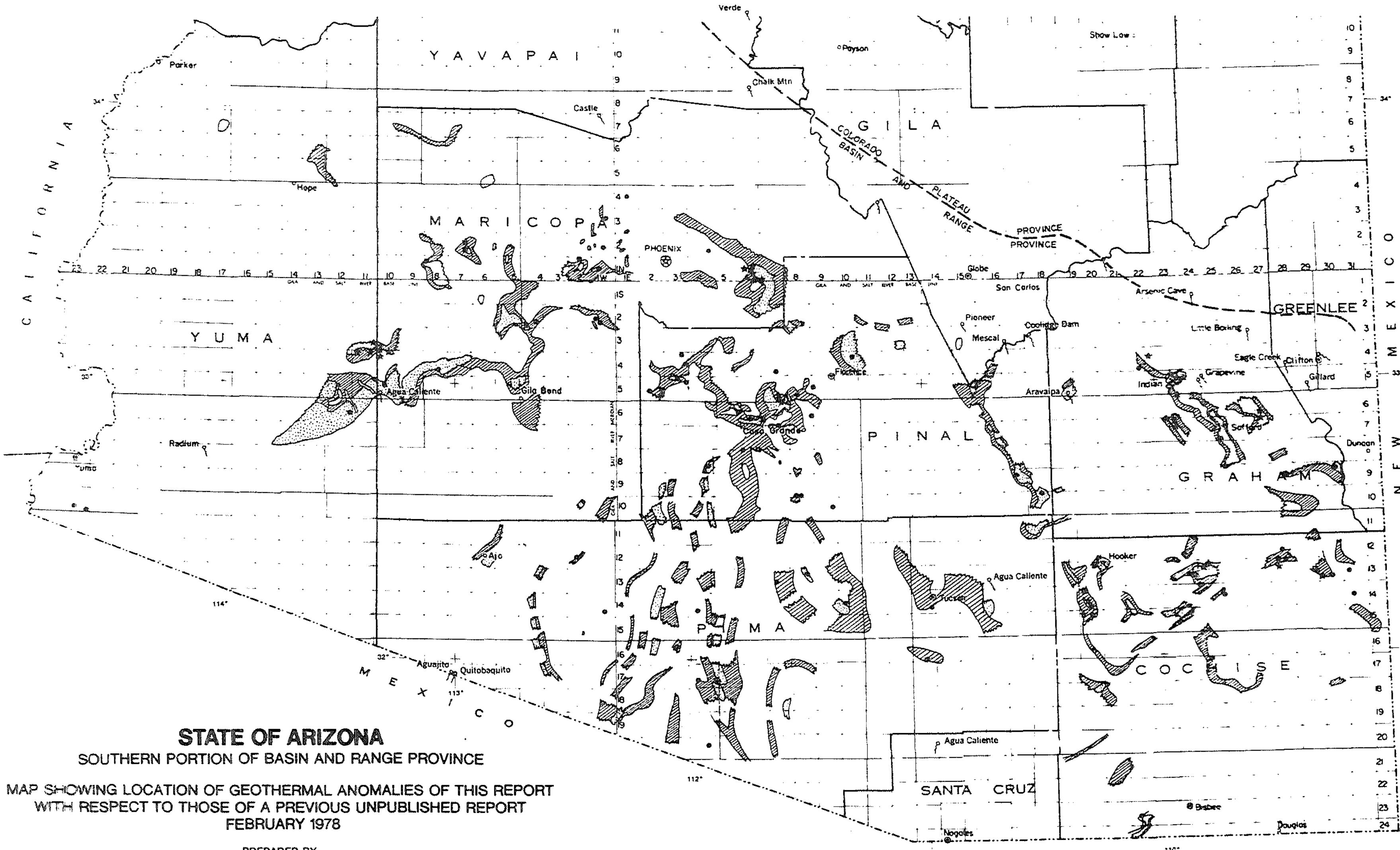
Key to thickness patterns *(from Cooley, 1967)*

700-ft 1200-ft 2000-ft

Cooley, M. E., 1967, Thickness and distribution of mid- and late-Cenozoic alluvial deposits: unpublished map, U.S. Geol. Survey, Water Resources Div., Tucson, Ariz.

ARIZONA OIL AND GAS CONSERVATION COMMISSION
JOHN BANNISTER, EXECUTIVE SECRETARY

PLATE 2



STATE OF ARIZONA

SOUTHERN PORTION OF BASIN AND RANGE PROVINCE

MAP SHOWING LOCATION OF GEOTHERMAL ANOMALIES OF THIS REPORT WITH RESPECT TO THOSE OF A PREVIOUS UNPUBLISHED REPORT
FEBRUARY 1978

PREPARED BY
ARIZONA OIL AND GAS CONSERVATION COMMISSION

SCALE
10 0 10 20 30 40 MILES

EXPLANATION

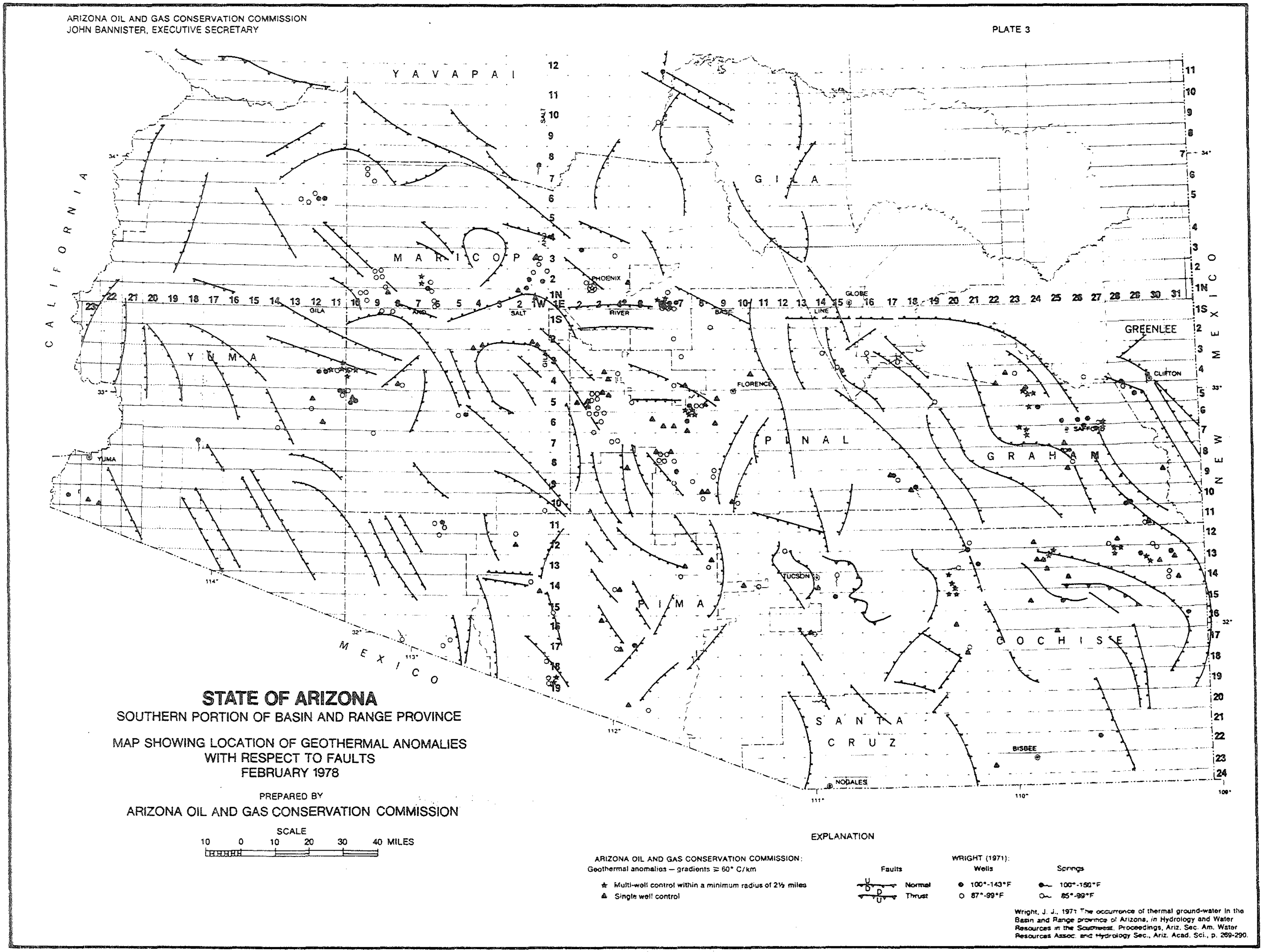
ARIZONA OIL AND GAS CONSERVATION COMMISSION

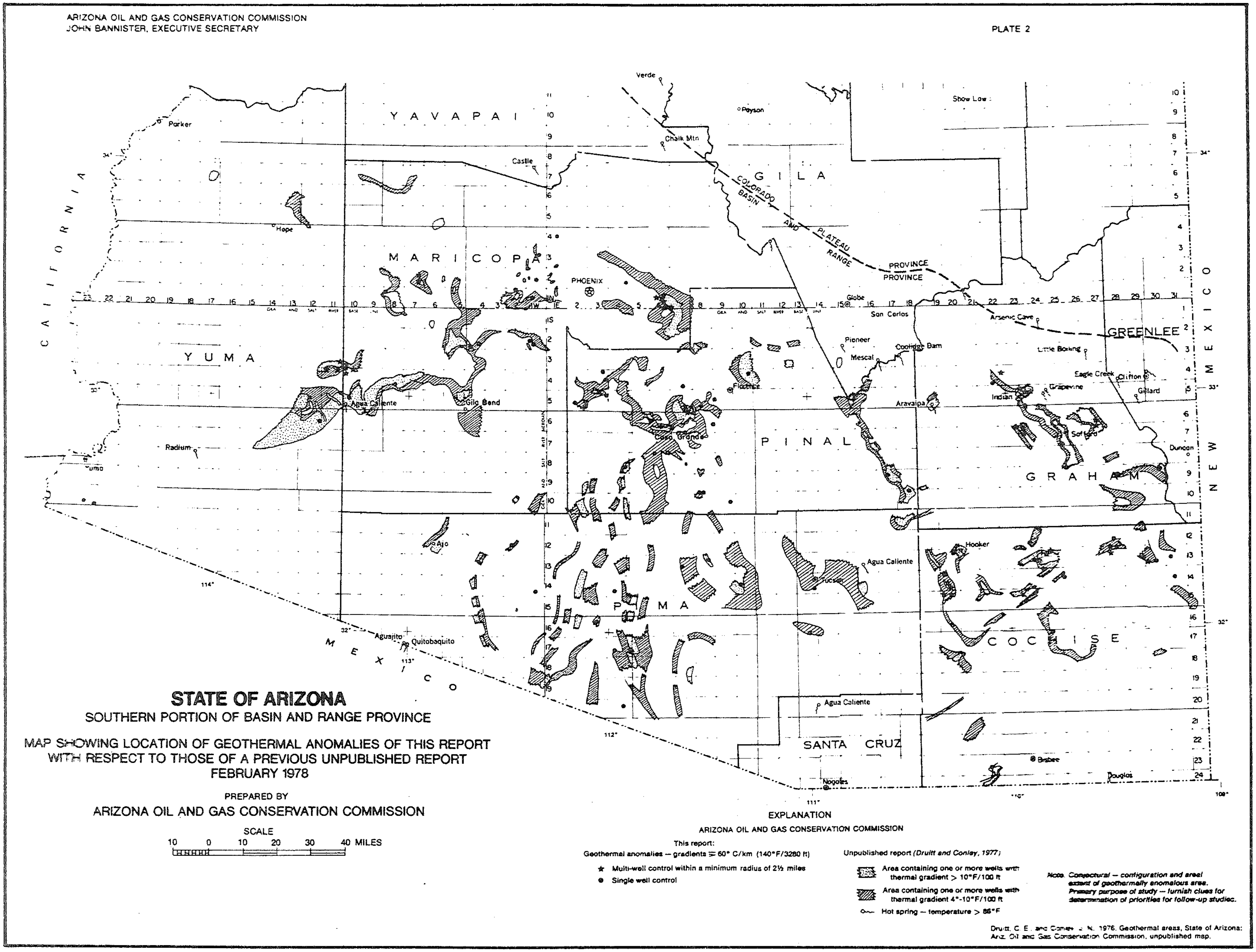
This report:
Geothermal anomalies — gradients ≥ 60° C/km (140°F/3280 ft)
★ Multi-well control within a minimum radius of 2½ miles
● Single well control

Unpublished report *(Druitt and Conley, 1977)*
Area containing one or more wells with thermal gradient > 10°F/100 ft
Area containing one or more wells with thermal gradient 4°-10°F/100 ft
Hot spring — temperature > 68°F

Note. Conjectural — configuration and areal extent of geothermally anomalous area. Primary purpose of study — furnish clues for determination of priorities for follow-up studies.

Druitt, C. E., and Conley, J. N., 1976, Geothermal areas, State of Arizona: Ariz. Oil and Gas Conservation Commission, unpublished map.


ARIZONA OIL AND GAS CONSERVATION COMMISSION
JOHN BANNISTER, EXECUTIVE SECRETARY
PLATE 3
YAVAPAI
GILA
MARICOPA
YUMA
PINAL
GRAHAM
GREENLEE
PIMA
COCHISE
SANTA CRUZ
CALIFORNIA
NEW MEXICO
MEXICO
PHOENIX
GLOBE
FLORENCE
CLIFTON
SAFFORD
TUCSON
BISBEE
NOGALES
YUMA
SALT RIVER BASE LINE
GILA AND SALT RIVER
STATE OF ARIZONA
SOUTHERN PORTION OF BASIN AND RANGE PROVINCE
MAP SHOWING LOCATION OF GEOTHERMAL ANOMALIES
WITH RESPECT TO FAULTS
FEBRUARY 1978
PREPARED BY
ARIZONA OIL AND GAS CONSERVATION COMMISSION
SCALE
10 0 10 20 30 40 MILES
EXPLANATION
ARIZONA OIL AND GAS CONSERVATION COMMISSION:
Geothermal anomalies — gradients ≥ 60° C/km
Multi-well control within a minimum radius of 2½ miles
Single well control
Faults
Normal
Thrust
WRIGHT (1971):
Wells
100°-143°F
87°-99°F
Springs
100°-160°F
85°-99°F
Wright, J. J., 1971 The occurrence of thermal ground-water in the Basin and Range province of Arizona, in Hydrology and Water Resources in the Southwest, Proceedings, Ariz. Sec. Am. Water Resources Assoc. and Hydrology Sec., Ariz. Acad. Sci., p. 269-290.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YAVAPAI
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CALIFORNIA
NEW MEXICO
MEXICO
COLORADO PLATEAU PROVINCE
BASIN AND RANGE PROVINCE
PHOENIX
Verde
Payson
Show Low
Chalk Mtn
Castle
Parker
Hope
Globe
San Carlos
Arsenic Cave
Pioneer
Mescal
Coolidge Dam
Little Boiling
Eagle Creek
Clifton
Gillard
Indian
Grapevine
Safford
Aravaipa
Florence
Casa Grande
Agua Caliente
Gila Bend
Radium
Duncan
Ajo
Hooker
Agua Caliente
Tucson
Aguajito
Quitobaquito
Agua Caliente
Bisbee
Douglas
Nogales
STATE OF ARIZONA
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Area containing one or more wells with thermal gradient 4°-10°F/100 ft
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Note: Conjectural — configuration and areal extent of geothermally anomalous area. Primary purpose of study — furnish clues for determination of priorities for follow-up studies.
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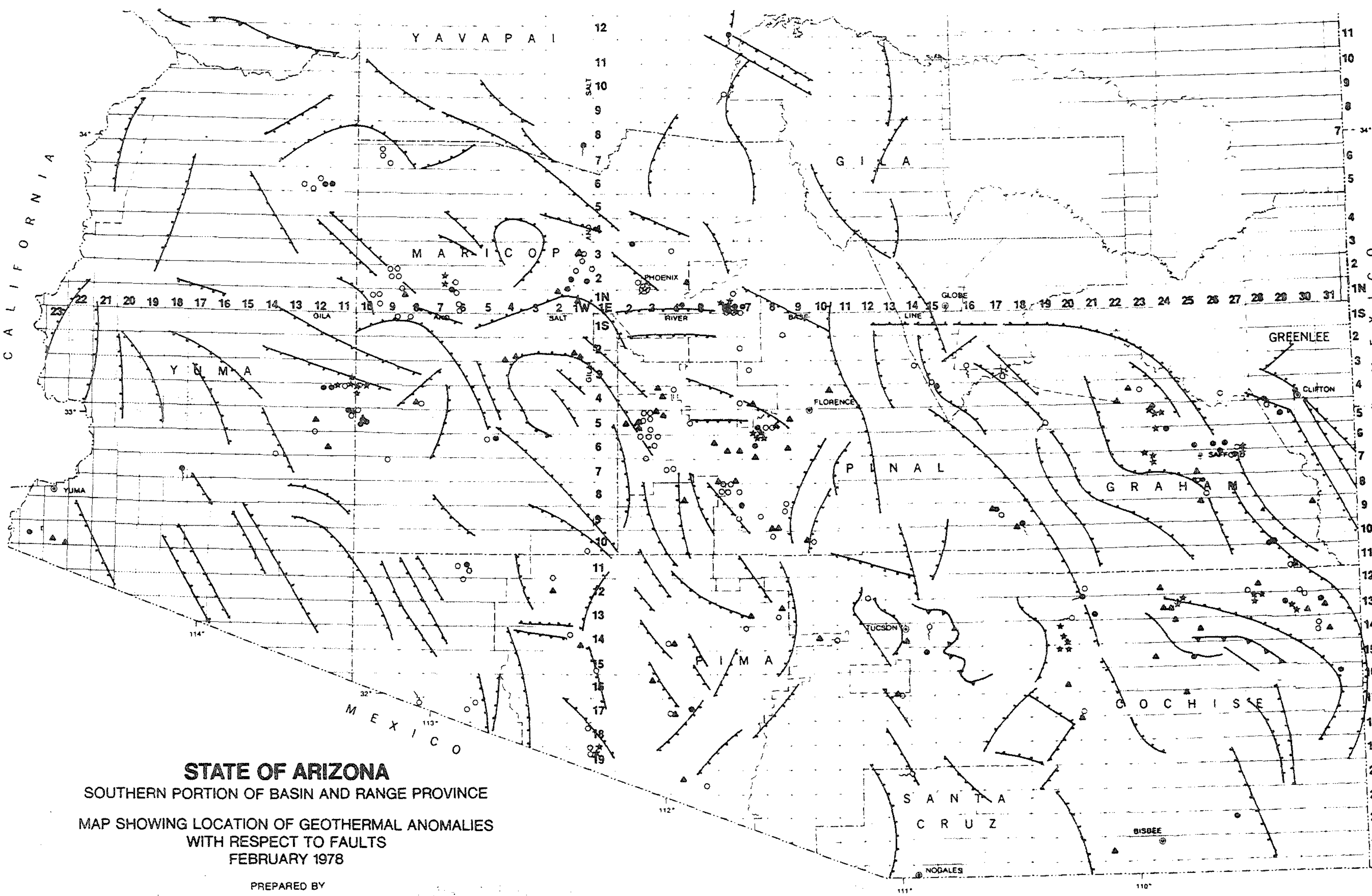

STATE OF ARIZONA

SOUTHERN PORTION OF BASIN AND RANGE PROVINCE

MAP SHOWING LOCATION OF GEOTHERMAL ANOMALIES
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FEBRUARY 1978

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EXPLANATION

ARIZONA OIL AND GAS CONSERVATION COMMISSION:
Geothermal anomalies — gradients ≥ 60° C/km

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Normal
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Wright, J. J., 1971 The occurrence of thermal ground-water in the Basin and Range province of Arizona, *in* Hydrology and Water Resources in the Southwest. Proceedings, Ariz. Sec. Am. Water Resources Assoc. and Hydrology Sec., Ariz. Acad. Sci., p. 269-290.

