UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Self-Potential Measurements at Newberry Crater, Oregon

by

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Introduction

This report describes self-potential (SP) measurements made along ten survey lines within or near Newberry Crater in central Oregon, approximately forty kilometers southwest of Bend, Oregon (Figure 1). An east-west baseline was established following the main road through the crater. Nine north-south trending lines were tied to the baseline. This study was carried out as part of a geophysical investigation to characterize the geothermal reservoir of Newberry Crater. It was funded by the Department of Energy under Agreement No. DE-A101-79RA50294.

Field Procedure and Equipment

Measurements were made using a 10 megohm input voltmeter and lead-lead chloride ($Pb-PbCl_2$) electrodes. Electrode drift was checked several times each day by measuring the potential difference between the electrodes when they were placed on a damp sponge. Daily drift was less than 1 mV. The fixed electrode was placed approximately 5 cm into the soil and covered with soil around its base to retain moisture. No watering was done to either the fixed or roving electrode. Each station was located in undisturbed soil away from roadway fill. The site was prepared by scraping down approximately 3 cm with a boot sole through dirt and/or organic material to reach moist mineral soil. This method produced the most repeatable readings as different depths produced different readings.

Readings were taken using a roving electrode at 50 m intervals, although closer spacing was used in a few cases to facilitate road crossings and to add more detail to the profile. At distance of one kilometer from the fixed electrode, the last station became the new fixed electrode location for the next kilometer. All north-south lines were tied to the east-west baseline by placing the fixed electrode at a previously occupied station on the baseline.

The readings were very stable, although variations, on the order of 30 mV were noted within a 2 m radius of any station. Noise due to telluric currents was negligible.

Observations

Main Road E-W Line

The raw and filtered data are shown in Figure 2 at a large scale to give an overall view of the data. The data are replotted at a smaller scale in Figures 3 and 4 to show more detail. The SP values increase eastward with a high at 2.4 km. The large negative anomaly at 3.8 km is from an unknown source. No evidence could be found to indicate a buried pipe or cable in the vicinity. The SP values show a decrease from 10.2 km to the east end of the line corresponding to a steady rise in elevation. The portion of the line between 2.4 km and 10.2 km is entirely on the Newberry Crater floor, and is a level plateau with a gradual downward trend to the east. There is a buried 14,400 volt powerline at 7.8 km which crosses the line at a right angle. However, it is unlikely this is the source of the large trough observed from 7 to 8.4 km on the baseline. This profile could be interpreted as a broad positive feature associated with the upwelling warm water in the caldera. The line would have to be extended farther from the caldera to confirm this

hypothesis. The negative features at 3.8 km and 7.8 km could be caused by cooler fluid descending down fault zone. A detailed geologic map of the area does not indicate the presence of faults near these points (MacLeod et al., 1982).

Line 1 (Figure 4b)

This line parallels the road to East Lake Campground. After an initial decrease near 0.2 km, there is a gradual increase.

Line 2 (Figure 4c)

This line goes south to the lava flow at Hot Springs Campground and north to East Lake. The SP values were slightly higher at the lake.

Line 3 (Figure 5a)

The SP anomaly at -0.3 km is due to the effect of metal casing in the USGS test hole Newberry 2. The SP values decrease slightly to the south.

Line 4 (Figure 5b)

This line goes north, following the road uphill into the central pumice cone. The SP values decrease abruptly at 0.9 km. This is in part due to a rapid gain in elevation. There is a change from rhyolitic tephra to pumice cone and ring deposits (MacLeod et al., 1982) that corresponds roughly to the start of the decrease.

Line 5 (Figure 5c)

This line parallels the road into the "Geologic Interest Area" that leads to the Big Obsidian Flow. The SP values decrease toward the flow.

Line 6 (Figure 5d)

This line goes downhill to the Little Crater Campground and ends at Paulina Lake. The SP values increase toward the lake. This is similar to the effect seen on line 2 as it approached East Lake.

Line 7 (Figure 6a)

This line follows the Summer Home road downhill to Paulina Lake. The SP values increase toward the lake as in line 2 and 6.

Line 8 (Figure 6b)

This line parallels the east edge of Paulina Horse Camp. There is a modest decrease in voltage toward the north.

Line 9 (Figure 6c)

This line follows a level road to the south. A decrease in voltage toward the south was observed on this line.

Summary

The broad positive feature along the E-W line may be due to the upward movement of warm water beneath the caldera floor. Fracture zones, providing pathways for the cooled fluids to descend down, could produce some of the localized negative anomalies. There is no geologic evidence for their existence. A topographic effect is seen on the E-W line between 9.9 km and 11.45 km producing a negative anomaly as the eastern caldera wall is climbed.

Reference

MacLeod, N. S., D. R. Sherrod, and L. A. Chitwood, 1982, Geologic map of Newberry Volcano, Deschutes, Klamath, and Lake Counties, Oregon: U.S. Geological Survey Open-File Report 82-847, 27 p.

Figure Captions

Figure 1. Location of self-potential lines in Newberry Crater, Oregon. The dots on the main road are kilometer marks. The numbers near the north-south lines indicates the profile.

