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GEOPHYSICAL STUDIES OF THE LAVIC LAKE FAULT,
LAVIC LAKE PLAYA, CALIFORNIA

A Thesis

Presented to

The Faculty of the Department of Geology

San José State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science

By

Halle R. Morrison

August 2002

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A handwritten signature in cursive script, appearing to read "Richard Sedlock", written over a horizontal line.

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Michael Rymer, United States Geological Survey

APPROVED FOR THE UNIVERSITY

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ABSTRACT

GEOPHYSICAL STUDIES OF THE LAVIC LAKE FAULT, LAVIC LAKE PLAYA, CALIFORNIA

by Halle R. Morrison

This study uses geophysical techniques to evaluate evidence of previous movement on the Lavic Lake fault, Mojave Desert, southern California. Of primary interest in this thesis is the southwest section of Lavic Lake playa. The preferred interpretation of geophysical data is that basalt buried beneath part of the playa has an irregular topography, inconsistent with an undisturbed lava flow. Geophysical data confirmed the presence of unusual buried features in close proximity to the Lavic Lake fault. Seismic refraction revealed the possibility that buried or absent basalt somehow influenced the morphology of the 1999 Hector Mine earthquake rupture. Most basalt is found at considerable depths. Observations lead to several kinematic models. The fissure flow model uses the depth of the basalt to suggest that the Lavic Lake fault was once host to a fissure flow that erupted the basalt found along the Lavic Lake fault. Faulting has since altered surficial topography.

Acknowledgments

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Table of Contents

LIST OF FIGURES.....	ix
LIST OF TABLES.....	xii
INTRODUCTION.....	1
LOGISTICS.....	2
GEOLOGIC SETTING.....	4
The Mojave Block and the Eastern California Shear Zone.....	4
Quaternary Geology.....	4
Faulting and Current Seismicity.....	11
PREVIOUS WORK.....	21
BACKGROUND AND PURPOSE.....	22
FIELD METHODS.....	26
Magnetometer Surveys.....	26
Seismic Refraction Surveys.....	26
DGPS/GIS Mapping.....	29
EXPERIMENTAL METHODS.....	33
Magnetic Data.....	33
Seismic Refraction Data.....	37
DGPS/GIS Data.....	39
<i>Differential Corrections</i>	39
<i>ArcView 3.2a Data Manipulation</i>	39

RESULTS.....	42
Magnetic Anomalies and Modeling.....	42
<i>Magnetic Anomaly Contour Mapping.....</i>	42
<i>Trends in the Linear Magnetic Profiles Across the Hand.....</i>	42
<i>Trends in the Linear Magnetic Profiles in Playa Sediment.....</i>	47
<i>Trends in the Magnetic Profiles Across the Hector Mine Rupture.....</i>	52
<i>Trends in Other Linear Magnetic Profiles.....</i>	56
Seismic Refraction.....	56
<i>Seismic Lines West of the Hand.....</i>	56
<i>Seismic Lines East of the Hand.....</i>	66
<i>Seismic Lines South of the Hand.....</i>	68
<i>Seismic Lines Across the Hector Mine Rupture.....</i>	70
<i>Seismic Lines Across a Major Steptover in the Rupture.....</i>	70
DGPS/GIS Data.....	71
DISCUSSION.....	74
Depth of the Basalt-Sediment Contact in the Subsurface.....	74
Geometry of the Basalt-Sediment Contact in the Subsurface.....	75
The Basalt-Sediment Contact in Relation to the Hector Mine Rupture.....	76
Geomorphic Features of the Sunshine Peak Flow and Lavic Lake Playa.....	77

Kinematic Models.....	78
<i>The Fissure Flow Model</i>	78
<i>The Multiple Dip-Slip Thrusting Model</i>	80
<i>The Basalt Exhumation Model</i>	83
Error Analysis.....	86
<i>Magnetic Surveys</i>	86
<i>Seismic Refraction Surveys</i>	87
<i>DGPS/GIS Data</i>	88
CONCLUSION.....	89
REFERENCES CITED.....	90
APPENDICES.....	92

List of Figures

Figure 1. Generalized map showing active faults of the southeastern Mojave tectonic block. Map modified from Rymer et al. (2002).....	5
Figure 2. Generalized geologic map of the Lavic Lake area. Map from Dibblee (1966).....	6
Figure 3. Photograph of surficial basalt units found on the northern tip of the hand in Lavic Lake playa.....	7
Figure 4. Photograph of surficial basalt units found within the hand near the Hector Mine earthquake rupture. Prominent fracturing is evident.....	8
Figure 5. Photograph of in place surficial basalt units. Prominent fracturing is evident.....	9
Figure 6. Photograph of basalt in the hand, close to the elevation of the sand and clay units of Lavic Lake playa.....	10
Figure 7. Photograph of surficial clay and sand units that compose most of Lavic Lake playa. Photo was taken facing to the north.....	12
Figure 8. Photograph of surficial clay units, with minor, shallow polygonal desiccation cracks and open fissure. The fissure formed from movement on the Lavic Lake fault.....	13
Figure 9. Vertical section of playa exposed due to the Hector Mine earthquake.....	14
Figure 10. Section of rupture between the hand and frisbee. Photograph was taken looking towards the south. Compression due to right-lateral movement is shown by playa sediment sheets being thrust towards the observer.....	15
Figure 11. Section of rupture cutting through the frisbee. Photograph was taken looking towards the northwest. Vertical relief is due to minor east-vergent thrusting.....	16
Figure 12. Section of rupture south of the hand. Photograph was taken looking to the south.....	17
Figure 13. Major strike-slip faults in the area of Lavic Lake, with the principal rupture of the Hector Mine earthquake shown in yellow. Map from USGS, SCEC, and CDMG (2000).....	18

Figure 14. Photograph of portion of the Lavic Lake fault rupture and the Pisgah fault offset, about 2 km to the west. This photograph was taken looking towards the west.....	19
Figure 15. Portion of 1:10,000 scale aerial photograph of study area in Lavic Lake, indicating the trace of the 1999 rupture.....	23
Figure 16. Locations of all magnetometer lines along which data was collected. This figure was generated by rover files imported into ArcView 3.2a.....	27
Figure 17. Locations of all seismic refraction lines along which data was collected. This figure was generated by rover files imported into ArcView 3.2a.....	28
Figures 18 and 19. Photographs of field apparatus for seismic refraction data collection. These seismic lines extend across the Hector Mine rupture, near the north end of the finger.....	30
Figure 20. Map of the field area showing the rough spatial relations of the hand, the frisbee, the Hector Mine rupture, and associated units.....	31
Figure 21. Plot of diurnal variation in the magnetic field at 34.66 N, 116.36 W (0.50 km in elevation) according to the IGRF2000 model.....	35
Figure 22. Portion of 1:250,000 scale aeromagnetic anomaly map of San Bernardino county. Map modified from Department of Conservation, Mines, and Geology (1988).....	36
Figure 23. Magnetic anomaly contour map of the field area.....	41
Figure 24. Magnetic anomaly plot of magnetometer line 1.....	43
Figure 25. Magnetic anomaly plot of magnetometer line 3.....	45
Figure 26. Magnetic anomaly plot of magnetometer line 4.....	46
Figure 27. Magnetic anomaly plot of magnetometer line 29.....	48
Figure 28. Magnetic anomaly plot of magnetometer line 5.....	49
Figure 29. Magnetic anomaly plot of magnetometer line 30.....	50
Figure 30. Magnetic anomaly plot of magnetometer line 34.....	51
Figure 31. Magnetic anomaly plot of magnetometer line 23.....	53

Figure 32. Magnetic anomaly plot of magnetometer line 24.....	54
Figure 33. Magnetic anomaly plot of magnetometer line 25.....	55
Figure 34. Magnetic anomaly plot of magnetometer line 26.....	57
Figure 35. Magnetic anomaly plot of magnetometer line 2.....	58
Figure 36. Three-dimensional DEM of the field area, showing the extent of major units. This figure was generated by rover files imported into ArcView 3.2a.....	72
Figure 37. Three-dimensional DEM of the field area, showing the extent of major units, minimum, and calculated depths to basalt bedrock. This figure was generated by rover files imported into ArcView 3.2a.....	73
Figure 38. Times 1, 2, and 3 for the fissure flow model (generalized).....	79
Figure 39. Times 1, 2, and 3 for the multiple dip-slip thrusting model (generalized).	82
Figure 40. Times 1, 2, 3, and 4 for the basalt exhumation model.....	84

List of Tables

Table 1. Seismic Line 1, Shots 1-8.....	59
Table 2. Seismic Line 2, Shots 1-4.....	60
Table 3. Seismic Line 6, Shots 1-2.....	60
Table 4. Seismic Line 12, Shots 1-29.....	61
Table 5. Seismic Line 17, Shots 1-4.....	62
Table 6. Seismic Line 18, Shots 1-18.....	62
Table 7. Seismic Line 16, Shots 1-4.....	63
Table 8. Seismic Line 19, Shot 1.....	63
Table 9. Seismic Line 20, Shots 1-10.....	63
Table 10. Seismic Line 27, Shots 1-18.....	64
Table 11. Seismic Line 28, Shots 1-30.....	65
Table 12. Seismic Line 7, Shots 1-10.....	66
Table 13. Seismic Line 8, Shots 1-4.....	66
Table 14. Seismic Line 9, Shots 1-2.....	67
Table 15. Seismic Line 10, Shots 1-2.....	67
Table 16. Seismic Line 11, Shots 1-2.....	67
Table 17. Seismic Line 13, Shots 1-4.....	67
Table 18. Seismic Line 14, Shots 1-4.....	67
Table 19. Seismic Line 15, Shots 1-4.....	68
Table 20. Seismic Line 21, Shots 1-10.....	68
Table 21. Seismic Line 31, Shots 1-5.....	69

Table 22. Seismic Line 32, Shots 1-6.....	69
Table 23. Seismic Line 33, Shots 1-8.....	69
Table 24. Seismic Line 22, Shots 1-4.....	70
Table 25. Seismic Line 35, Shots 1-3.....	70

INTRODUCTION

The 1992 M7.3 Landers and the 1999 M7.1 Hector Mine earthquakes underscored the need for a better understanding of earthquake recurrence and fault kinematics in the eastern California shear zone (ECSZ) of southern California. In direct response to this need, this report investigates evidence for previous activity on the Lavic Lake fault, which produced the Hector Mine earthquake of October 16, 1999 in the Mojave Desert of southern California.

The main objectives of this study are to investigate and identify evidence of previous activity on the Lavic Lake fault. This evidence primarily includes surface and subsurface basalt geomorphology, and is investigated through seismic refraction surveys, magnetometer surveys, and detailed Global Positioning Systems and Geographic Information Systems (GPS/GIS) mapping. This study then presents kinematic models that may not only explain the local geology but also give some clues about previous major earthquake activity on the Lavic Lake fault and neighboring fault systems.

LOGISTICS

Lavic Lake is located entirely within Twentynine Palms Air-Ground Combat Center, a Marine Corps training facility in active operation since World War II. Its remote location makes it an ideal locality on which to hold training exercises, controlled bombing runs, and tank driver training. For security and safety reasons, unauthorized civilian access to the base is illegal. Access to the base is allowed only during brief "windows of opportunity" when military exercises are not scheduled.

Any civilian wishing to gain access to the base during these windows must first take a brief (<1 hour) ordnance and desert safety training from the Marine Corps on the main base in Twentynine Palms. Training addresses the dangers of live or unexploded ordnance, desert survival techniques, and protocol for contacting BEARMAT, the range coordinators. Civilians must work in groups of at least two, and must use a four-wheel drive vehicle. Contact with BEARMAT must be established by cellular phone or radio when entering and leaving the base and at pre-determined intervals of time while on the base. I have received ordnance training, and am authorized to work on the base with anyone who has also received the training. Permission to work and a planned itinerary must be authorized in advance by Karl Gross of the USGS, who relays the request to the Marine Corps in Twentynine Palms.

Previous military activity may affect this study in several ways. Aerial photographs and ground-based work indicate that the field area has been bombed heavily in the past. Impact craters, unexploded shells, and shell debris are widespread, and are especially abundant in the study area. Large explosions may have severely altered the

geomorphology of basalt or lake sediments, or may have exposed bedrock or other features in the near subsurface. Ordnance and scrap metal that can be seen on the surface, and that perhaps are buried in the young lake sediments, may be a source of error in the magnetometer surveys. Since Lavic Lake is located at the northern end of the base, ordnance collection teams visit Lavic Lake relatively infrequently, allowing scrap metal to accumulate. A further discussion of errors can be found in the "Error Analysis" section.

GEOLOGIC SETTING

The Mojave Block and the Eastern California Shear Zone

The study area is at Lavić Lake, a playa in the Mojave Desert, southern California west of the Bullion and Cady Mountains (Ross, 1992). The playa is located near the center of the Mojave block, which is bounded by the Garlock fault to the north and the San Andreas fault to the southwest, among other fault systems in southern California. The Mojave block is cut by the ECSZ, in which deformation is dominated by north-northwest-trending right-lateral strike-slip faults, mostly Cenozoic in age (Fig. 1) (Jagiello et al., 1992). Collectively, the closely spaced faults of the ECSZ accommodate 13-14 mm/yr of dextral shear (Miller et al., 2001).

Quaternary Geology

All surficial units in and near Lavić Lake playa are Quaternary in age (Fig. 2) (Dibblee, 1966). The playa is bounded to the north by flows that originated from Pisgah Crater, and to the west by basalt flows that probably originated from Sunshine Craters. Two small, isolated basalt bodies crop out near the western edge of Lavić Lake playa. These bodies are called the "hand" and the "frisbee." due to their shape. The Sunshine Craters flows, along with the hand and the frisbee, are similar in lithology to the Pisgah flow – fine-grained, vesicular, massive basalt with sparse olivine phenocrysts (Dibblee, 1966) (Figs. 3-6). The lake sediment was characterized by Dibblee (1966) as coarse- to fine-grained alluvium and clay. Field observations indicate that sedimentary units range from extremely poorly sorted gravel to well-sorted fine clay deposits that are prone to

Figure 1. Generalized map showing active faults of the southeastern Mojave tectonic block. The location of Lavic Lake is shown, and the heavy black line shows the location of the 1999 Hector Mine earthquake surface rupture. Map modified from Rymer et al. (2002).

