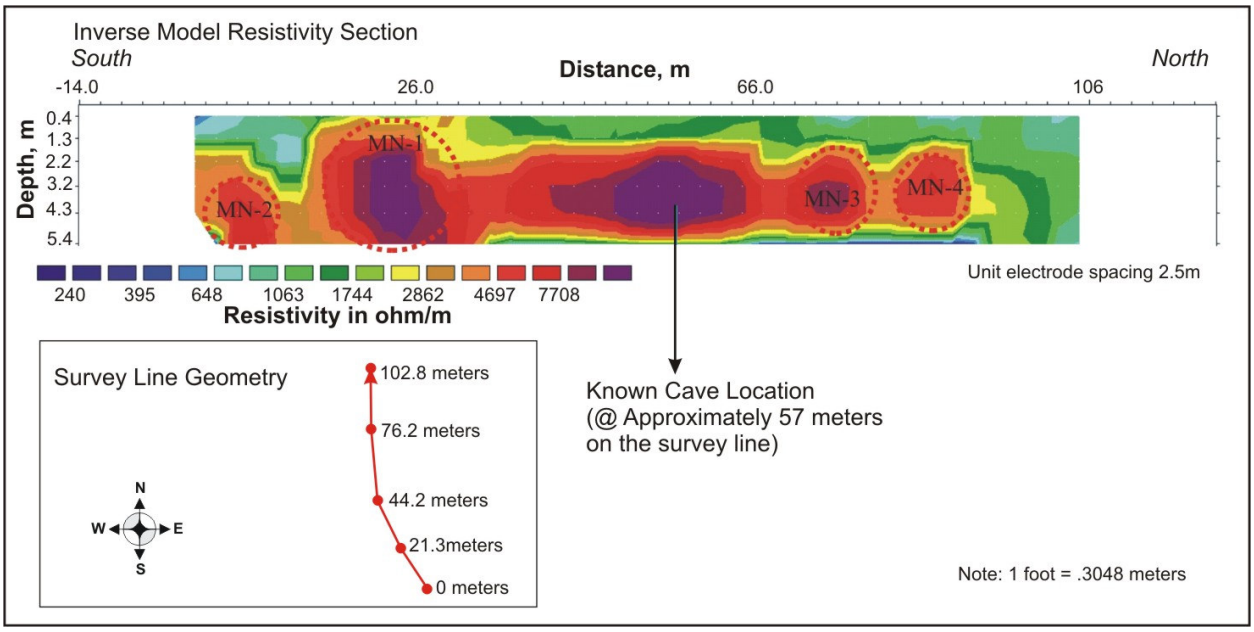

Figure 37. Cross Section. Electrical resistivity data collected over Monument Road Cave.

There is an anomalous resistivity high of 14,300 ohm-m at the location of the known cave, and it is likely that this results from the void space in the cave. The interpreted depth to the top of the void is 3.0 m (9.8 ft). The width of the cave is interpreted to be approximately 12.5 m (41.0 ft), which agrees with survey data. The interpreted height of the cave, at only 2.4 m (7.9 ft), is much less than the measured height of 5.4 m (17.7 ft). However, more information at greater depths is needed to fully characterize the cave

MN-1 is a large anomaly with a maximum value of 12,000 ohm-m at a depth of 3.0 m (9.8 ft). The interpretation section (figure 37) suggests that the depth to the top of this feature is about 2.2 m (7.2 ft) and the depth to its bottom is about 5.5 m (18.0 ft); however, more information at greater depths is need to characterize the bottom of this anomaly. The interpretation of the anomaly over the cave showed that the interpreted depth was too shallow. Based on these results it is possible that the interpreted depth to the source of this anomaly, which may be an unknown cave, may be too shallow and the depth to its bottom may be too small.

MN-2 is located on the southern side of the traverse and appears slightly deeper than the other anomalies. More survey information at a greater depth is needed to fully characterize this anomaly. MN-3 and MN-4 have maximum values of 8,300 ohm-m and 6,459 ohm-m, respectfully. It is possible that each of these anomalies represents small cavities.

Seismic Reflection

Figure 38 displays the approximate location of the HRSW survey line as it passed over Monument Road Cave [17] and table 11 gives the location of every tenth geophone along the geophysical survey line. The Monument Road Cave profiles are included as figure 39 and in appendix D.

