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**Induced-Polarization Measurements
at Roosevelt Hot Springs
Thermal Area, Utah**

by

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Table of Contents

Abstract	1
1.0 Introduction	3
2.0 Data Presentation	4
List of Illustrations	5

ABSTRACT

Induced-Polarization Measurements at Roosevelt Hot Springs Thermal Area, Utah

J. J. Chu, W. R. Sill and S. H. Ward

During the summer of 1978 an induced polarization survey was conducted at Roosevelt Hot Springs, using the dipole-dipole array. The survey consisted of two profile lines, one across the southern end of the system (2200N) and another across the northern portion (5950N). A total of 15 line-km of profiles was run, with 100 m and 300 m dipoles out to n spacings of 4 to 6.

Apparent resistivity amplitude and phase data were gathered with a phase-sensitive receiver at frequencies between 32 Hz and 1/256 Hz. The data are presented in the form of apparent resistivity and phase pseudo-sections.

Induced polarization effects in geothermal environments can result from clays and pyrite which are associated with hydrothermal alteration. Laboratory measurements on altered material show some induced polarization effects at frequencies below 1 Hz which are thought to be due to pyrite. A higher frequency polarization (> 1 Hz) is attributed to the effects of clays. The primary purpose of this survey was to investigate the feasibility of mapping clay alteration zones, and separating them from other conductive features, by making use of their polarization characteristics.

The field data show some small, low frequency phase anomalies which may be the result of pyrite deposition. The higher frequencies show

considerable phase effects, which can be the result of clays, but the effects of electromagnetic coupling have not, as yet, been assessed.

1.0 Introduction

During the summer of 1978, an induced polarization survey was conducted at Roosevelt Hot Springs thermal area, using the dipole-dipole array. A total of three traverses was made using two different dipole spacings: 2 km of traverse line were surveyed with 100 m dipoles (out to n spacings of 4), and 13.2 km with 300 m dipoles (out to $n = 6$).

The locations of the dipole-dipole I.P. surveys are indicated on Figure 1. Traverse line 1 is located just below 2200N, while line 2 follows the 5950N road. The 100 m dipole traverse is located on line 1 and from station 0 to 20 W. A 300 m dipole transverse also follows this line, starting at 30 E in Big Cedar Cove, and extending to 30 W. Line 2, on the northern portion of the hydrothermal system, starts in Salt Cove at 15 E and goes to 54 W; it is the second 300 m traverse.

Apparent resistivity amplitude and phase data were gathered with a phase-sensitive receiver at frequencies of 32 Hz, 16 Hz, 4 Hz, 1 Hz, 1/4 Hz, 1/16 Hz, 1/64 Hz and 1/256 Hz. Data stacking ranged from 256 stacks at 32 Hz, to 4 - 9 stacks at the lowest frequency.

Induced polarization effects in geothermal environments can result from clays and pyrite which are associated with the hydrothermal alteration. Laboratory measurements on altered material show some induced polarization effects at frequencies below 1 Hz which are thought to be due to pyrite. A higher frequency polarization (> 1 Hz) is attributed to the effects of clays. The primary purpose of this survey was to investigate the feasibility of mapping clay alteration zones, and separating them from other conductive features, by making use of their polarization characteristics.

The field data show some small, low frequency phase anomalies which may be the result of pyrite deposition. The higher frequencies show considerable phase effects, which can be the result of clays, but the effects of electromagnetic coupling have not, as yet, been assessed.

2.0 Data Presentation

Amplitude and phase data have been plotted in pseudo-section in Figures 3-27. Eight pseudo-sections have been drawn for each of the three dipole-dipole traverses: apparent resistivity plots at two frequencies (4 Hz and 1/256 Hz).

Each data point in the pseudo-section is plotted at the intersection of two lines drawn at 45° 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 $n = 1, 2, 3, 4, 5, 6$. This is the standard method of presenting data from a dipole-dipole survey. The pseudo-sections involving apparent resistivity represent combined profiling-sounding; the greater the n separation, the deeper the level of exploration.

The phase data have not been corrected for instrument drift. However, the error introduced by this mainly affects the frequencies higher than 1 Hz, and even then is minimal. Representative amplitude and log phase versus log frequency plots are also included.