Figure 2. Generalized geologic map of the Lavic Lake area. Key: Q_{bs}=Basalt of the Sunshine Crater flow and craters, Q_b=Basalt of the Pisgah flow and crater, Surficial sediments: Q_c=clay, Q_a=alluvium. Map from Dibblee (1966).

Figure 3. Photograph of surficial basalt units found on the northern tip of the hand in Lavic Lake playa. The basalt is massive but altered by eolian weathering. Pencil for scale.

Figure 4. Photograph of surficial basalt units found within the hand near the Hector Mine earthquake rupture. Prominent fracturing is evident. Pencil for scale.

Figure 5. Photograph of in-place surficial basalt units. Prominent fracturing is evident. Pencil for scale.

Figure 6. Photograph of flow basalt in the hand, close to the elevation of the sand and clay units of Lavic Lake playa. The impact crater found in the right foreground is approximately 1.5 m across.

desiccation cracking (Figs. 7-9).

The age of the basalt flows within Lavic Lake is the subject of some debate, but all studies agree that the units are late Quaternary. The age of the Pisgah flow has not been determined. The age of the Sunshine Peak flow has been determined (through K-Ar dating) by two researchers. In 1993, John Nakata of the US Geological Survey (USGS) obtained dates of 0.36 ± 0.1 Ma and 0.26 ± 0.1 Ma (A. Glazner, personal communication, 2000). Brett Cox of the USGS dated the basalt at 0.60 Ma (A. Glazner, personal communication, 2000). It is unknown whether an attempt was made to delineate separate flows within the basalt units.

Faulting and Current Seismicity

At 2:46 am PST (0946 GMT) on October 16, 1999, a magnitude **M7.1** earthquake occurred on the Lavic Lake fault, an unnamed fault of the ECSZ. The epicenter of the event was located about 76 km east-southeast of Barstow, California, within Twentynine Palms Air-Ground Combat Center. This earthquake, named the Hector Mine earthquake, produced a spectacular surface rupture with a total length of 48 km (Treiman et al., 2002). Portions of the Bullion fault to the southwest and at least four other faults ruptured coseismically. The trace of surface rupture along the Lavic Lake fault is clearly expressed in the sediments and basalt of Lavic Lake playa (Figs. 10-12).

Lavic Lake and the surrounding areas host many other named and unnamed strike-slip faults, all part of the ECSZ (Fig. 13). The Pisgah fault has a visible step in the Sunshine Peak lava flow about 2 km west of the Lavic Lake fault (Fig. 14). Farther west are the Bullion, Calico, and Emerson faults, all of which are defined as active. The

Figure 7. Photograph of surficial clay and sand units that compose most of Lavic Lake playa. Photo was taken facing to the north. Truck tracks for scale.

Figure 8. Photograph of surficial clay units, with minor, shallow polygonal desiccation cracks and open fissure. The fissure formed from movement on the Lavic Lake fault. Maximum width of fissure is approximately 0.2 m.

Figure 9. Vertical section of playa exposed due to the Hector Mine earthquake. Pencil for scale.

Figure 10. Section of rupture between the hand and frisbee. Photograph taken looking to the south. Compression due to right-lateral movement is shown by playa sediment "sheets" thrust towards the observer. Bushes are approximately 1.0 m across.

Figure 11. Section of rupture cutting through the frisbee. Photograph taken looking to the northwest. Vertical relief is due to minor east-vergent thrusting. Person is 2.0 m tall.

Figure 12. Section of rupture south of the hand. Photograph taken looking to the southeast. Bushes are approximately 1.0 m across.

Figure 13. Major strike-slip faults in the area of Lavić Lake, with the principal 1999 Hector Mine rupture shown in yellow. Map from USGS, SCEC, and CDMG (2000).

Figure 14. Photograph of portion of the Lavic Lake fault rupture and the Pisgah fault offset, about 2 km to the west. Photograph taken looking to the west. Pink "X" in the foreground is approximately 0.3 m in length and width.

Bullion fault intersects the Lavic Lake fault southeast of Lavic Lake in a 700-m-wide zone of deformation made evident by the Hector Mine earthquake (USGS, SCEC, and CDMG, 2000). The close spacing of all of these faults suggests that they may be related seismogenically or have the ability to transfer stress from one fault to the next. All of these faults have very low slip rates, suggesting very long recurrence intervals (USGS, SCEC, and CDMG, 2000).

PREVIOUS WORK

The geology of the study area was mapped by Dibblee (1966) and Wise (1966). Since the 1992 M7.3 Landers and the 1999 Hector Mine earthquakes, the region has been the subject of renewed geologic interest to many researchers. However, much of this research is not yet published.

On the day of the Hector Mine earthquake, helicopter reconnaissance flights identified and mapped the entire surface rupture. Aerial photographs of the rupture at 1:10,000 scale were taken two days later, after military operations ended. During fieldwork, geologists measured offsets at more than 300 locations along the entire fault rupture. All of this work was a collaboration of the USGS, the Southern California Earthquake Center (SCEC), and the California Division of Mines and Geology (CDMG) (USGS, SCEC, and CDMG, 2000).

Besides the documentation of the surface rupture days after the earthquake, further work was done to study the fault in more detail. In April 2000, trenches were dug at three locations on the surface rupture in Lavic Lake playa, for the purpose of paleoseismic studies (Rymer et al., 2002). Photogrammetric surveys were also taken by Michael Rymer near stepovers on the surface rupture, and some precise mapping data were collected with a total station.

BACKGROUND AND PURPOSE

The Landers and Hector Mine earthquake sequences provide opportunities to gain a greater understanding of the fault histories and recurrence intervals of major earthquakes within the ECSZ. Moreover, geomorphic features of the rupture in western Lavic Lake playa are amenable to the use of field techniques that complement traditional paleoseismic studies.

This study concentrates solely on the western edge of Lavic Lake, where the Lavic Lake fault ruptured directly through isolated outcrops of basalt, the hand, and the frisbee (Fig. 15). The presence of basalt along the fault rupture may indicate that the hand and the frisbee are somehow fault-related. Moreover, USGS scientists identified “ancient, subdued fault scarps along the 1999 [Lavic Lake fault] rupture zone,” implying that the fault zone may have an extensive rupture history (M. Rymer, personal communication).

Below are three groups of questions addressed by this study and a general description of the techniques used for each.

A. The basalt-sediment contact

1. *What is the depth of the basalt beneath Lavic Lake playa, specifically west and directly east of the hand?*
2. *What is the geometry of the basalt-sediment contact in the subsurface?*
3. *Are the hand and the main Sunshine Crater flows connected in the subsurface?*
4. *Which features in the Sunshine Peak flow and the hand are geomorphic (i.e. features consistent with a typical lava flow) and which are fault-related?*

Figure 15. Portion of 1:10,000-scale aerial photograph of study area in Lavić Lake, showing trace of the 1999 rupture. The isolated basalt feature located to the northeast is termed the "hand." The "frisbee" is not shown; it is about 1 km to the northwest.

B. The relationship between the 1999 Hector Mine rupture and the surface morphology

5. *Can the surface patterns of the Hector Mine earthquake be spatially correlated with the basalt's geomorphic features?*
6. *Can the patterns of the surface rupture in the hand and frisbee be used to explain why the two isolated features seem disconnected from the main flow?*

C. Kinematic models of the current morphology of the hand and frisbee

7. *Do patterns indicate or refute a kinematic model in which the hand and frisbee were separated from the Sunshine Peak flow by previous faulting?*

Seismic refraction and magnetometer surveys helped address the group A questions. Since only a few unique geologic units are present in the field area, all with differing seismic velocities, seismic refraction can be used to successfully distinguish between basalt, semi-consolidated alluvial material, and near-surface clay, silt, and unconsolidated sand layers. Subsurface structure can be interpreted from such seismic refraction data. Detailed magnetometer surveys can be used to infer depths to mafic basalt bedrock, or possibly to speculate on the shapes or subsurface orientations of this bedrock. Because basalt is the only highly magnetic rock in the field area, a magnetic study may successfully distinguish between basalt and the other units present. Detailed field observations were also used to address question A4.

Groups B and C were addressed most effectively with Differential GPS, which displays spatial data with high accuracy. Geomorphic features can be studied in extraordinary detail on a very fine scale. The GIS can be used to make correlations

between spatially related features, shedding light on how the Hector Mine rupture and geomorphic features of the basalt flow may be related. Interpolation of the spatial data is necessary to develop a model for how the hand and frisbee may have been affected by previous faulting.

FIELD METHODS

Magnetometer Surveys

Measurements of the magnetic field were taken in the western part of Lavic Lake playa to ascertain the remanent magnetization of basalt structures, the underlying playa sediment, and subsurface basalt (Fig. 16). Measurements were made with a Geometrics portable magnetometer. First and second measurements were taken at a single position. The second measurement was recorded if it differed from the first by less than approximately 0.5 nanotesla (nT). If the difference was greater than about 0.5 nT, the measurement was taken a third time, and the third measurement was recorded. If this measurement differed significantly from the others, either no measurement was recorded or the measurement process was started again.

Linear magnetic surveys of the playa were conducted to provide geographic coverage of the study area. The spacing of the magnetometer readings ranged from 10 to 50 feet. If the instrument was unable to yield a readable magnetic field at a particular location, points were chosen 10 feet away in all four compass directions until the field could be measured. Magnetometer lines discussed in this report include lines 1-5, 23-26, 29, 30, and 34 (Fig. 16). In addition to the linear surveys, random points on the playa were also surveyed in order to cover "gaps" that could not be reached by standard linear surveys.

Seismic Refraction Surveys

Seismic refraction data were collected along linear survey lines of varying lengths and geophone spacing (Fig. 17). Data were collected with a Bison Geopro Model 8012A

Figure 16. Locations of all magnetometer lines along which data were collected. This figure was generated by spatial data files imported into ArcView 3.2a.

Figure 17. Locations of all seismic refraction lines along which data were collected. This figure was generated by spatial data files imported into ArcView 3.2a. Black triangles indicate the points where the strike plate was hit – connecting those points gives a rough orientation of a seismic line.

seismic refraction instrument with a cable of 12 geophones (maximum 30-foot spacing) (Figs. 18, 19).

Seismic energy was generated by hitting a strike plate on the ground with a 10-lb. sledgehammer. This sledgehammer was fitted with a trigger, which signaled the refraction instrument to record waves generated by the impact. The strike plate was initially placed at geophone 1 (or 10 feet behind geophone 1) and a “shot” was produced at that point. To test for a dipping layer in the subsurface, the line was reversed by placing the strike plate at the opposite end of the line at geophone 12 (or 10 feet behind geophone 12). Depending on the chosen spacing of the geophones, the reversed shot was either 330 ft. or 110 ft. from the original shot at geophone 1. Arrivals of the direct and refracted waves to the seismograph were chosen off the instrument display, and their times (in milliseconds) were recorded.

DGPS/GIS Mapping

Spatial data in Lavic Lake were collected using a Trimble ProXRS Differential GPS (DGPS) unit. All spatial data collected were differentially corrected to ensure the greatest possible accuracy, typically under $\pm$ one meter.

Using the DGPS unit, a geologic map of the field area was generated to accurately determine the two-dimensional and three-dimensional shape of the hand, the frisbee, and associated surficial geologic units (Fig. 20). The fault rupture caused by the Hector Mine earthquake within the hand and the frisbee was also mapped, along with the locations of every magnetic field measurement, shot point, and other points of interest in the field area. Ample latitude, longitude, and elevation (“x-y-z not in feature”) points were

Figures 18 and 19. Photographs of field apparatus for seismic refraction data collection. These seismic lines extend across the Hector Mine rupture, near the north end of the finger. Truck and field assistant for scale.

Figure 20. Map of the field area showing the rough spatial relations of the hand, the frisbee, the Hector Mine rupture, and associated units. This figure was generated by spatial data files imported into ArcView 3.2a.

collected by walking random paths around the field area. These data were exported into ArcView version 3.2a for spatial analysis, and are best viewed and manipulated with ArcView GIS software.

EXPERIMENTAL METHODS

Magnetic Data

Because each magnetometer reading taken at Lavic Lake playa represents the total induced magnetic field at a specified point, each must be corrected to account for variations in the field due to position (latitude and longitude), elevation, diurnal variations, solar storms, magnetic storms, and the regional trend in the magnetic anomaly.

To correct for position on Earth's surface, or the magnetic field produced by Earth's core, the predicted magnetic field was calculated using the International Geomagnetic Reference Field (IGRF). The field was recently updated for the year 2000, and is termed the IGRF2000 model. The IGRF is produced by geomagnetic field modelers with the International Association of Geomagnetism and Aeronomy (IAGA) Division V, Working Group 8, who merge various geomagnetic field representations used to calculate the Earth's main magnetic field and its secular variation into one universal model. The resulting IGRF2000 formula relates the magnetic field to the dependent variables elevation (radius from Earth's center), latitude, and longitude, up to two decimal places. The formula itself defines a set of Gauss coefficients, g_n and h_n , contained in a geomagnetic potential function in a series expansion truncated at $N=10$ (120 coefficients) (IAGA, 2000). The equation is as follows:

$$V = a \sum_{n=1}^N \sum_{m=0}^n \left(\frac{a}{r} \right)^{n+1} \left(g_n^m \cos m\phi + h_n^m \sin m\phi \right) P_n^m(\cos\theta) \quad (1)$$

where g_n and h_n are the Gauss coefficients, a is the mean radius of Earth (6371.4 km), r is the distance from the center of Earth (elevation in km), ϕ is the decimal longitude east of

the prime meridian, θ is the decimal colatitude (90° minus the latitude), V is the magnetic field (given in its three vector components and their sum), and $P_n(\cos \phi)$ are Schmidt quasi-normalized associated Legendre functions of degree n and order m ($n \geq 1$ and $m \leq n$) (IAGA, 2000). Output was determined through the use of a designed program, “IGRF2000,” which utilizes the IGRF model equation. The output of the calculation also has a maximum of two decimal places.

