GL01126

TECHNICAL REPORT: VOLUME 76-1

Dipole-Dipole Resistivity Delineation of the Near-Surface Zone at the Roosevelt Hot Springs KGRA

Energy Research and Development Administration

Contract EY-76-S-07-1601

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ABSTRACT

Recent dipole-dipole resistivity surveys using 100 m and 300 m dipoles at Roosevelt Hot Springs KGRA, near Milford, Utah have suggested that the north-south length of the convective hydrothermal system may be as great as 20 km. Tertiary granite of the Mineral Mountain pluton seems to be intensely fractured along a narrow (500 m?) sinuous zone trending north and coinciding in part with the Dome Fault. This north-south fracture zone is crosscut by numerous east-west and some northwest-southeast faults. The brine in the fractures and alteration of feldspars to clay both result in lowered resistivites. Leakage of brine westward from the Dome Fault fracture zone is still a realistic interpretation of low resistivity values several kilometers west of the Dome Fault.

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1.0 Introduction

During the summers of 1974 and 1975, dipole-dipole resistivity surveys were conducted at Roosevelt Hot Springs KGRA. Three different dipole spacings were used; 99 km of traverse line were surveyed with 100 m dipoles, 50 km with 300 m dipoles, and 44 km with 1 km dipoles. These surveys were extended during the 1976 summer field season by 14 km of traverse surveyed with 100 m dipoles, and 36 km surveyed and with 300 m dipoles. For 100 m and 300 m dipoles, the frequencies employed were 1.0hz and 0.3hz respectively, in order to minimize coupling while simultaneously minimizing observation time.

The objective of the 100 m and 300 m dipole-dipole resistivity surveying was to detect and delineate regions of low resistivity associated with fracturing, brines, high temperatures, and clay alteration. The resistivity of rocks that are typical of hydrothermal environments is due to two main conduction mechanisms. The mechanisms are electrolytic conduction through pores and fractures and surface conduction due to a thin zone of cations attracted to those mineral surfaces with net negative charges (especially clay minerals). For saturated rocks, the resistivity due to electrolytic conduction is a function of the effective porosity of the fractured rock, of the temperature, and of the salinity of the fluid filling the pores and fractures. The resistivity decreases as the effective porosity, water saturation, salinity, and temperature increase. The presence of clay minerals and pyrite will also decrease the resistivity. The locations of the 1976 100 m dipole and 300 m dipole traverses are indicated on Figure 1 as:

100 m	D-D' G-G'
300 m	X-X' A-A' B-B' C-C' E-E' F-F'

2.0 Data Presentation

The apparent resistivities have been plotted in pseudo-section in Figures 3 through 10. Each data point in the pseudo section is plotted at the intersection of two lines drawn at 45^{o} from the centers of the transmitting and receiving dipoles as shown in Figure 2. In this latter figure, a is the dipole length and n is the separation which assumes the discrete values n = 1, 2, 3, 4, ---. This is the standard method of presenting data from a dipole-dipole resistivity survey. The larger the separation the deeper the exploration so that each of Figures 3 through 10 represents combined profiling - sounding.

For dipole lengths of 100 m and 300 m the scales at which the pseudo-sections have been plotted are 1:5000 and 1:15000 respectively.

We have departed from convention in drawing solid and dashed bars over regions of resistivity $< 10\ \Omega m$ and 10 to 20 Ωm, respectively. This procedure merely draws attention to zones of low resistivity and does not imply any qualitative interpretation.

The 300 m first separation (n=1) apparent resistivity values have been contoured in Fig. 1 on a scale of 1:24000 and may be overlain on the 7 1/2 minute topographic quadrangles of the region.

3.0 Interpretation

3.1 Qualitative

The first separation apparent resistivity map of Figure 1, obtained with 300 m dipoles appears to map the convective hydrothermal system over a north-south length of 20 km from point S on the south to point N on the north. While not strictly cut off on the north and south ends, the resistivities are sufficiently high near S and N to suggest termination nearby. The sinuous low resistivity zone between S and N is related to brine-filled fractures, in some of which, at least, clay alteration is intensive. There is no necessity for high temperature throughout this length although the thermal gradients suggest that this is so. We cannot ascertain that the fracturing is sufficiently permeable or that the temperatures are sufficiently high for commercial steam production throughout this 20 km. However, the combination of resistivity and thermal gradient data define a drilling target which warrants extensive testing.