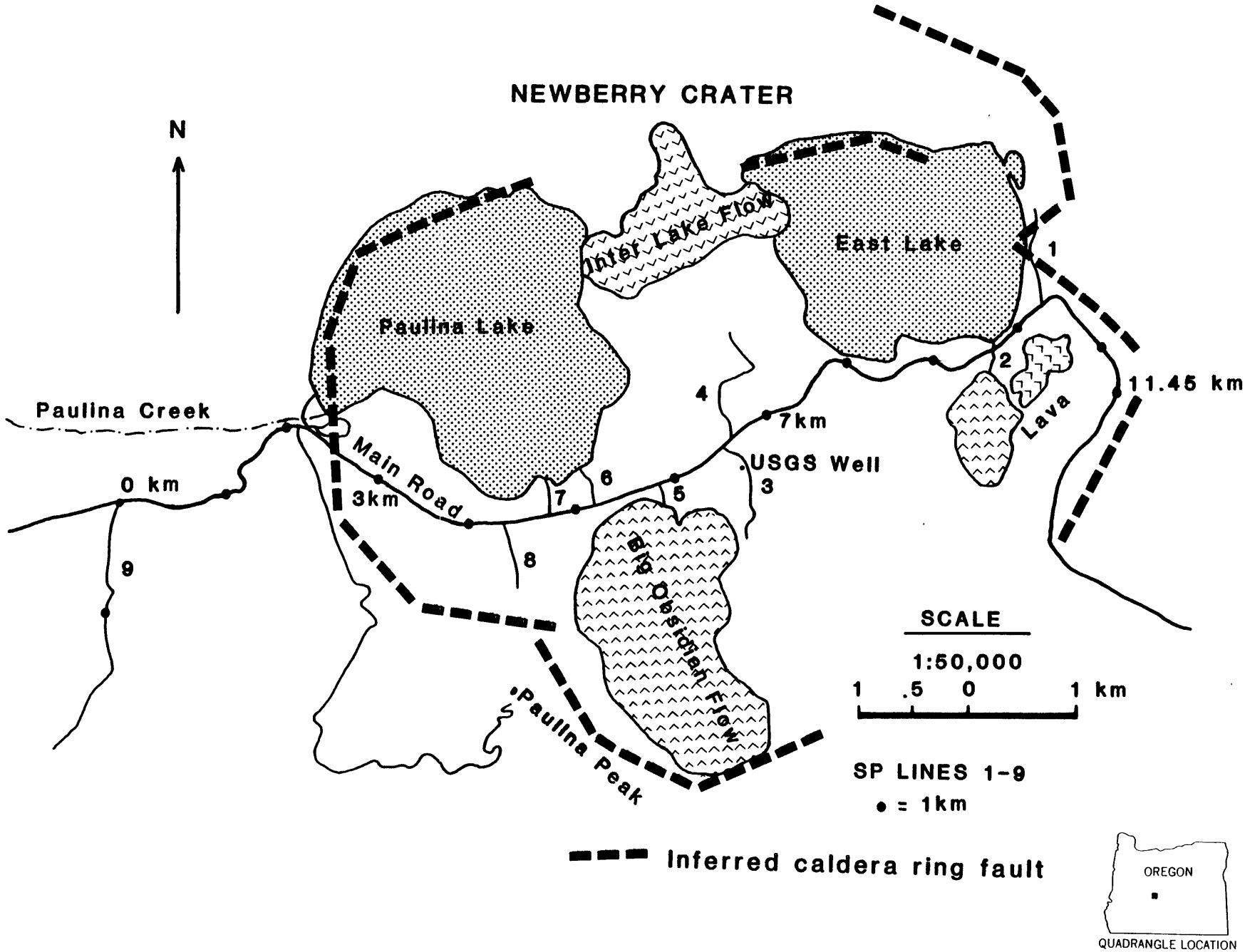
Figure 2. a. Raw data from the main east-west line. b. Data filtered using a running average filter with an effective length of 8.