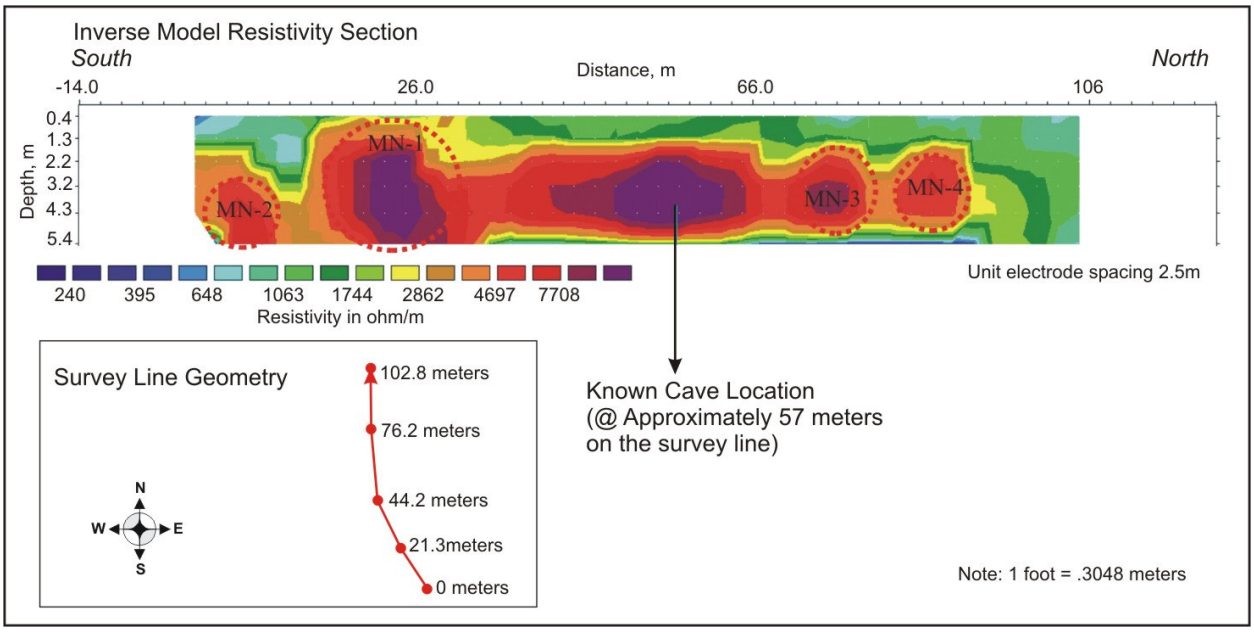

Figure 38. Map. HRSW survey line at Monument Road Cave. [17]

The seismic data is dominated by reverberating reflection events, indicating the presence of a shallow subsurface layer with a high velocity contrast. A scoria bed between lava flows could produce such an effect. The known cave is centered on shot point 165, extending 6.1 m (20.0 ft) on either side of this point. Zero time on the section is at an elevation of 1311.0 m (4301 ft).

Table 11. Geophone coordinate locations over Monument Road Cave.

ID	Easting (m)	Northing (m)	Elevation (m)
Geophone 101	619724.00	4625386.98	1303.24
Geophone 111	619722.34	4625392.77	1303.06
Geophone 121	619720.66	4625398.60	1302.85
Geophone 131	619719.05	4625404.42	1302.64
Geophone 141	619717.48	4625410.20	1302.44
Geophone 151	619715.91	4625415.97	1302.25
Geophone 161	619714.34	4625421.73	1302.07
Geophone 171	619712.93	4625427.58	1301.85
Geophone 181	619711.45	4625433.40	1301.63
Geophone 191	619710.08	4625439.25	1301.42
Geophone 196	619709.43	4625442.19	1301.31
All coordinates are listed in NAD 83/UTM Zone 10.			