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LANDSAT LINEAMENT MAP OF ARIZONA

WITH EMPHASIS ON

QUATERNARY FRACTURES

1:1,000,000 SCALE

Prepared for the Energy Research and Development Administration, Division of Geothermal Energy and the Bureau of Geology and Mineral Technology, Geological Survey Branch, University of Arizona under Contract EG-77-S-02-4362, with partial support from NSF Grant EAR 76-02590 to Paul E. Damon, University of Arizona.

October, 1977

8841 NORTH CALLE LOMA LINDA
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ABSTRACT

Regional lineaments were traced from Landsat photographs. Special attention was given to those believed to represent deep-seated crustal ruptures controlling recent igneous activity. Pre-Quaternary features were included because 1. The configuration of older structures is needed to define the magnitude of Quaternary plate motions; and 2. Accessory data should be used to confirm ages of regional fracture or fault zones. An older lineament map was used to demonstrate optical Fourier processing.

The new lineament map compares favorably with the tectonic models of Titley, Purvis, and Rehrig and Heidrick. Alignments of recent volcanoes with lineaments suggest NE and NW control on the Colorado Plateau and NNW and ENE control in the Sonoran Desert.

Recommendations are as follows:

1. The lineament map should be processed with an OFA masking technique to produce a map of probable Quaternary faults;

2. The lineament map should be interpreted synergistically with the following maps:
   a. magnetic and gravity anomaly contours,
   b. age-dated and petrographically classified recent igneous rocks,
   c. known thermal and chemical manifestations of geothermal activity,
   d. fault plane solutions from seismic records;

3. Tectonic models of recent plate motions should be derived.

LIST OF FIGURES

INTRODUCTION

Objectives

The Landsat Lineament Map of Arizona was constructed on the assumption that many of the regional geologic photolineaments represent deep-seated earth ruptures controlling recent igneous activity. Although Quaternary fractures were emphasized in tracing the lineaments, the enclosed map was not intended to be a map of Quaternary fractures. The configuration of older structures is needed to confirm the existence and to determine the magnitude of lateral offsets along Quaternary faults. Other information and further analysis is needed. Once this data is drawn together the map can be redrafted with the Quaternary systems traced in a different line code as in Tapponier and Molnar (1977).

For demonstration purposes, optical Fourier Analysis was applied to an older lineament map. It should be noted that optical Fourier processing can also be applied to help classify lineament systems by age.

Background

The advent of the Landsat (ERTS) and other truly regional data such as aeromagnetic and gravity surveys and the development of the plate tectonics and hotspot concepts has changed the meaning and significance of lineaments in the last decade.

The largest recent collection of papers on lineaments is probably the Proceedings of the International Conference on New Basement Tectonics (Hodgson, et al 1974). Most of the writers agree that lineaments are deep-seated features that penetrate through the crust. Evans Mayo (1958) classified lineaments in the Southwest into four directional trends. Mayo points out that intrusive and volcanic features are located at the intersection of NE and NW lineaments. Jacques Guillemot (1974) interpreted Landsat lineaments of over 100 kilometers in length as deep-seated wrench faults. He considered morphological alignments of river beds, relief, vegetation, etc. to be of geological nature when interspersed with a prolongation of structural alignments. Ground checking of Landsat lineaments showed many of them represent extensions of known faults and fracture systems. Shoemaker, et al 1973, found that the originally Precambrian Bright Angel and Mesa Butte NE fault systems are active Holocene faults. Landsat and aeromagnetic lineament extensions of the known faults are currently active epicenters and include centers of Quaternary volcanism.

In their field check of aerial photolineaments, Sherman and Hatheway (1964) found that NW vegetation and drainage lineaments in the Tucson basin mark an active fault zone causing fractures in buildings. Elston and Scott (1973), in their study of a Landsat scene of Central Arizona, found that major eruptive centers of the San Francisco volcanic field are aligned in NE and N-trending Precambrian lineament systems (for example, the Mesa Butte and Oak Creek Faults).

George Davis (1975) used Landsat published structural and magnetic data, and laboratory deformation experiments in his tectonic analysis of folds in the Colorado Plateau. His conclusions are similar to those of Gilbert Thomas (1974), wherein a series of basement weakness zones are represented at the surface by lineaments to define a series of basement blocks.

Abdel-Gawad and Tubbesing (1974, 1976) used Skylab and Landsat photographs to produce lineament maps and tectonic models of the southwestern U. S. at a scale of approximately 1:13 million. NASA-sponsored analyses of Landsat photos for mineral exploration in Arizona were reported by Wilson, et al, 1975, Brewer, et al, 1973, and Saunders, et al, 1973.

The use of Landsat photographs, aeromagnetic and gravity maps, and thermal data for mapping potential geothermal resources in Arizona was reported by L. K. Lepley and A. K. Doss (1975). This was a cooperative effort between the Arizona State Land Department (Doss), and the Office of Arid Lands Studies (Lepley) and Laboratory of Geophysics (J. S. Sumner and C. L. V. Aiken) at the University of Arizona.

At Mt. Lassen, California, previously unmapped curvilinear structures were mapped from Landsat imagery (Freidman, et al, 1973). Major thermal manifestations are aligned along these ring structures. On Lassen Peak, smaller thermal anomalies mapped by airborne thermal scanner are controlled by the contact margins of silicic or intermediate extrusive plugs and may mark a line of structural weakness.

Barbier and Fanelli (1975) found that 80% of the Italian hot springs lie on long (over 100 km) Landsat lineaments. There are "hot" lineaments upon which the number of springs and geothermal field are particularly high.

Seismic fault plane solutions from earthquake data and Quaternary volcanism have been used to define present day plate boundaries (Smith and Sbar, 1974; Suppe, Powell and Berry, 1975). Tapponier and Molnar (1977) have mapped the active tectonics and faulting of China based on the interpretations of Landsat imagery supplemented with fault plane solutions from seismic data.

It is presumed that active fault and fracture systems will have preferred directional trends. Optical Fourier analysis, the use of diffraction of laser light by patterns in an image, has been used to produce directional rose histograms and directionally-filtered maps from complex lineament maps (Jacobson, et al 1973; Pincus and Dobrin, 1974; Pincus and Doe, 1974; Correa and Lyon, 1974; Lepley, 1978).

METHODS AND MATERIALS

Lineament Map of Arizona

The enclosed map is a compilation from three lineament maps of Arizona: (1) A lineament map made specifically for this project from 1:1 million scale B&W band 6 (solar infrared) Landsat imagery especially suited for showing structural features, (2) A lineament map previously constructed using 1:1 million color transparencies composited from Landsat band 4, 5, and 7 by the U. S. Department of Agriculture at Salt Lake City, and (3) A lineament map previously constructed from the band 6 B&W 1:½ million scale USGS Landsat Mosaic of Arizona.

The first data set listed above, the band 6 imagery, was the principle data set for this study and the other maps were used as supplements. The band 6 images were mosaiced into strips corresponding to the N12°E swaths covered by scanner on the orbiting satellite. Sterio coverage for most of the state was available, not only in areas of side lap between adjacent swaths, but also by repetitive coverage of the same area where sterio displacement was obtained by the slight lateral E-W drift of the satellite orbit between passes.

The following swaths of Band 6 winter-time Landsat imagery, the principle data for this study, are designated by the four digit image numbers common to all images in the swath:

1124-Lake Meade-Mohave Reservoir
1159-Lake Mead to Gulf of California
1194-Grand Canyon to Pinacate Mountains
1176-Grand Canyon to Pinacate Mountains
1193-Black Butte to Sasabe
1157-Black Butte to Sasabe
1156-White Mountains to Nogales
1174-White Mountains to Nogales
1173-San Bernadino Valley

The following bands 4, 5, and 7 color infrared Landsat USDA composite transparencies were used:

1123-17441	1410-17353	1049-17315
1105-17443	1283-17334	1102-17271
1069-17441	1283-17341	1318-17265
1446-17361	1068-17385	1101-17215
1554-17343	1285-17332	1101-17221
1374-17380	1516-17250	1283-17332

These 18 images were purchased under NSF grant EAR 76-02590.

Geomorphic and tonal indication of fault and fractures were traced with special attention given to areas of Quaternary volcanics where fracture zones were found to coincide with alignments of volcanoes. Circular or arcuate ring structures were traced because many of these represent cauldera walls, ring dikes, concentric fracturing over stocks or other structural manifestations of igneous centers.

Bedding plane traces along steeply dipping formations were traced for a number of reasons: 1. Major regional strike slip faults are commonly abutted by steeply upturned beds. 2. Many faults are bedding plane faults. Lutton (1958) concluded that steep bedding faults are a consequence of basement wrench faults that tend to localize igneous intrusions.

At this stage of the study, no attempt was made to separate Quaternary faults and fractures from older structures. Age classification was deferred because: 1. Supplementary data will be used to help date these structures. Landsat photographs or the maps derived from them should not be used alone but should be interpreted synergistically with other appropriate data such as seismic fault plane solutions, known thermal manifestations, age dating of igneous rocks, position of known recent silicic or intermediate igneous centers, magnetic and gravity anomalies, and subsurface hydrologic data.

Optical Fourier Analysis Demonstration

A lineament map drawn not especially to detect Quaternary systems had previously been constructed by this writer by interpretation of the Geological Surveys Landsat mosaic of Arizona. Due to the inherent loss of resolution in the mosaicing and reproduction process, the resulting lineament map shows fewer lineaments than the map enclosed in this report. Previous to the inception of the study described in this report, 1/160 X glass reduction of this map had already been prepared for input to the optical Fourier apparatus. Therefore to demonstrate some of the capabilities of optical Fourier analysis (OFA), this pre-existing map was used to produce a few directional rose histograms and directionally filtered maps. It should be kept in mind that the OFA results in this report were not derived from the enclosed lineament map constructed for this study.

The laser OFA computor processes maps and other images by using diffraction of light by the input image. The resulting diffraction pattern is equivalent to a two-dimensional power spectrum of spacial frequency (lines per unit length) of the image, but the process is vastly different to that performed in digital computors. The Fourier analysis performed by OFA is superior to that produced by digital techniques because the digital process produces aliasing in photographic images and has less resolution in line maps due to approximations in digitizing.

The optical computor (OFA) is similar to a diffraction spectrometer in a sense. In the spectrometer, a beam of light to be analyzed for wavelength content (color spectrum) is superimposed on a diffraction grating having a known, single spacial frequency (grooves per millimeter). The resulting diffraction pattern is the "beat pattern" or interference pattern which is a stationary power spectrum projected on some screen or film. This is equivalent to a one-dimensional Fourier spectrum.

In the case of the laser computor, a beam of light having a known, fixed wavelength (laser beam) is superimposed on the unknown diffraction grating (the input map). The resulting "beat pattern" in this case is a two-dimensional power spectrum describing the statistics of the spacial frequency content of the image. A two dimension Fourier analysis has been performed. Since two dimensions were used, directional statistics are also shown.

Figure 1 is a photoreduction of the 1:1 million scale map constructed for this study, whereas figure 2 is the input image used to demonstrate some of the types of computation available with non-digital OFA. The scene of figure 2 was processed in two ways. Directional rose histograms were generated to show the azumithal distribution of lineaments within fields of view corresponding to 700 kilometers. The length of the rays on these figures is proportional to the square root of the total line length oriented in the direction of the rays. Figures 2 and 3 show the three portions of the lineament map analyzed to produce the three rose histograms of figure 4.

A directional filter that passes lines oriented with a 30 degree directional interval was inserted into the instrument and eight directionally filtered maps produced. The filter was rotated in 22½ degree increments to divide the compass into octants.

The lineament maps and histograms of this report can be compared with each other quantitatively, but should be compared only qualitatively with regional structure maps derived by other techniques. The exclusive use of Landsat images for detection of lineaments produces two types of directional anisotropy. One type of bias is due to the fact that all of the Landsat images were obtained at mid-morning. Northeasterly trending topographic features are illuminated with more contrast by the sun's rays from the southeast and more of the subtle northwesterly lineaments will remain undetected.

Tomes, et al (1973) found that Skylab images (obtained in afternoon) showed bias toward northwesterly striking linear features and Landsat lineaments from the same area showed bias toward northeasterly striking features.

A different source of direction bias very important to this study is the masking of lineaments striking N81°W $\pm 2°$ by the N81°W scan lines on the Landsat imagery. The spacial frequency of the striping, due to mis-calibration of within sets of six scan lines, is 2 stripes per kilometer. Therefore, topographic or tonal lineament sets of lineaments trending near N81°W and spaced at near ½ kilometer apart will be masked. Components of the Texas lineament zone may have been excluded by this systematic filter.

Extreme caution should be used before attempting to compare different photointerpreter's results in lineament analysis. In statistical tests by the Jet Propulsion Laboratory (Siegal, 1977), cluster analysis of orientation data displayed clustering by operators rather than by images.

Thus, due to the bias imposed by the solar illumination direction, scan line striping direction, and uniqueness of style of photointerpreters, quantitative comparisons must be made within lineament maps and not between them.

RESULTS

Conclusions

The general lineament map of figure 1 and plate 1 should be considered a preliminary edition until it is analyzed in the light of accessory data. These would include age dates and positions of siliceous and intermediate Quaternary igneous rocks, epicenters and fault plane solutions from seismic data, magnetic and gravity anomaly patterns, and known thermal manifestations of both surface and subsurface. Although these studies were beyond the scope of this project, I will make a few remarks about the new lineament map and the demonstration optical Fourier analysis of the old lineament map.

To map Quaternary faults in a region laced with known faults and fractures of Precambrian, Mesozoic, and Tertiary origin, one must suspect that many of the older block boundaries have guided Quaternary faulting. Therefore, in the attempt to construct plate models for the purpose of locating potential hidden geothermals, the plate or block configuration resulting from the older tectonic events should be understood. The conventional methods for relating stress and strain apply to a homogenous medium only and they do not apply to regions containing weak faults bounding strong plates (Atwater, 1972). This situation applies to Arizona, especially on the Colorado Plateau, (Davis, 1975, Elson, et al, 1973, Shoemaker, et al, 1973).

The Arizona Geological Society Digest, Volume X Tectonic Digest (Wilt and Jenny, 1976) contains three papers with small scale maps especially suitable for comparison with figure 1 through 13 of this report. These are: Spence Titley's figure 2, page 75; Rehrig and Heidricks' figure 1, 3, and 4, pages 207, 211, and 218; and William Purves' figure 3, p. 269.

Titley's six northwesterly linear discontinuities can be traced on figure 7 of this report. The EW lineament shown on figure 5 of this report might be related to the EW Cambrian zero isopachs at 35°N latitude cited by Pierce et al (1970).

Purves's orthogonal system of NE and NW blocks is especially evident on my figure 8. Note the truncation of the NE lineaments along a NW system corresponding to Purves's "Las Vegas" zone LA 30 to LK 40.

Rehrig and Heidricks' figure 4, when compared to figures 7 and 9 of this report showing NW and NNW lineaments, suggests that at least in western Arizona the strong NW trend shown by the Basin and Range histogram of my figure 4 may be due in large part to bedding plane lineaments related to Rehrig and Heidricks regional arch. It is also useful to compare Rehrig and Heidricks' rosette plots of NNW late Tertiary and Laramide tensional structures (their figures 3 and 1) with the rosettes figure 5 of this report. The ENE trends are distinct on the optical patterns.

The San Andreas NW right lateral fault system can be traced through the southwest corner of Arizona. Plate 1 and Figure 1 shows the San Jacinto fault in the far lower left and a similar lineament passing through the vicinity of Yuma.

An examination of the alignment of recent volcanoes with lineaments at Flagstaff, and in the Sentinal and Pinacate regions suggests a clockwise rotation of the Sonoran systems relative to the Plateau system. The controlling lineaments at Flagstaff are NW and NE and NNW and ENE at Sentinal and Pinacates. The Plateau structures are renovated faults along older structures. The long cross-cutting NNW and ENE lineaments in southwest Arizona may be in response to Quaternary stress. The question arises, did the faulting directions rotate through time in response change of relative direction of plate movement (Peter Coney, 1976), or as R. C. Bostrom suggests, did the plate systems rotate clockwise in response to tidal bulge formation?

Recommendations

The following analyses are suggested for full integration of the 1:1,000,000 lineament study.

1. The lineament map should be filtered to produce a map of suspected Quaternary fracture and fault zones. A number of approaches should be used. A quantitative statistical method is as follows: Two masks are constructed to fit the lineament map. One mask leaves visible only the lineaments in Quaternary surfaces; the other mask uncovers only pre-Quaternary surfaces. Optical Fourier strike-histogram rosettes would be constructed from the lineament map exposed through the Quaternary and preQuaternary mask . The two resulting rosettes would be photographically subtracted. The result should produce a histogram strongly related to "Quaternary - only" lineaments. From this histogram, a Fourier filter can be constructed to display a map of the desired lineament set (Lepley, 1978).

