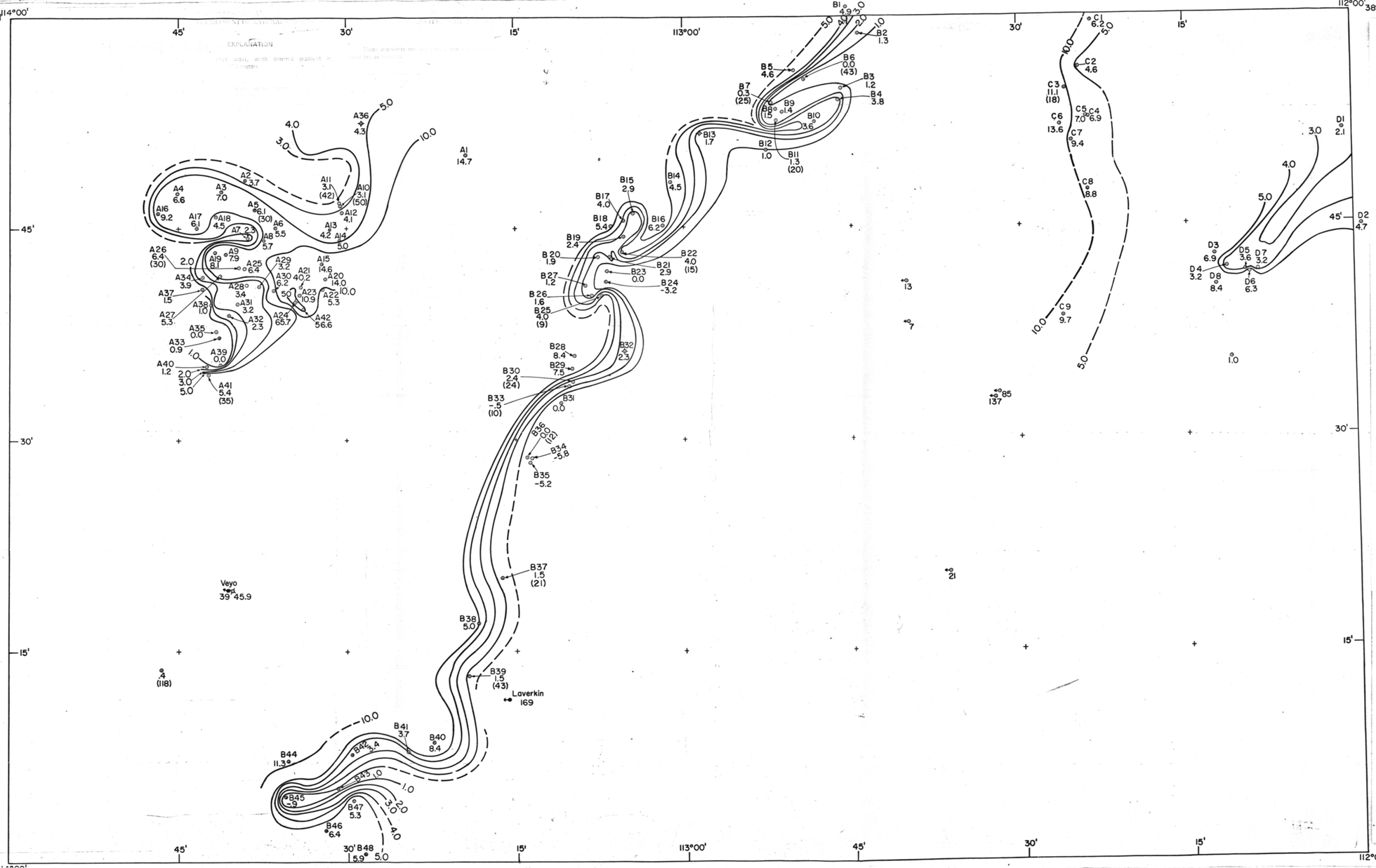

STATE OF UTAH
UTAH GEOLOGICAL AND MINERAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

MAP 40
GEOTHERMAL GRADIENT DATA
CEDAR CITY, UTAH, 2° AMS SHEET

EXPLANATION

- 4.3 — Water well, with thermal gradient in °C/100 meters
- 4.3 (11.3) — Water well, with thermal gradient in °C/100 meters and calculated equilibration temperature in °C
- 7.2 — Oil well, with thermal gradient in °C/100 meters
- 150 — Warm or hot spring, with calculated equilibration temperature in °C
- 7 — Cold spring, with calculated equilibration temperature in °C

Geothermal gradient data for Utah are sparse. Previously available data included 19 drill holes from Wright (1966), the A. A. P. G. Portfolio Map ASA No. 19 (21 holes in Utah Basin and Range) and unpublished data on 21 drill holes in the Roosevelt Known Geothermal Resource Area (Department of Geology and Geophysics, University of Utah).

