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COMMENTS ON RESULTS OF GRADIENT HOLES 55-2 AND 35-1

SUPPLEMENT TO GEOTHERMEX REPORT:

GEOLOGIC ASSESSMENT OF THE FISH LAKE GEOTHERMAL FIELD, NEVADA

MAY, 1985

for

STEAM RESERVE CORPORATION

DENVER, COLORADO

by

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March 1986

COMMENTS ON RESULTS OF GRADIENT HOLES 55-2 AND 35-1

We have reviewed the data obtained from gradient holes 35-1 and 55-2, which have been drilled since our May 1985 report "Geologic Assessment of the Fish Lake Geothermal Field, Nevada". As recommended in our report, these holes were drilled on the structural high north of discovery wells 88-11 and 88-11A (figure 1). The following conclusions are based on the data obtained from these two new holes:

1. The high gradients found in these wells confirm our earlier conclusion that the Fish Lake temperature anomaly is associated with the structural high located north of wells 88-11 and 88-11A.

2. Based on the temperature data from these holes, our map of temperature distribution at +3,800 feet elevation (figure 4I of the May 1985 report) has been updated (figure 1, this report). Temperature contours can now be closed to the north, showing that the Fish Lake anomaly covers an area of about 3 square miles.

3. We have reviewed D. D. Blackwell's reports of November, 1985 and January, 1986, and have the following comments:

    a. We agree that the temperature gradients measured in holes 81-14 and 64-11 are influenced by fluid circulating in a nearby fault, not because of the poor match of these gradients with the margin effects model, but because of the shallow, high temperatures found in the holes, and the proximity of the holes to mapped faults.

b. Whether the decreasing gradients with depth measured in holes 55-2, 35-1, and 42-7 reflect boundary effects or vertical changes in conductivity is still undetermined. The November, 1985 report recommends, among other things, to deepen 35-1. If, on deepending, heat flow was found to be constant with depth, then increasing conductivity with depth would explain the decreasing gradients. If heat flow was found to decrease with depth, this would indicate the lateral boundary effect is influencing the change of gradients. On deepening 35-1, it was found that the resulting data could be interpreted either way, depending on whether more validity was assigned to averaged data, or data from discrete depth intervals in the hole.