2. Seismic fault plane solutions are important in understanding recent plate tectonics. Little or no such work has been done for Arizona but should be undertaken to help define Holocene plate motions and boundaries.

3. Regional magnetic and gravity anomalies should be analyzed to (a) define deep-seated fault zones (b) search for anomalies due to magma chambers, intrusions, and altered rocks. Lineament maps should be analyzed in conjunction with the available geophysical maps (Sauk and Sumner, 1970; West and Sumner, 1973; Aiken, Schmidt, and Sumner, 1975).

4. Recent igneous rocks should be dated and classified with special attention given to mapping siliceous and intermediate rock younger than 2 million years. Landsat and other photography can extrapolate from these point data.

5. Known surface and subsurface thermal manifestations should be plotted.

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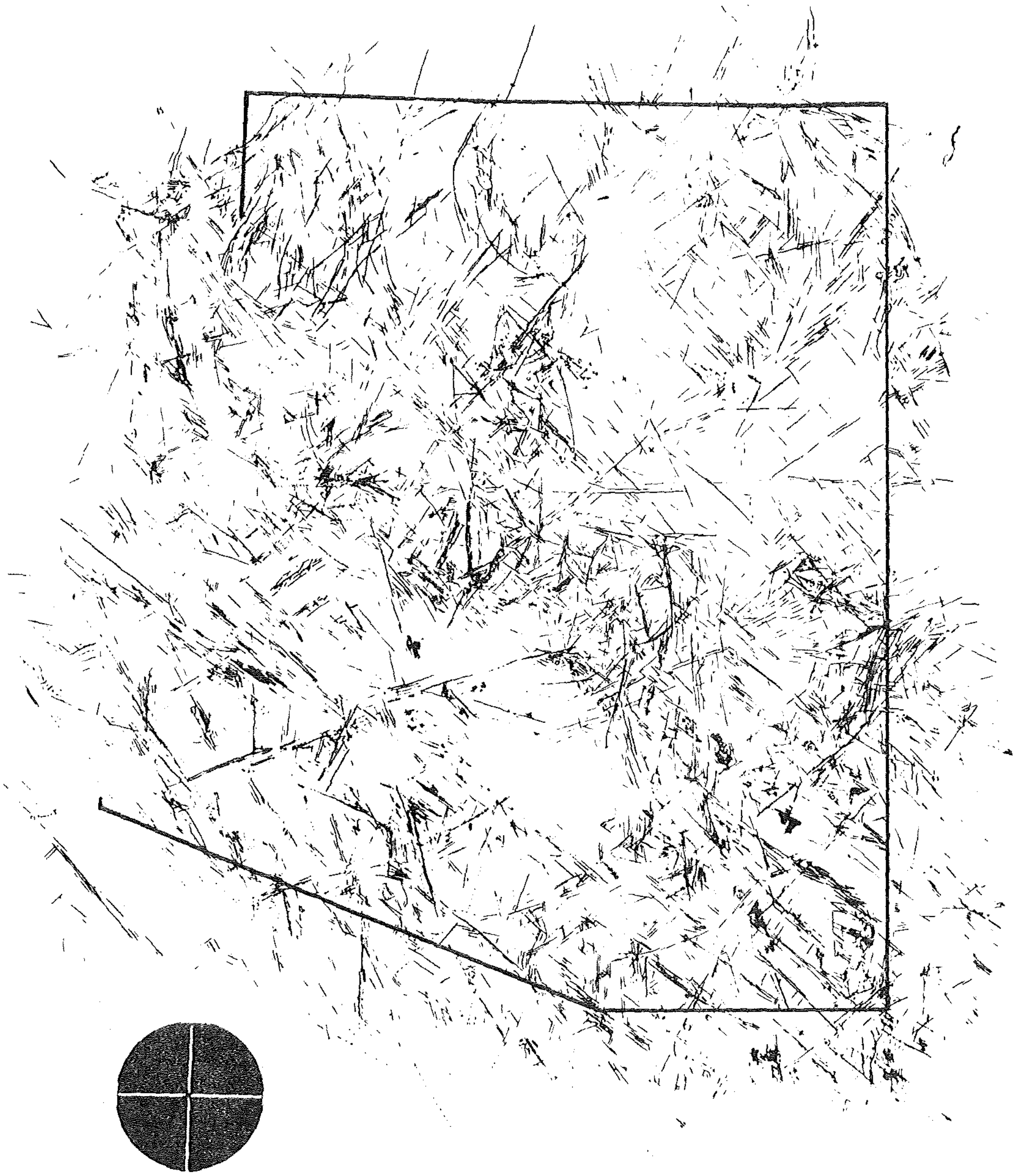

Figure 1. Landsat lineament map of Arizona (1977) interpreted principally from 1:1,000,000 scale band 6 sterio sets and band 4, 5, and 7 color composites.

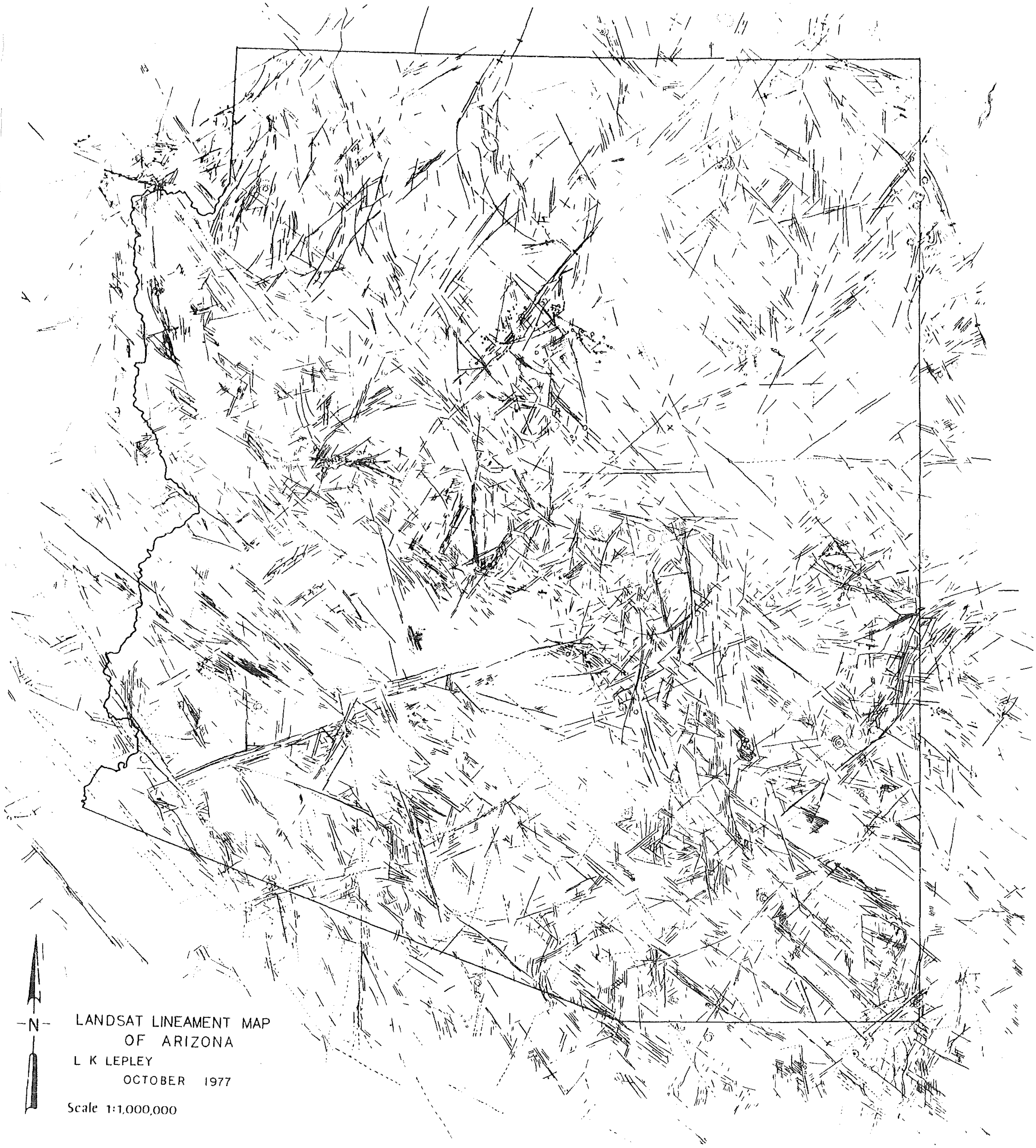

Figure 1. Enlarged

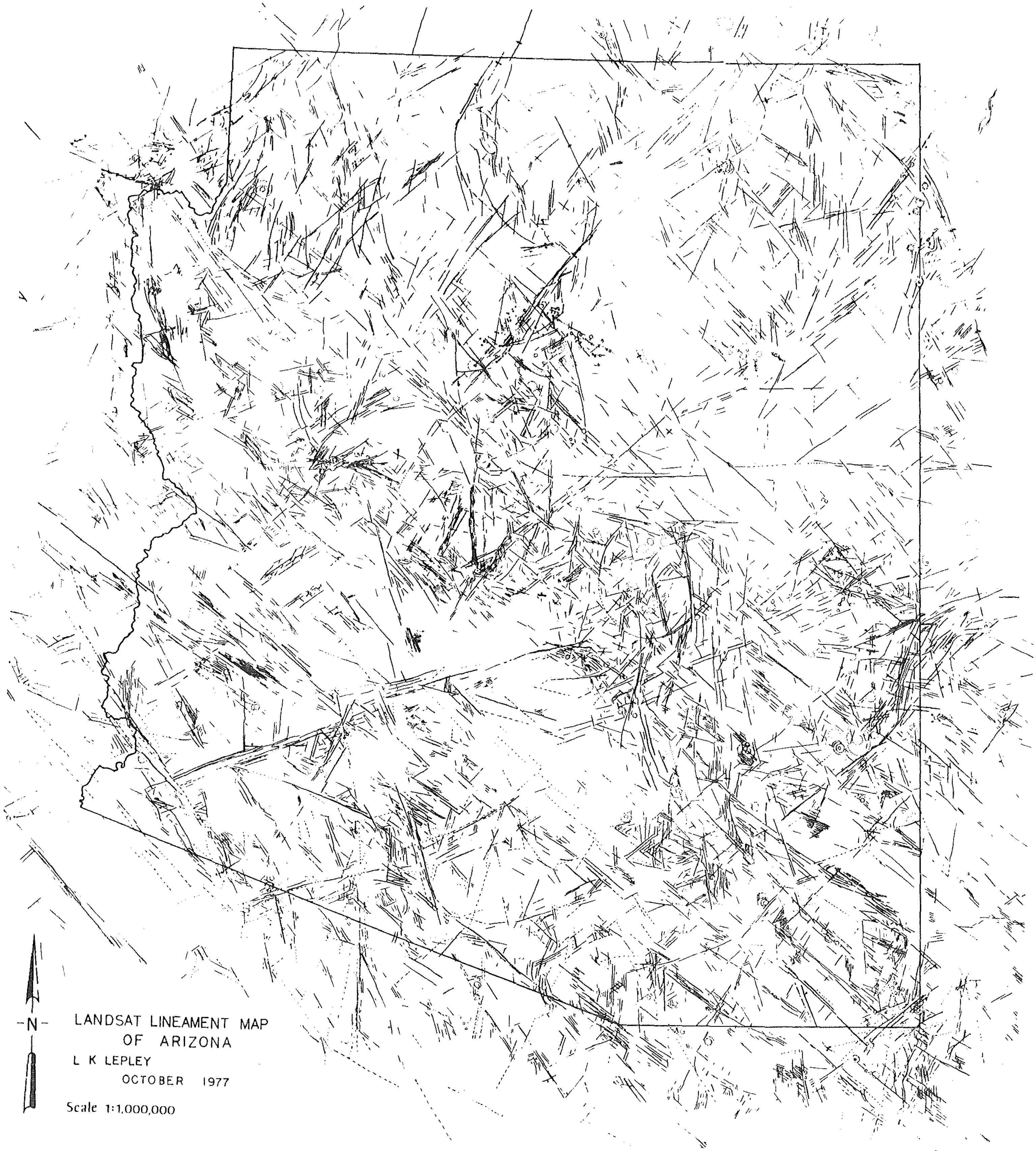

Figure 1. Enlarged

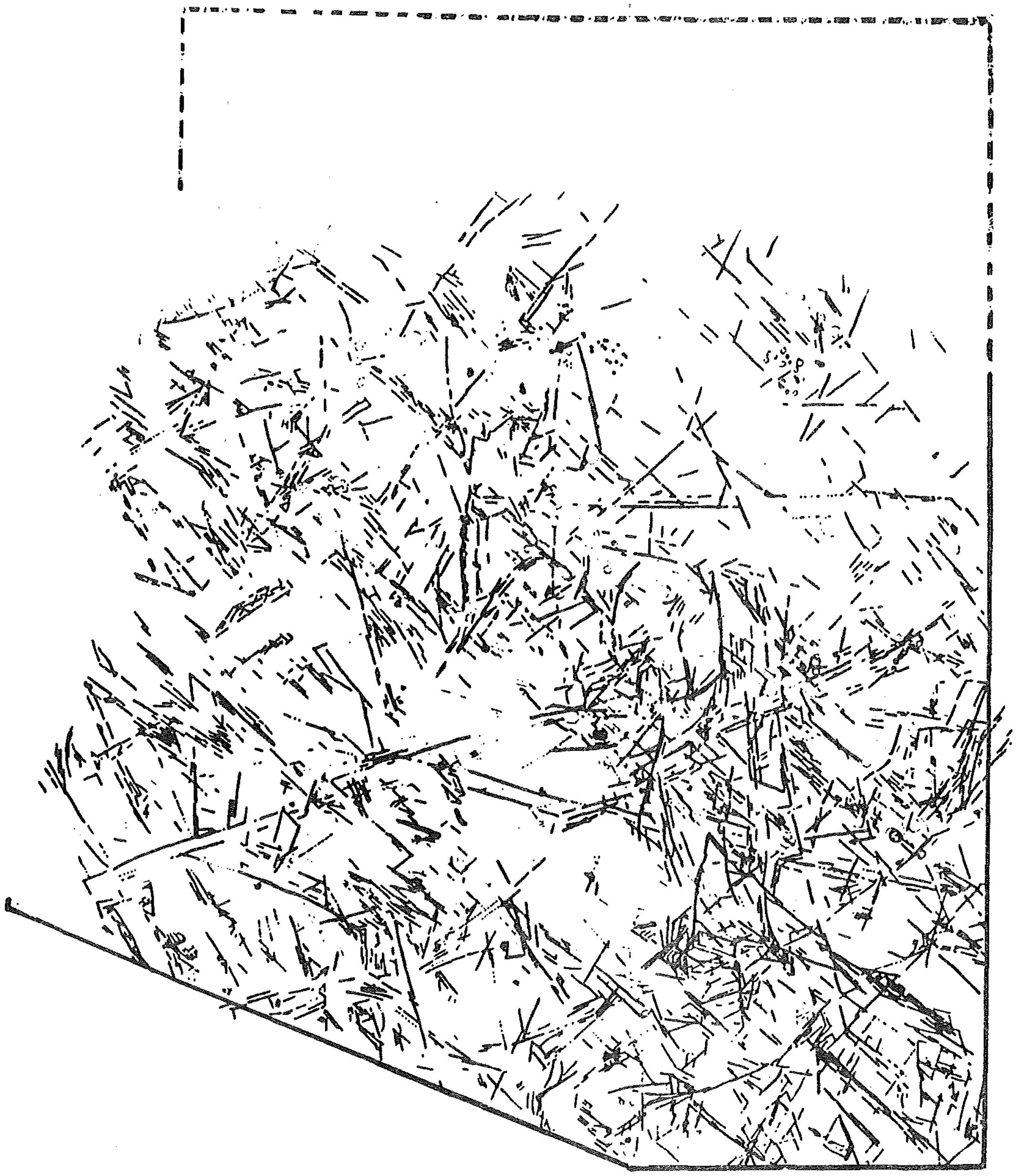

Figure 2. Landsat lineament map of Arizona (1976) interpreted principally from 1:500,000 scale U. S. Geological Survey ERTS-1 mosaic of Arizona. Upper part truncated by 700-kilometer (equivalent) field view of Optical Fourier instrument integrated to produce the center strike-histogram rosette of figure 4.