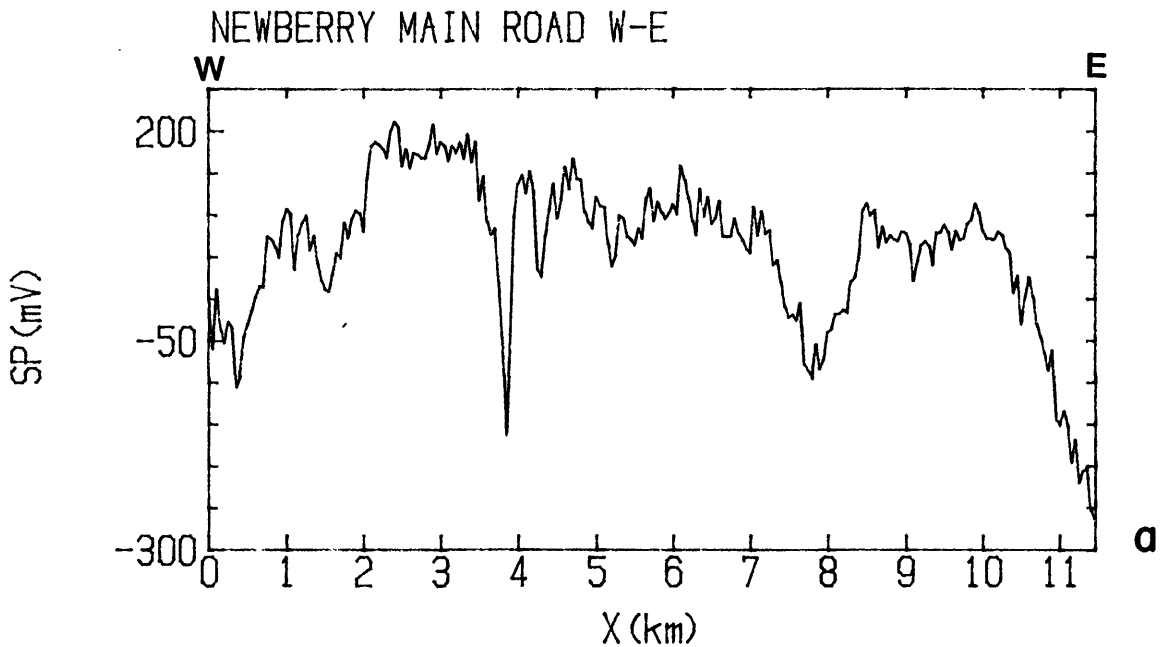
Figure 3. Main east-west line data.

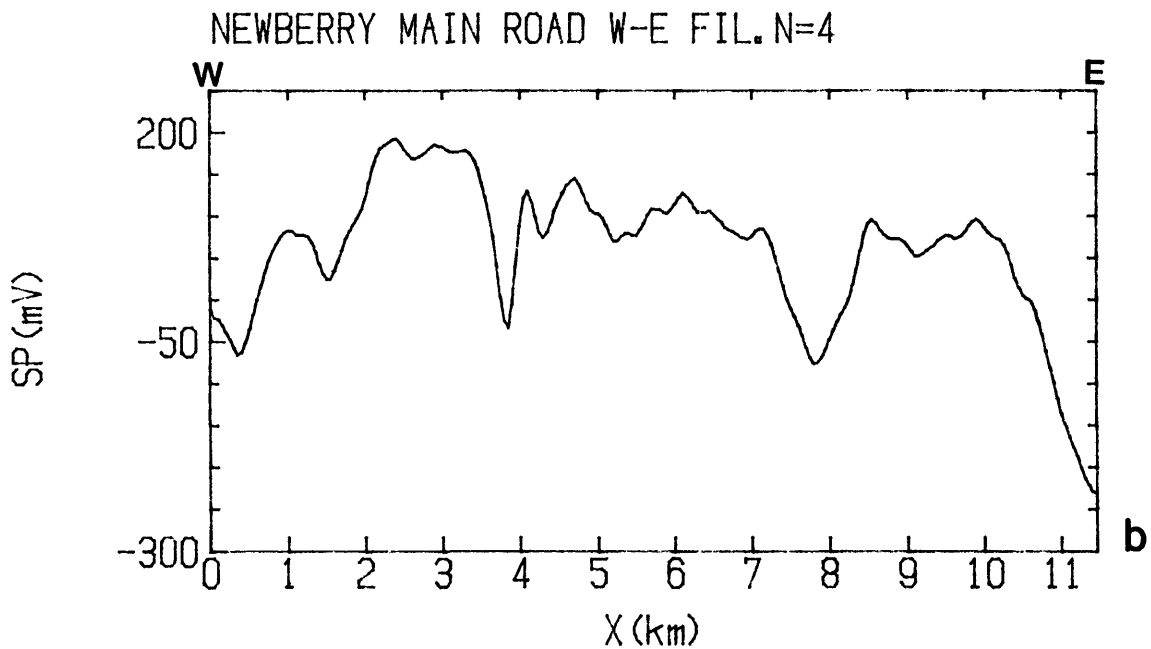
Figure 4. a. Continuation of main east-west line. b. North-south line 1; zero point at 10.2 km on E-W line. c. N-S line 2; zero point at 9.55 km on E-W line.