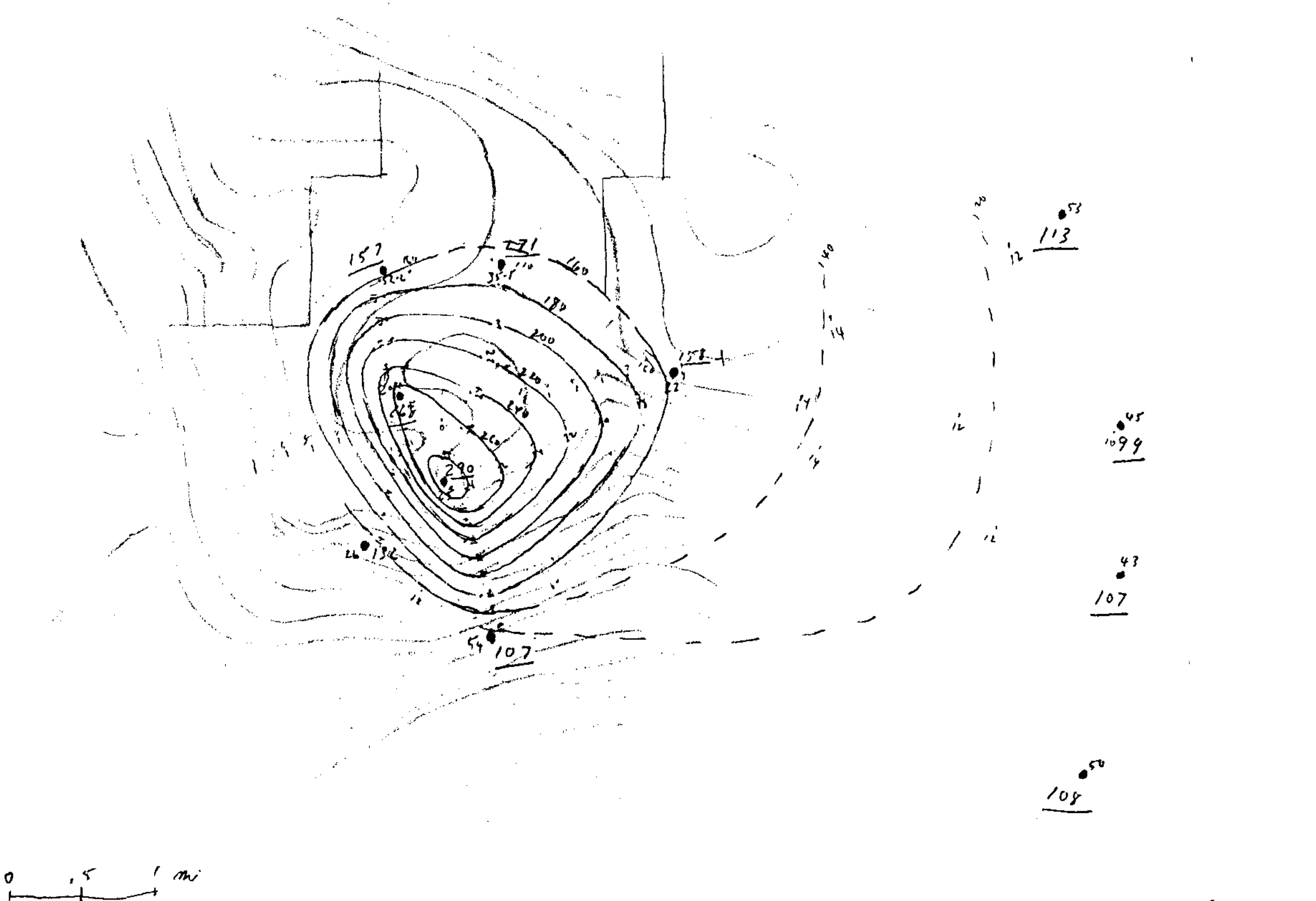
c. We conclude that holes 81-14 and 64-11 are influenced either directly or indirectly by convection, and the gradients measured in the three northern holes (55-2, 35-1, and 42-7) are influenced only by conduction. Furthermore, we interpret the decrease of gradient with depth in these northern holes to be due to increasing conductivity with depth, rather than to boundary effects, because: (a) we think it unlikely that all three holes happened to be drilled within 2,300 to 3,000 feet of a boundary; and (b) the thermal conductivity data does show a general decrease of conductivity with depth, as would be expected due to compaction. We conclude, therefore, that the northern holes are over the anomaly, but that considerable caution must be taken in extrapolating temperature to depth because of changing rock conductivity with depth.

4. The conductive temperature gradient measured in hole 35-1 decreases with depth from about 6.6 to 3.3°F/100'. If temperature at the top of the basement is about 335°F, as in wells 88-11 and 88-11A, then extrapolation of the bottom-most gradient in hole 35-1 indicates basement occurs at a depth of about 6,600 feet. Alternatively, if basement is at a depth of about 4,000 feet, the temperature at the top of basement would be about 270°F. There is insufficient data to determine which of these interpretations is correct.

   The lower part of the gradient in hole 55-2 is disturbed by fluid movement and has not been extrapolated to depth.

5. Assuming that: (a) basement is at about 4,000 feet depth in the area of hole 35-1 (and, therefore, temperature at the top of the basement is 270°F); (b) the temperature gradient in basement rock decreases to 0.6°F/100 feet, as in wells 88-11 and 88-11A; and (c) the same permeable horizon exists at the same depth beneath the 35-1 well as in the deep exploration wells, then fluid temperature should be about 300°F in the 35-1 area (figure 2).

In summary, the new data from holes 55-2 and 35-1 have confirmed the model proposed in our May 1985 report, and have defined the extent of the Fish Lake anomaly. Based on these new data, we can refine the drilling recommendation made in our May 1985 report (page 19). Blackwell's analysis supports our conclusion that the N-trending fault zone is permeable. We now recommend, therefore, that a deep test be drilled to test that permeability. The well should be collared about 1/2 mile NE of well 88-11 and drilled directionally to the NW so as to penetrate the NE-trending fault at about +1,000 feet msl, to look for fault permeability at the top of the basement. The hole should then be continued to the NE into the basement high, to an elevation of -3,000 feet msl, to test for stratigraphic permeability.