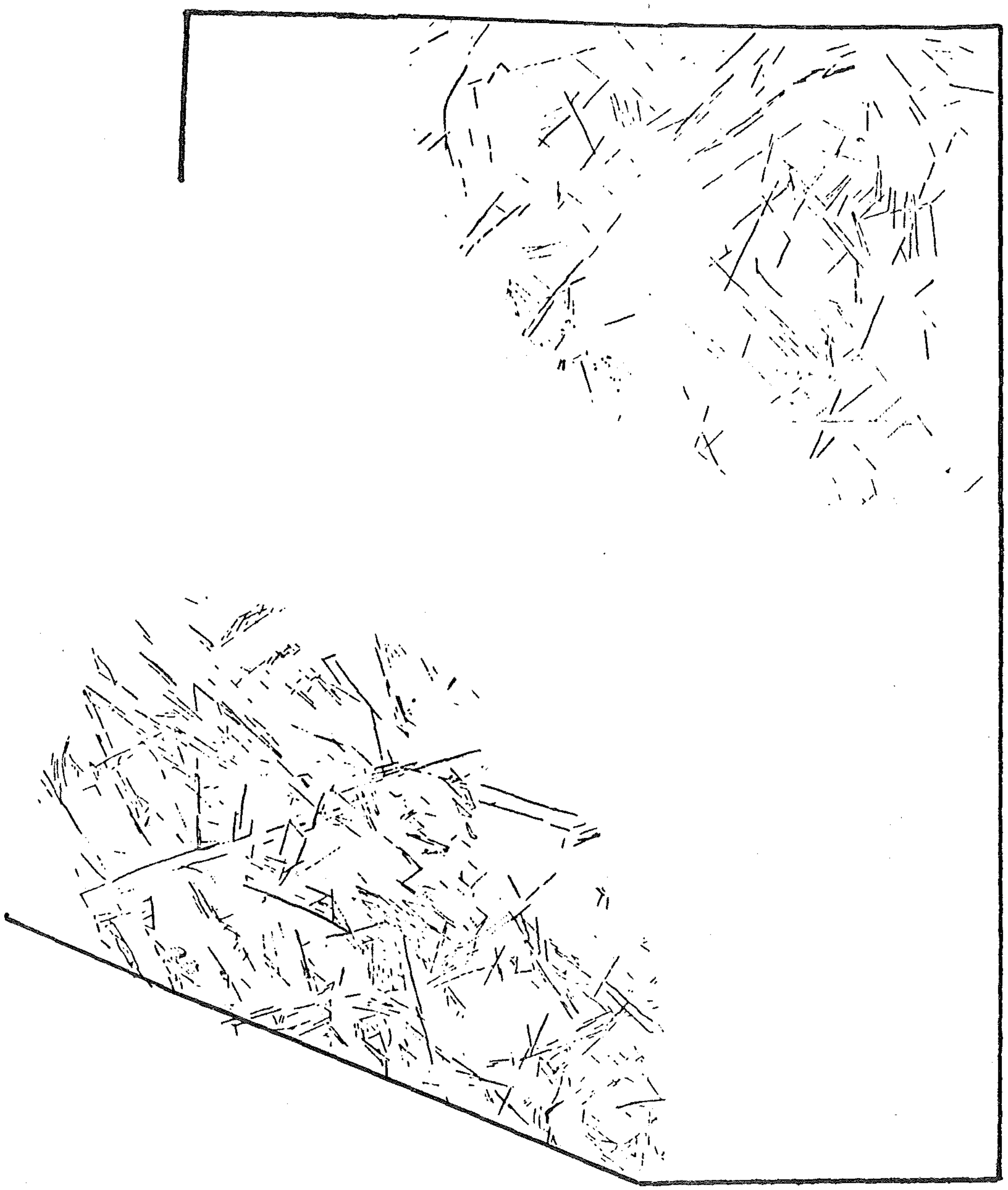

Figure 3. Navajo section of the Colorado Plateau Province (upper right) and the Sonoran Desert section of the Basin and Range Province (lower left). These two fields were integrated to produce the strike-histogram rosettes of figure 4.

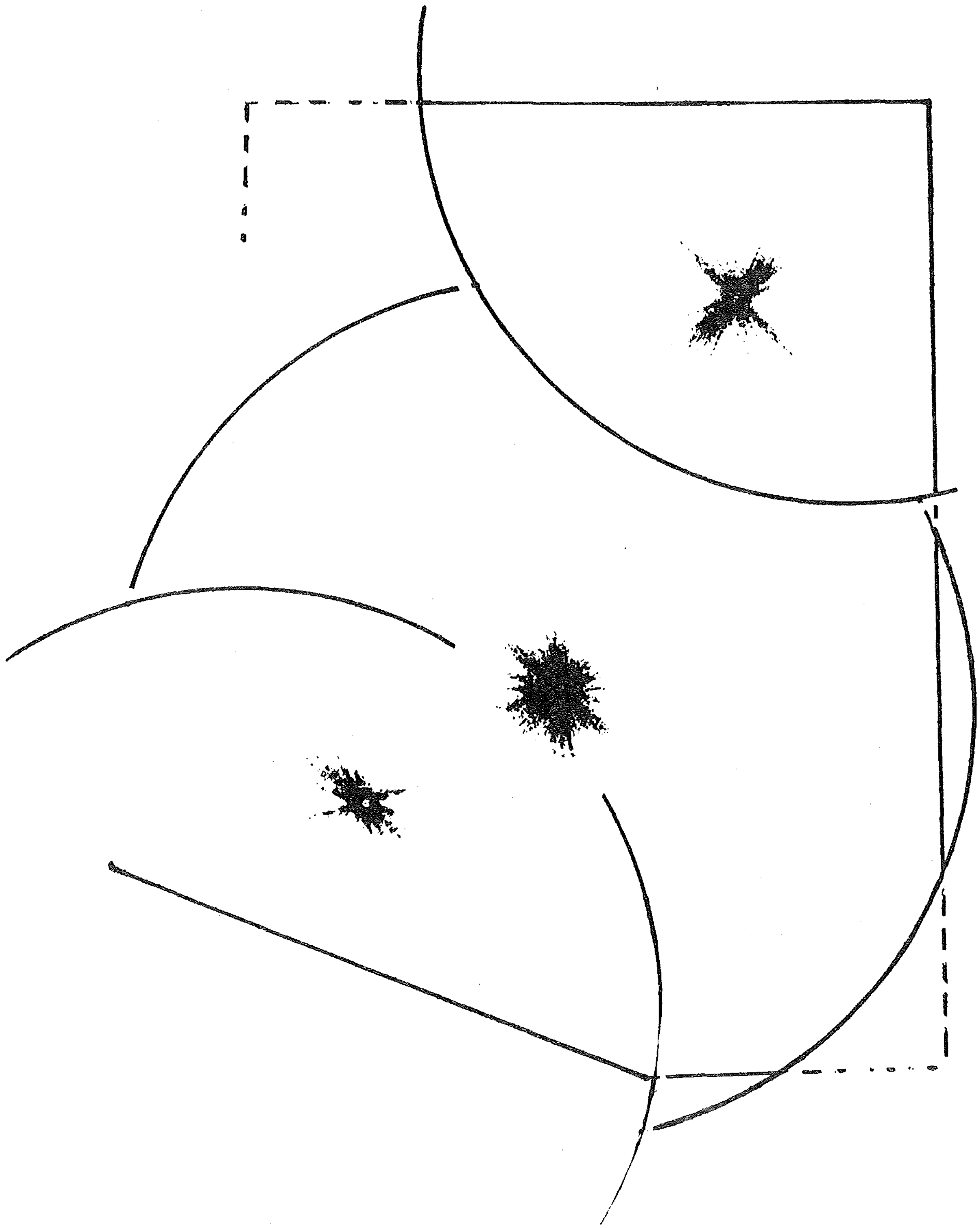

Figure 4. Strike-histogram rosettes describing the directional statistics of the fields shown in figure 2 and 3. The lengths of the rays are proportional to the square root of the total line lengths in the lineament map.

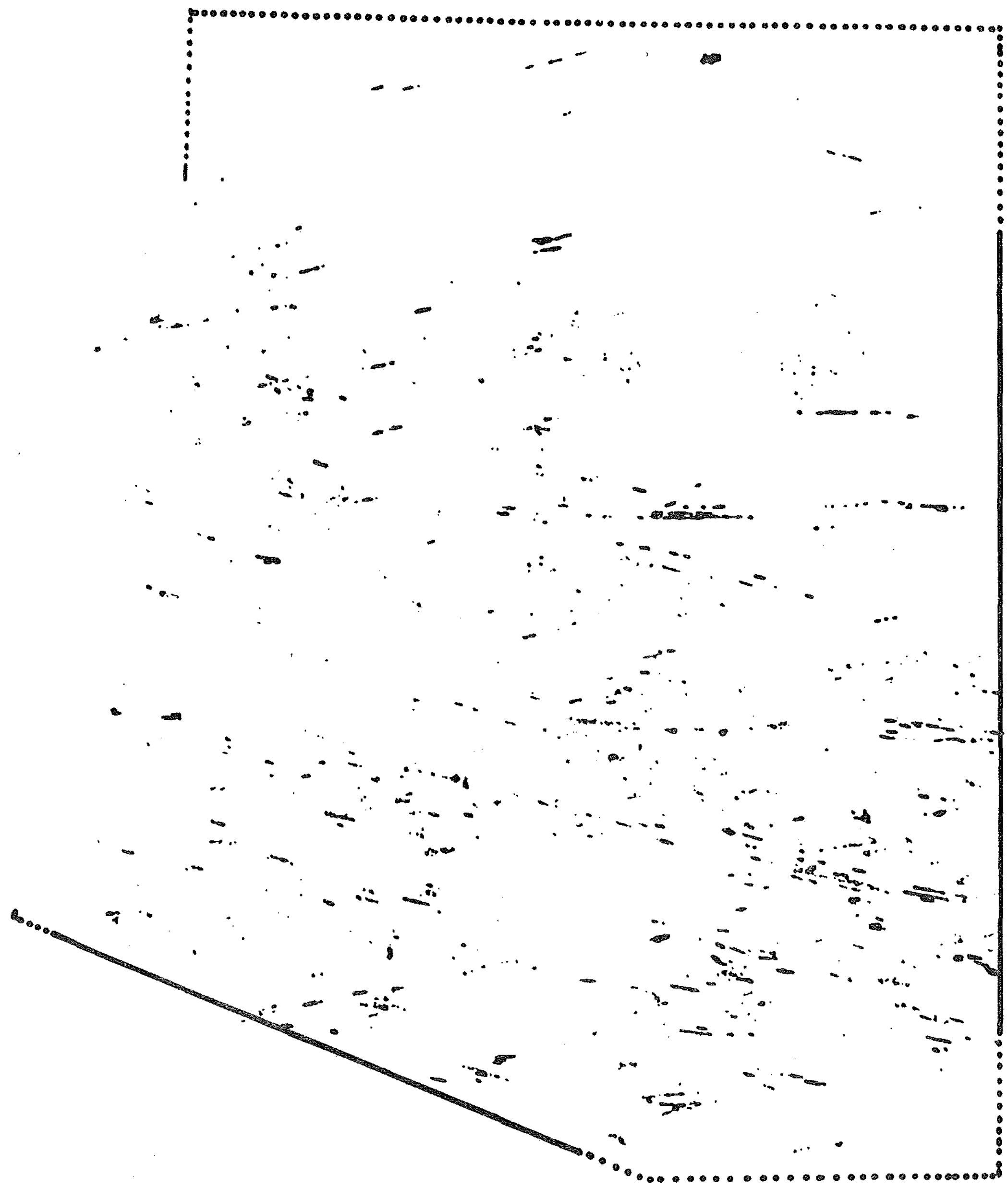

Figure 5. E–W lineaments optically filtered from the map of figure 2.

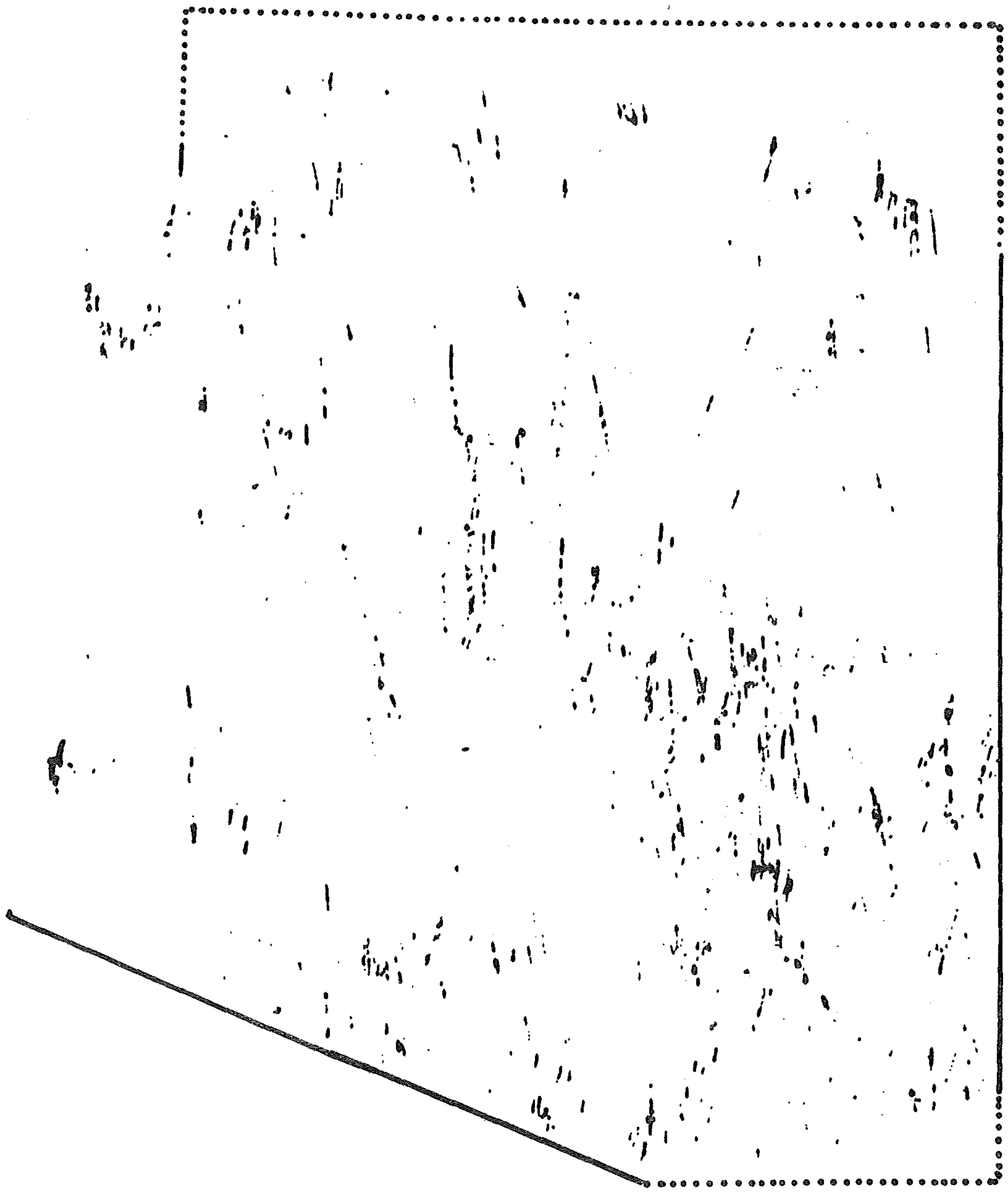

Figure 6. N-S lineaments optically filtered from the map of figure 2.

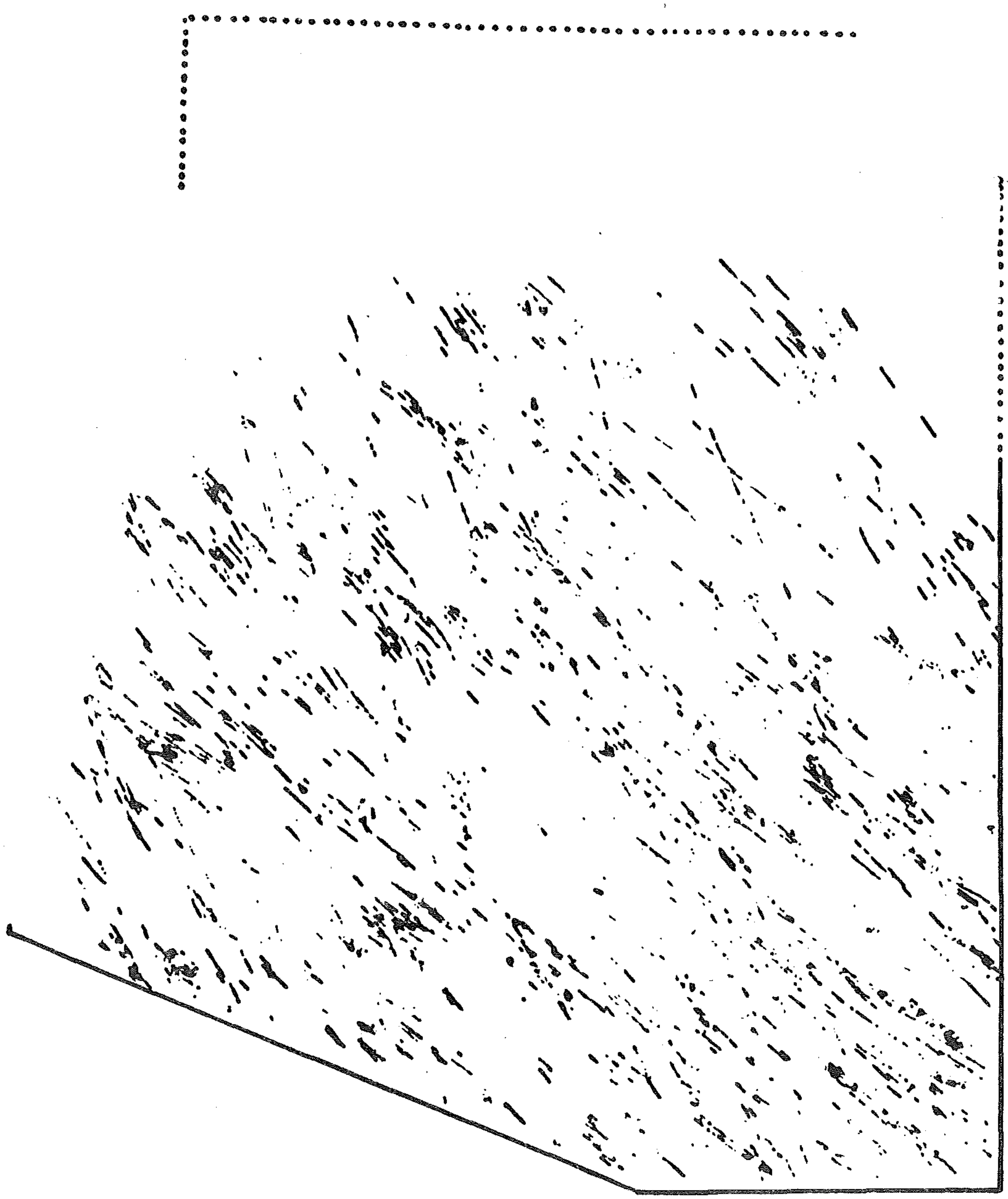

Figure 7. N-W lineaments optically filtered from the map of figure 2.