To correct for diurnal variation of the magnetic field, the same IGRF2000 model was used, but the elevation, latitude, and longitude variables were kept constant by choosing arbitrary coordinates within Lavic Lake playa (34.66 N, 116.36 W, 0.50 km in elevation). The variation of the magnetic field at these coordinates was plotted in terms of time, in calendar years, from July 7, 2000 to January 5, 2001, bounding the times of data collection (Fig. 21). This correction is meant to account for known solar activity, solar storms, magnetic storms, and any other variations in the magnetic field predicted by the IGRF2000 model. A linear fit to the graph defines a simple relationship between the magnetic field and time:

$$F_t = -69.345t + 187,869 \quad (2)$$

where t is time in decimal years and F_t is the magnetic field in nT. Note that this is a negative correlation.

Figure 21. Plot of diurnal variation in the magnetic field at 34.66 N, 116.36 W (0.50 km in elevation) according to the IGRF2000 model. A linear fit to the data with its corresponding equation is indicated.

The relative change in magnetic field from the first measurement (49142.3865 nT) was calculated using the following equation:

$$\Delta F = 49142.3865 - F_t \quad (3)$$

where ΔF is the relative change in the magnetic field.

To correct for the regional trend, I measured the magnetic anomaly on an aeromagnetic map of San Bernardino County (Fig. 22) over a distance of 6.5 km across Lavic Lake playa. The chosen distance displayed a relatively constant change in the magnetic anomaly, and the regional trend is reported as 65.8944 nT/mi, dubbed the constant R_{con} (Department of Conservation, Mines, and Geology, 1988).

Figure 22. Portion of 1:250,000 scale aeromagnetic anomaly map of San Bernardino County. The regional trend in the magnetic anomaly was measured along the indicated line, trending northeast across Lavic Lake. Map modified from Department of Conservation, Mines, and Geology (1988).

In the last step of this process, the residual magnetic anomaly was calculated in order to subtract all of the above effects in the magnetic field at any given point. This was found by the following equation:

$$F_a = F - \Delta F - V - R_{con} \quad (4)$$

where F_a is the residual magnetic anomaly, and F is the original reading taken from the magnetometer.

All calculated magnetic anomalies were imported into their respective survey locations using ArcView 3.2a software. The resulting data set was used to produce a contour map of the magnetic anomalies in the field area.

Seismic Refraction Data

Seismic refraction data were plotted on a graph of distance versus time, with the x-axis displaying distance of the geophone from the source of the shot, and the y-axis displaying the arrival time of the direct or refracted wave, in milliseconds. To maintain clarity, forward and reverse shots were not superimposed. On such a graph, a crossover distance (if any) was identified simply as an inflection point between two different slopes in the graph. If no crossover distance was found, the arrival time farthest from the shot was considered the crossover distance, and the following equation was used to calculate a minimum depth to basalt bedrock:

$$z = \left(\frac{1}{2} \right) \frac{V_1 V_2 \left(T - \frac{x_c}{V_2} \right)}{\left[(V_2)^2 - (V_1)^2 \right]^{0.5}} \quad (5)$$

where z is the minimum depth to basalt bedrock (in m), V_1 is the seismic velocity of the overlying material (in m/s), V_2 is the velocity of basalt bedrock (3.87 km/s, or 3870 m/s) (assumed constant if no crossover was found), x_c is the crossover distance from the shot (in m), and T (in units of seconds) is the y-intercept of the linear fit of the graph showing the greatest seismic velocity. Seismic velocities of the graph segments were determined by computing the reciprocal of the respective slope, and are reported in units of ft/ms, ft/s, and km/s. The value 3.87 km/s chosen for basalt bedrock is the average weighted velocity of seismic waves calculated from all instances where basalt bedrock was encountered during the surveys.

Shots yielded results of variable quality, probably due to variable field conditions (e.g., variations in thickness of lake sediment) and equipment problems (e.g., electrical malfunctions in some geophones). In some shots, scatter of the data made it difficult to estimate accurate seismic velocities. In other instances, geophones farther from the shot yielded times that were earlier than a geophone closer to the shot. Due to these inconsistencies, shots were given a qualitative grade in order to describe the overall quality of the shot data and the ability of the shot data to yield accurate results.

A: The data from the shot show minimal scatter with all points on or very close to a best-fit line.

B: The data show some scatter with some points not on or very close to a best-fit line.

C: The data show significant scatter from a best-fit line. Best-fit lines applied to these data are assumed to be only somewhat accurate, although usable.

D: The data show obvious, pronounced scattering, with poor correspondence to a best-fit line. Only a few data points in the shot can be used.

F: The data are so scattered that best-fit lines are inapplicable. Results appear to contradict physical laws, and are not usable.

This grading system was employed to calculate the weighted-average seismic velocity of basalt bedrock in the field area (3.87 km/s). In A shots, the velocity found was used three times. In B shots, the velocity found was used two times. In C shots, the velocity found was used one time. D and F shots were not considered in the calculation due to their low confidence.

DGPS/GIS Data

Differential Corrections

Corrections used files from a GPS base station operated by the United States Forest Service, Sequoia National Forest, Porterville, California, located about 400 km northwest of Lavic Lake. This was the nearest GPS base station available. Trimble Pathfinder Office version 2.51 software was used to perform the differential correction.

ArcView 3.2a Data Manipulation

All spatial data files collected in the field were exported into ArcView 3.2a to

shapefile format, the standard vector-based spatial data format used by ArcView GIS. The exporting process successfully transferred most data points with the respective date (standard format mm/dd/yy), time (Pacific Standard or Daylight time), latitude and longitude (in decimal degrees), and elevation (in meters) at which they were taken. The data points (approximately 20,000 total) were combined into one large two-dimensional shapefile (planar map view) and one large three-dimensional shapefile for display as a digital elevation model (DEM). Elevation points that did not match field observations were removed from the DEM.

Separate shapefiles contained data points associated with either geologic contacts, the Hector Mine rupture, specific magnetic or seismic surveys, or other observed features. The resulting two-dimensional shapefiles were used to create maps of the area (Figs. 16, 17, 20). A new field was created in the magnetic survey shapefiles for the magnetic anomaly of each data point. The resulting data set was then contoured to display relatively high and low values of the magnetic anomaly on mapped features on the playa (Fig. 23).

Figure 23. Magnetic anomaly contour map of the field area. The base contour is -1200 nT, and the contour interval is 100 nT. This figure was generated by rover files imported into ArcView 3.2a.

RESULTS

Magnetic Anomalies and Modeling

The calculated residual magnetic anomalies give a good representation of the magnetic character of the field area. The entire data set is presented in Table A1 of the appendix, and summaries of important points are presented below.

Magnetic Anomaly Contour Mapping

The contour map generated by the calculated magnetic anomalies is shown in Figure 23. In general, low magnetic anomalies exist predominantly in areas underlain by clay and sand, including (1) the area between the hand and the Lava Bed Mountains, (2) the northeast side of the “finger” (the northern elongate section of the hand), (3) at the very tip of the finger, and (4) west of the finger tip. High magnetic anomalies are found on the south side of the hand, where basalt is exposed, and southwest of the hand.

Trends in the Linear Magnetic Profiles Across the Hand

Magnetic anomalies calculated from data along the 12 linear survey lines are plotted on graphs showing horizontal distance versus the magnetic anomaly (in nT). Magnetometer line 1 runs along the southern base of the hand, crossing the Hector Mine rupture (Fig. 16). From 0 ft., at the edge of the Lava Bed Mountains, to 300 ft., the magnetic anomaly remains relatively low, never exceeding -475 nT (Fig. 24). At 500 ft., the magnetic anomaly increases to almost 15 nT, and then steadily decreases to about -580 nT near 750 ft. The local minimum from 700 ft. to 900 ft. coincides with the proximity of a large basalt “island” at the southwest edge of the hand. A large spike

Figure 24. Magnetic anomaly plot of magnetometer line 1.

in the magnetic anomaly at 1000 ft. reaches 385 nT, but over the next 100 ft. values drop to -600 nT. From 1310 to 1650 ft. the magnetic anomaly increases dramatically to reach dominantly positive values, with a maximum of 622 nT. These positive values coincide with the position of the basalt rocks found on the southwest corner of the hand. For the remainder of the line, clearing the southern base of the hand, the anomaly remains relatively low except for a small increase to 114 nT at 2100 ft. The line crosses the Hector Mine rupture from 1900 ft. to 2100 ft., approximately coinciding with a local minimum.

Magnetometer line 3 parallels the trend of line 1, surveying the playa sediment to the northeast and southwest of the hand (Fig. 16). The entire line displays predominantly negative magnetic anomalies, except near 650 ft., where the anomaly reaches as high as 425 nT (Fig. 25). The highest value of 425 nT is found directly in the center of the mapped Hector Mine rupture. The positive value of approximately 125 nT at 50 ft. coincides with a section of basalt bedrock at the base of the Lava Bed Mountains. Negative anomalies from 1000 ft. to 1250 ft. coincide with small mapped cracks in the playa sediment believed to be a result of the 1999 surface rupture.

Magnetometer line 4 began in playa sediment on the west side of the hand and crossed the bottom section of the finger (Fig. 16). A marked increase in the magnetic anomaly from 150 ft. to 300 ft. coincides with basalt bedrock at the base of the Lava Bed Mountains (Fig. 26). One positive magnetic anomaly (305 nT) at 1350 ft. coincides with basalt that composes the finger. Local minima on either side of this maximum mark the position where the survey crosses the Hector Mine rupture and "overthrust" playa

Figure 25. Magnetic anomaly plot of magnetometer line 3.

Figure 26. Magnetic anomaly plot of magnetometer line 4.

deposits (clay).

On magnetometer line 29, which extends 3000 ft. from the base of the Lava Bed Mountains eastward across the hand (Fig. 16), the magnetic anomalies remain negative throughout the playa sediment on the west side of the hand (Fig. 27). Erratic positive and negative values are evident east of 1950 ft., where the line begins to cross the basalt that composes the main part of the hand. However, the magnetic anomaly reaches a maximum value of only 350 nT at 2350 ft. Negative values from 2100 ft. to 2300 ft. were obtained where the survey line crosses the Hector Mine rupture.

Trends in the Linear Magnetic Profiles in Playa Sediment

Magnetometer line 5, which runs perpendicular to lines 1-4, extends entirely within playa sediment on the west side of the hand (Fig. 16). The anomalies shown in the plot are all negative except for one positive value of 16.4 nT at 100 ft. (Fig. 28). This reading was taken approximately between the basalt body at the base of the Lava Bed Mountains and the tip of the finger. Magnetometer line 30, a continuation of line 5 that crosses the south end of the hand (Fig. 16), also has predominantly negative anomalies, with two positive values that do not exceed 25 nT (Fig. 29).

In contrast, Line 34, on the east side of the hand, displays some markedly positive magnetic anomalies. At 250 ft., the magnetic anomaly reaches 191 nT, decreases sharply in 50 ft., and then increases again to 269 nT at 350 ft. (Fig. 30). The highest positive anomaly is found at 700 ft., with a value of 652 nT. No mapped features on the playa coincide with the position of these local maxima.

Figure 27. Magnetic anomaly plot of magnetometer line 29.

Figure 28. Magnetic anomaly plot of magnetometer line 5.

Figure 29. Magnetic anomaly plot of magnetometer line 30.

Figure 30. Magnetic anomaly plot of magnetometer line 34.

Trends in the Linear Magnetic Profiles Across the Hector Mine Rupture

As discussed in a previous section, magnetometer lines 1, 3, and 4 all cross the Hector Mine rupture. On lines 1 and 4, the rupture is coincident with marked negative anomalies (Figs. 24, 26). However, on line 3, high magnetic anomalies are found at the position of the rupture, while negative anomalies coincide with small mapped cracks believed to be the result of the earthquake (Fig. 25).

Magnetometer line 23 (Fig. 16) crosses the Hector Mine rupture from 240 ft. to 360 ft., although the rupture was not mapped by GPS in this area. The projected location of the rupture on line 23 is marked by a obvious decrease in the magnetic anomaly (Fig. 31). Positive values near the east end of the line do not coincide with any mapped features besides playa sediment.

Magnetometer line 24 (Fig. 16) crosses the Hector Mine rupture from 300 ft. to 500 ft., although the rupture was not mapped in this area. Magnetometer line 25 (Fig. 16) also crossed the rupture at 300 ft. to 500 ft., where the rupture makes a major left step. This left step is the location of two trenches excavated by the USGS in April 2000 (M. Rymer, personal communication). The projected location of the rupture on line 24 is marked by a maximum bounded by two minima in the magnetic anomaly (Fig. 32). Line 25 likewise shows a local maximum with bounding minima where it crosses the rupture (Fig. 33). Line 25 is about 100 m northwest of line 24 (Fig. 16).

Magnetometer line 26 (Fig. 16) crosses another major left-stepping fault jog in the Hector Mine rupture from 400 ft. to 550 ft., although the rupture was not mapped in this area. From the western end of the line, the magnetic anomaly steadily increases to almost

Figure 31. Magnetic anomaly plot of magnetometer line 23.

Figure 32. Magnetic anomaly plot of magnetometer line 24.

Figure 33. Magnetic anomaly plot of magnetometer line 25.

150 nT, and then shows a sharp decrease where the fault jog is encountered (Fig. 34). The magnetic anomaly remains negative along the eastern half of the survey line.

On magnetometer line 29, as discussed in the previous section, negative values from 2100 ft. to 2300 ft. are found where the survey crossed the Hector Mine rupture (Fig. 27). These local minima in the magnetic anomaly are bounded by relatively positive maxima.