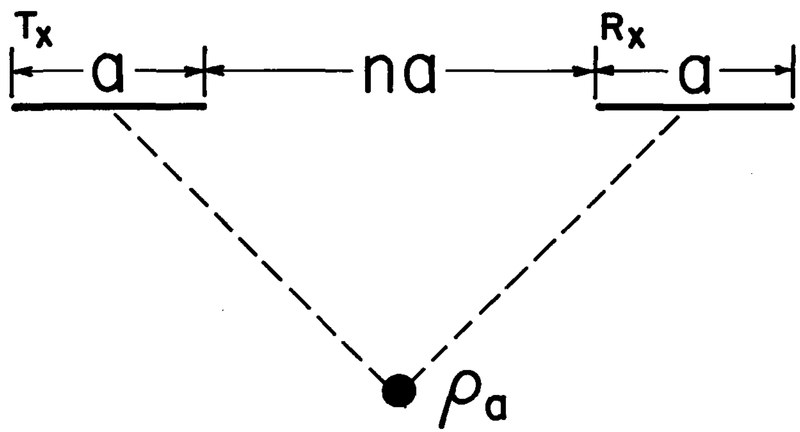
The steep southward gradient in resistivity in the region from 0 + 00 N to line AA' supports an earlier notion, obtained from 100 m dipole surveying, that two east-west faults near 0 + 00 downthrow the convective hydrothermal system to the south. The system appears to be terminated by an east-west fault through Ranch Canyon.

An attempt was made to delineate a low resistivity zone found roughly where the Pole Line Road crosses the crest of the Mineral Range. Two lows have been delineated there but the results, while repeatable, are suspect and may be due to a nearby grounded power line.

The 100 m dipole data from 1976 surveying added nothing to the fracture pattern previously determined and hence this surveying was truncated.

The low resistive zone trending northwest from 5950 N at the baseline is still believed to be associated with a fracture zone which leaks brine out of the convective hydrothermal system.

List of Illustrations



DATA PLOTTING SCHEME
DIPOLE-DIPOLE ARRAY

Figure 2

DEPARTMENT OF
GEOLOGY AND GEOPHYSICS

REPORT: TECHNICAL: VOLUME 76-1

CONTRACT: EY-76-S-07-1601

AGENCY: ERDA

TITLE: DIPOLE-DIPOLE RESISTIVITY DELINEATION OF THE NEAR-SURFACE ZONE AT THE ROOSEVELT HOT SPRINGS AREA

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DATE: November, 1976

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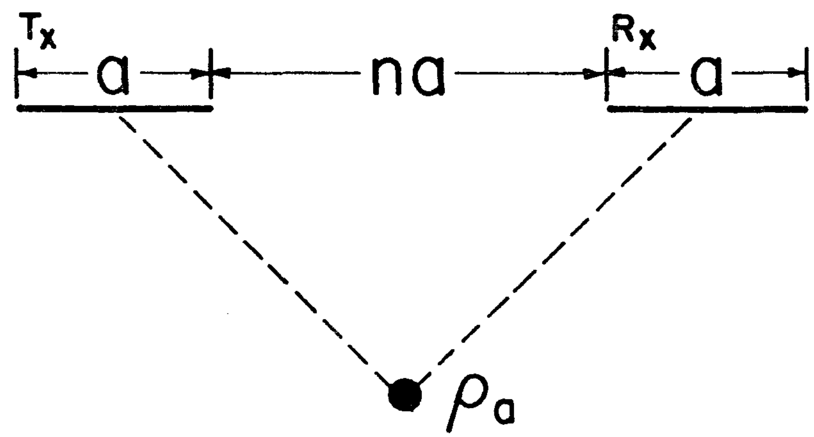

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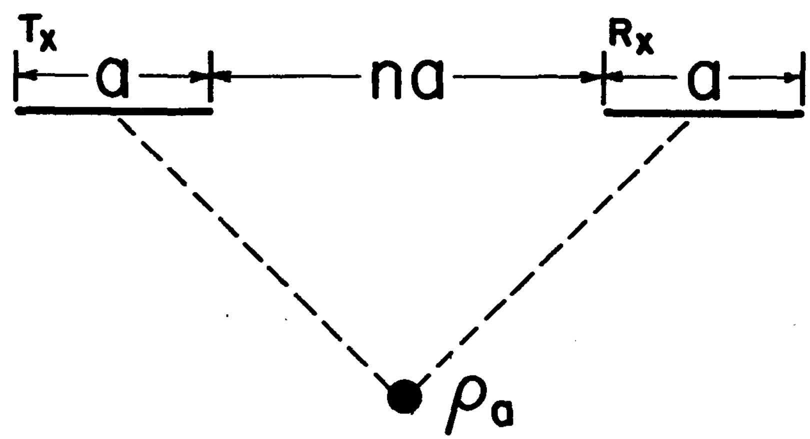
Figure 2