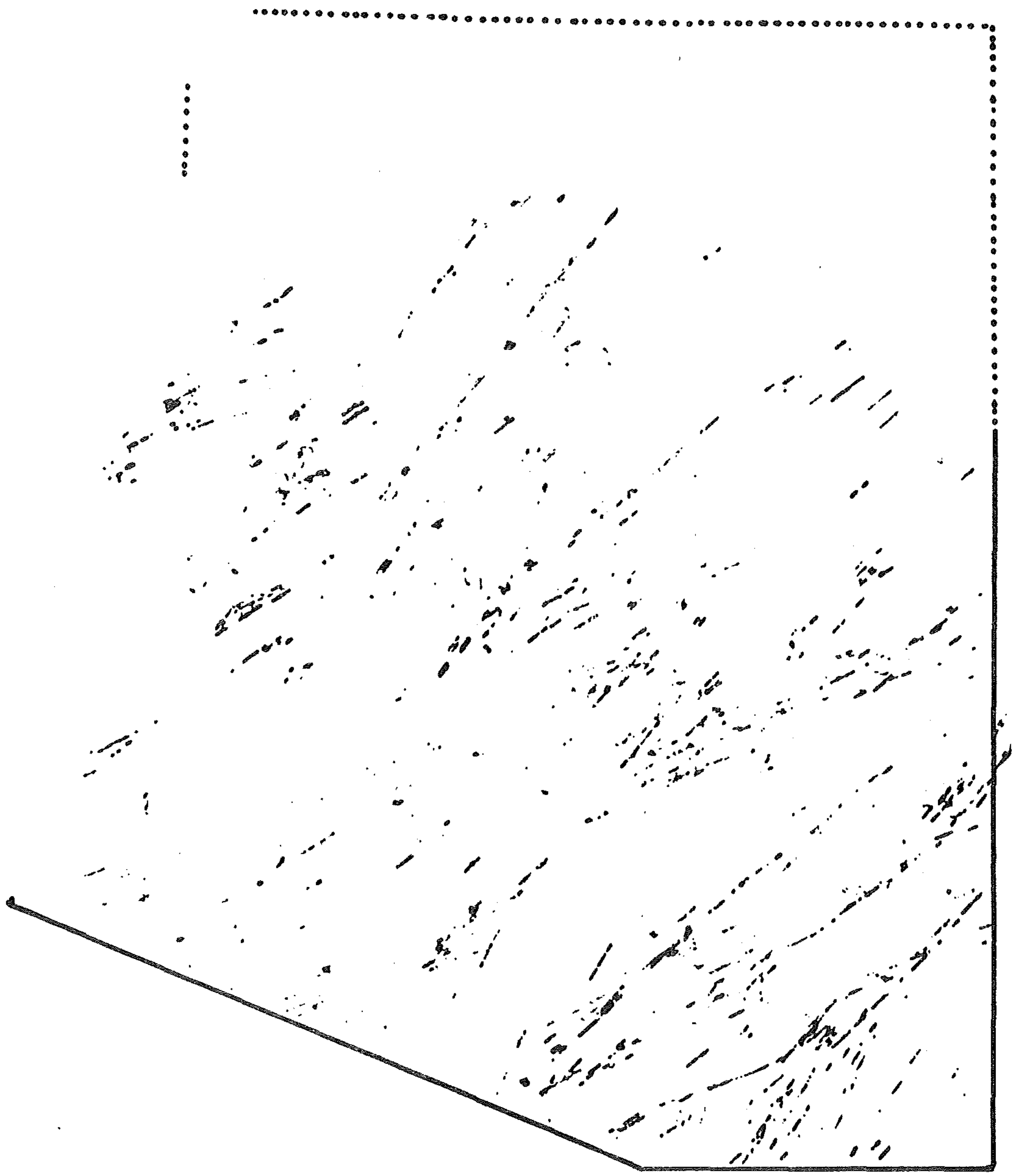

Figure 8. N-E lineaments optically filtered from the map of figure 2.

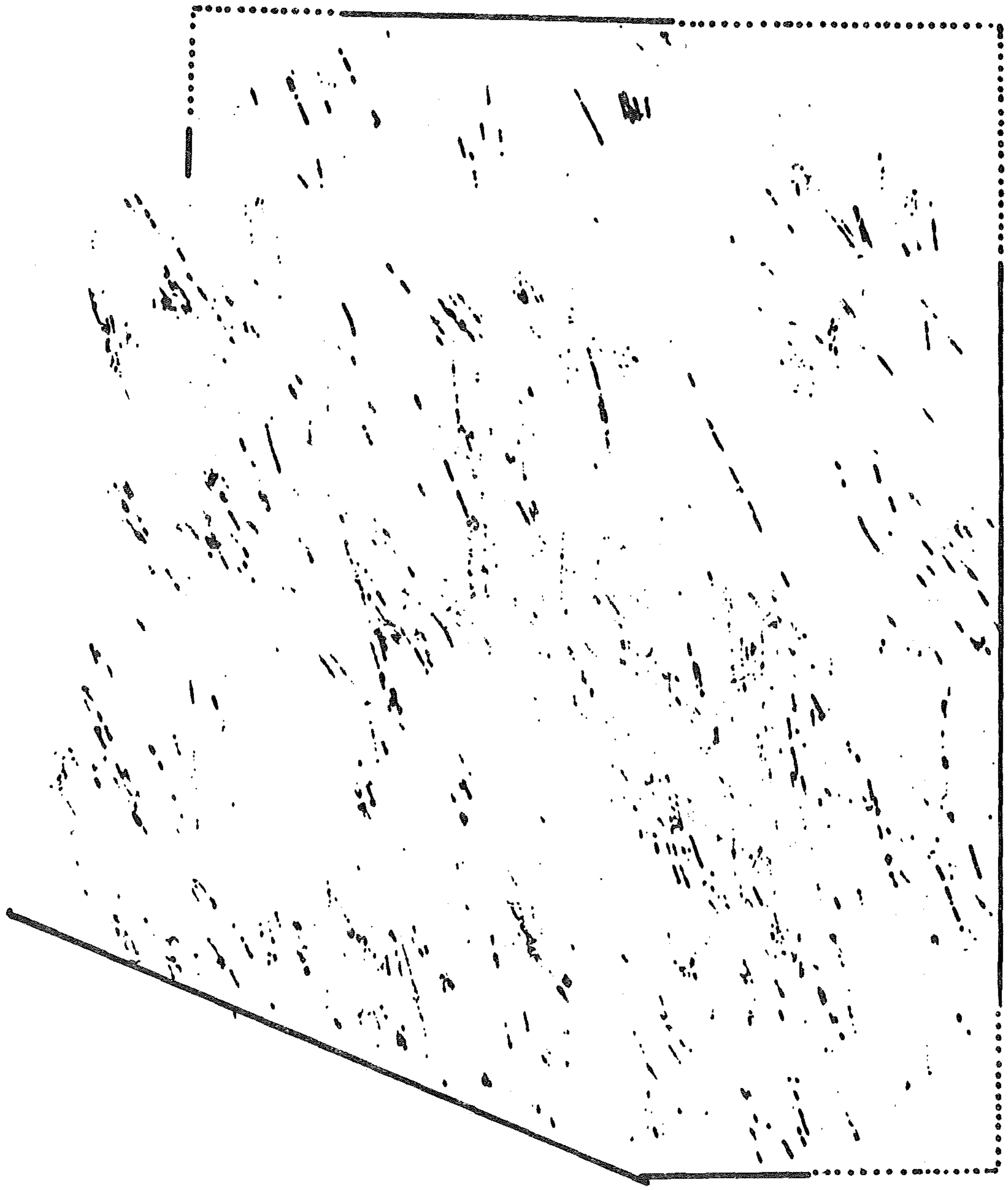

Figure 9. NNW lineaments optically filtered from the map of figure 2.

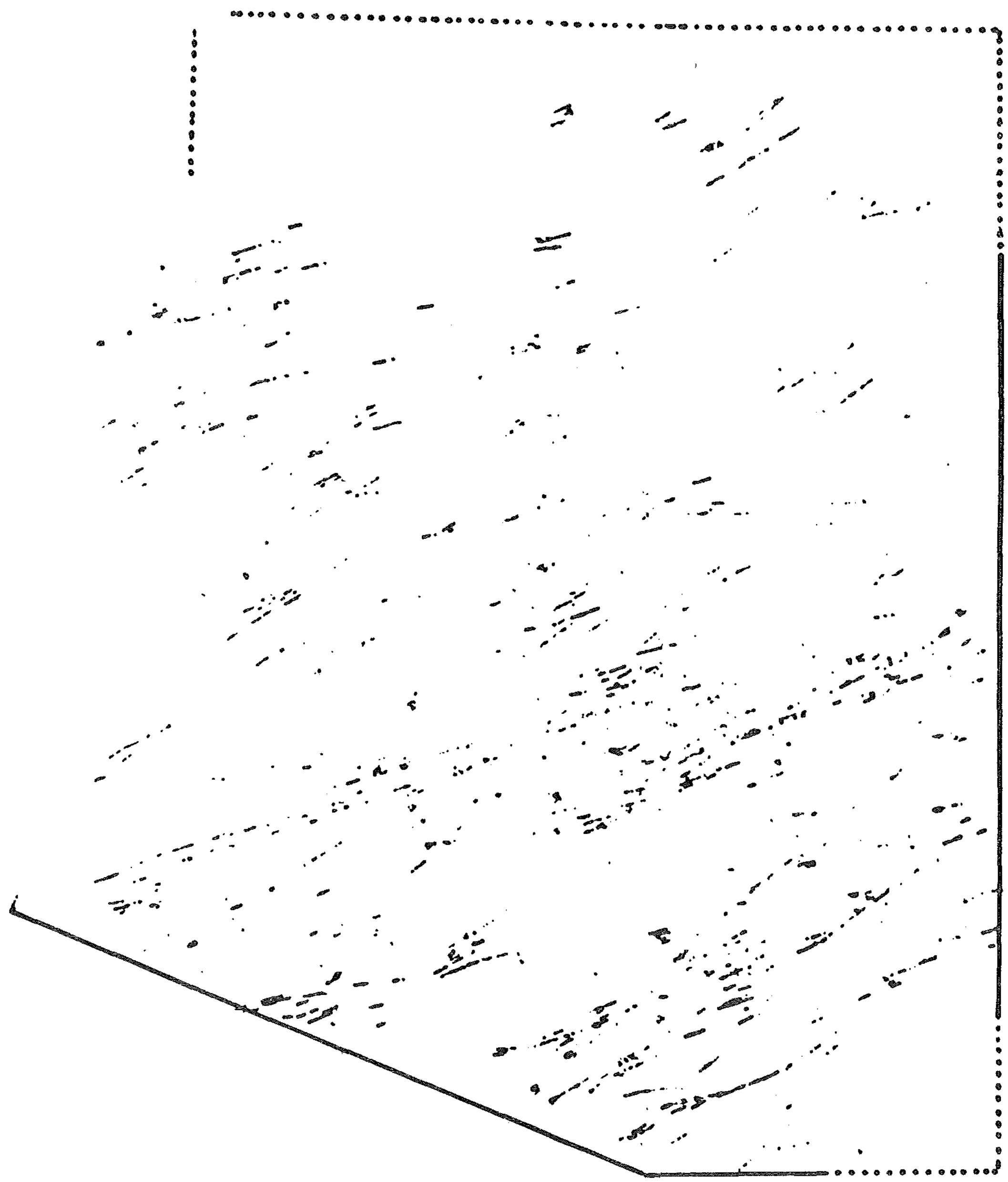

Figure 10. ENE lineaments optically filtered from the map of figure 2.

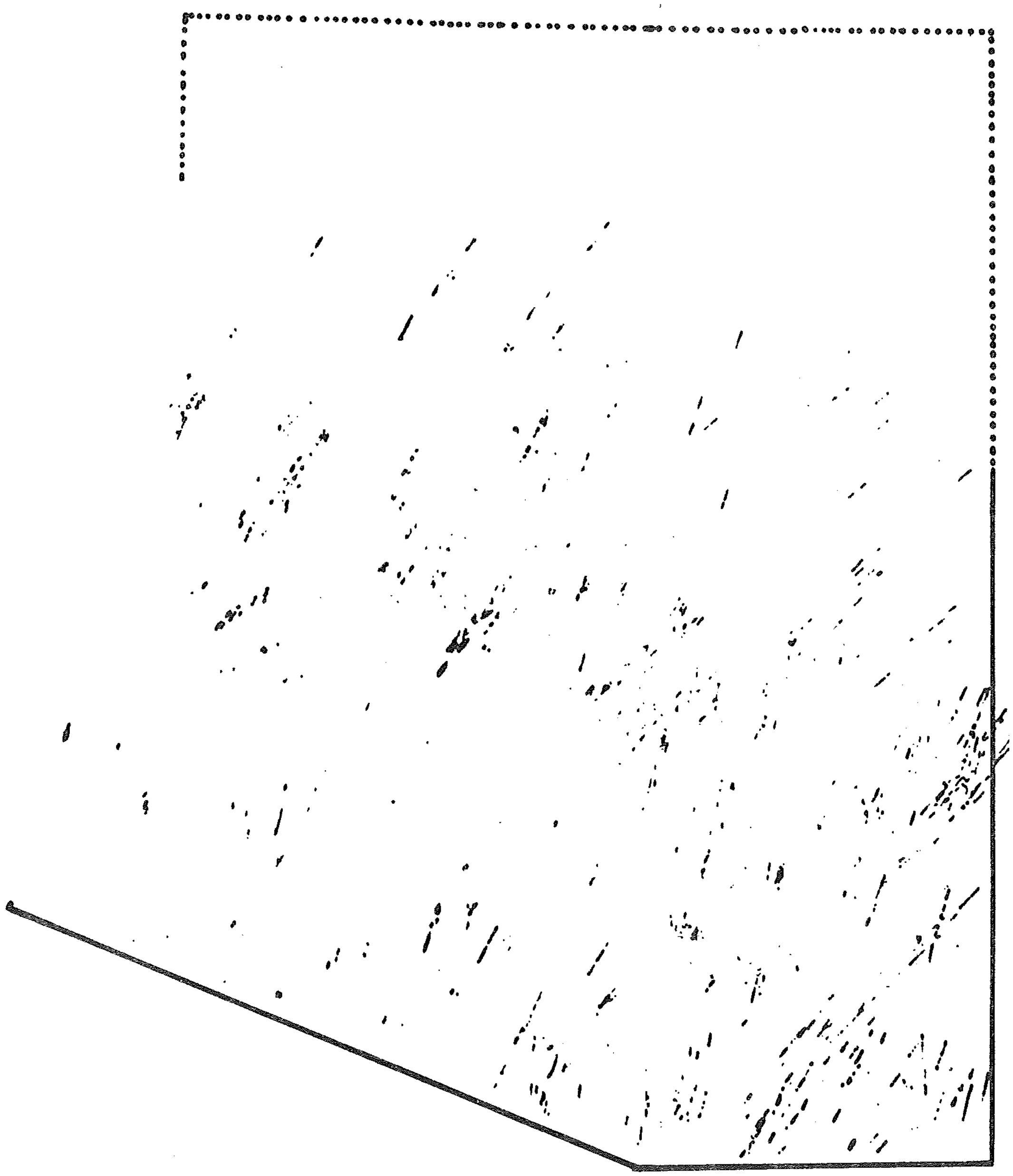

Figure 11. NNE lineaments optically filtered from the map of figure 2.

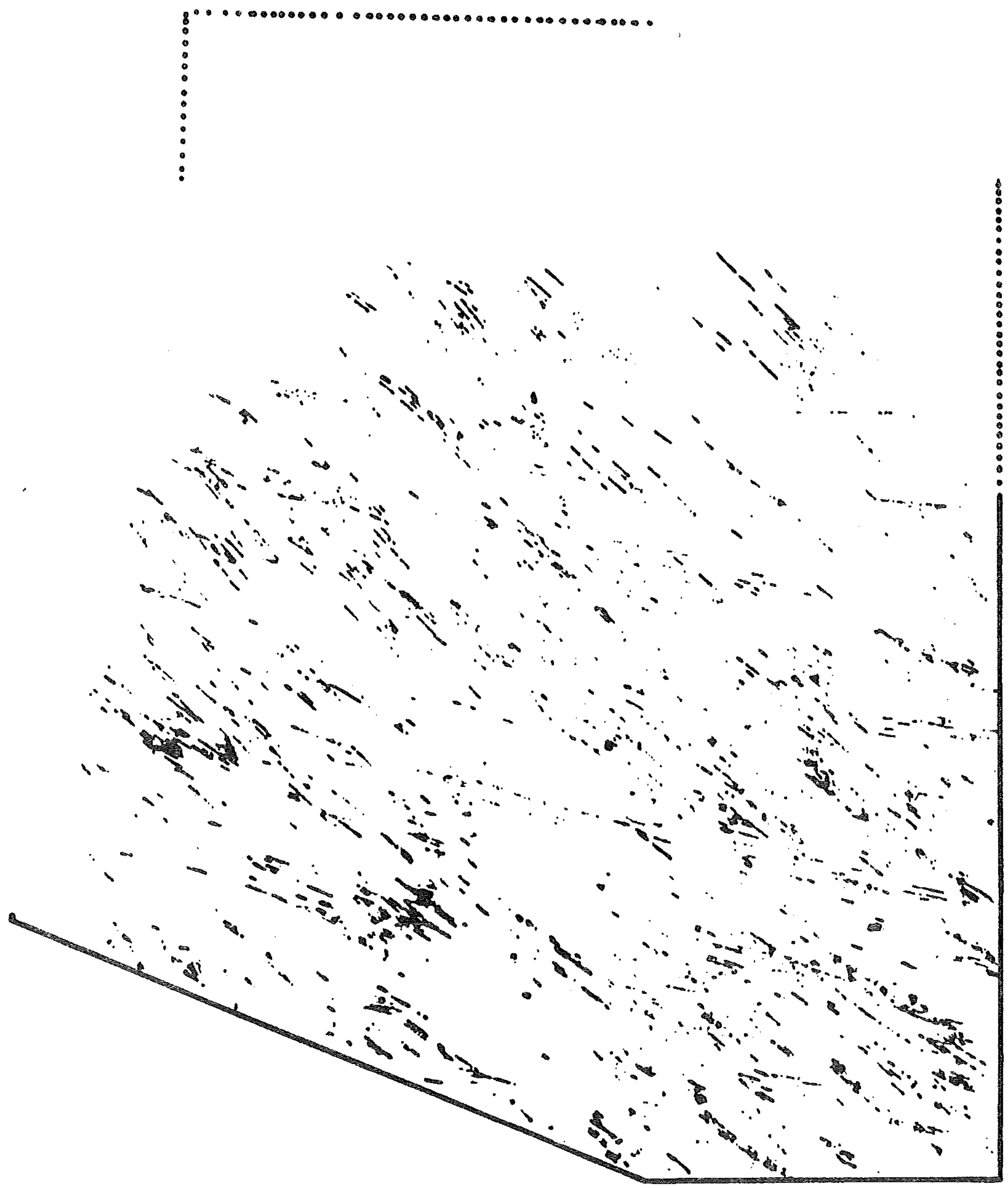

Figure 12. WNW lineaments optically filtered from the map of figure 2.