Obtaining geothermal gradient data is expensive because drill holes usually go to depths greater than 125 feet at a cost of eight to twenty dollars per foot. Therefore, such holes are normally drilled only when other exploratory methods indicate a possible geothermal anomaly. If the regional gradient data were available, exploration could proceed in the reverse sense. Regions with high gradients could be chosen for intensive exploration, and regions with very low gradients excluded from exploratory programs. Also, mean gradients for an area could be determined so that abnormal gradients can be recognized.

This map, the first in a series of geothermal gradient maps for Utah, attempts to provide such regional geothermal gradients. It was prepared utilizing all available data. The largest single source was water well data. Where water temperature and depths for wells were available, mean air temperature was subtracted from water temperature and the result divided by depth. Such gradient data should be used with caution for the following reasons:

(1) The data represent gradients taken in convective systems.

(2) Lateral movement of water combined with data from a few irregularly spaced wells may give indications of highs or lows at a considerable lateral distance from an actual high or low.

(3) Wells completed in shallow aquifers may conceal the gradient below the aquifer.

(4) Water wells may be completed in more than one aquifer.

(5) Temperatures measured in wells that are flowing or being pumped represent nonequilibrium heat conditions.

Mean gradients for the four areas contoured on the sheet are as follows:

Area		Thermal gradient °C/100 m	Sample size	Standard deviation
A	Basin and	5.79	45	13.08
B	Range	2.93	48	2.66
C	Colorado	8.59	9	2.75
D	Plateau	4.80	8	2.19

The mean geothermal gradient for the part of the Basin and Range Province shown on this map is 5.6°C per 100 meters, and the gradient for the part of the Colorado Plateau shown is 6.7°C per 100 meters. Gradient values were determined by weighting the mean gradient for each set of contours by the area contoured. On that basis, the mean gradient for the map is 5.8°C per 100 meters.

Hot springs, taken from Mundorff (1970), are also shown on the map. The numbers shown at the hot springs are the calculated equilibration temperatures as determined from the Na-K-Ca thermometer of Fournier and Truesdell (1973) by W. T. Parry (personal communication, 1975) and by Swanberg (1974). This calculated temperature represents the minimum reservoir temperature.

Cold springs for which water analyses are available (Mundorff, 1971) and their calculated equilibration temperatures are also plotted.

Minimum reservoir temperatures are plotted for wells for which water analyses have been published.

ACKNOWLEDGEMENT

This map was prepared under National Science Foundation Grant No. GI-43741 to the Department of Geology and Geophysics, University of Utah.

SOURCES OF DATA

American Association of Petroleum Geologists, Geothermal gradient of Utah-Western Colorado (Portfolio Map Area No. 19), American Association of Petroleum Geologists.

Carpenter, C. H., G. B. Robinson, Jr., and L. J. Bjorkland, 1964, Selected hydrologic data, upper Sevier River basin, Utah: Utah Department of Natural Resources, Division of Water Rights, Basic Data Report No. 8.

Cordova, R. M., G. W. Sandberg, and W. McConkie, 1972, Ground-water conditions in the central Virgin River basin, Utah: Utah Department of Natural Resources, Division of Water Rights, Technical Publication No. 40.

Fournier, R. O. and A. H. Truesdell, 1973, An empirical Na-K-Ca geothermometer for natural waters: Geochimica et Cosmochimica Acta, v. 37, p. 1255-1276.

Mundorff, J. C., 1970, Major thermal springs of Utah: Utah Geological and Mineral Survey Water-Resources Bulletin 13, 60 p.

——1973, Nonthermal springs of Utah: Utah Geological and Mineral Survey Water-Resources Bulletin 16, 70 p.

Sandberg, G. W., 1963, Ground-water data, parts of Washington, Iron, Beaver, and Millard Counties, Utah: Utah Department of Natural Resources, Division of Water Rights, Basic Data Report No. 6.

Swanberg, C. A., 1974, The application of the Na-K-Ca geothermometer to thermal areas of Utah and the Imperial Valley, California: Geothermics, v. 3, p. 53-54.

Wright, P. M., 1966, Geothermal gradient and regional heat flow in Utah: Unpublished Ph. D. thesis, University of Utah, 181 p.

Scale 1:250,000
5 0 5 10 15 Miles
5 0 5 10 15 20 Kilometers

N

Map 40
GEOTHERMAL GRADIENT DATA
CEDAR CITY, UTAH, 2° AMS SHEET

compiled by J.A. Whelan

1976