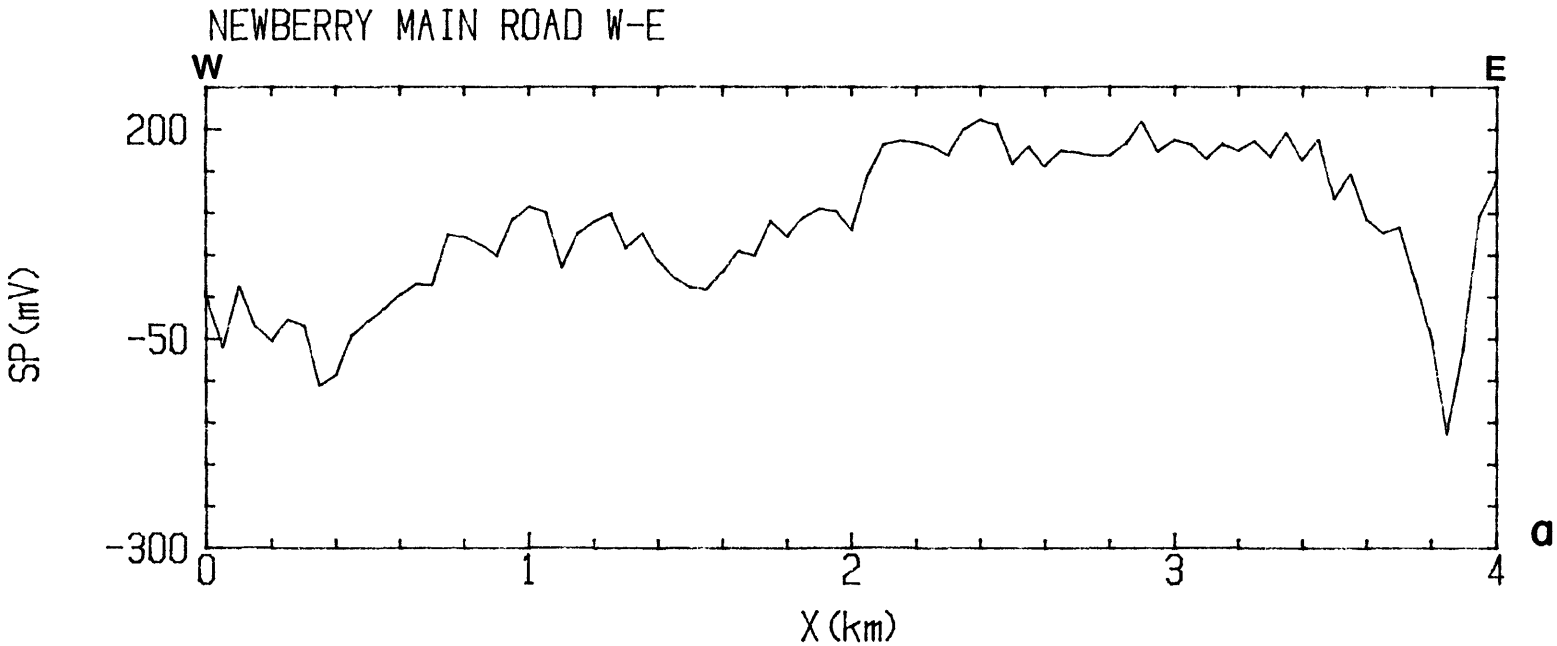
Figure 5. a. N-S line 3; zero point at 6.5 km on E-W line. b. N-S line 4; zero point at 6.6 km on E-W line. c. N-S line 5; zero point at 5.8 km on E-W line. d. N-S line 6; zero point at 5.15 km on E-W line.

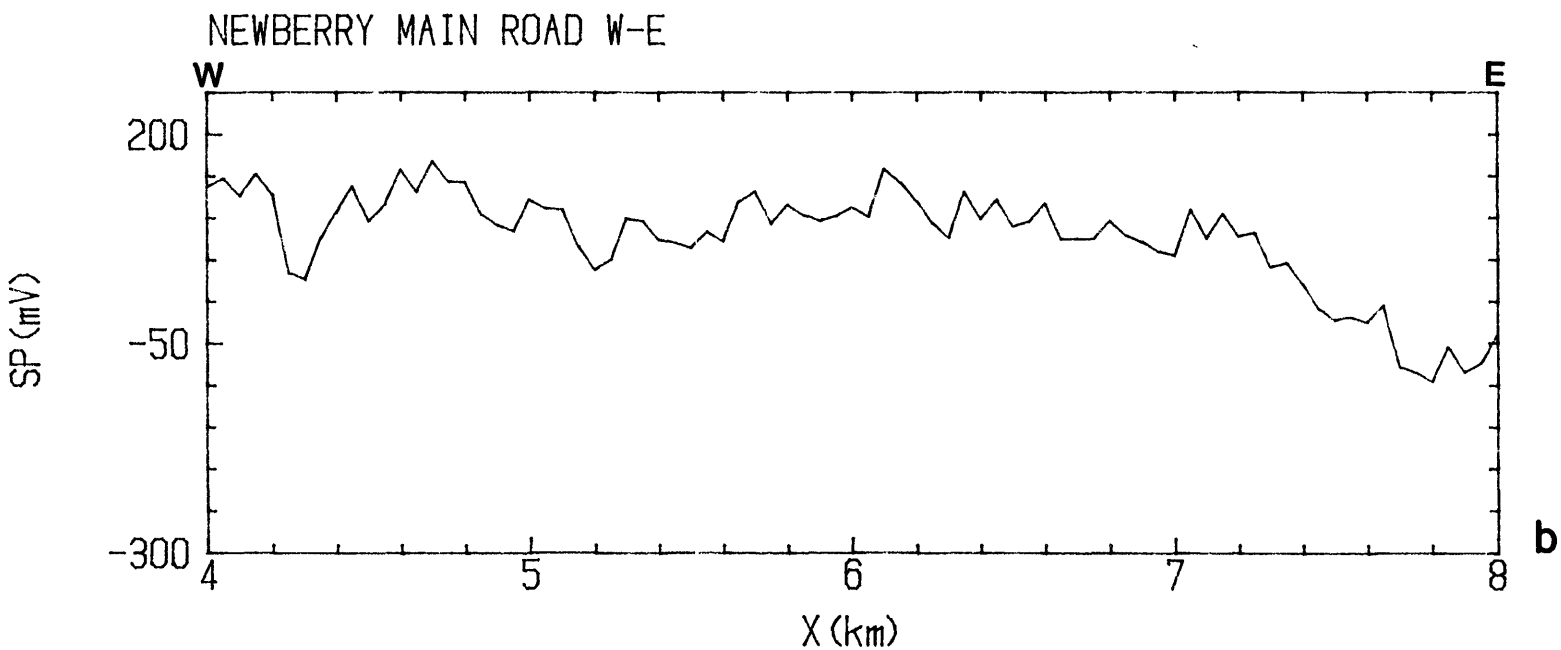
Figure 6. a. N-S line 7; zero point at 4.75 km on E-W line. b. N-S line 8; zero point at 4.35 km on E-W line. c. N-S line 9; zero point at 0.0 km on E-W line.