GEOTHERMAL LEASING AND DRILLING ACTIVITY IN ARIZONA

By C. Stone

Leasing

Leasing activity has increased significantly on both state and federal lands in Arizona during the past year (see Figures following). Several lease applications and two Notices of Intent to Conduct Geothermal Resource Exploration Operations have been filed at various Bureau of Land Managment (BLM) Arizona district offices. On the state level one lease renewal and one new lease application were filed with the State Land Department.

Reed Nix of Nix Drilling Company, Globe, Arizona, obtained a lease on state land T5S R24E S16 in November, 1972, to drill a geothermal test hole. Drilling commenced April 23, 1974, and continued to the present. In November, 1977, Nix applied for a two year lease extension, but the extension was not granted by the State Land Department. Four individuals jointly applied for a geothermal lease on state land on the Hassayampa Plain, T5N R6W S36 and T4N R6W S2, in March, 1978. Upon receipt of such applications the State Land Department must advertise for competitive bidding for ten weeks. Lease issuance is currently pending action by the BLM, which is conducting an environmental study of surrounding federal land.

The BLM Safford District Office reported on seven older noncompetitive geothermal lease applications on federal lands in the Clifton area, within townships T4-6S R28-30E. Dates and applicants are unknown; however, four of the leases were granted to Phillips Petroleum Company, Del Mar, California, on July 1, 1975. All of the applications may have been filed by Phillips as all sections are in proximity.

Geothermal leasing of federal lands during the past year has been even more active than in former years. The BLM Kingman Resource Area Office reported receiving two Notices of Intent, one from the U. S. Geological Survey, Menlo Park, California, to drill five shallow (400 ft) heat flow holes in the Kingman district (See Drilling Section, below) and a second from Cyprus Georesearch of Los Angeles, California, to conduct three geophysical surveys in each of two areas: T20N R17-18W near Kingman and T15N R11W and T14N R10-11W south of Wickieup. The Kingman BLM office also received a geothermal lease application from a Utah lease broker for 20 sections south of Wickieup in townships T14-15N R10-11W. The lease applications are pending completion of an environmental assessment of the area.

On other federal lands, geothermal lease applications were filed in September and October, 1977, by Chevron U.S.A., Inc., Denver, Colorado, for land near San Francisco Peaks. Chevron applied for 56, 091.6 acres within the townships T21-25N R7-9E, but in December, 1977, they withdrew applications on 8558.77 of those acres. The status of these applications is currently unknown but probably is pending an environmental assessment.

Southland Royalty Company, Fort Worth, Texas, applied for geothermal leases on 2899.23 acres of federal land in San Bernardino Valley within the townships T23S R31E and T24S R30-31E. The applications were filed in December, 1977, and action is pending an environmental assessment of the area by the BLM Safford District Office.

On January 1, 1977, the BLM Phoenix District Office granted a geothermal lease to Gary and Frances Smith for federal land on the Hassayampa Plain, specifically T5N R6W S25. This section is contiguous to land under application from the State Land Department by four individuals mentioned above, two of whom are also Gary and Frances Smith.

Drilling Activity

Three deep geothermal test wells have been drilled in the state to date, with limited success. Two of these wells were drilled in 1973 by Geothermal Kinetics Systems, Phoenix, Arizona, near Chandler. The well locations are T2S R6E S1 NE SE and T2S R6E S1 SE NE. Amax Exploration, Inc., Denver, Colorado, drilled the third well near Eloy, T7S R8E S8 SE SW, in 1974. The fourth geothermal test well is that mentioned above, being drilled by the Nix Drilling Company.

In March, 1978, the U. S. Geological Survey, as mentioned above, began drilling five shallow (400 ft) heat flow holes in the Kingman area. It is the intention of the U.S.G.S. to drill a total of 50 shallow heat flow holes throughout southern Arizona during 1978, for geothermal exploration. It is also anticipated that the Bureau of Reclamation will fund a drilling program in the Springerville area for shallow (500 ft) heat flow holes during 1978 with additional and possibly deeper holes in the Clifton area.

EXPLANATION

Federal Geothermal Resources Lease Application

Federal Notice of Intent to Conduct Geothermal Resources Exploration Operations

G Gillard Hot Springs; Federal Known Geothermal Resource Area (KGRA)

C Clifton Hot Springs; Federal Known Geothermal Resource Area (KGRA)

State of Arizona Designated Known Geothermal Resource Area (KGRA)

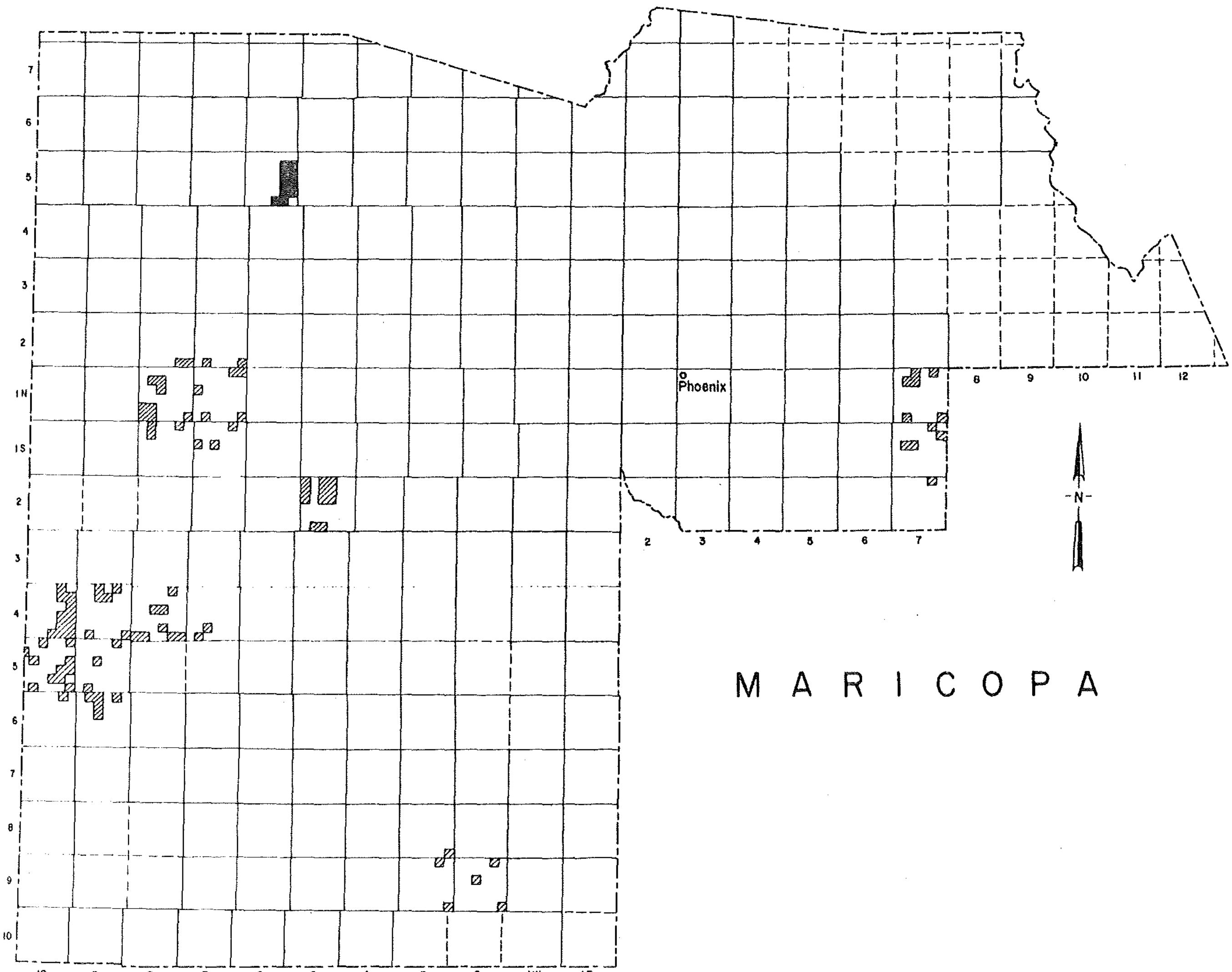

Figure 1. Geothermal land status of Maricopa County, Arizona, as of April, 1978. See Explanation.

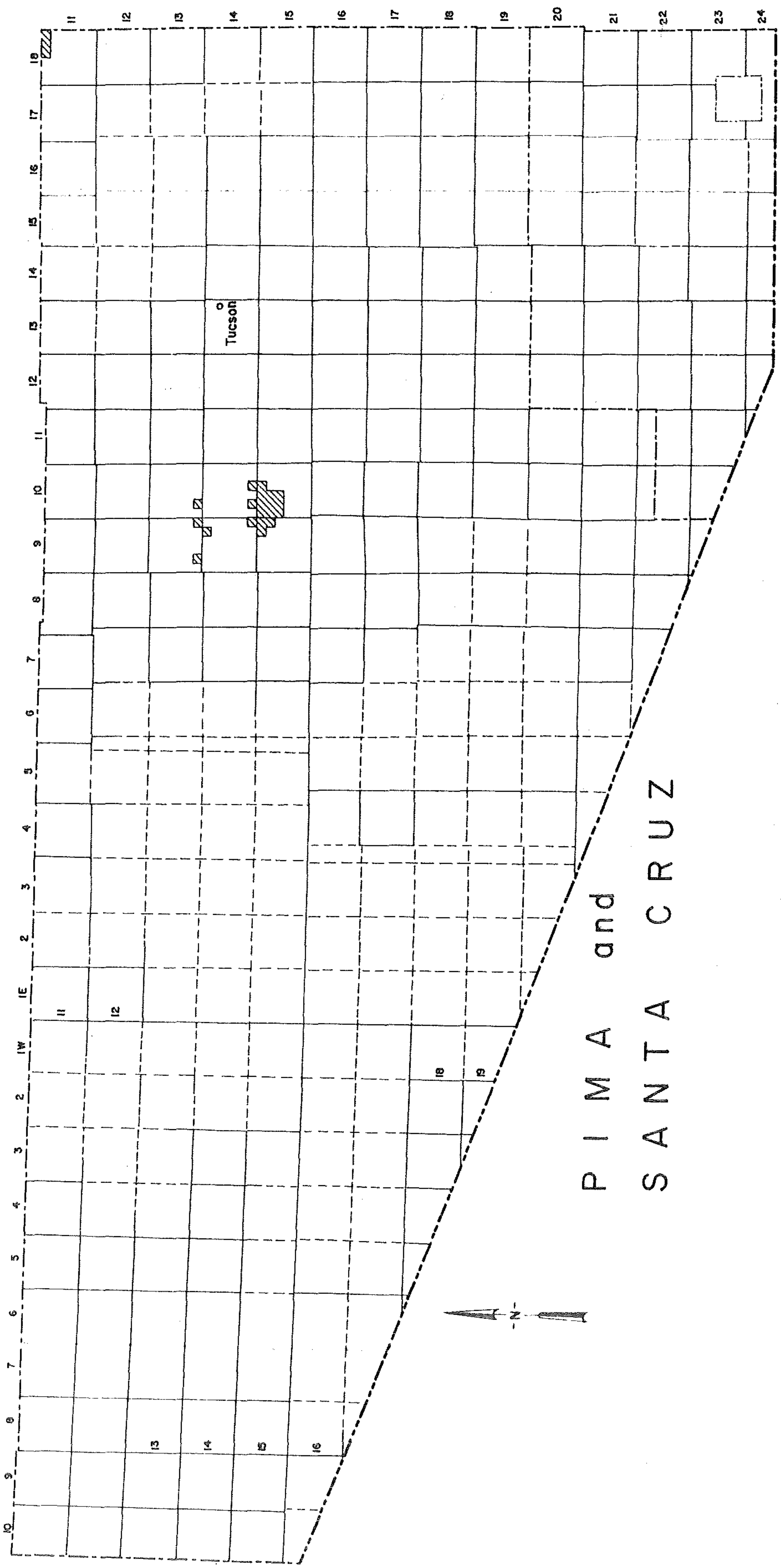
PIMA and
SANTA CRUZ
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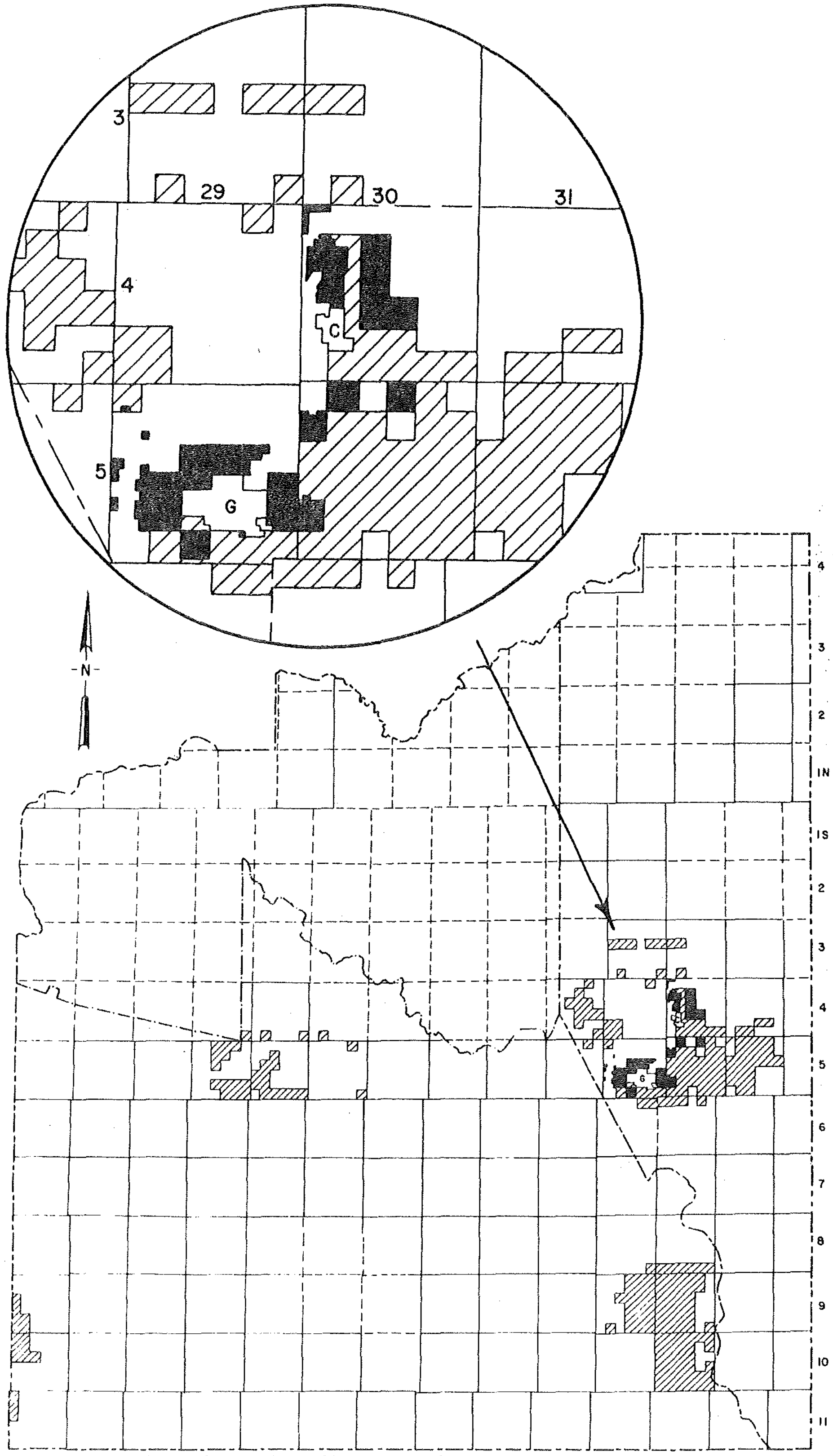
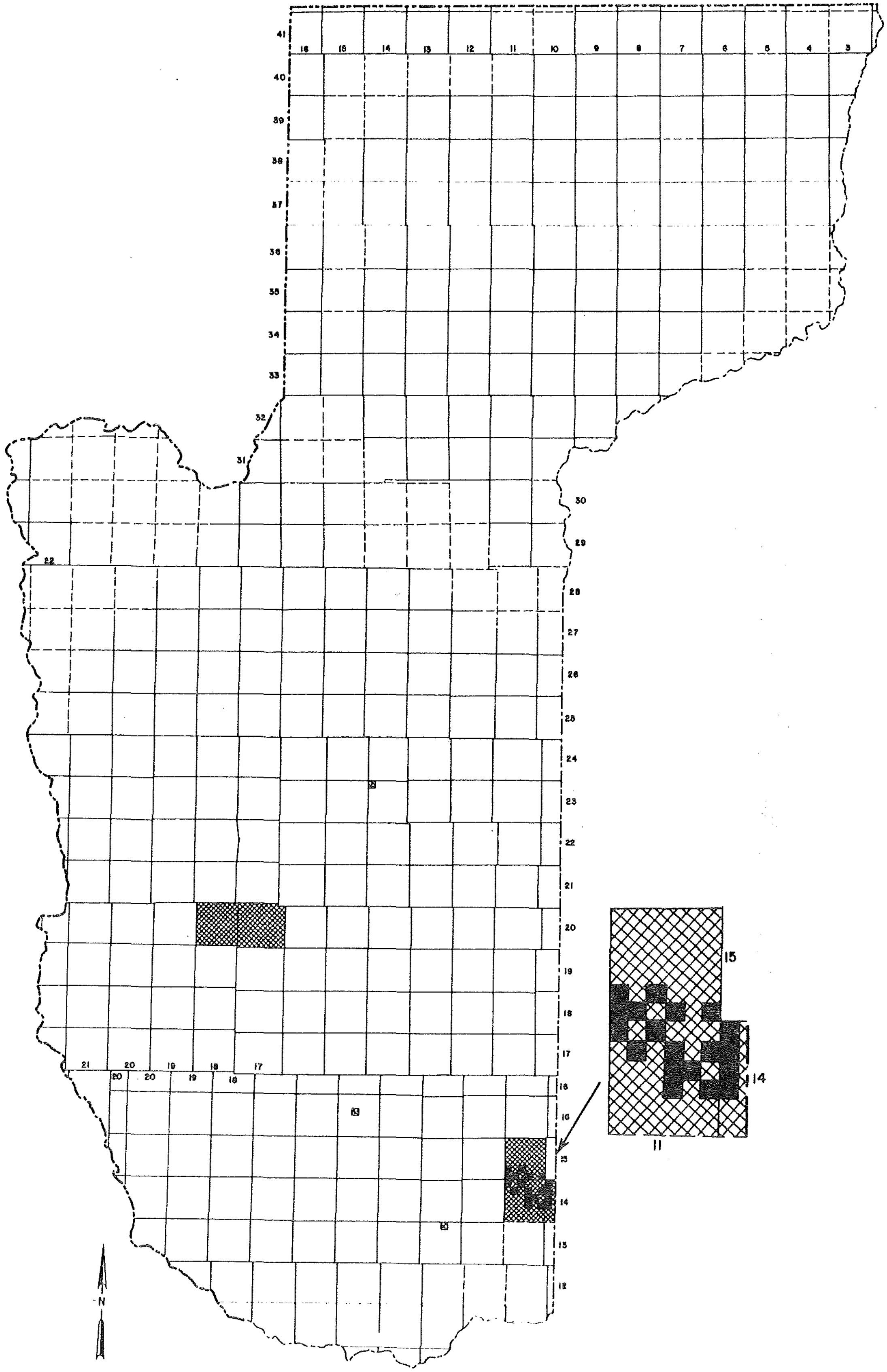
Figure 2. Geothermal land status of Pima and Santa Cruz Counties, Arizona, as of April, 1978. See Explanation.