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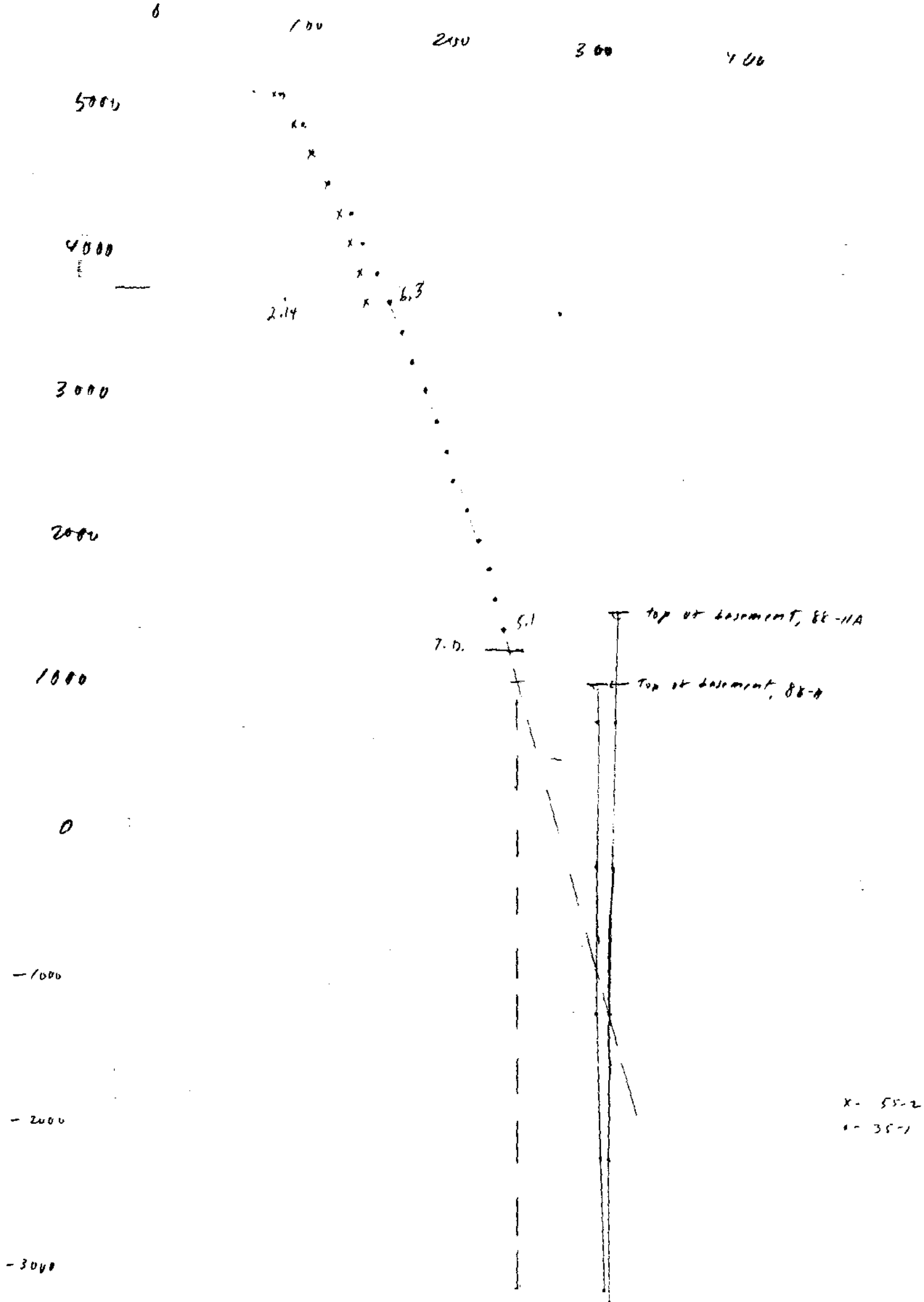
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T.D.
Top of basement, 88-11A
Top of basement, 88-A
x - 55-2
• - 35-1