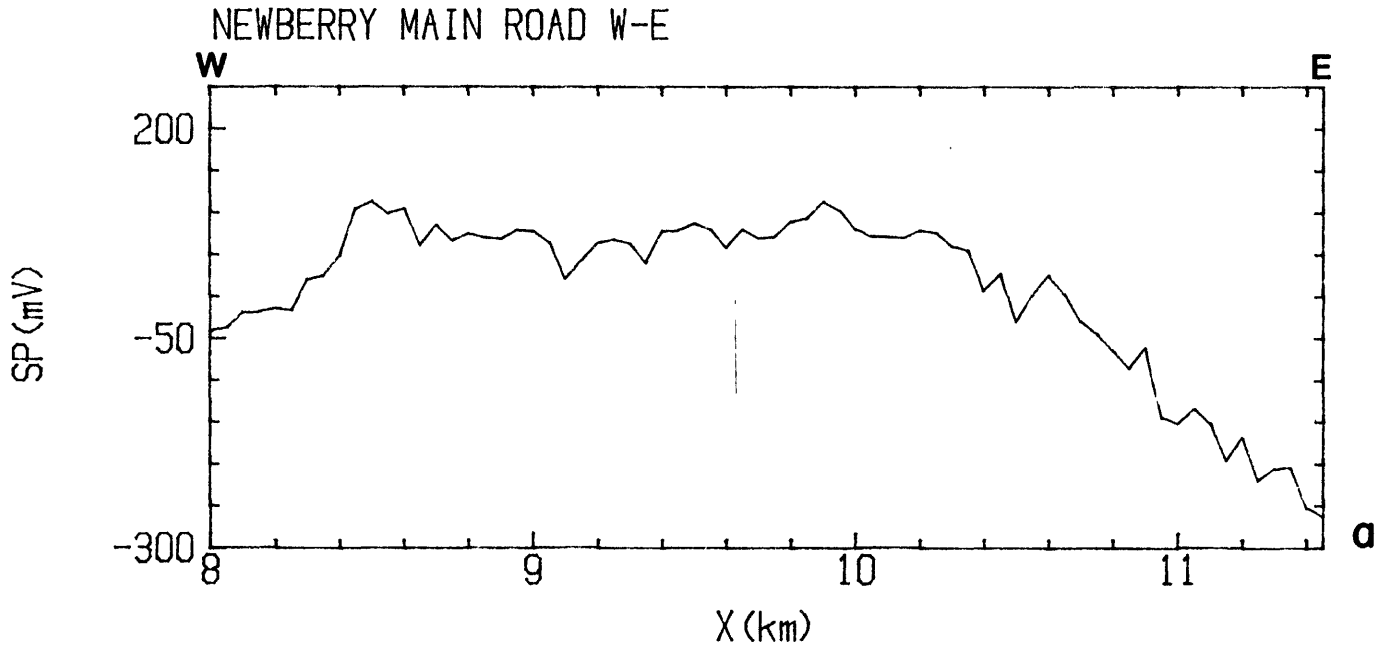

NEWBERRY CRATER
N
Paulina Lake
Inter Lake Flow
East Lake
Paulina Creek
Main Road
0 km
3km
7km
USGS Well
11.45 km
Lava
Big Obsidian Flow
Paulina Peak
1
2
3
4
5
6
7
8
9
SCALE
1:50,000
1 .5 0 1 km
SP LINES 1-9
• = 1km
Inferred caldera ring fault
OREGON
QUADRANGLE LOCATION