DATA PLOTTING SCHEME
DIPOLE-DIPOLE ARRAY

Figure 2

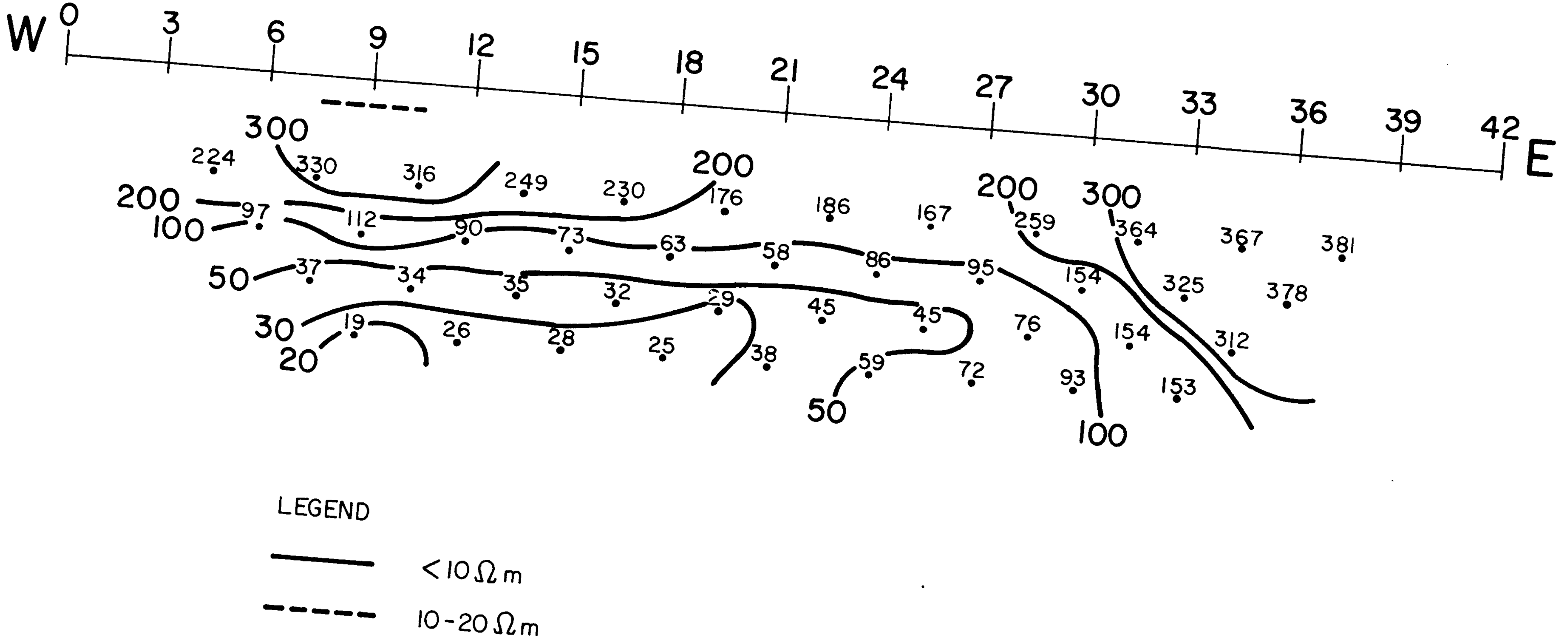
LEGEND

——— <10 Ω m

- - - - 10-20 Ω m

LINE G-G' Figure 4

PROJECT–KGRA
LOCATION–ROOSEVELT HOT SPRINGS
DIPOLE-DIPOLE RESISTIVITY–PSEUDOSECTION
SCALE–1:5000
a=100m CONTOURS AT 1,2,3,5,10...