GRAHAM and GREENLEE

Figure 3. Geothermal land status of Graham and Greenlee Counties, Arizona, as of April, 1978. See Explanation.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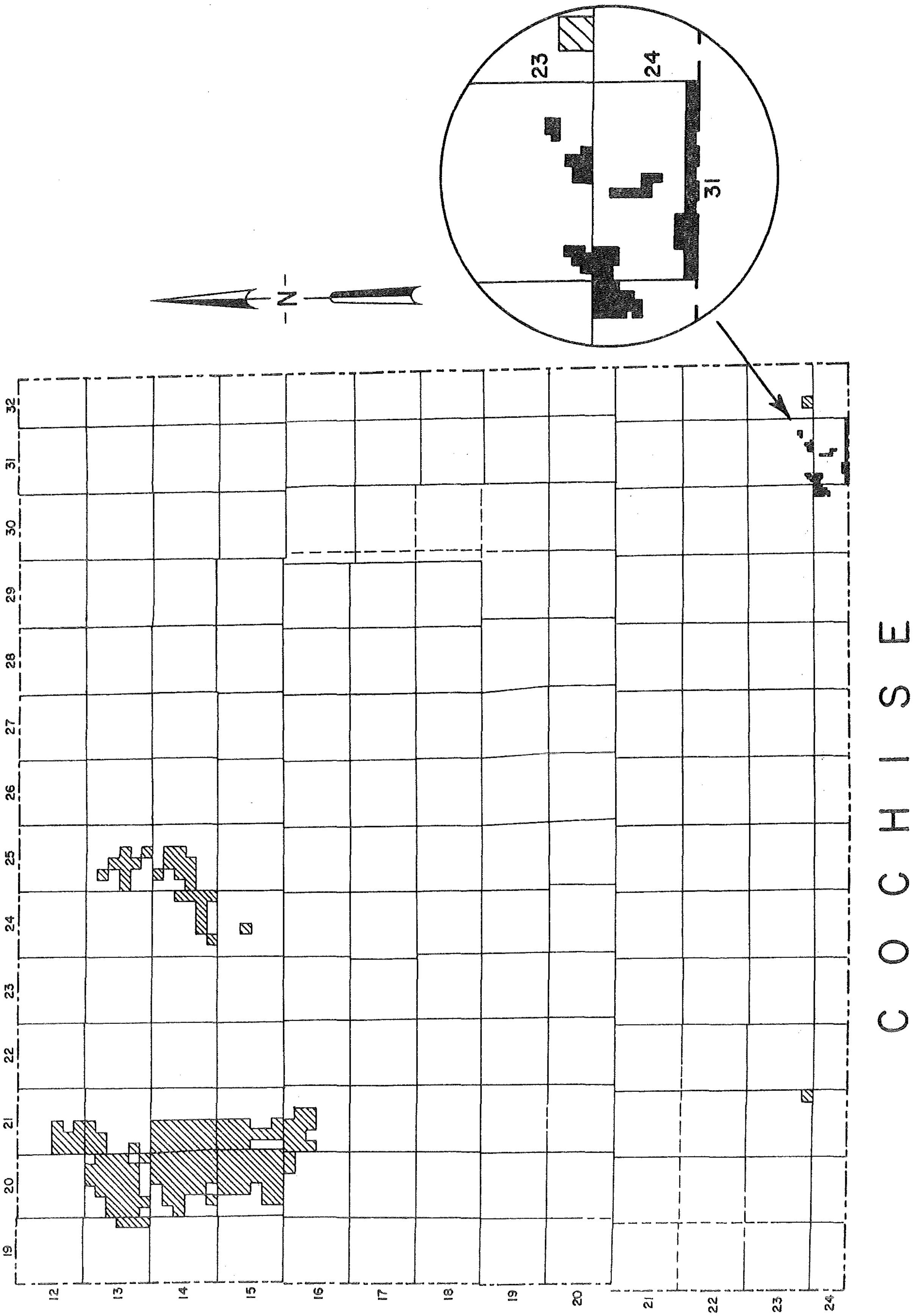
M O H A V E

Figure 4. Geothermal land status of Mohave County, Arizona, as of April, 1978. See Explanation.



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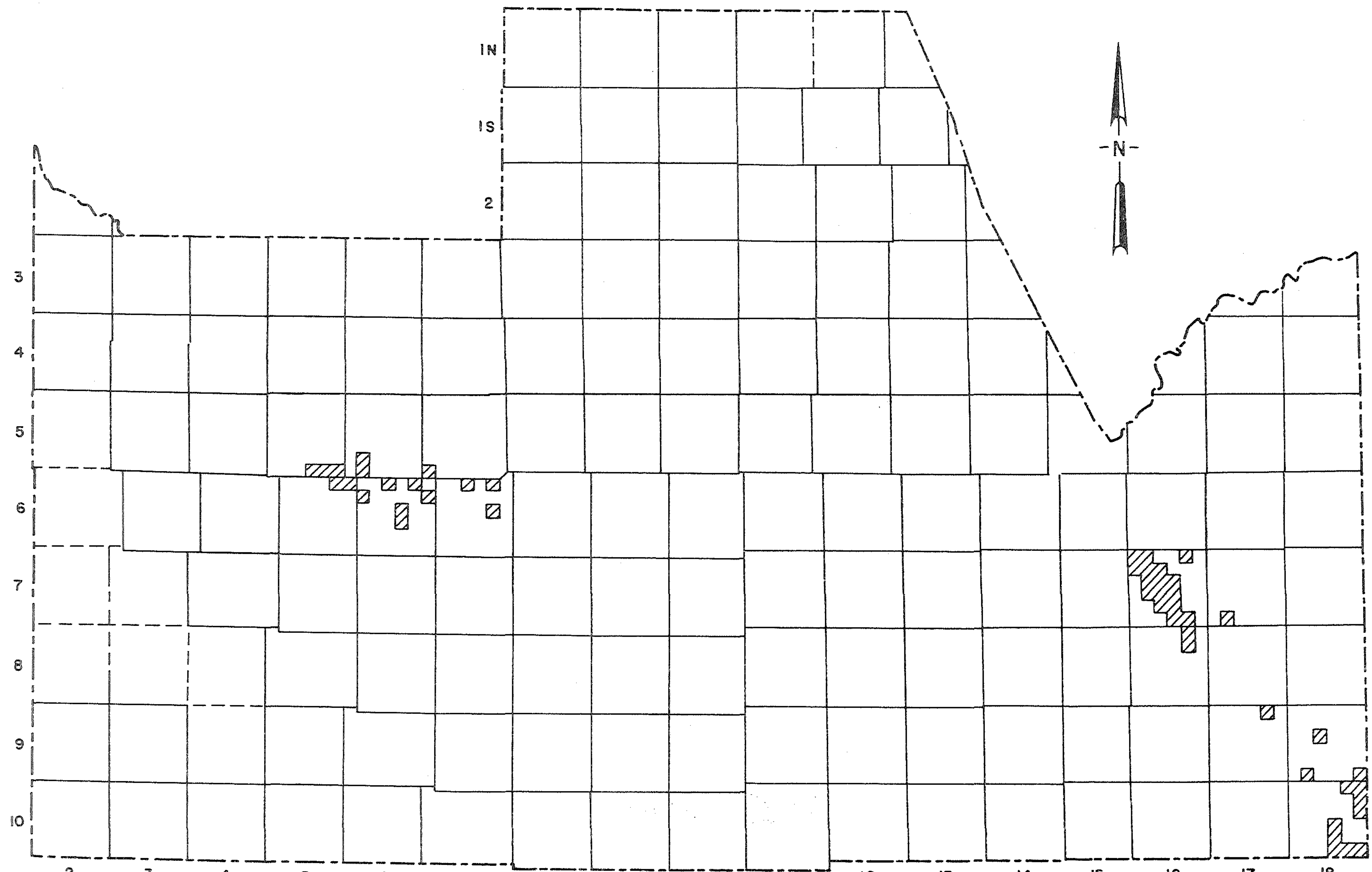
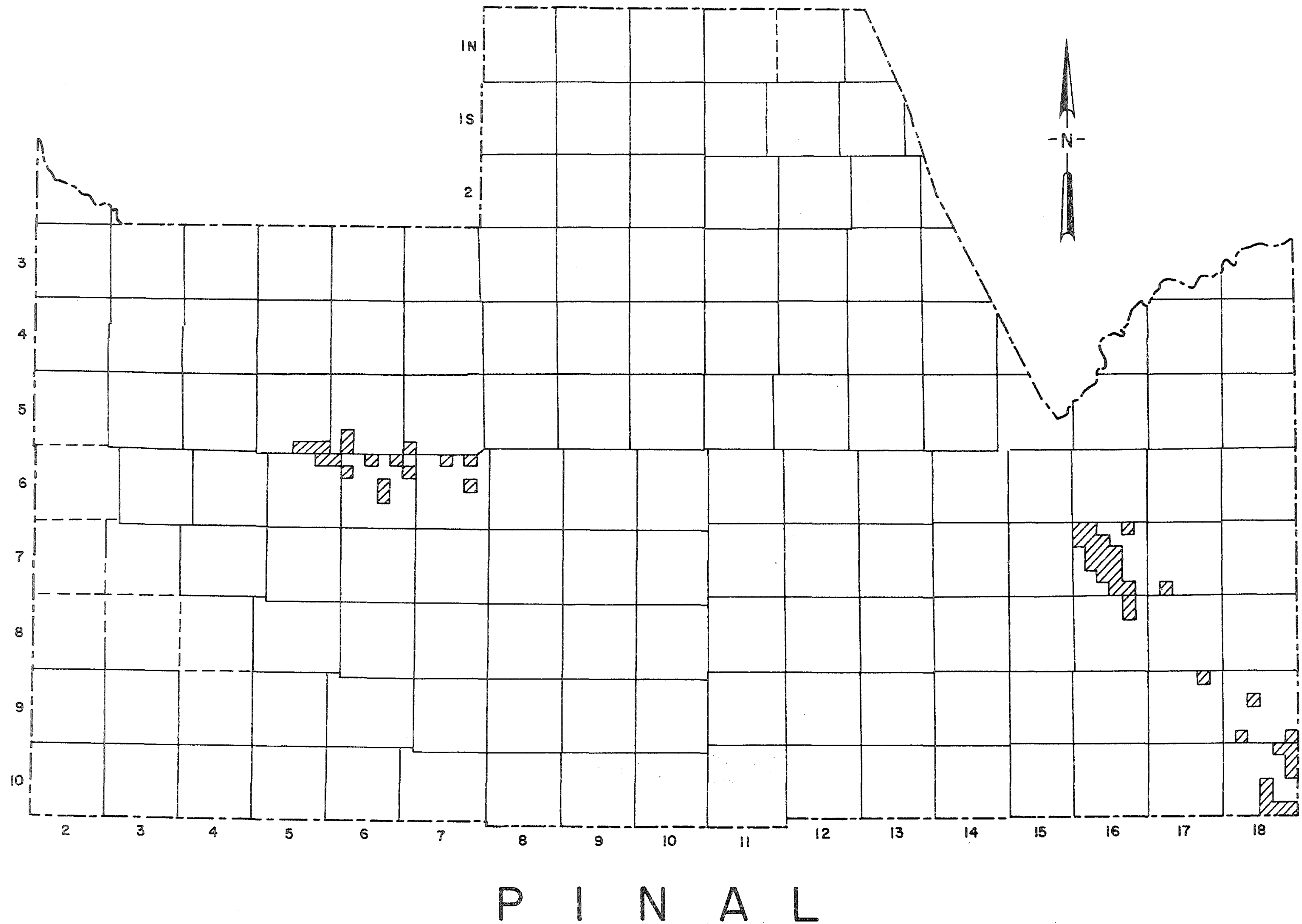
COCHISE

Figure 5. Geothermal land status of Cochise County, Arizona, as of April, 1978. See Explanation.



P I N A L

Figure 5. Geothermal land status of Cochise County, Arizona, as of April, 1978. See Explanation.



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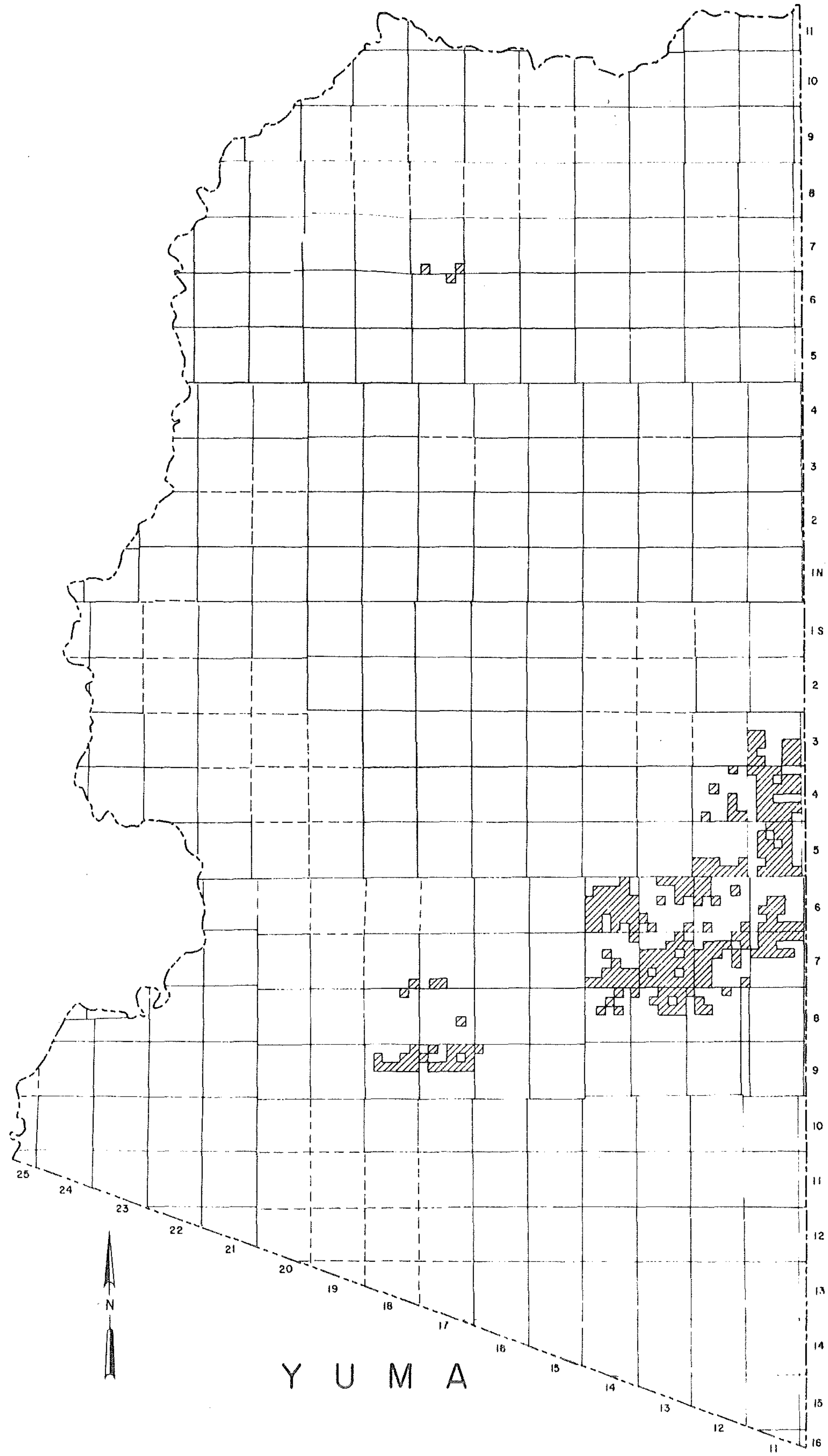
PINAL

Figure 6. Geothermal land status of Pinal County, Arizona, as of April, 1978. See Explanation.



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YUMA

Figure 7. Geothermal land status of Yuma County, Arizona, as of April, 1978. See Explanation.

PROGRESS REPORT ON ARIZONA GRAVITY MAP

by J. S. Sumner

Department of Geosciences, University of Arizona

In order to expedite the production of the Arizona Residual Gravity Map, a decision has been made to complete the terrain corrections using average elevations of one minute map rectangles. This requires a manual review of topographic maps and a compilation of elevation values. A work-study student has been hired for this purpose, and at the present time about one-quarter of the state has been completed. When the southern one-third is done, then computer runs will be made for the terrain-corrected Bouguer gravity anomaly.

It is anticipated that the Residual Bouguer Gravity Anomaly Map of Arizona will be completed about the end of this summer. The compilation will initially be on a map scale of 1:250,000 with inked drafting on a scale of 1:500,000. The finally produced printed map can be on a scale of 1:1,000,000.

Figure 1

Residual Bouguer Gravity Anomaly Map of Arizona (1976).

Figure 2

Residual Aeromagnetic Map of Arizona (1970).