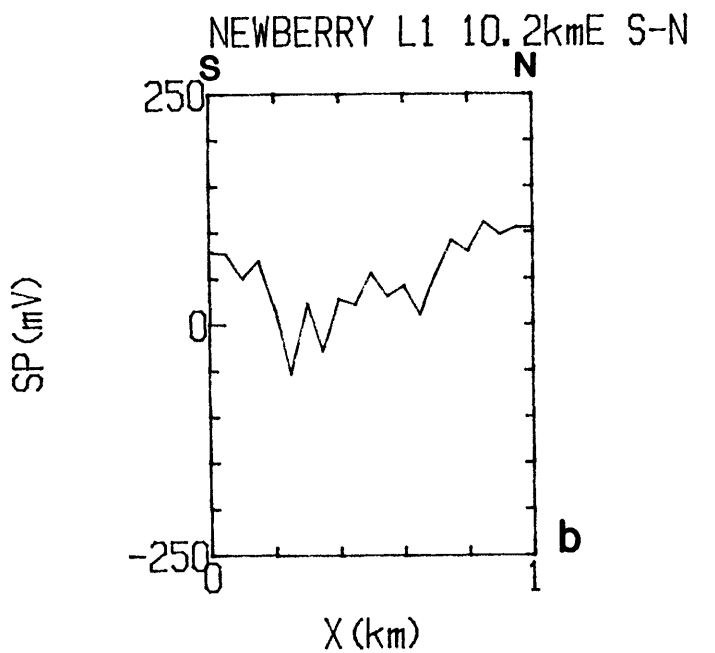

NEWBERRY MAIN ROAD W-E
W
E
200
-50
-300
SP(mV)
0 1 2 3 4 5 6 7 8 9 10 11
X(km)
a

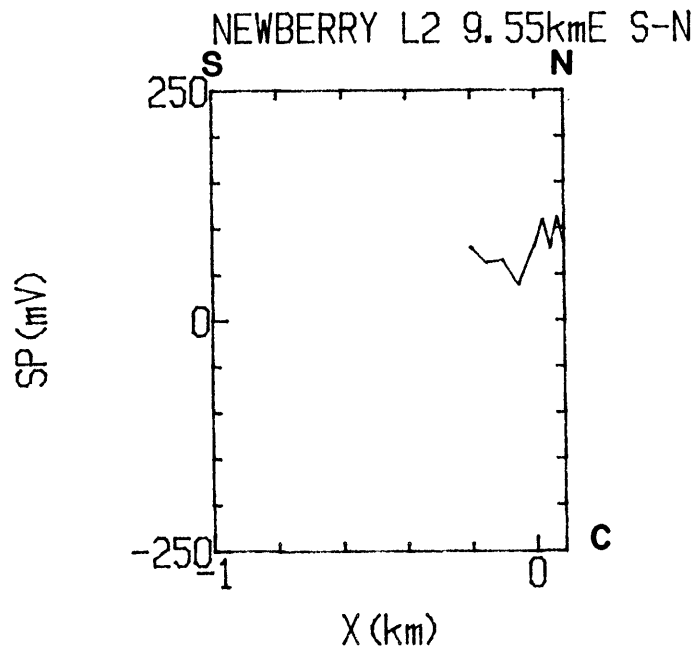

NEWBERRY MAIN ROAD W-E FIL. N=4
W
E
200
-50
-300
SP(mV)
0 1 2 3 4 5 6 7 8 9 10 11
X(km)
b

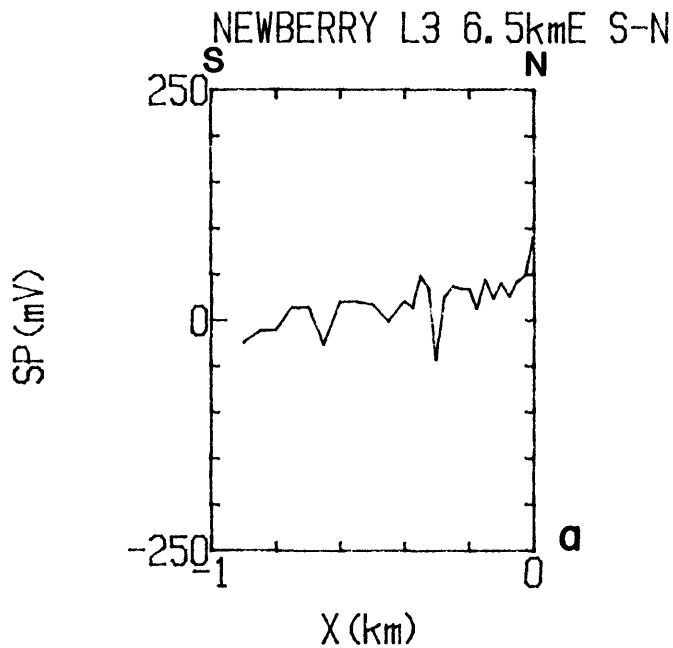

NEWBERRY MAIN ROAD W-E
W
E
200
-50
-300
SP(mV)
0
1
2
3
4
X(km)
a

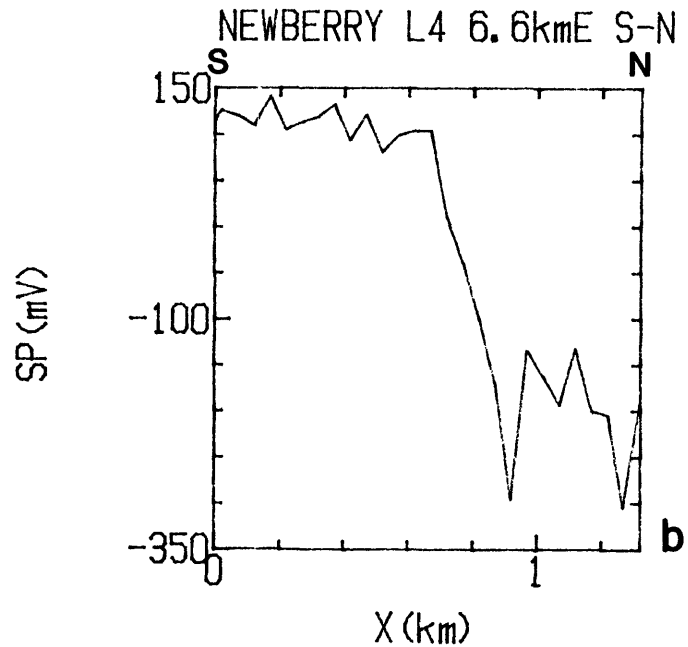

NEWBERRY MAIN ROAD W-E
W
E