LINE A-A'

PROJECT-KGRA

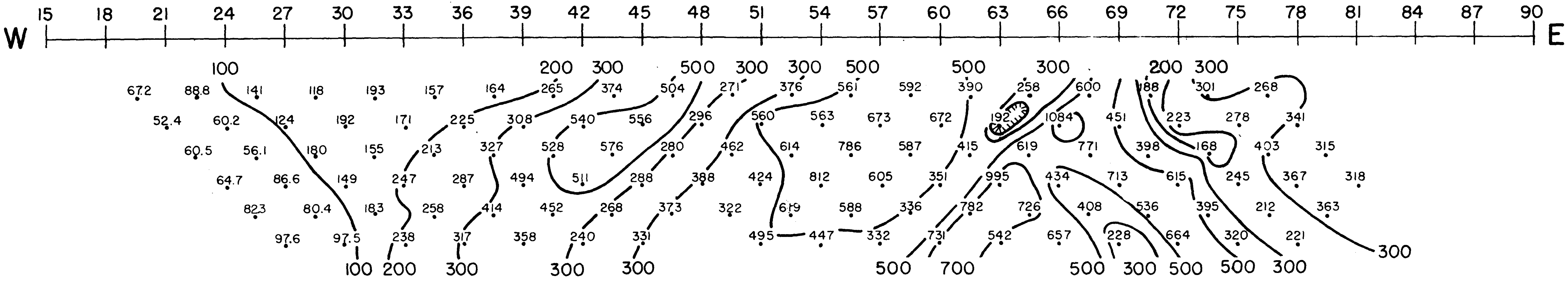
Figure 5

LOCATION-ROOSEVELT HOT SPRINGS

DIPOLE-DIPOLE RESISTIVITY-PSEUDOSECTION

SCALE-1:15,000

a=300m CONTOURS AT 1,2,3,5,10....