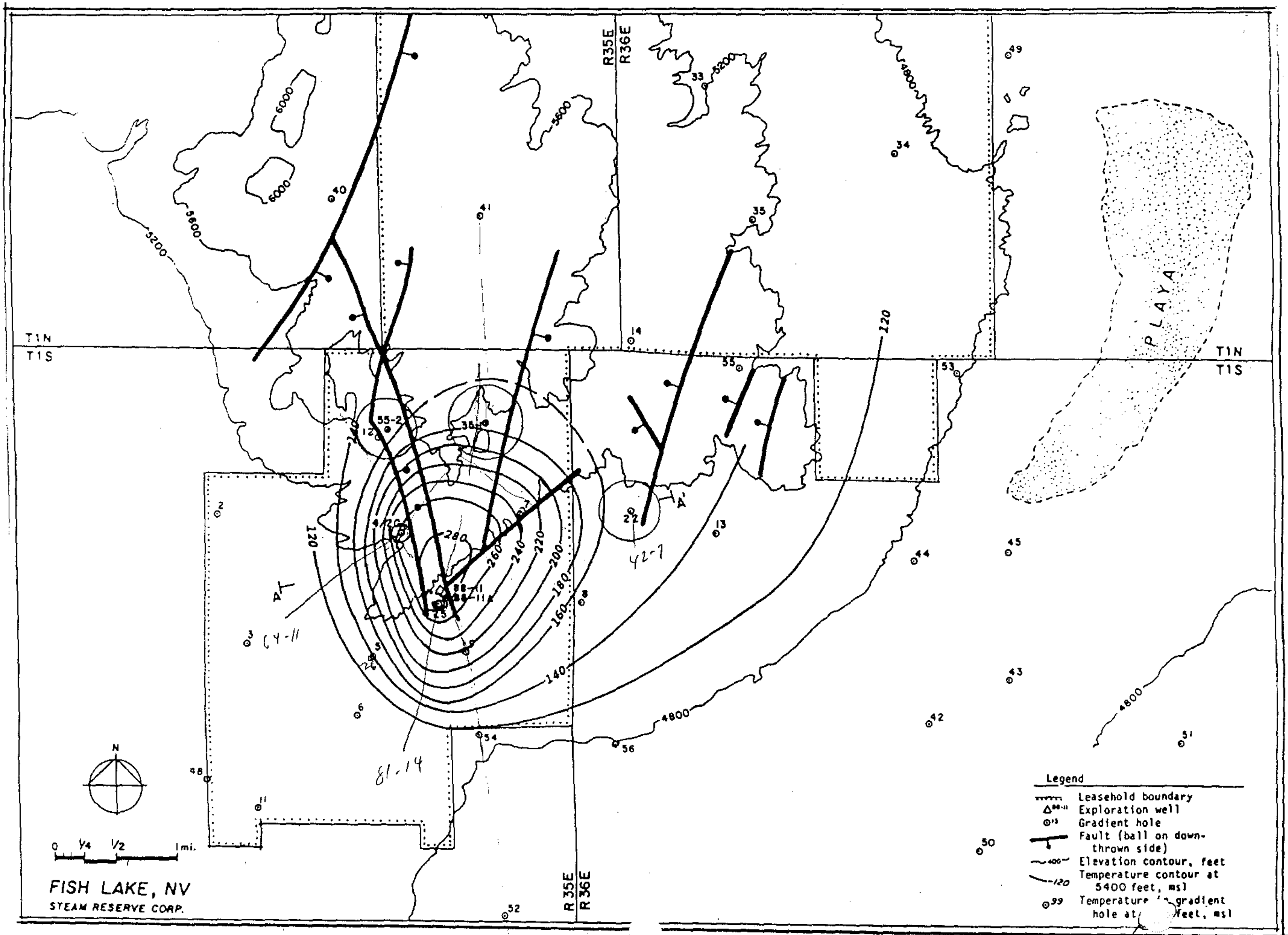

Figure 1. Temperature distribution, °F at +3,8… Fish Lake, Nevada.