200
-50
-300
SP(mV)
4
5
6
7
8
X(km)
b

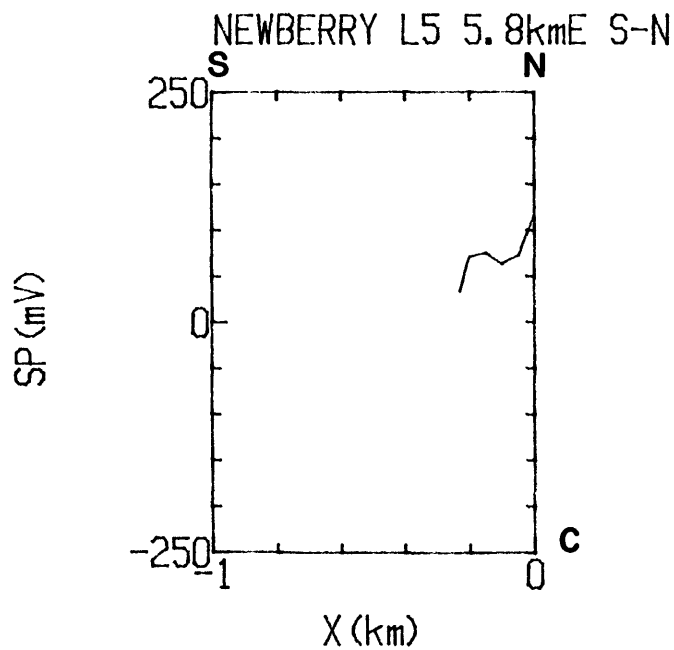

NEWBERRY MAIN ROAD W-E
W
E
200
-50
-300
SP (mV)
8
9
10
11
X (km)
a

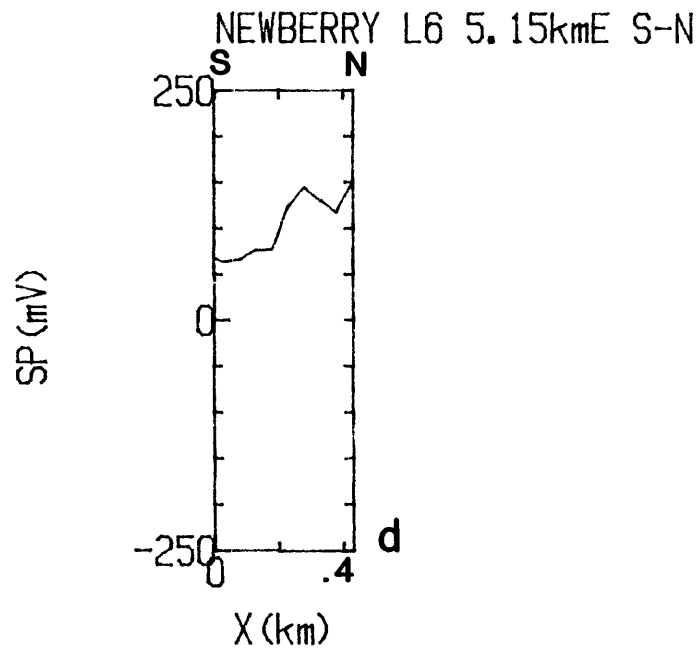

NEWBERRY L1 10.2kmE S-N
S
N
250
0
-250
SP (mV)
0
1
X (km)
b

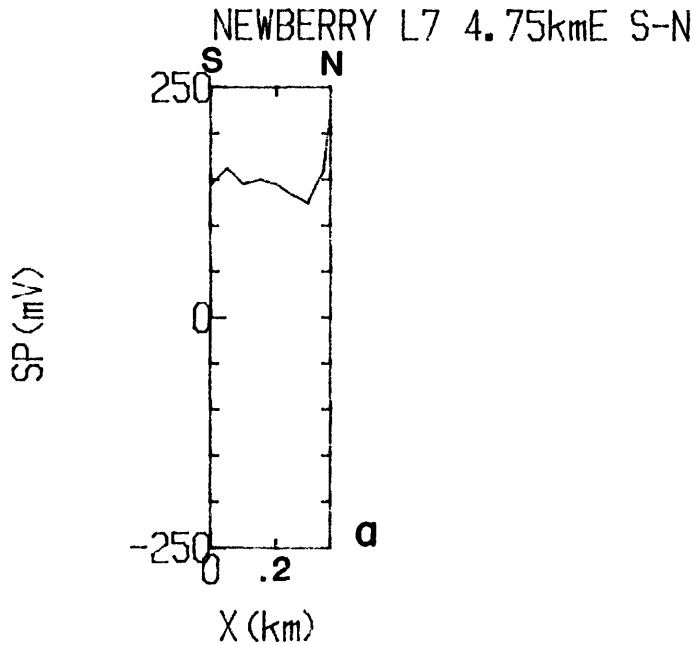

NEWBERRY L2 9.55kmE S-N
S
N
250
0
-250
SP (mV)
-1
0
X (km)
c

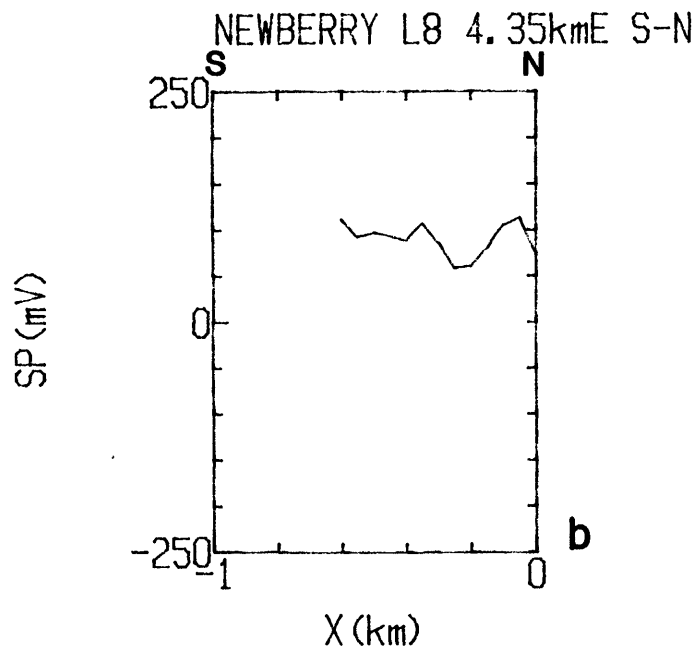

NEWBERRY L3 6.5kmE S-N
S
N
250
0
-250