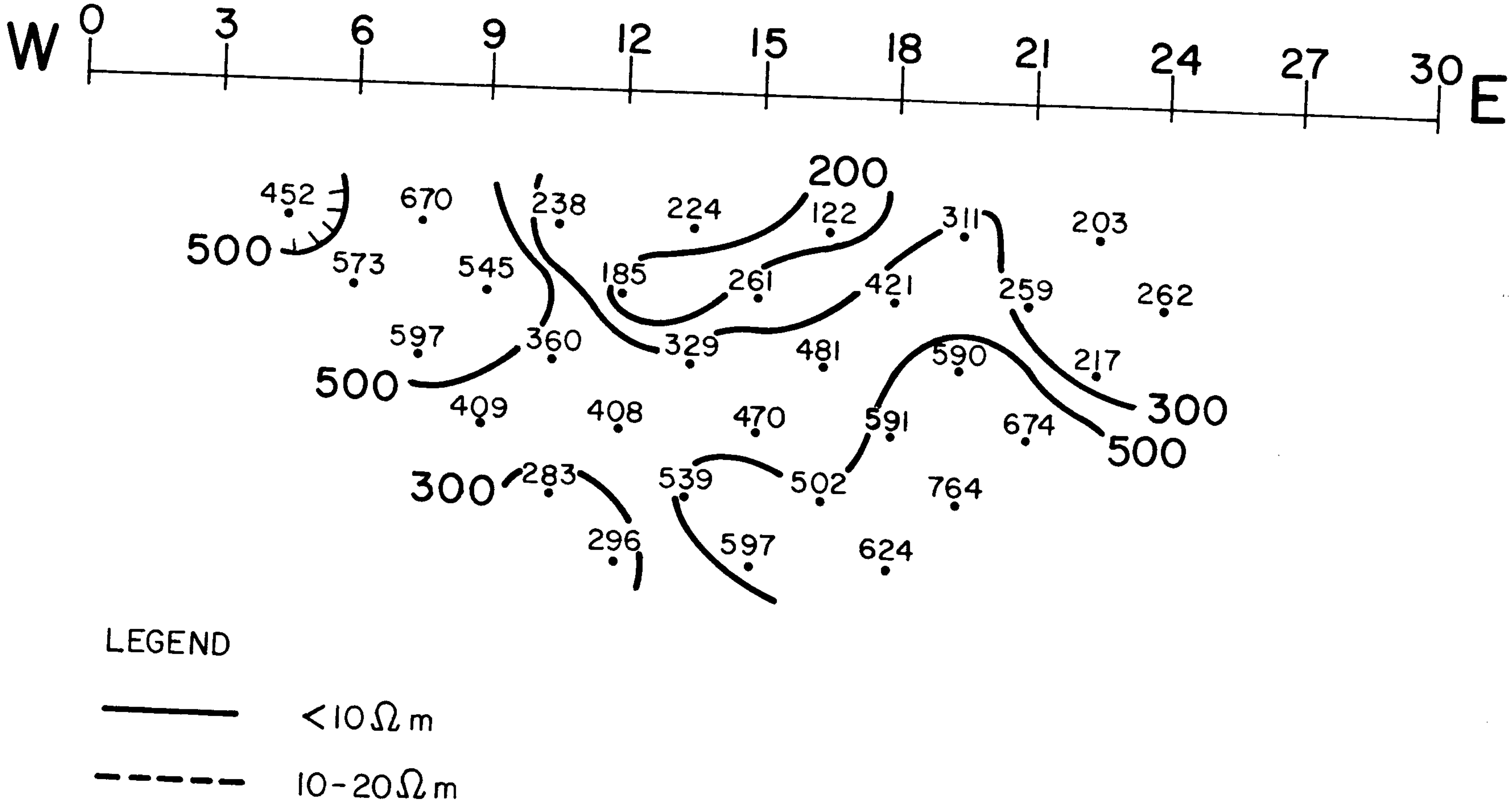


LEGEND

——— < 10 Ωm

- - - - - 10-20 Ωm

LINE B-B' Figure 6
PROJECT – KGRA
LOCATION – ROOSEVELT HOT SPRINGS
DIPOLE-DIPOLE RESISTIVITY – PSEUDOSECTION
SCALE – 1:15,000
a = 300m CONTOURS AT 1,2,3,5,10....