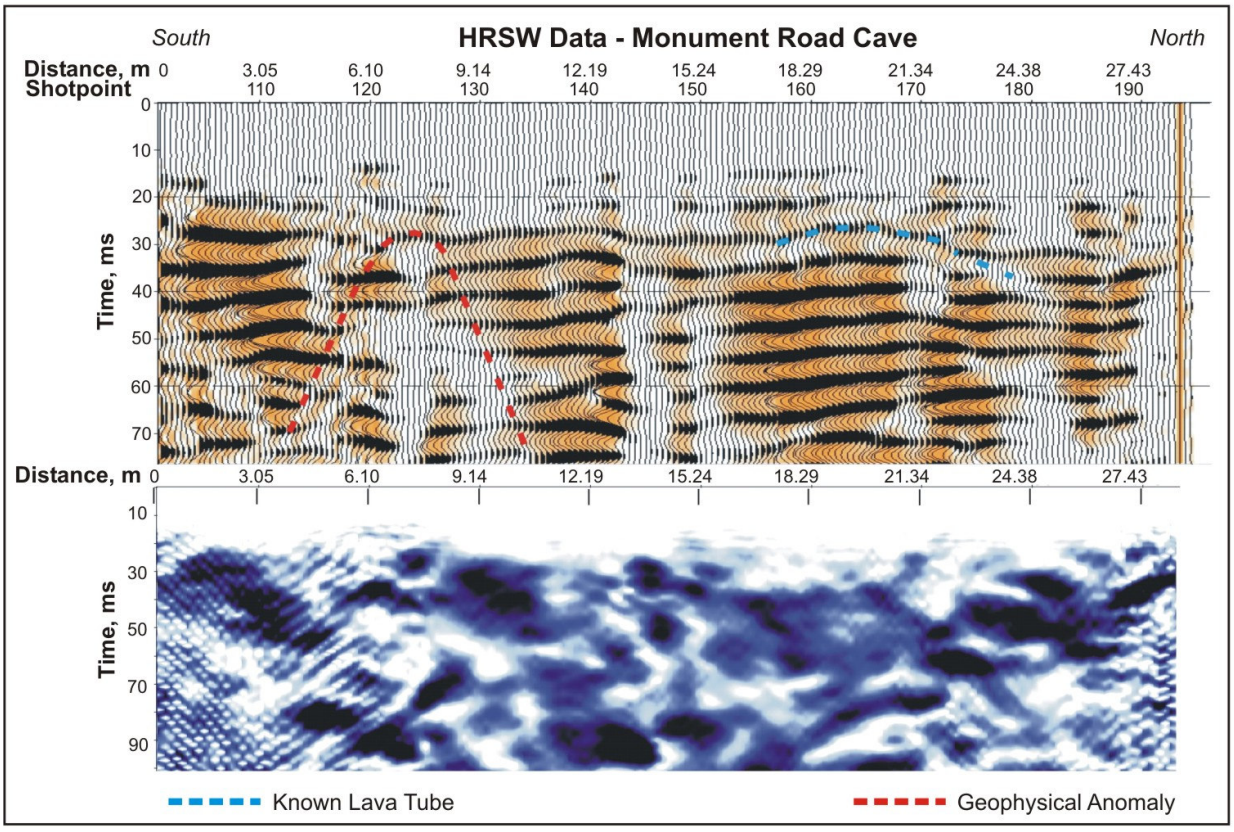

Figure 39. Cross Section. HRSW data collected over Monument Road Cave.

The stacking velocity in the vicinity of the known cave is 914 m/sec (2999 ft/sec), which is considerably slower than velocities seen at the other lava tube sites. As a result, the anomaly from the known cave should occur 12 ms below the ground surface. The ground surface is at 14 ms on this line. An arcuate reflector can be seen at this point, but diffractions are not clearly evident. Strong reverberations occur beneath this anomaly, but they do not retain the arcuate shape of the top of the cave reflector. This indicates that the shallow layering causing the reverberations lies between the ground surface and the top of the cave.

A suspected lava tube is interpreted as being centered on shot point 123 and highlighted in red. The interpretation is based on an arcuate reflector over a disturbed zone. This anomaly occurs at 13 ms below the ground surface and is about 2.4 m (7.9 ft) across.

4.4.3 Comparisons

Figure 40 shows the anomalous zones interpreted from the different data sets recorded at this site. Monument Road Cave was detected with the HRSW, electrical resistivity, and magnetic data sets. All of the interpreted locations and dimensions correspond well with each other and with the surveyed location of the cave. Additional anomalies were selected to the south of the known cave in each of the methods. As with some of the other sites, there appears to be better correlation between the electrical resistivity and magnetic data sets, rather than the HRSW and the GPR data sets. However, at this site, all of the methods apart from GPR show anomalies coincident with the known cave. In addition to identifying the correct location of the cave, the magnetic method also appeared to predict its trend.