Trends in Other Linear Magnetic Profiles

Magnetometer line 2, colinear with line 1, lies wholly within the Lava Bed Mountains. This line placement was chosen to evaluate magnetic anomalies in areas of known basalt bedrock. As seen from Figure 35, the magnetic anomaly can be highly irregular even on basalt bedrock. Values of the anomaly range from -530 nT to almost 260 nT.

Seismic Refraction

Seismic Lines West of the Hand

Seismic lines 1, 2, 6, 12, 16-20, 27, and 28 transect the playa sediment between the hand and the Lava Bed Mountains (Fig. 17). Data collected from those lines address the subsurface structure and depth of the basalt in that region. All data collected from shots and calculations are tabulated in Appendix 2.

Line 1, southwest of the hand, yielded refraction data with no crossovers, indicating that basalt was not encountered within the penetration depth of the survey. The data are summarized in Table 1, and individual shots are presented in Tables A2-A9.

Figure 34. Magnetic anomaly plot of magnetometer line 26.

Figure 35. Magnetic anomaly plot of magnetometer line 2.

Because no crossovers were seen, sections of the graph with the highest seismic velocities were chosen for the subsequent velocity and minimum depth calculations. Thus, V_1 are maxima. These data show that basalt bedrock could lie anywhere from 17 m to almost 80 m below the playa sediment in this region of the field area.

TABLE 1. SEISMIC LINE 1, SHOTS 1-8

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.70	3.87	no		44.54	B
2	1.65	3.87	no		55.35	B
3	1.91	3.87	no		47.35	B
4	1.69	3.87	no		55.50	B
5	0.53	3.87	no		19.94	C
6	2.12	3.87	no		78.11	C
7	0.67	3.87	no		17.45	C
8	1.25	3.87	no		47.15	B

Line 2, on the edge of the Lava Bed Mountains near the northern tip of the hand, did show a crossover, but only on the first (forward) shot (Table 2, Tables A10-A13). The reverse shot (shot 2, Table A11) did not yield reliable data to determine a reciprocal time. No other crossovers were seen with subsequent shots.

Line 6, which crosses the 1999 Hector Mine rupture near the west end of the finger, also shows no crossovers (Table 3, Tables A14-A15). Only minimum depths to bedrock could be calculated.

TABLE 2. SEISMIC LINE 2, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.39	4.23	yes	3.97		A
2	0.74	3.87	no		32.81	C
3	0.88	3.87	no		14.73	A
4	0.61	3.87	no		36.62	A

TABLE 3. SEISMIC LINE 6, SHOTS 1 AND 2

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.34	3.87	no		13.60	A
2	0.41	3.87	no		14.87	A

Lines 12, 17, and 18 extend eastward from the finger into playa sediment between the hand and the Lava Bed Mountains (Fig. 17). The data from these lines are summarized in Tables 4-6, and individual shots are presented in Tables A35-A62, A79-A82, and A83-A100. Some crossovers into basalt bedrock were identified, but basalt bedrock could not be found with most shots.

TABLE 4. SEISMIC LINE 12, SHOTS 1-29

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.27	3.87	no		40.83	A
2	0.56	3.87	no		14.79	A
3	0.84	3.87	no		18.54	A
4	0.84	3.87	no		23.50	B
5	1.24	3.87	no		29.75	A
6	3.05	3.87	no		170.11	B
7	0.35	3.96	yes	8.18		A
8	1.24	3.87	no		27.47	B
9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
10	1.25	3.87	no		28.37	B
11	1.16	3.87	no		24.10	A
12	1.62	3.87	no		34.91	B
13	0.40	4.44	yes	6.92		B
14	1.79	3.87	no		28.21	B
15	1.35	3.87	no		25.98	B
16	0.72	3.87	no		16.14	B
17	2.15	3.87	no		37.69	A
18	2.67	3.87	no		51.37	A
19	1.86	3.87	no		30.48	B
20	0.33	3.61	yes	5.34		B
21	2.64	3.87	no		52.41	A
22	0.98	3.87	no		19.55	A
23	0.86	3.87	no		15.73	A
24	2.44	3.87	no		36.22	C
25	1.46	3.87	no		22.05	A
26	1.66	3.87	no		28.66	A
27	1.31	3.87	no		27.90	B
28	1.43	3.87	no		20.52	B
29	1.75	3.87	no		29.74	A

n.a.=not available, shot was never run.

TABLE 5. SEISMIC LINE 17, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.78	3.87	no		14.34	B
2	2.31	3.87	no		67.25	B
3	0.39	3.87	no		14.44	A
4	0.36	3.87	no		15.66	A

TABLE 6. SEISMIC LINE 18, SHOTS 1-18

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.53	3.87	no		14.92	B
2	1.43	3.87	no		40.48	B
3	0.53	3.87	no		13.93	C
4	0.42	3.87	no		13.39	A
5	0.43	3.87	no		29.91	A
6	1.09	3.87	no		89.18	A
7	0.65	3.87	no		46.40	B
8	1.17	3.87	no		23.08	B
9	1.83	3.87	no		43.23	A
10	1.03	3.87	no		19.95	A
11	1.09	3.87	no		26.03	A
12	1.16	3.87	no		23.55	A
13	0.95	3.87	no		17.83	A
14	1.26	3.87	no		19.84	C
15	3.05	3.87	no		80.80	B
16	0.80	3.87	no		12.33	C
17	2.37	3.87	no		43.80	C
18	0.74	3.87	no		14.96	A

Lines 16, 19, 20, and 27 all trend eastward from the base of the Lava Bed Mountains towards the hand (Fig. 17, Tables 7-10, A75-78, A101, A102-A111, A126-A143). These data indicate that subsurface basalt is at best 15-30 m deep in most areas, up to a maximum depth of almost 57 m.

TABLE 7. SEISMIC LINE 16, SHOTS 1-4

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.80	3.87	no		18.64	A
2	0.64	3.87	no		22.18	B
3	0.41	3.87	no		10.44	A
4	0.50	3.87	no		18.87	A

TABLE 8. SEISMIC LINE 19, SHOT 1

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.91	3.87	no		33.55	D

TABLE 9. SEISMIC LINE 20, SHOTS 1-10

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.34	3.87	no		17.73	A
2	1.39	3.87	no		25.19	B
3	0.98	3.87	no		14.69	B
4	0.90	3.87	no		17.39	D
5	0.97	3.87	no		20.59	B
6	1.54	3.87	no		38.08	A
7	1.92	3.87	no		44.67	A
8	1.03	3.87	no		21.12	A
9	0.68	3.87	no		20.85	A
10	1.80	3.87	no		40.22	B

TABLE 10. SEISMIC LINE 27, SHOTS 1-18

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.42	3.87	no		20.96	B
2	1.87	3.87	no		21.79	B
3	2.18	3.87	no		26.78	D
4	1.67	3.87	no		21.09	A
5	1.81	3.87	no		27.81	B
6	1.95	3.87	no		34.27	B
7	0.96	3.87	no		18.97	A
8	2.11	3.87	no		56.92	B
9	1.26	3.87	no		31.85	C
10	0.81	3.87	no		20.20	B
11	0.83	3.87	no		16.24	A
12	0.91	3.87	no		23.06	C
13	1.62	3.87	no		36.69	C
14	1.03	3.87	no		25.86	C
15	1.03	3.87	no		18.32	A
16	1.81	3.87	no		33.60	B
17	1.00	3.87	no		17.55	B
18	0.75	3.87	no		16.10	B

Line 28 extends from the base of the Lava Bed Mountains all the way to the western edge of the hand (Fig. 17). These data are displayed in Table 11 and Tables A144-A173. Again, no crossovers were seen, so minimum depths to bedrock are shown.

TABLE 11. SEISMIC LINE 28, SHOTS 1-30

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.34	3.87	no		23.75	A
2	2.82	3.87	no		91.46	B
3	0.34	3.87	no		13.92	A
4	0.34	3.87	no		16.32	A
5	0.34	3.87	no		15.41	A
6	0.34	3.87	no		16.46	A
7	0.34	3.87	no		15.26	A
8	0.35	3.87	no		17.26	A
9	0.40	3.87	no		9.41	A
10	0.35	3.87	no		17.27	A
11	0.73	3.87	no		23.54	A
12	0.69	3.87	no		18.61	B
13	1.42	3.87	no		28.07	B
14	1.41	3.87	no		31.84	A
15	1.62	3.87	no		35.24	B
16	0.87	3.87	no		24.47	B
17	1.81	3.87	no		36.82	B
18	0.94	3.87	no		23.34	B
19	1.17	3.87	no		28.23	C
20	0.47	3.87	no		17.47	A
21	1.93	3.87	no		50.41	C
22	1.98	3.87	no		50.95	A
23	1.95	3.87	no		49.89	A
24	1.07	3.87	no		24.29	A
25	0.69	3.87	no		20.37	A
26	1.50	3.87	no		34.18	A
27	1.31	3.87	no		30.51	B
28	0.87	3.87	no		24.76	B
29	2.72	3.87	no		71.74	A
30	1.22	3.87	no		25.41	A

Seismic Lines East of the Hand

Seismic lines 7-11, 13-15, and 21 trend eastward into the playa from the eastern edge of basalt bedrock in the hand (Fig. 17). Data from Lines 7-11 and 13 are shown in Tables 12-17, A16-A34, and A63-A66. A crossover was detected with one shot on line 12, showing the basalt-sediment contact to be 33.76 m deep below that point. On seismic line 14, basalt bedrock was detected at a depth of 11.91 m (Tables 18, A67-A70). However, on Lines 15 and 21, no bedrock-basalt was detected (Tables 19-20, A71-A74, A112-A121).

TABLE 12. SEISMIC LINE 7, SHOTS 1-9

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.40	3.87	no		24.44	A
2	1.58	3.87	no		84.49	B
3	2.51	3.87	no		99.86	C
4	1.13	3.87	no		39.96	B
5	1.34	3.87	no		102.43	B
6	1.58	3.87	no		40.06	B
7	0.52	3.27	yes	33.76		B
8	0.93	3.87	no		47.51	B
9	1.69	3.87	no		45.23	D

TABLE 13. SEISMIC LINE 8, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.38	3.87	no		13.63	A
2	0.41	3.87	no		15.82	C
3	1.49	3.87	no		27.68	B
4	0.72	3.87	no		14.37	C

TABLE 14. SEISMIC LINE 9, SHOTS 1-2

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.49	3.87	no		14.07	B
2	0.78	3.87	no		23.75	A

TABLE 15. SEISMIC LINE 10, SHOTS 1-2

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.41	3.87	no		13.30	A
2	0.41	3.87	no		14.89	B

TABLE 16. SEISMIC LINE 11, SHOTS 1-2

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	2.54	3.87	no		34.14	D
2	0.58	3.87	no		14.28	B

TABLE 17. SEISMIC LINE 13, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.20	3.87	no		18.82	A
2	2.14	3.87	no		40.42	B
3	2.11	3.87	no		32.23	A
4	1.44	3.87	no		21.72	B

TABLE 18. SEISMIC LINE 14, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.03	3.87	no		11.10	C
2	1.09	3.81	yes	11.91		C
3	1.10	3.87	no		15.53	B
4	2.01	3.87	no		30.12	B

TABLE 19. SEISMIC LINE 15, SHOTS 1-4

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.99	3.87	no		19.73	A
2	0.68	3.87	no		17.10	B
3	0.75	3.87	no		13.67	C
4	0.70	3.87	no		15.86	B

TABLE 20. SEISMIC LINE 21, SHOTS 1-10

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.61	3.87	no		13.80	B
2	0.34	3.87	no		16.89	A
3	0.40	3.87	no		9.65	A
4	0.34	3.87	no		16.78	A
5	0.34	3.87	no		15.25	A
6	0.33	3.87	no		16.57	A
7	0.33	3.87	no		15.29	A
8	0.34	3.87	no		16.24	A
9	0.36	3.87	no		13.64	A
10	0.36	3.87	no		16.50	A

Seismic Lines South of the Hand

Seismic lines 31-33 transect various areas south of the hand (Fig. 17). Basalt was encountered in the subsurface only at one location on line 32 at a depth of 4.81 m (Tables 21-23, A179-A184).

TABLE 21. SEISMIC LINE 31, SHOTS 1-5

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	1.06	3.87	no		18.73	B
2	0.78	3.87	no		17.31	A
3	0.95	3.87	no		20.58	A
4	0.46	3.87	no		13.97	A
5	0.34	3.87	no		15.18	A

TABLE 22. SEISMIC LINE 32, SHOTS 1-6

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.63	3.81	yes	4.81		C
2	1.58	3.87	no		22.16	A
3	2.21	3.87	no		33.74	A
4	1.34	3.87	no		23.40	A
5	0.66	3.87	no		9.15	A
6	0.35	3.87	no		8.62	D

TABLE 23. SEISMIC LINE 33, SHOTS 1-8

Shot	V ₁ (km/s)	V ₂ (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	2.51	3.87	no		36.20	A
2	2.04	3.87	no		33.08	B
3	1.37	3.87	no		25.14	B
4	2.31	3.87	no		58.05	A
5	2.27	3.87	no		68.46	B
6	0.80	3.87	no		31.03	A
7	0.33	3.87	no		15.11	A
8	0.33	3.87	no		16.67	A

Seismic Lines Across the Hector Mine Rupture

Seismic line 22 was run across the Hector Mine rupture where no subsurface basalt was detected (Fig. 17). No crossovers were identified (Tables 24, A122-A125).

TABLE 24. SEISMIC LINE 22, SHOTS 1-4

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.33	3.87	no		15.07	A
2	1.91	3.87	no		66.47	A
3	0.34	3.87	no		15.19	A
4	0.34	3.87	no		16.73	A

Seismic Lines Across a Major Steptover in the Rupture

Seismic line 35 was run across a major stepover in the Hector Mine rupture, where the Lavic Lake fault makes a prominent surface step to the left (Fig. 17). This is the same fault jog where paleoseismic trenches were dug by Rymer and others, and where magnetometer line 25 crosses the fault rupture. Subsurface basalt was detected on one shot, at a depth of 13.18 m (Tables 25, A193-A195).