List of Illustrations

- Fig. 1. Location of survey lines.
- Fig. 2. Data plotting scheme, dipole-dipole array.
- Fig. 3. Line 1, $a = 100$ m, resistivity pseudosection at 4 Hz.
- Fig. 4. Line 1, $a = 100$ m, resistivity pseudosection at $1/256$ Hz.
- Fig. 5. Line 1, $a = 100$ m, phase pseudosection at 4 Hz.
- Fig. 6. Line 1, $a = 100$ m, phase pseudosection at 1 Hz.
- Fig. 7. Line 1, $a = 100$ m, phase pseudosection at $1/4$ Hz.
- Fig. 8. Line 1, $a = 100$ m, phase pseudosection at $1/16$ Hz.
- Fig. 9. Line 1, $a = 100$ m, phase pseudosection at $1/64$ Hz.
- Fig. 10. Line 1, $a = 100$ m, phase pseudosection at $1/256$ Hz.
- Fig. 11. Line 1, $a = 300$ m, resistivity pseudosection at 4 Hz.
- Fig. 12. Line 1, $a = 300$ m, resistivity pseudosection at $1/256$ Hz.
- Fig. 13. Line 1, $a = 300$ m, phase pseudosection at 4 Hz.
- Fig. 14. Line 1, $a = 300$ m, phase pseudosection at 1 Hz.
- Fig. 15. Line 1, $a = 300$ m, phase pseudosection at $1/4$ Hz.
- Fig. 16. Line 1, $a = 300$ m, phase pseudosection at $1/16$ Hz.
- Fig. 17. Line 1, $a = 300$ m, phase pseudosection at $1/64$ Hz.
- Fig. 18. Line 1, $a = 300$ m, phase pseudosection at $1/256$ Hz.
- Fig. 19. Line 2, $a = 300$ m, resistivity pseudosection at 4 Hz.
- Fig. 20. Line 2, $a = 300$ m, resistivity pseudosection at $1/256$ Hz.
- Fig. 21. Line 2, $a = 300$ m, phase pseudosection at 4 Hz.
- Fig. 22. Line 2, $a = 300$ m, phase pseudosection at 1 Hz.
- Fig. 23. Line 2, $a = 300$ m, phase pseudosection at $1/4$ Hz.
- Fig. 24. Line 2, $a = 300$ m, phase pseudosection at $1/16$ Hz.
- Fig. 25. Line 2, $a = 300$ m, phase pseudosection at $1/64$ Hz.

Fig. 26. Line 2, $a = 300$ m, phase pseudosection at $1/256$ Hz.

Fig. 27. Amplitude and log phase vs. log frequency plot, $a = 100$ m.

Fig. 28. Amplitude and log phase vs. log frequency plot, $a = 300$ m.

ROOSEVELT HOT SPRINGS KGRA LOCATION OF TRAVERSE LINES

Figure 1: Heavy dashed lines indicate I.P. traverses. Contours (in Ω m) based upon data from previous resistivity surveys.

DATA PLOTTING SCHEME
DIPOLE-DIPOLE ARRAY

FIGURE 2

Figure 3: Line 1 (2200 N Road)
 100 m dipoles
 Dipole-dipole resistivity pseudosection at 4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 4: Line 1 (2200 N Road)
 100 m dipoles
 Dipole-dipole resistivity pseudosection at 1/256 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 6: Line 1 (2200 N Road)
 100 m dipoles
 Phase pseudosection at 1 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 7: Line 1 (2200 N Road)
 100 m dipoles
 Phase pseudosection at 1/4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs.

Figure 8: Line 1 (2200 N Road)
 100 m dipoles
 Phase pseudosection at 1/16 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 9: Line 1 (2200 N Road)
 100 m dipoles
 Phase pseudosection at 1/64 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 10: Line 1 (2200 N Road)
 100 m dipoles
 Phase pseudosection at 1/256 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 11: Line 1 (2200 N Road)
 300 m dipoles
 Dipole-dipole resistivity pseudosection at 4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 12: Line 1 (2200 N Road)
 300 m dipoles
 Dipole-dipole resistivity pseudosection at 1/256 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 13: Line 1 (2200 N Road)
 300 m dipoles
 Phase pseudosection at 4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 14: Line 1 (2200 N Road)
 300 m dipoles
 Phase pseudosection at 1 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 15: Line 1 (2200 N Road)
300 m dipoles
Phase pseudosection at 1/4 Hz
Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
Location - Roosevelt Hot Springs

Figure 16: Line 1 (2200 N Road)
 300 m dipoles
 Phase pseudosection at 1/16 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 17: Line 1 (2200 N Road)
 300 m dipoles
 Phase pseudosection at 1/64 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 19: Line 2 (5950 N Road)
 300 m dipoles
 Dipole-dipole resistivity pseudosection at 4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 20: Line 2 (5950 N Road)
 300 m dipoles
 Dipole-dipole resistivity pseudosection at 1/256 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 21: Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 22: Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 1 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 23: Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 1/4 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 24; Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 1/16 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 25: Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 1/64 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 26: Line 2 (5950 N Road)
 300 m dipoles
 Phase pseudosection at 1/256 Hz
 Contours at 1, 1.5, 2, 3, 5, 7, 10 ...
 Location - Roosevelt Hot Springs

Figure 27

LINE 1 (2200N ROAD)

 $n=3$ $a=300\text{m}$

Tx 3W-6W; Rx 6E-9E

Figure 28

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