-1
0
SP (mV)
X (km)
a

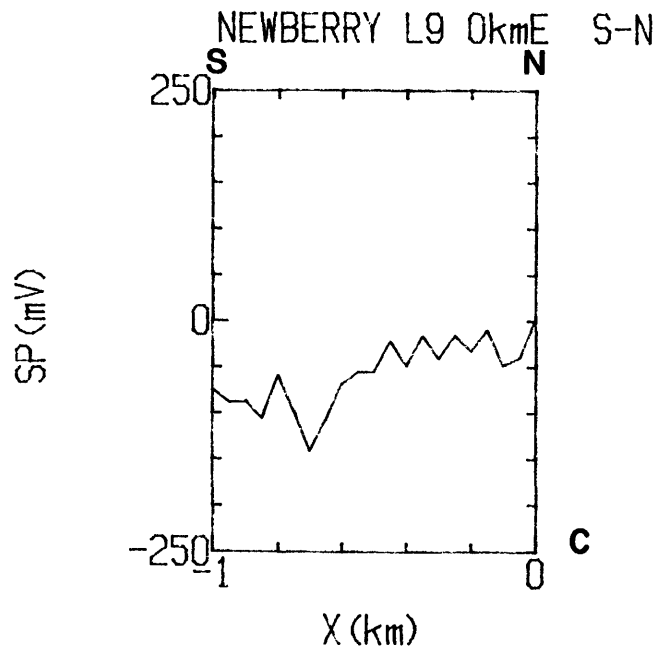

NEWBERRY L4 6.6kmE S-N
S
N
150
-100
-350
0
1
SP (mV)
X (km)
b


NEWBERRY L5 5.8kmE S-N
S
N
250
0
-250
-1
0
SP (mV)
X (km)
c


NEWBERRY L6 5.15kmE S-N
S
N
250
0
-250
0
.4
SP (mV)
X (km)
d


NEWBERRY L7 4.75kmE S-N
S
N
250
0
-250
0
.2
SP (mV)
X (km)
a


NEWBERRY L8 4.35kmE S-N
S
N
250
0
-250
-1
0
SP (mV)
X (km)
b


NEWBERRY L9 0kmE S-N
S
N
250
0
-250
-1
0
SP (mV)
X (km)
c