TABLE 25. SEISMIC LINE 35, SHOTS 1-3

Shot	V_1 (km/s)	V_2 (km/s)	Crossover?	If Yes, Depth to Basalt Refractor (m)	If No, Minimum Depth to Refractor (m)	Grade of Shot
1	0.37	3.52	yes	13.18		B
2	3.27	3.87	no		317.56	C
3	2.54	3.87	no		167.03	C

DGPS/GIS Data

Using ArcView 3.2a, a geologic map was generated of the field area (Fig. 20). The 3D DEM generated of the field area is shown in a three-dimensional view in Figure 36. A 3D DEM was also generated that shows minimum and calculated depths to basalt bedrock beneath the field area (Fig. 37). The reader is invited to view these figures on the included disk for increased resolution.

Figure 36. Three-dimensional DEM of the field area, showing the extent of major units. The Hector Mine rupture is shown in red, the edge of thrust sheets are shown in blue, and the basalt-sediment contact is shown as a heavy black line. This figure was generated by rover files imported into ArcView 3.2a.

Figure 37. Contour map of minimum or calculated basalt-sediment contact elevations (in meters) in the field area. The contour interval is 20 m, and the base contour is 400 m. Portions of this figure were generated by rover files imported in ArcView 3.2a.

DISCUSSION

Depth to the Basalt-Sediment Contact in the Subsurface

In most seismic lines west (Tables 1-6, 11), east (Tables 12-20), and south (Tables 21-23) of the hand, basalt could not be detected in the subsurface. The absence or considerable depth of the basalt on these seismic lines supports the interpretation that the hand is isolated from the main lava flow on the Lava Bed Mountains.

Basalt crossovers were found only in eight shots, four of which were located west of the hand (lines 2 and 12), two to the east of the hand (lines 7 and 14), one to the south of the hand (line 32), and one under a major stepover (line 35). The depth of the basalt-sediment contact ranged from a shallow 3.97 m west of the hand to 33.76 m east of the hand.

The contour map showing minimum and calculated basalt-sediment contact elevations in the subsurface (Fig. 37) shows a local minimum (408 m elevation) of the minimum basalt-sediment contact elevation directly west of the base of the finger. Other lows are present near the east of the tip of the finger (476 m elevation) and west of the hand (485 m elevation). These results imply that basalt either is not present or lies at considerable depths in these areas.

The shape of the curves in the various magnetic anomaly graphs from the linear magnetic surveys may offer clues to the depth of basalt bedrock in various areas of the playa (Breiner, 1973). Curves in a variety of broad to tight shapes suggest that the basalt may be found at a variety of depths in the subsurface. For example, on line 1, at 1000 ft. a very tight curve in the graph shows that basalt could be relatively close to the surface

(Fig. 24). On the same graph, a broad curve from 1250 ft. to 1700 ft. could indicate that basalt is found at great depths. However, these relations do not address the shape or orientation of the body affecting the anomalies. Furthermore, although basalt is the only factor discussed here, other buried features could affect the magnetic anomaly, including buried metal, military equipment, void spaces, or other unknown objects.

Geometry of the Basalt-Sediment Contact in the Subsurface

Because basalt bedrock was encountered in some lines but was absent or too deep to detect in others, the basalt-sediment contact could be highly irregular in the subsurface (Tables 1-25). This topography could be very similar to the surface topography of the hand, the frisbee, and the base of the Lava Bed Mountains. The erratic patterns of the magnetic contours in Figure 23 also indicate that the basalt could have an irregular subsurface topography. The DGPS/GIS DEMs and maps produced in this study clearly illustrate the presence of anomalous local highs in the topography of the hand and frisbee. This irregular topography is unlikely to be primary morphology of an undisturbed lava flow, suggesting post-flow disturbances from fault movement, local subsidence, cracking, slumping, or exploding ordnance. It is also important to note that irregular subsurface and surface topography could also be the result of erosion due to pre-playa sedimentation processes, such as lacustrine erosion, repeated burial, or erosion due to possible exposure of the basalt to other processes which have occurred over the last 600,000 years.

Although basalt could not be detected on most of the seismic lines, it may be present at depths greater than the resolution of the instruments used. This may indicate that the hand and frisbee are, in fact, isolated from the main flow of the Sunshine Peak

basalt, separated only by thick deposits of playa sediment. This apparent isolation of the hand and frisbee by playa sediment could be the result of faulting or even a volcanic fissure, which various kinematic models attempt to address in later sections.

The Basalt-Sediment Subsurface Contact in Relation to the Hector Mine Rupture

The seismic line across a linear part of the Hector Mine rupture revealed no basalt in the subsurface within the depth limits of the survey (Table 24). However, basalt bedrock was encountered on a line across the major left-step in the rupture to the north of the hand (Table 25). In line 1, the anomaly remains negative but clearly fluctuates near the rupture, suggesting a magnetic source in the subsurface. In lines 3 and 4, a magnetic source causes a sharp increase in the magnetic anomaly in the center of the rupture area, produced by a magnetic source that could be a buried extension of the finger. The negative anomalies surrounding this sharp increase are probably related to thick playa sediment cut by the fault. In line 23, a sharp decrease in the magnetic anomaly around the rupture indicates an absence of a magnetic body around the subsurface rupture. However, in lines 24-26, another magnetic source sharply increases the magnetic anomaly around the rupture area. Lines 25 and 26 of this group cross a major left step. Thus, whatever caused the increase in the magnetic anomaly may also have caused the rupture to form the left step.

These observations suggest that, where basalt is uncommon or absent in the subsurface, the Hector Mine rupture in Lavic Lake is linear (or dominated by right-lateral en-echelon tension gashes). In other words, the rupture would probably tend to propagate

in a pattern dictated by the properties of the dry clay and sand of the playa. However, where basalt is present in the subsurface, the rupture steps left (or right, although it has not been observed in this study), creating positive (or negative) flower structures, respectively. The presence of restraining bends in the rupture near the hand and frisbee indicates that the basalt may direct propagation of fault rupture. The hand and frisbee may be positive flower structures produced by multiple earthquakes at such restraining bends. This interpretation has other implications that will be discussed later in several kinematic models.

Geomorphic Features of the Sunshine Peak Flow and Lavic Lake Playa

Field observations and previous research indicate that not all features on the hand, frisbee, and Sunshine Peak flow on the Lava Bed Mountains are related to movement on the Lavic Lake fault. Basaltic stone pavement, or desert pavement, is very common on the surface of the hand and frisbee, and in many places on the playa. Wells et al. (1995) presented a soil development model, based on young basalts in the Mojave Desert, to explain how these unusual features form. As the surface of a low-relief basalt flow is exposed to eolian weathering, wind-blown sediment and shrinking and swelling of soil horizons lifts basalt clasts and other material vertically away from bedrock. This process eventually forms an accretionary mantle, or package of wind-blown sediment, between the pavement and the substrate. This package of sediment is generally more poorly sorted than typical playa sediment, which consists of mostly clay-sized particles (Wells et al., 1995). Therefore, the mere presence of basalt in the field area may indicate that some

poorly sorted or denser subsurface layers may also be present, consistent with a typical desert soil-development profile.

Kinematic Models

Various kinematic models may explain the observations presented in this study. Each of these proposed models uses basic physical or geological principles to explain how these complex features could have formed from young volcanic eruptions, fault movement, principal stress directions, and regional tectonics.

The Fissure Flow Model

The basic premise of this model is that the Lavic Lake fault was, and continues to be, a vertical conduit or "path of least resistance" for rising basaltic magma in this section of the Mojave Desert. This implies that in the recent geologic past, perhaps no earlier than the Pleistocene, the Lavic Lake fault zone and the Pisgah fault zone were conduits for fissure flows, following the approximate strike of the two faults. A kinematic model for this process is shown in Figure 38. At time 1, faulting occurs with no surface basalt present. At time 2, basaltic lavas are erupted. At time 3, subsequent faulting alters the subsurface and surface topography.

This model is supported by several lines of evidence:

1. In most areas near the hand, basalt bedrock could not be found within detection limits, indicating it is found at considerable depths or is completely absent. This distribution is more consistent with near-vertical emplacement of basalt in a fissure than eruption of a surficial lava flow with a gentle slope.

Time 1 (>1 mya)

Time 2 (0.8-0.5 mya)

Time 3 (0.5 mya-present)

Figure 38. Times 1, 2, and 3 for the fissure flow model (generalized).

2. The spatial correlation of the Lavic Lake fault and the basalt of the hand suggests that the basalt and the fault may be genetically related. The same is true of the Pisgah fault, which strikes directly through the Lava Bed Mountains.
3. The overall trend of the Pisgah lava flow and the Lava Bed Mountains is roughly northwest, parallel to the strikes of most of the strike-slip faults in this region, including the Pisgah and Lavic Lake faults. Both faults may have controlled where and how the basalt was erupted.

However, this model has inconsistencies that were not resolved by this study.

1. Basalt encountered in the subsurface between the hand and the Lava Bed Mountains shows that not all the basalt in the subsurface is found at considerable depths in this region. These exceptions are difficult to explain as products of fissure flows, because they do not occur along active faults.
2. The methods used in this study cannot identify the nature of subsurface materials beneath the hand and frisbee. If such materials are sedimentary, the hand and the frisbee could be large collections of basalt "exhumed" or isolated from the original lava flow.
3. Available data are insufficient to determine whether the irregular topography in the basalt's surface and near-surface contact is a result of normal lava intrusion or multiple faulting events.
4. The overall northwest trend of the Pisgah lava flow and the Lava Bed Mountains could be coincidental, rather than fault-controlled.

The Multiple Dip-Slip Thrusting Model

This model attributes the hand and the frisbee not to the eruption of a fissure flow,

but to the combined movement of many earthquakes, comparable in size and amount of surface slip with the Hector Mine and Landers earthquakes. Because the basalt has an age of approximately 0.6 Ma (A. Glazner, personal communication, 2000), and the Lavić Lake fault has an unknown, but long recurrence time (M. Rymer, personal communication), many surface-rupturing earthquakes would have to occur in this model. At time 1 (Fig. 39), the lava in the Lava Bed Mountains erupts from the Sunshine and Pisgah craters (the latter not shown in figure). At time 2, large earthquakes produce ruptures that cut solidified lava flows. This surface faulting has components of both strike-slip movement and thrusting on both sides of the hand and frisbee as observed in the Hector Mine surface rupture. Thrusting forms in stepovers, where the hand and frisbee are located. At time 3, between faulting events, playa depositional processes occur to form Lavić Lake playa. Events portrayed at time 2 and time 3 alternate until the present, defining what is now known as the hand and frisbee (Fig. 39).

The evidence to support this model is as follows:

1. Field observations unequivocally support the occurrence of a minor component of thrusting along the flanks of both the hand and the frisbee along the Hector Mine rupture. These observations include the presence of basalt thrust across the fault rupture, thrusts within playa sediment, and compressional ridges. These structures show thrust movement towards the east and west, and are found predominantly around the hand and frisbee.
2. The irregular surface topography between the hand and the Lava Bed Mountains indicates that faulting also may have occurred in that region. Such hypothetical

Figure 39. Times 1, 2, and 3 for the multiple dip-slip thrusting model (generalized).

subsidiary faults may have aided in the upward movement of the hand and the frisbee.

However, the problems with this model make it less likely to explain the local geology.

1. The amount of thrusting produced during the Hector Mine earthquake is too small. Assuming the 1999 rupture is typical, and given the assumed recurrence interval of the Lavic Lake fault and other faults of the ECSZ, thousands of earthquakes would have to occur to produce the amount of separation between the hand and the Lava Bed Mountains.
2. The model assumes that thrust movement occurred in the majority of the past earthquakes. There is no evidence that this is the case.

The Basalt Exhumation Model

This model explains the formation of the hand and the frisbee as the latest in a series of stages involving vertical movement (exhumation) of large basalt blocks from the original lava flows. This model also involves the combined effects of many earthquakes comparable to the size of the Hector Mine or Landers earthquakes since the basalt was erupted. At time 1 (Fig. 40), the lava in the Lava Bed Mountains erupts from the Sunshine and Pisgah craters (the latter not shown in figure). At time 2, eolian processes bury portions of the new lava flow with sand and clay. At time 3, faulting occurs from sizable earthquakes, cutting the solidified lava flows and playa sediment. This faulting has components of both strike-slip movement and thrusting towards the east, as observed in the Hector Mine surface rupture. Buried basalt continues to crack from weathering. At time 4, in areas where the fault produces a left step, large basalt boulders are vertically

Figure 40. Times 1, 2, 3, and 4 for the basalt exhumation model.

Time 3 (0.5-0.2 mya)

Time 4 (0.2 mya-present)

Figure 40 (continued). Times 1, 2, 3, and 4 for the basalt exhumation model.

lifted and rotated. Events portrayed at time 3 and time 4 alternate repeatedly until the present, defining what is now known as the hand and frisbee.

The evidence to support this model is as follows:

1. A minor component of thrusting accompanied the Hector Mine earthquake, best shown in the hand and the frisbee, where the Lavic Lake fault makes a left (restraining) step. Repeated earthquakes with similar slip could lift the basalt found in the hand and frisbee several tens of meters from the original lava flow below.
2. Seismic line 35 positively detected a buried basalt structure under a major stepover in the rupture, north of the hand.

However, some evidence refutes this model:

1. There is no way to determine whether the basalt that makes up the hand and the frisbee is underlain by playa sediments or basalt bedrock. The latter would support a fissure flow model, discussed in the previous section. The former would support this model, showing that the hand and frisbee are indeed large collections of basalt being “exhumed” or isolated from the original lava flow.
2. The model assumes a thrust component in the majority of the past earthquakes, but such slip is indeterminate.

Error Analysis

Magnetic Surveys

The magnetic surveys in this study were subject to several sources of uncertainty or error. Multiple readings of the magnetic field taken at one point on the surface varied by a few nT to a few hundred nT despite the short time (several seconds) elapsed between

readings. The magnetic readings presented here represent the final reading in a series of three taken at one point, rather than an average of all three.