4.5 BEARPAW BRIDGE

4.5.1 Site Description

Bearpaw Bridge is located between Merrill Cave and Bearpaw Cave. The bridge is oriented in an east to west direction. On either side of the bridge, the roof of the cave has collapsed leaving large amounts of rubble consisting of volcanic boulders in huge pits. The cave dimensions were obtained from a plan map from The Lava Beds Book. The depth from the road surface to the bottom of the cave is approximately 10.5 m (34.4 ft) with the maximum overburden thickness of approximately 6.4 m. The cave is approximately 15.2 m (49.9 ft) wide with a height of 3.0 m (9.8 ft) below the road surface. Electrical resistivity data were collected along the road at this location. Figure 41 shows both a plan and profile view of the Bearpaw Bridge [6] with the approximate location of the electrical resistivity line superimposed on the plan map. Figure 42 is a photo of Bearpaw Bridge. Only electrical resistivity data were collected over Bearpaw Bridge.

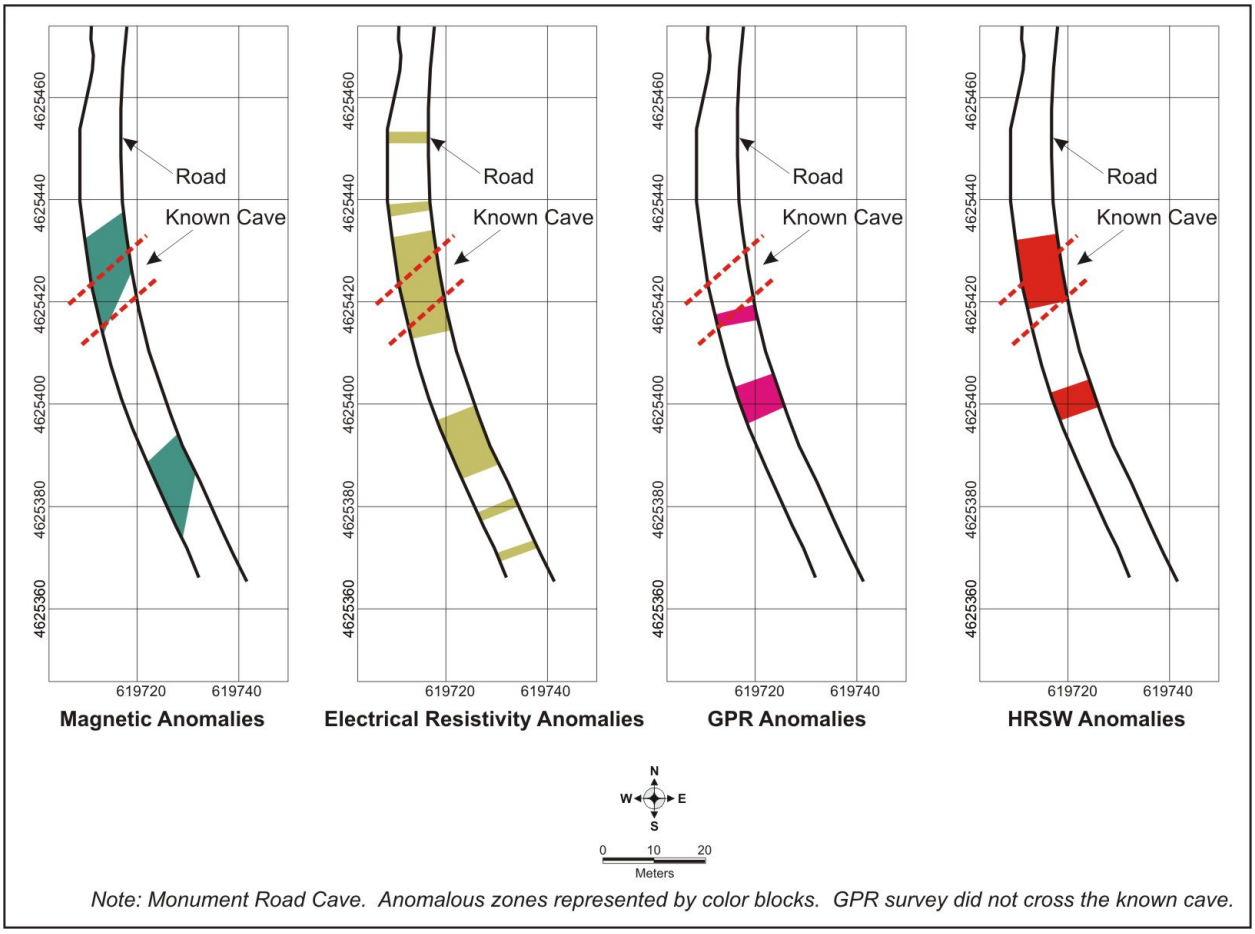

Figure 40. Map. Comparison of anomalous zones at Monument Road Cave.