LINE C-C' Figure 7

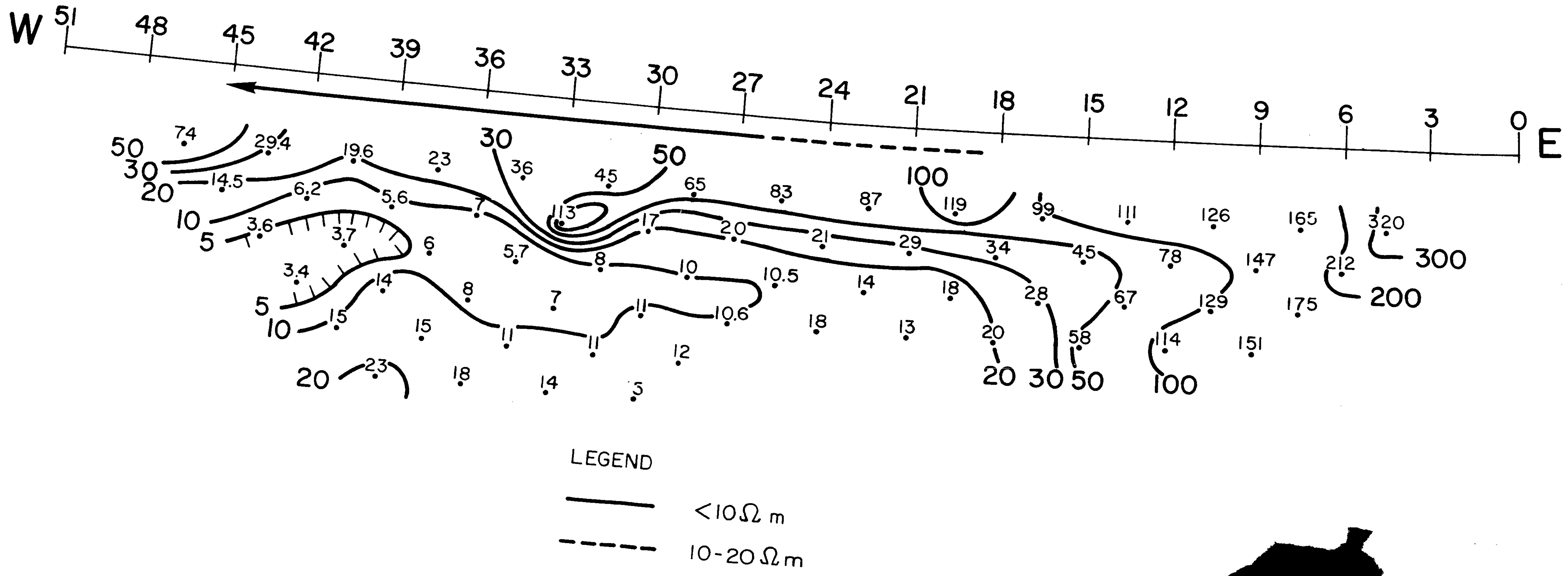
PROJECT–KGRA

LOCATION–ROOSEVELT HOT SPRINGS

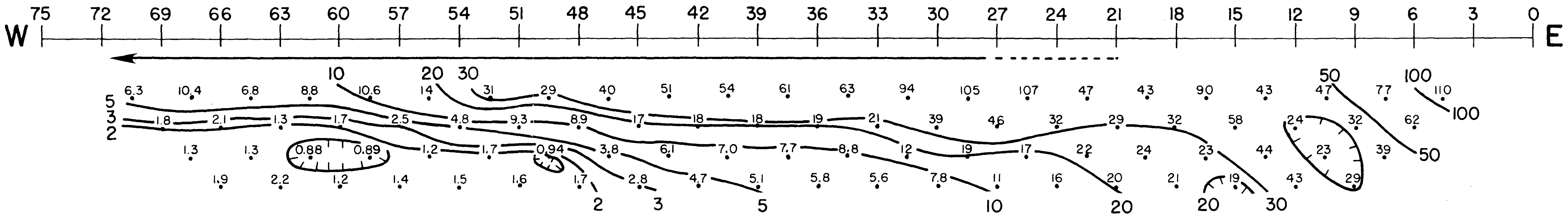
DIPOLE-DIPOLE RESISTIVITY – PSEUDOSECTION

SCALE – 1:15,000

a=300m CONTOURS AT 1,2,3,5,10....



LINE E-E'
PROJECT-KGRA
LOCATION-ROOSEVELT HOT

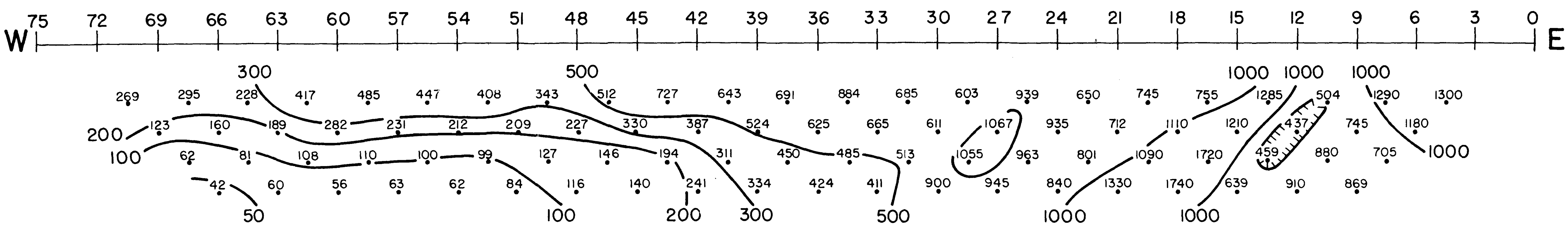


LEGEND

——— <10 Ω m

- - - - 10-20 Ω m

LINE F-F' Figure 9
PROJECT-KGRA
LOCATION-ROOSEVELT HOT SPRINGS
DIPOLE-DIPOLE RESISTIVITY-PSEUDOSECTION
SCALE-1:15,000
a=300m CONTOURS AT 1,2,3,5,10...



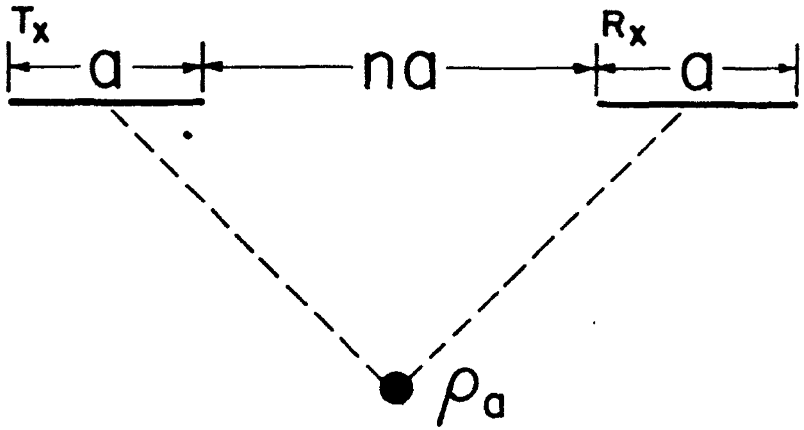
LEGEND

——— < 10 Ω m

- - - - - 10-20 Ω m

LINE X-X' Figure 10

PROJECT—KGRA
LOCATION—ROOSEVELT HOT SPRINGS
DIPOLE-DIPOLE RESISTIVITY—PSEUDOSECTION
SCALE—1:15,000
a=300m CONTOURS AT 1,2,3,5,10...



DATA PLOTTING SCHEME
DIPOLE-DIPOLE ARRAY

Figure 2