The magnetic data show a bull's eye pattern on the contour map generated by ArcView 3.2a. This pattern is due to aliasing of the magnetic data in map areas that lacked sufficient data. In order to correct this alias, more data should be collected to fill in obvious "gaps."

The IGRF model used in the magnetic field corrections only employs a few variables in the projected calculation of the magnetic field at a particular point on Earth's surface: latitude, longitude, and elevation up to two decimal places. Given the relatively small field area in this study, greater precision in the magnetic field is needed to show more detailed variations in the magnetic field. This precision cannot be given by the IGRF model. This imprecision is also carried into the calculations of diurnal variation.

Seismic Refraction Surveys

Seismic refraction surveys incorporated sufficient uncertainties. During the collection of most of the data, geophones 8, 9, and 11 proved inoperable and did not yield reliable data. Most lines were overlapped to attempt to correct for this problem. Also, when a shot was performed and the seismic waves were displayed, arrival times could only be determined to the nearest 0.4 ms.

In many areas of the playa, seismic refraction proved to be difficult to implement, given the unconsolidated and desiccated nature of the playa sediments. Where geophones could not be inserted into the sediment firmly, or were inserted inside vertical or semi-vertical cracks, recorded arrival times may have been earlier or later than the true

arrival times.

Multiple interpretations of the seismic data are possible. For example, different researchers could have different opinions about the location of a crossover for a particular seismic shot, or where to pick an arrival time on a geophone's waveform. Data presented here represent the best interpretation of these aspects.

DGPS/GIS Data

Even with the removal of selective availability, all satellite data collected in this study have many sources of error that can be the result of the DGPS unit or tropospheric aberrations. Inconsistencies in the elevation or position of the base station can yield GPS positions that are consistently inaccurate. Inaccurate base station files used in the differential corrections of all the GPS data can make the entire data set slightly inaccurate. Furthermore, due to the fact that the base station is located almost 400 km away from Lavic Lake, accuracy of the spatial data can be affected because of a possible difference of space vehicles in view at the field area and at the base station at any given time.

CONCLUSION

After the Landers and Hector Mine earthquakes, two prominent earthquakes in the ECSZ, this study was conducted in part to aid in our understanding of the Lavic Lake fault's previous activity in this section of the Mojave Desert. Seismic refraction, magnetics, and DGPS/GIS systems were all utilized in various aspects of this study. Seismic refraction and magnetic results suggest that the basalt buried beneath various sections of Lavic Lake playa has an irregular topography, not consistent with an undisturbed lava flow. The exact depths and orientations of this buried basalt-sediment interface could not be determined by these methods. Magnetics and seismic refraction confirmed the presence of anomalous features (perhaps basalt) near the Lavic Lake fault zone that ruptured in the Hector Mine earthquake. Seismic refraction revealed the possibility that the deep burial or absence of basalt somehow influenced the formation of prominent left steps and linear sections of the Lavic Lake fault zone. It is safe to conclude that most basalt is found at considerable depths below many sections of Lavic Lake playa between the hand and the Lava Bed Mountains.

These observations lead to several models to describe the local geology. The most likely model, dubbed the fissure flow model, considers the depth of the basalt and suggests that the Lavic Lake fault once acted as a conduit for escaping basaltic lava, which created the hand and frisbee. Subsequent faulting has since altered the surface topography. Other less likely models include the dip-slip thrusting and basalt exhumation models. Clearly, more work in this area needs to be completed to further understand which of these models is the most realistic.

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APPENDICES

Summaries of Data

Table A1. Summary of Magnetometer Data
Tables A2-A195. Summary of Seismic Refraction Data

TABLE A1. SUMMARY OF MAGNETOMETER DATA

Reading	Decimal Date	Elevation (m)	F (nT)	ΔF (nT)	F_i (nT)	V (nT)	F_a (nT)
line 1-0ft	2000.52799	576.554	48467.1	0.0000	49142.4	49137.0	-735.794
line 1-50ft	2000.52800	576.557	48116.3	0.0004	49142.4	49137.0	-1086.595
line 1-100ft	2000.52800	576.702	48181.1	0.0006	49142.4	49137.0	-1021.795
line 1-150ft	2000.52802	577.098	48576.2	0.0019	49142.4	49137.0	-626.696
line 1-200ft	2000.52802	577.115	48536.6	0.0020	49142.4	49137.0	-666.296
line 1-250ft	2000.52803	577.173	48639.7	0.0026	49142.4	49137.0	-563.197
line 1-300ft	2000.52803	576.885	48727.4	0.0028	49142.4	49137.0	-475.497
line 1-350ft	2000.52804	577.700	48957.1	0.0033	49142.4	49137.0	-245.798
line 1-400ft	2000.52804	577.693	48820.8	0.0034	49142.4	49143.0	-388.098
line 1-450ft	2000.52806	577.008	49182.5	0.0047	49142.4	49143.0	-26.399
line 1-500ft	2000.52806	576.731	49223.8	0.0048	49142.4	49143.0	14.901
line 1-550ft	2000.52807	576.922	49167.4	0.0054	49142.4	49143.0	-41.500
line 1-600ft	2000.52807	577.121	49105.9	0.0055	49142.4	49143.0	-103.000
line 1-650ft	2000.52808	577.203	49079.5	0.0061	49142.4	49143.0	-129.400
line 1-700ftredo	2000.52809	576.689	48993.9	0.0070	49142.4	49145.0	-217.001
line 1-750ft	2000.52809	576.423	48632.1	0.0071	49142.4	49145.0	-578.802
line 1-800ftredo	2000.52811	577.708	48680.4	0.0081	49142.4	49145.0	-530.502
line 1-850ft	2000.52819	579.611	48687.3	0.0135	49142.4	49145.0	-523.608
line 1-900ft	2000.52819	579.511	48851.0	0.0136	49142.4	49145.0	-359.908
line 1-950ft	2000.52819	579.094	49331.9	0.0140	49142.4	49145.0	120.992
line 1-1000ft	2000.52819	578.739	49595.9	0.0142	49142.4	49145.0	384.991
line 1-1100ft	2000.52821	576.841	48617.5	0.0154	49142.4	49145.0	-593.410
line 1-1050ft	2000.52821	577.398	49070.6	0.0156	49142.4	49145.0	-140.310
line 1-1200ft	2000.52822	577.259	48441.7	0.0162	49142.4	49145.0	-769.211
line 1-1150ft	2000.52823	577.729	49026.9	0.0163	49142.4	49145.0	-184.011
line 1-1260ft	2000.52824	576.790	49239.4	0.0172	49142.4	49145.0	28.488
line 1-1310ft	2000.52825	576.713	49832.7	0.0181	49142.4	49145.0	621.788
line 1-2300ft	2000.52844	578.821	49022.9	0.0308	49142.4	49145.0	-188.025
line 1-2250ft	2000.52844	578.563	48994.9	0.0309	49142.4	49145.0	-216.025

line 1-2200ft	2000.52844	578.504	48864.4	0.0311	49142.4	49145.0	-346.525
line 1-2150ft	2000.52844	578.520	49229.8	0.0312	49142.4	49145.0	18.874
line 1-2100ft	2000.52844	578.508	49324.8	0.0313	49142.4	49145.0	113.874
line 1-2050ft	2000.52844	578.050	49231.8	0.0314	49142.4	49145.0	20.874
line 1-2000ft	2000.52845	578.004	49098.4	0.0315	49142.4	49145.0	-112.526
line 1-1950ft	2000.52845	578.124	49126.8	0.0317	49142.4	49145.0	-84.126
line 1-1900ft	2000.52845	578.078	48820.3	0.0318	49142.4	49145.0	-390.626
line 1-1850ft	2000.52845	578.275	48858.9	0.0319	49142.4	49145.0	-352.026
line 1-1800ft	2000.52845	578.146	49040.8	0.0320	49142.4	49145.0	-170.126
line 1-1750ft	2000.52845	578.480	48778.9	0.0321	49142.4	49145.0	-432.027
line 1-1700ft	2000.52846	578.548	48843.1	0.0322	49142.4	49145.0	-367.827
line 1-1650ft	2000.52846	578.316	49374.7	0.0325	49142.4	49145.0	163.773
line 1-1600ft	2000.52846	578.423	49343.2	0.0326	49142.4	49145.0	132.273
line 1-1550ft	2000.52846	578.303	49476.4	0.0327	49142.4	49145.0	265.473
line 1-1500ft	2000.52846	578.185	49481.5	0.0328	49142.4	49145.0	270.573
line 1-1450ft	2000.52847	578.176	49456.0	0.0329	49142.4	49145.0	245.073
line 1-1410ft	2000.52847	578.145	49619.3	0.0330	49142.4	49145.0	408.373
line 1-1350ft	2000.52847	578.071	49701.7	0.0331	49142.4	49145.0	490.772
line 2-490ft	2000.52854	580.874	48866.1	0.0383	49142.3	49137.0	-336.833
line 2-450ft	2000.52854	580.065	48702.6	0.0384	49142.3	49137.0	-500.333
line 2-400ft	2000.52855	579.476	48953.3	0.0385	49142.3	49137.0	-249.633
line 2-360ft	2000.52855	579.126	49392.4	0.0386	49142.3	49137.0	189.467
line 2-300ft	2000.52855	577.804	48614.9	0.0387	49142.3	49137.0	-588.033
line 2-200ft	2000.52855	578.311	48936.8	0.0389	49142.3	49137.0	-266.133
line 2-150ft	2000.52855	578.029	49007.7	0.0390	49142.3	49137.0	-195.233
playa A-1	2000.52859	577.100	48897.0	0.0416	49142.3	49147.0	-315.936
playa A-2	2000.52859	577.331	49100.9	0.0418	49142.3	49147.0	-112.036
playa A-3	2000.52860	577.318	49125.5	0.0420	49142.3	49147.0	-87.436
playa A-4	2000.52860	577.176	49104.4	0.0421	49142.3	49147.0	-108.536
playa A-5	2000.52860	577.166	49085.5	0.0422	49142.3	49147.0	-127.437
playa A-6	2000.52860	576.599	49101.4	0.0423	49142.3	49147.0	-111.537

playa A-7	2000.52860	576.512	49117.1	0.0424	49142.3	49147.0	-95.837
playa A-8	2000.52860	576.637	49145.4	0.0425	49142.3	49147.0	-67.537
playa A-9	2000.52861	576.434	49149.7	0.0426	49142.3	49147.0	-63.237
playa A-10	2000.52861	576.142	49109.5	0.0428	49142.3	49147.0	-103.437
playa A-11	2000.52861	576.528	49022.1	0.0429	49142.3	49147.0	-190.837
playa A-12	2000.52861	576.408	49032.7	0.0431	49142.3	49147.0	-180.237
line 3-0ft	2000.53064	577.516	49002.5	0.1835	49142.2	49143.0	-206.578
line 3-50ft	2000.53064	577.651	49257.7	0.1838	49142.2	49143.0	48.622
line 3-100ft	2000.53065	576.992	49076.9	0.1841	49142.2	49143.0	-132.179
line 3-150ft	2000.53065	576.191	49014.9	0.1845	49142.2	49143.0	-194.179
line 3-200ft	2000.53066	576.063	48852.4	0.1848	49142.2	49143.0	-356.679
line 3-250ft	2000.53066	576.099	49014.8	0.1853	49142.2	49143.0	-194.280
line 3-300ft	2000.53067	575.882	49323.1	0.1855	49142.2	49143.0	114.020
line 3-350ft	2000.53067	575.263	48848.3	0.1858	49142.2	49143.0	-360.780
line 3-400ft	2000.53067	575.234	48586.2	0.1861	49142.2	49143.0	-622.881
line 3-450ft	2000.53068	575.890	48885.2	0.1865	49142.2	49143.0	-323.881
line 3-500ftredo	2000.53069	578.263	48973.9	0.1874	49142.2	49143.0	-235.182
line 3-550ft	2000.53070	579.701	48924.7	0.1878	49142.2	49143.0	-284.382
line 3-600ft	2000.53070	580.433	48987.9	0.1881	49142.2	49143.0	-221.183
line 3-650ftredo	2000.53072	580.521	49570.2	0.1895	49142.2	49145.0	359.116
line 3-700ft	2000.53073	579.104	48693.2	0.1898	49142.2	49145.0	-517.884
line 3-750ft	2000.53073	576.873	48739.1	0.1903	49142.2	49145.0	-471.985
line 3-800ft	2000.53074	576.853	48602.9	0.1906	49142.2	49145.0	-608.185
line 3-850ft	2000.53074	576.553	48682.1	0.1910	49142.2	49145.0	-528.985
line 3-900ft	2000.53075	576.476	48870.5	0.1912	49142.2	49145.0	-340.586
line 3-950ft	2000.53075	576.618	48918.6	0.1916	49142.2	49145.0	-292.486
line 3-1000ft	2000.53076	576.679	48753.2	0.1918	49142.2	49145.0	-457.886
line 3-1050ft	2000.53076	576.398	48775.1	0.1922	49142.2	49145.0	-435.987
line 3-1100ft	2000.53077	575.480	48845.0	0.1926	49142.2	49145.0	-366.087
line 3-1150ft	2000.53077	577.061	48708.8	0.1930	49142.2	49145.0	-502.287
line 3-1250ft	2000.53078	576.037	48774.9	0.1936	49142.2	49145.0	-436.188