Figure 3

Residual Bouguer Gravity Anomaly Map of Arizona (1975).

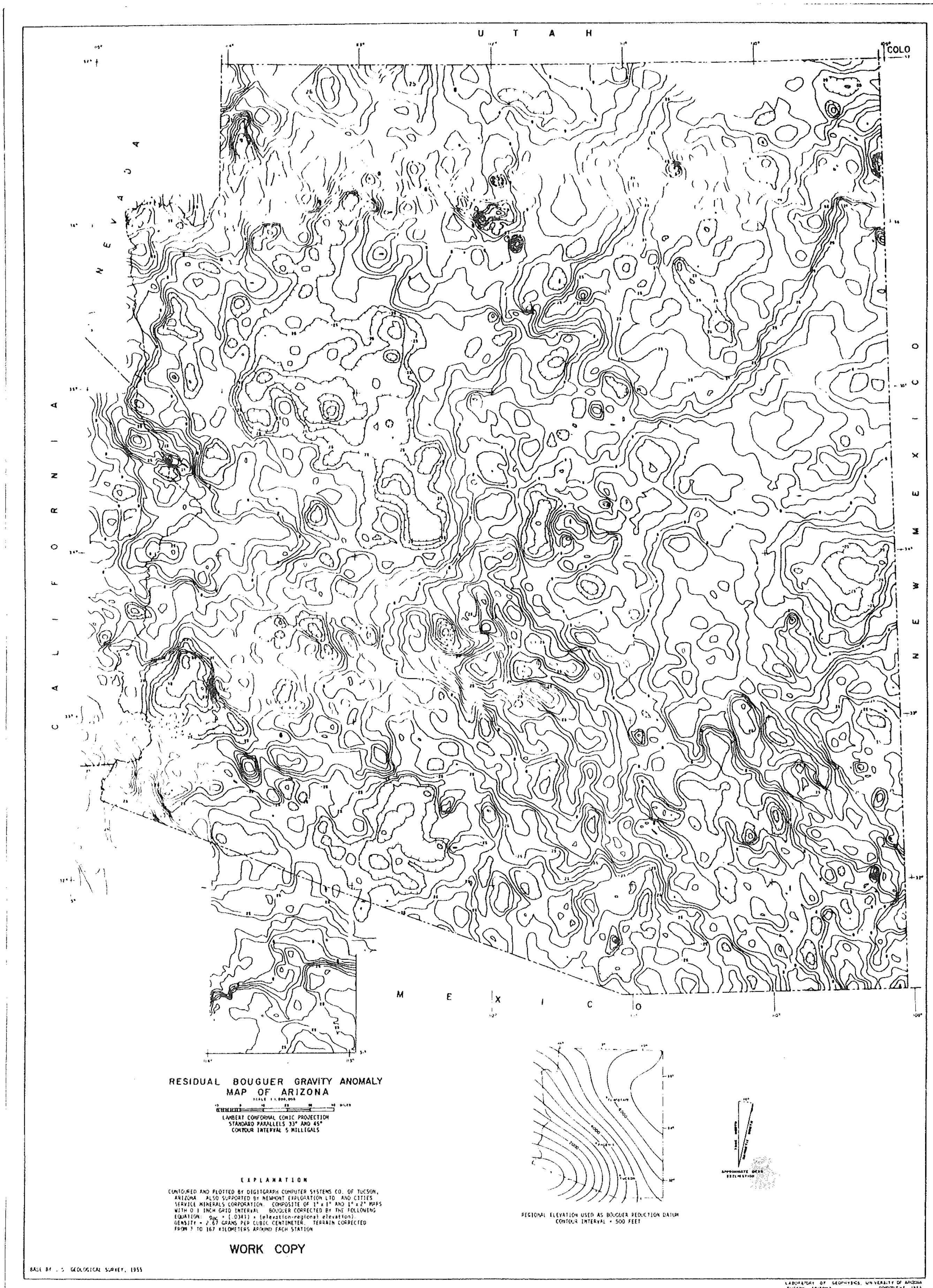

Figure 1. Residual Bouguer Gravity Anomaly Map of Arizona (1976).

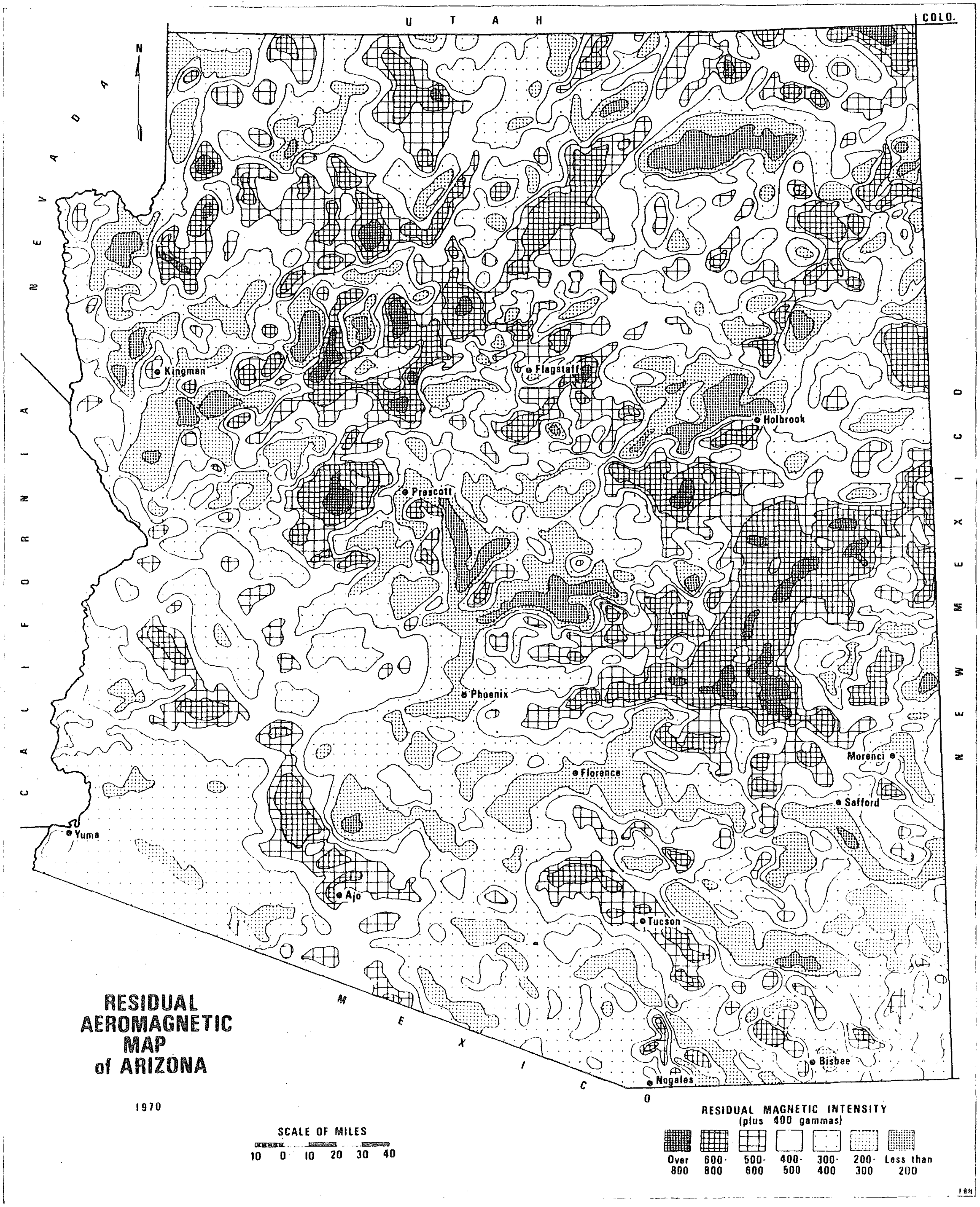

Figure 2. Residual Aeromagnetic Map of Arizona (1970).

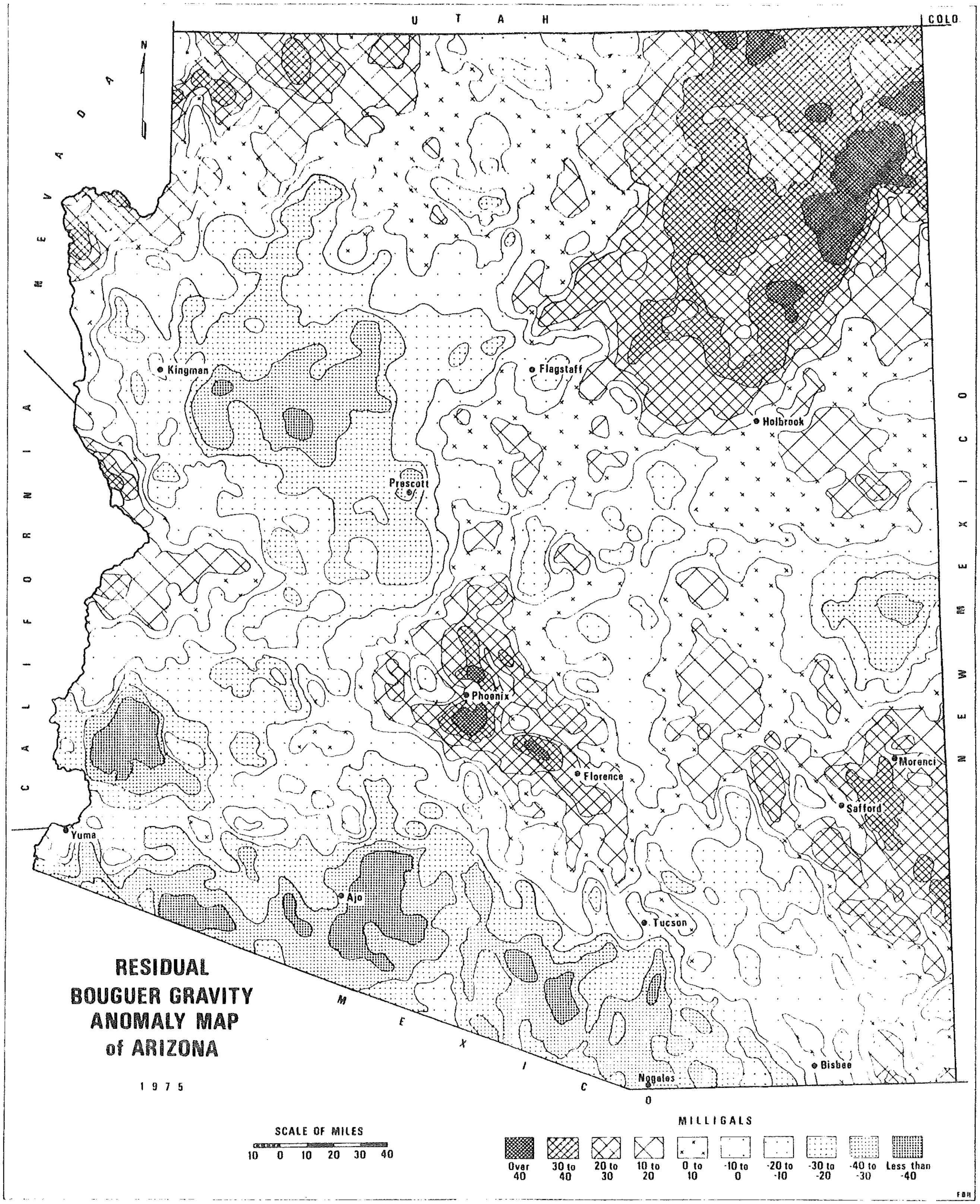

Figure 3. Residual Bouguer Gravity Anomaly Map of Arizona (1975).

RANKING OF GEOTHERMAL RESOURCES IN ARIZONA

by Chandler A. Swanberg

During the present quarter we have addressed the problem of cataloging and ranking the geothermal resources of Arizona. The resources have been divided into high temperature (>150°C), intermediate temperature (90-150°C) and low temperature (20-90°C) with further modifications to determine the reliability of the assessment. The "confirmed" category includes only those geothermal areas whose subsurface temperature has been verified by drilling. The "prospects" category includes those areas which have thermal waters (hot springs and wells) whose chemical constituents suggest a much higher subsurface temperature than can be measured at the surface. The "potential for discovery" category includes those areas which appear promising on the basis of various geological, geophysical, and geochemical criteria but for which little or no detailed information is currently available. In preparing the following tables, we have utilized all geothermal data currently available although we have relied most heavily upon the geothermal complilation works of Swanberg et al. (1977) and Hahman et al. (1978).

Table 1. High Temperature Geothermal Resources (>150°C)

NAME	LAT	LONG	MEASURED SUBSURFACE TEMPERATURE (°C)
Confirmed			
Power Ranch Wells	33 17.1	111 41.2	184
Prospects			ESTIMATED SUBSURFACE TEMPERATURE (°C)
Clifton H. S.	33 4.2	109 17.9	160
Verde H. S.	34 21.5	111 42.5	150
Potential for Discovery - Areas having groundwaters whose chemical geotemperatures exceed 150°C			
San Bernardino Basalt Area	31.4	109.4	
Springerville	34.1	109.3	
St. Johns	34.4	109.4	
Joseph City	34.8	110.4	
Flagstaff	35.1	111.9	
Oatman	35.0	114.4	
Weaver Park	34.4	112.9	
Rancoras Plain	33.5	113.7	
Rainbow Valley	33.2	112.5	
Phoenix	33.4	112.0	
San Simone*	32.2	109.3	
Yuma*	32.5	114.8	

* Measured temperature 130-140°C. See also intermediate temperature geothermal resources confirmed.

Table 1. High Temperature Geothermal Resources (>150°C) -Cont'd-

Potential for Discovery - Areas having shallow boreholes whose temperature gradients exceed 150°C/km

Number of Prospects	Aggregate Area
73	2200 km^2

Potential for Discovery - Quaternary volcanics

Number of Prospects	Aggregate Area
50	11,100 km^2 (C.P.=9800 km^2, B&R=1300 km^2)

Table 2. Intermediate Temperature Geothermal Resources (90-150°C)

NAME/AREA	LAT	LONG	MEASURED* SUBSURFACE TEMPERATURE (°C)
<u>Confirmed</u>			
San Simon	32.2	109.3	134
Yuma	32.5	114.8	138
<u>Prospects</u>			ESTIMATED SUBSURFACE TEMPERATURE (°C)
Gillard H. S.	32 58.4	109 20.9	140
Eagle Creek H. S.	32 2.9	109 26.4	130
Coolidge H. S.	33 10.3	110 31.7	120
Coffers H. S.	34 41.6	113 34.5	120
Cat Tank	32 43.8	109 22.7	115
Javelina Peak	32 31.4	109 25.6	110
Safford Area	32 50.7	109 33.6	110
Indian H. S.	33 0.2	109 54.0	105
Castle H. S.	33 59.0	112 21.7	105

<u>Potential for Discovery</u> - Areas having shallow boreholes whose temperature gradients fall between 36 and 150°C/km

Number of Prospects	Aggregate Area	
~ 100	36-150°C/km	4900 km^2
	55-150°C/km	6000 km^2

* Numerous other wells in Arizona have reported temperatures in the 90-150°C range but have been omitted from this table because the inferred temperature gradient is not sufficiently above normal to constitute a geothermal anomaly. See low temperature resources confirmed.

Table 2. Intermediate Temperature Geothermal Resources -Cont'd-

Potential for Discovery - Cenozoic Volcanics

Nearly 20% of the total land surface area of Arizona is covered by Cenozoic volcanic rocks and therefore should be considered as potential areas for geothermal discoveries.

Table 3. Low Temperature Geothermal Resources (20-90°C)

NAME/AREA	LAT	LONG	MEASURED TEMPERATURE (°C)
Confirmed			
Littleton	32.1	110.9	147* @ 3830m
Casa Grande (North)	32.9	111.5	113* @ 2440m
Casa Grande (South)	32.8	111.5	110* @ 3095m
Wilcox	32.3	109.9	87* @ 2027m
Whitewater	31.5	109.8	64* @ 1510m
Coolidge Area	32 54.2	111 34.0	61
Radium Sp.	32 44.4	114 4.2	>50
Hooker's H. S.	32 20.2	110 14.3	53
Buckhorn Area	33 25	111 42.2	49
Hyder Valley	33.1	113.3	49* @ 789m
Agua Caliente	32 59.6	113 18.3	46
Artesia H. W.	32 43.1	109 42.5	44
Mt. Graham	32 51.8	109 44.9	44
Lucats Spa	32 44.7	109 44.7	42
Palomas Mts.	33 0.0	113 30.5	42
Branon Mtn.	33 6.7	113 24.5	39
Theba	32 55.9	112 45.1	38
Bowie	32 19.1	109 29.0	36
Mobil Area	33 12.2	112 21.9	35
Artesia Area	32 41.0	109 42.3	33

* High temperatures reflect the depth of the well. The inferred temperature gradient is not sufficiently above normal to constitute a geothermal anomaly.

Table 3. Low Temperature Geothermal Resources -Cont'd-

NAME/AREA	LAT	LONG	MEASURED TEMPERATURE (°C)
Confirmed -Cont'd-			
Warm Sp.	33 4.3	109 59.0	32
Hoover Dam Sp.	36.0	114.8	~40
Cottonwood Sp.	36.5	114.0	warm
Lava Sp.	36.2	113.1	warm
Colorado Pool	36.5	111.9	warm
Prescott Sp.	34.6	112.6	warm
Soda Sp.	34.7	111.7	warm
Chalk Mtn. Sp.	34.1	111.7	warm
Roosevelt Dam Sp.	33.6	111.2	warm
Bronco Gulch Sp.	33.4	110.2	warm
Mescal Sp.	33.2	110.6	warm
Pioneer Sp.	33.2	110.8	warm
Arsenic Cave Sp.	33.3	109.8	warm
Little Boiling Sp.	33.2	109.6	warm
Graperine Sp.	33.0	109.8	warm
Agua Caliente	32.3	110.7	warm
Agua Caliente	31.8	111.0	warm

Prospects - Water temperatures in excess of 20°C

The entire Basin and Range province which includes roughly ½ the total land surface of Arizona should be considered to be a low temperature geothermal prospect. The mean water temperature of the Basin and Range is 26°C.

Potential for Discovery

The entire Basin and Range province and roughly 1/3 of the Colorado Plateau (~60-70% of the entire state) have some type evidence suggesting the presence of low temperature geothermal resources.

REFERENCES

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