line 3-1300ft	2000.53082	576.739	48850.4	0.1962	49142.2	49145.0	-360.691
line 3-1350ft	2000.53083	576.509	48770.5	0.1966	49142.2	49145.0	-440.591
line 3-1400ft	2000.53083	576.190	48919.5	0.1969	49142.2	49145.0	-291.591
line 3-1450ft	2000.53084	576.484	48855.2	0.1973	49142.2	49145.0	-355.892
line 3-1500ft	2000.53084	576.292	49100.5	0.1974	49142.2	49145.0	-110.592
line 3-1550ft	2000.53084	576.420	49143.4	0.1977	49142.2	49145.0	-67.692
line 3-1600ft	2000.53085	576.774	48863.4	0.1980	49142.2	49145.0	-347.692
line 3-1650ft	2000.53085	577.522	48899.1	0.1984	49142.2	49145.0	-311.993
line 3-1700ft	2000.53086	577.715	48740.5	0.1987	49142.2	49145.0	-470.593
line 3-1800ft	2000.53086	577.773	48838.1	0.1992	49142.2	49145.0	-372.994
line 3-1750ft	2000.53086	577.400	48564.1	0.1993	49142.2	49145.0	-646.994
line 4-0ft	2000.53089	576.574	48424.9	0.2009	49142.2	49143.0	-784.195
line 4-50ft	2000.53090	577.945	48259.0	0.2018	49142.2	49143.0	-950.096
line 4-100ft	2000.53090	577.651	48753.5	0.2019	49142.2	49143.0	-455.596
line 4-150ft	2000.53091	577.878	48936.4	0.2024	49142.2	49143.0	-272.697
line 4-200ft	2000.53092	577.525	49080.3	0.2029	49142.2	49143.0	-128.797
line 4-250ft	2000.53095	575.855	48957.2	0.2054	49142.2	49143.0	-251.900
line 4-300ft	2000.53096	575.872	49120.6	0.2059	49142.2	49143.0	-88.500
line 4-350ft	2000.53097	576.389	48850.6	0.2064	49142.2	49143.0	-358.501
line 4-400ft	2000.53097	576.030	48706.6	0.2067	49142.2	49143.0	-502.501
line 4-450ft	2000.53098	575.866	48696.0	0.2071	49142.2	49143.0	-513.101
line 4-500ft	2000.53098	575.402	48821.3	0.2072	49142.2	49143.0	-387.802
line 4-550ft	2000.53098	575.575	48459.8	0.2075	49142.2	49143.0	-749.302
line 4-600ftredo	2000.53100	575.802	48507.1	0.2084	49142.2	49143.0	-702.003
line 4-650ft	2000.53100	577.697	48551.5	0.2089	49142.2	49143.0	-657.603
line 4-700ft	2000.53101	577.525	48696.6	0.2092	49142.2	49143.0	-512.504
line 4-750ft	2000.53101	577.712	49078.0	0.2096	49142.2	49143.0	-131.104
line 4-800ft	2000.53102	577.868	48726.2	0.2097	49142.2	49145.0	-484.904
line 4-840ft	2000.53108	576.100	48916.3	0.2143	49142.2	49145.0	-294.809
line 4-900ft	2000.53108	575.868	48607.2	0.2145	49142.2	49145.0	-603.909
line 4-950ft	2000.53109	575.032	48562.9	0.2148	49142.2	49145.0	-648.209

line 4-1000ft	2000.53109	574.722	48707.0	0.2151	49142.2	49145.0	-504.110
line 4-1050ft	2000.53110	576.503	48698.5	0.2156	49142.2	49145.0	-512.610
line 4-1100ft	2000.53110	576.897	48604.5	0.2158	49142.2	49145.0	-606.610
line 4-1150ft	2000.53111	577.045	48592.5	0.2162	49142.2	49145.0	-618.611
line 4-1200ft	2000.53111	576.407	48603.0	0.2164	49142.2	49145.0	-608.111
line 4-1250ft	2000.53112	576.602	48748.9	0.2167	49142.2	49145.0	-462.211
line 4-1290ft	2000.53112	576.365	48524.0	0.2172	49142.2	49145.0	-687.112
line 4-1350ft	2000.53113	576.325	49450.1	0.2178	49142.2	49145.0	238.988
line 4-1400redo	2000.53114	577.021	49018.7	0.2187	49142.2	49145.0	-192.413
line 4-1450ft	2000.53115	575.877	49110.4	0.2191	49142.2	49145.0	-100.713
line 4-1500ft	2000.53115	575.230	48911.5	0.2193	49142.2	49145.0	-299.614
line 4-1550ft	2000.53116	575.437	48720.7	0.2198	49142.2	49145.0	-490.414
line 4-1600ft	2000.53116	575.486	48594.0	0.2199	49142.2	49145.0	-617.114
line 4-1650ft	2000.53117	574.935	48583.6	0.2203	49142.2	49145.0	-627.515
line 4-1700ft	2000.53117	575.180	48824.0	0.2205	49142.2	49145.0	-387.115
line 4-1750ft	2000.53118	575.261	48494.0	0.2210	49142.2	49145.0	-717.115
line 4-1800ft	2000.53118	575.274	48430.1	0.2211	49142.2	49145.0	-781.016
line 4-1850ft	2000.53118	575.766	48466.2	0.2215	49142.2	49145.0	-744.916
line 4-1900ft	2000.53119	575.657	48424.0	0.2217	49142.2	49145.0	-787.116
line 4-1950ft	2000.53119	575.350	48442.6	0.2221	49142.2	49145.0	-768.517
line 4-2000ft	2000.53120	575.492	48565.3	0.2223	49142.2	49145.0	-645.817
line 5-0ft	2000.53128	575.950	48705.5	0.2282	49142.2	49143.0	-503.623
line 5-50ft	2000.53129	576.665	49090.4	0.2288	49142.2	49143.0	-118.723
line 5-100ft	2000.53129	576.648	49159.4	0.2290	49142.2	49143.0	-49.723
line 5-150ft	2000.53130	576.301	48778.8	0.2293	49142.2	49143.0	-430.324
line 5-200ft	2000.53130	575.644	48411.2	0.2296	49142.2	49143.0	-797.924
line 5-250ft	2000.53131	575.958	49033.7	0.2300	49142.2	49143.0	-175.424
line 5-300ft	2000.53131	576.149	48894.2	0.2302	49142.2	49143.0	-314.925
line 5-350ft	2000.53132	576.357	49142.2	0.2306	49142.2	49143.0	-66.925
line 5-400ft	2000.53132	575.832	48755.9	0.2308	49142.2	49143.0	-453.225
line 5-450ft	2000.53133	575.707	48754.7	0.2313	49142.2	49143.0	-454.426

line 5-500ft	2000.53133	575.607	48870.1	0.2314	49142.2	49143.0	-339.026
line 5-550ft	2000.53133	575.888	48677.0	0.2319	49142.2	49143.0	-532.126
line 5-600ft	2000.53134	575.938	48831.7	0.2321	49142.2	49143.0	-377.426
line 5-650ft	2000.53134	575.857	48491.8	0.2325	49142.2	49143.0	-717.327
line 5-700ft	2000.53135	575.588	48719.6	0.2327	49142.2	49143.0	-489.527
line 5-750ft	2000.53135	576.656	48549.5	0.2331	49142.2	49143.0	-659.627
line 5-800ft	2000.53136	576.843	48689.6	0.2335	49142.2	49143.0	-519.528
line 5-850ft	2000.53137	577.174	48707.4	0.2341	49142.2	49143.0	-501.728
line 5-900ft	2000.53137	577.276	48595.3	0.2342	49142.2	49143.0	-613.829
line 5-950ft	2000.53138	576.769	48439.6	0.2350	49142.2	49143.0	-769.529
line 5-1000ft	2000.53138	576.879	48683.1	0.2351	49142.2	49143.0	-526.029
line 5-1050ft	2000.53139	576.709	48642.3	0.2356	49142.2	49143.0	-566.830
line 5-1100ft	2000.53139	576.450	48785.0	0.2358	49142.2	49143.0	-424.130
line 5-1150ft	2000.53140	576.157	48631.8	0.2361	49142.2	49143.0	-577.331
line 5-1200ft	2000.53140	576.201	48616.9	0.2363	49142.2	49143.0	-592.231
playa b 1	2000.53141	576.189	48488.9	0.2372	49142.1	49143.0	-720.232
playa b 2	2000.53142	576.728	48553.9	0.2376	49142.1	49143.0	-655.232
playa b 3	2000.53142	576.722	48821.4	0.2378	49142.1	49145.0	-389.732
playa b 4	2000.53142	576.416	48603.7	0.2381	49142.1	49145.0	-607.433
playa b 5	2000.53143	578.514	49110.8	0.2385	49142.1	49145.0	-100.333
playa b 6	2000.53143	576.894	48837.2	0.2388	49142.1	49145.0	-373.933
playa b 7	2000.53144	575.659	48831.3	0.2393	49142.1	49145.0	-379.834
playa b 8	2000.53144	575.442	48663.3	0.2395	49142.1	49145.0	-547.834
playa b 9	2000.53145	575.599	48595.5	0.2397	49142.1	49145.0	-615.634
playa b 10	2000.53145	575.082	49129.4	0.2399	49142.1	49143.0	-79.734
s 542	2000.80716	574.864	48628.6	19.3592	49123.0	49124.0	-580.654
s 543	2000.80717	574.868	48666.2	19.3594	49123.0	49124.0	-543.054
s 544	2000.80717	574.843	48600.0	19.3596	49123.0	49124.0	-609.254
s 545	2000.80717	574.639	48543.9	19.3599	49123.0	49124.0	-665.354
s 546	2000.80718	576.862	48715.3	19.3601	49123.0	49124.0	-493.955
s 547	2000.80718	576.648	48902.7	19.3604	49123.0	49124.0	-306.555

s 548	2000.80718	576.621	48872.0	19.3607	49123.0	49124.0	-337.255
s 549	2000.80719	576.787	48936.8	19.3609	49123.0	49124.0	-272.455
s 550	2000.80720	577.628	48884.6	19.3615	49123.0	49124.0	-324.656
s 551	2000.80720	577.777	48975.9	19.3616	49123.0	49124.0	-233.356
s 552	2000.80720	577.776	49136.2	19.3619	49123.0	49124.0	-73.056
s 553	2000.80721	577.552	48969.3	19.3621	49123.0	49124.0	-239.957
s 554	2000.80721	575.949	48772.0	19.3624	49123.0	49126.0	-439.257
s 555	2000.80721	575.000	49067.2	19.3628	49123.0	49124.0	-142.057
s 556	2000.80722	576.394	48316.2	19.3635	49123.0	49124.0	-893.058
s 557	2000.80723	577.274	48402.1	19.3637	49123.0	49124.0	-807.158
s 558	2000.80723	578.472	49135.1	19.3641	49123.0	49124.0	-74.158
s 559	2000.80724	578.698	49554.6	19.3643	49123.0	49124.0	345.341
s 560	2000.80724	577.445	48853.6	19.3646	49123.0	49124.0	-355.659
s 561	2000.80724	577.184	48716.7	19.3648	49123.0	49124.0	-492.559
s 562	2000.80725	577.144	48487.3	19.3653	49123.0	49124.0	-721.960
s 563	2000.80725	576.852	48673.5	19.3655	49123.0	49124.0	-535.760
s 564	2000.80726	576.539	48693.4	19.3657	49123.0	49126.0	-517.860
s 565	2000.80726	576.447	48808.4	19.3659	49123.0	49126.0	-402.860
s 566	2000.80726	576.704	48529.6	19.3662	49123.0	49126.0	-681.661
s 567	2000.80727	575.892	48545.8	19.3664	49123.0	49126.0	-665.461
s 568	2000.80727	576.347	48683.1	19.3666	49123.0	49126.0	-528.161
s 569	2000.80727	575.887	48675.0	19.3668	49123.0	49126.0	-536.261
s 570	2000.80728	576.011	48574.4	19.3670	49123.0	49126.0	-636.861
s 571	2000.80728	576.467	48527.3	19.3673	49123.0	49126.0	-683.962
s 572	2000.80729	580.109	49060.8	19.3678	49123.0	49126.0	-150.462
s 573	2000.80730	581.528	49642.6	19.3687	49123.0	49124.0	433.337
s 574	2000.80731	579.397	48953.9	19.3692	49123.0	49124.0	-255.364
s 575	2000.80732	577.580	48831.8	19.3698	49123.0	49124.0	-377.464
s 576	2000.80732	578.889	49119.8	19.3700	49123.0	49124.0	-89.464
s 577	2000.80733	579.592	49058.7	19.3707	49123.0	49126.0	-152.565
s 578	2000.80733	579.091	49002.7	19.3709	49123.0	49126.0	-208.565

s 579	2000.80734	577.353	49205.4	19.3713	49123.0	49126.0	-5.866
s 580	2000.80734	577.304	48746.7	19.3717	49123.0	49126.0	-464.566
s 581	2000.80746	576.392	48539.6	19.3797	49123.0	49124.0	-669.674
s 582	2000.80746	576.125	48587.6	19.3799	49123.0	49124.0	-621.674
s 583	2000.80746	575.914	48553.8	19.3801	49123.0	49124.0	-655.475
s 584	2000.80747	575.588	48664.0	19.3805	49123.0	49124.0	-545.275
s 585	2000.80747	575.797	48581.5	19.3808	49123.0	49124.0	-627.775
s 586	2000.80752	574.821	48846.4	19.3837	49123.0	49124.0	-362.878
s 587	2000.80752	574.818	48821.9	19.3839	49123.0	49124.0	-387.378
s 588	2000.80752	574.949	48874.7	19.3841	49123.0	49124.0	-334.579
s 589	2000.80753	574.803	48900.0	19.3843	49123.0	49124.0	-309.279
s 590	2000.80753	574.898	48711.8	19.3845	49123.0	49124.0	-497.479
s 591	2000.80753	574.899	48502.5	19.3848	49123.0	49124.0	-706.779
s 592	2000.80753	574.820	48501.0	19.3850	49123.0	49124.0	-708.279
s 593	2000.80754	574.673	49029.6	19.3852	49123.0	49124.0	-179.680
s 594	2000.80754	574.600	48868.4	19.3854	49123.0	49124.0	-340.880
s 595	2000.80754	574.752	48414.8	19.3856	49123.0	49124.0	-794.480
s 596	2000.80755	574.685	49146.7	19.3858	49123.0	49124.0	-62.580
s 597	2000.80755	578.197	48997.7	19.3862	49123.0	49124.0	-211.581
s 598	2000.80756	576.166	48488.3	19.3864	49123.0	49124.0	-720.981
s 599	2000.80756	577.418	48740.0	19.3869	49123.0	49124.0	-469.281
s 600	2000.80757	576.934	49403.8	19.3871	49123.0	49124.0	194.518
s 601	2000.80758	581.524	48916.3	19.3878	49123.0	49124.0	-292.982
s 602	2000.80758	582.244	49454.4	19.3880	49123.0	49124.0	245.118
s 603	2000.80758	579.499	48566.3	19.3882	49123.0	49124.0	-642.983
s 604	2000.80758	576.821	48336.0	19.3884	49123.0	49124.0	-873.283
s 605	2000.80759	574.672	48065.3	19.3888	49123.0	49124.0	-1143.983
s 606	2000.80759	574.642	48560.8	19.3891	49123.0	49124.0	-648.483
s 607	2000.80760	574.621	48356.3	19.3894	49123.0	49124.0	-852.984
s 608	2000.80763	574.827	48492.0	19.3915	49123.0	49124.0	-717.286
s 609	2000.80763	574.997	48854.6	19.3917	49123.0	49124.0	-354.686

s 610	2000.80763	575.083	48560.9	19.3919	49123.0	49124.0	-648.386
s 611	2000.80764	575.327	48963.0	19.3921	49123.0	49124.0	-246.287
s 612	2000.80764	575.530	48898.1	19.3923	49123.0	49124.0	-311.187
s 613	2000.80764	575.494	48566.7	19.3925	49123.0	49124.0	-642.587
s 614	2000.80765	575.451	48899.8	19.3927	49123.0	49124.0	-309.487
s 615	2000.80765	575.591	48935.1	19.3929	49123.0	49124.0	-274.187
s 616	2000.80765	575.247	48659.5	19.3932	49123.0	49124.0	-549.788
s 617	2000.80766	575.229	48745.4	19.3934	49123.0	49124.0	-463.888
s 618	2000.80766	575.183	48771.2	19.3936	49123.0	49124.0	-438.088
s 619	2000.80767	575.453	48341.6	19.3945	49123.0	49124.0	-867.689
s 620	2000.80768	575.412	48292.5	19.3947	49123.0	49124.0	-916.789
s 621	2000.80768	575.377	48556.4	19.3949	49123.0	49124.0	-652.889
s 622	2000.80768	575.094	49057.2	19.3951	49123.0	49124.0	-152.090
s 623	2000.80768	576.157	48914.5	19.3954	49123.0	49124.0	-294.790
s 624	2000.80769	577.406	49289.6	19.3956	49123.0	49124.0	80.310
s 625	2000.80769	578.652	49094.7	19.3958	49123.0	49124.0	-114.590
s 626	2000.80769	580.104	49152.2	19.3961	49123.0	49124.0	-57.090
s 627	2000.80772	578.793	48699.8	19.3976	49123.0	49124.0	-509.492
s 628	2000.80772	574.408	49311.0	19.3979	49123.0	49124.0	101.708
s 629	2000.80773	573.557	48898.2	19.3983	49123.0	49124.0	-311.093
s 630	2000.80773	573.347	49031.6	19.3985	49123.0	49124.0	-177.693
s 631	2000.80773	573.340	48464.9	19.3987	49123.0	49124.0	-744.393
s 632	2000.80774	573.508	48590.9	19.3989	49123.0	49124.0	-618.393
s 633	2000.80774	573.825	48355.7	19.3991	49123.0	49124.0	-853.594
s 634	2000.80774	573.765	48702.0	19.3994	49123.0	49126.0	-509.294
s 635	2000.80774	573.893	48624.5	19.3995	49123.0	49126.0	-586.794
s 636	2000.80955	579.462	48787.7	19.5244	49122.9	49126.0	-423.719
s 637	2000.80955	578.744	48600.0	19.5249	49122.9	49126.0	-611.419
s 638	2000.80956	578.427	49382.6	19.5251	49122.9	49126.0	171.180
s 639	2000.80956	578.530	48699.4	19.5253	49122.9	49126.0	-512.020
s 640	2000.80956	578.636	49317.1	19.5256	49122.9	49126.0	105.680

s 641	2000.80957	578.203	48433.1	19.5258	49122.9	49126.0	-778.320
s 642	2000.80957	578.315	49767.3	19.5260	49122.9	49126.0	555.880
s 643	2000.80957	577.929	49136.7	19.5262	49122.9	49126.0	-74.721
s 644	2000.80958	578.025	49104.2	19.5265	49122.9	49126.0	-107.221
s 645	2000.80958	578.220	49530.3	19.5267	49122.9	49119.0	325.879
s 646	2000.80958	578.385	48707.3	19.5269	49122.9	49119.0	-497.121
s 647	2000.80958	578.565	48689.0	19.5271	49122.9	49119.0	-515.422
s 648	2000.80959	578.878	49328.9	19.5274	49122.9	49119.0	124.478
s 649	2000.80959	578.984	49428.8	19.5276	49122.9	49119.0	224.378
s 650	2000.80959	578.918	48846.6	19.5278	49122.9	49119.0	-357.822
s 651	2000.80960	579.219	48829.1	19.5280	49122.9	49119.0	-375.322
s 652	2000.80960	578.936	49041.1	19.5282	49122.9	49119.0	-163.323
s 653	2000.80960	578.666	49343.7	19.5285	49122.9	49119.0	139.277
s 654	2000.80961	578.378	49066.5	19.5286	49122.9	49119.0	-137.923
s 655	2000.80961	578.504	48805.3	19.5288	49122.9	49119.0	-399.123
s 656	2000.80961	578.462	48602.6	19.5290	49122.9	49119.0	-601.823
s 657	2000.80962	578.464	49342.6	19.5293	49122.9	49119.0	138.176
s 658	2000.80962	578.356	48904.9	19.5295	49122.9	49119.0	-299.524
s 659	2000.80962	578.177	48765.0	19.5297	49122.9	49119.0	-439.424
s 660	2000.80962	577.922	48753.9	19.5299	49122.9	49119.0	-450.524
s 661	2000.80963	577.849	48834.2	19.5301	49122.9	49119.0	-370.225
s 662	2000.80963	577.647	49032.4	19.5303	49122.9	49119.0	-172.025
s 663	2000.80963	577.302	48854.3	19.5306	49122.9	49126.0	-357.125
s 664	2000.80965	577.048	48714.3	19.5318	49122.9	49126.0	-497.126
s 665	2000.80966	577.507	48822.8	19.5326	49122.9	49126.0	-388.627
s 666	2000.80967	578.587	49025.2	19.5329	49122.9	49126.0	-186.227
s 667	2000.80967	577.347	48866.0	19.5331	49122.9	49126.0	-345.427
s 668	2000.80969	576.326	48566.4	19.5343	49122.9	49126.0	-645.029
S 683	2000.80969	578.467	49108.0	19.5344	49122.9	49126.0	-103.429
s 669	2000.80969	579.738	48734.9	19.5347	49122.9	49126.0	-476.529
S 684	2000.80970	575.753	48568.6	19.5348	49122.9	49126.0	-642.829

s 670	2000.80970	580.446	49665.3	19.5349	49122.9	49126.0	453.871
s 671	2000.80971	581.529	48865.1	19.5356	49122.9	49126.0	-346.330
s 672	2000.80971	580.403	49275.2	19.5359	49122.9	49126.0	63.770
s 673	2000.80972	576.945	48792.8	19.5364	49122.9	49126.0	-418.631
s 674	2000.80972	576.331	49064.9	19.5366	49122.8	49126.0	-146.531
s 675	2000.80972	575.818	48579.4	19.5368	49122.8	49126.0	-632.031
s 676	2000.80973	576.310	48670.7	19.5370	49122.8	49126.0	-540.731
s 677	2000.80973	575.604	48227.7	19.5373	49122.8	49126.0	-983.732
s 678	2000.80973	575.628	48723.1	19.5375	49122.8	49126.0	-488.332
s 679	2000.80974	575.629	48800.7	19.5378	49122.8	49126.0	-410.732
s 680	2000.80974	575.607	48368.0	19.5381	49122.8	49126.0	-843.432
s 685	2000.80975	579.827	49143.6	19.5387	49122.8	49126.0	-67.833
s 681	2000.80980	575.471	48791.4	19.5418	49122.8	49126.0	-420.036
s 682	2000.80980	575.610	48608.7	19.5420	49122.8	49126.0	-602.736
s 686	2000.81250	574.541	48762.6	19.7290	49122.7	49126.0	-449.023
s 687	2000.81250	574.687	48621.3	19.7292	49122.7	49126.0	-590.324
s 688	2000.81251	575.175	49107.9	19.7299	49122.7	49125.0	-102.724
s 689	2000.81251	575.445	48639.1	19.7301	49122.7	49125.0	-571.524
s 690	2000.81252	575.188	48877.1	19.7304	49122.7	49125.0	-333.525
s 691	2000.81252	575.267	48672.6	19.7306	49122.7	49125.0	-538.025
s 692	2000.81252	575.327	48651.8	19.7308	49122.7	49125.0	-558.825
s 693	2000.81252	575.514	48749.8	19.7310	49122.7	49125.0	-460.825
s 694	2000.81253	575.714	48725.3	19.7311	49122.7	49125.0	-485.326
s 695	2000.81253	575.833	48673.3	19.7313	49122.7	49125.0	-537.326
s 696	2000.81253	575.930	49104.4	19.7316	49122.7	49125.0	-106.226
s 697	2000.81254	575.998	49166.7	19.7318	49122.7	49125.0	-43.926
s 698	2000.81254	576.126	48938.9	19.7320	49122.7	49125.0	-271.726
s 699	2000.81254	576.088	49072.1	19.7324	49122.7	49125.0	-138.527
s 700	2000.81263	573.424	48325.5	19.7380	49122.6	49126.0	-886.132
s 701	2000.81263	574.008	48532.1	19.7384	49122.6	49126.0	-679.533
s 702	2000.81264	574.549	48851.3	19.7387	49122.6	49126.0	-360.333

s 703	2000.81264	575.538	48289.7	19.7389	49122.6	49125.0	-920.933
s 704	2000.81264	575.334	48540.5	19.7391	49122.6	49125.0	-670.134
s 705	2000.81264	576.313	48456.5	19.7393	49122.6	49125.0	-754.134
s 706	2000.81265	575.486	48420.3	19.7396	49122.6	49125.0	-790.334
s 707	2000.81265	574.392	48610.6	19.7398	49122.6	49126.0	-601.034
s 708	2000.81266	577.102	48572.4	19.7403	49122.6	49125.0	-638.235
s 709	2000.81268	575.482	48496.4	19.7417	49122.6	49125.0	-714.236
s 710	2000.81268	576.077	48854.1	19.7419	49122.6	49125.0	-356.536
s 711	2000.81268	576.571	48769.1	19.7421	49122.6	49125.0	-441.537
s 712	2000.81269	576.753	48765.5	19.7424	49122.6	49125.0	-445.137
s 713	2000.81269	576.478	48623.5	19.7426	49122.6	49123.0	-585.137
s 714	2000.81269	576.202	48846.8	19.7428	49122.6	49123.0	-361.837
s 715	2000.81270	576.051	48640.8	19.7431	49122.6	49123.0	-567.837
s 716	2000.81271	577.479	48540.9	19.7442	49122.6	49123.0	-667.739
s 717	2000.81273	577.464	48271.4	19.7456	49122.6	49123.0	-937.240
s 718	2000.81502	575.948	48723.4	19.9042	49122.5	49129.0	-491.399
s 720	2000.81504	575.881	48569.4	19.9051	49122.5	49129.0	-645.400
s 721	2000.81504	575.538	48621.3	19.9054	49122.5	49129.0	-593.500
s 722	2000.81504	575.997	48528.2	19.9057	49122.5	49129.0	-686.600
s 723	2000.81505	575.159	48783.1	19.9060	49122.5	49129.0	-431.700
s 724	2000.81505	575.157	49049.0	19.9062	49122.5	49129.0	-165.801
s 725	2000.81505	575.010	49040.1	19.9064	49122.5	49129.0	-174.701
s 726	2000.81506	575.557	49256.0	19.9067	49122.5	49129.0	41.199
s 727	2000.81506	576.146	49295.5	19.9070	49122.5	49129.0	80.699
s 728	2000.81507	575.216	49063.8	19.9075	49122.5	49129.0	-151.002
s 729	2000.81507	575.141	49181.9	19.9077	49122.5	49129.0	-32.902
s 730	2000.81508	575.421	49025.2	19.9082	49122.5	49129.0	-189.603
s 731	2000.81508	575.449	49135.5	19.9084	49122.5	49129.0	-79.303
s 732	2000.81509	575.601	48989.8	19.9086	49122.5	49129.0	-225.003
s 733	2000.81509	575.588	48892.6	19.9087	49122.5	49129.0	-322.203
s 734	2000.81509	575.594	48832.6	19.9089	49122.5	49129.0	-382.203

s 735	2000.81509	575.644	48976.5	19.9091	49122.5	49129.0	-238.303
s 736	2000.81510	575.507	48799.6	19.9093	49122.5	49129.0	-415.204
s 737	2000.81510	575.717	48941.2	19.9094	49122.5	49129.0	-273.604
s 738	2000.81510	575.822	48952.7	19.9097	49122.5	49129.0	-262.104
s 739	2000.81510	576.149	49030.0	19.9099	49122.5	49129.0	-184.804
s 740	2000.81511	576.487	49319.9	19.9101	49122.5	49129.0	105.096
s 741	2000.81511	576.762	49000.2	19.9102	49122.5	49129.0	-214.605
s 742	2000.81511	576.384	48655.9	19.9104	49122.5	49129.0	-558.905
s 743	2000.81511	575.355	49003.8	19.9106	49122.5	49129.0	-211.005
s 744	2000.81512	574.506	48464.4	19.9109	49122.5	49130.0	-751.405
s 745	2000.81512	575.880	49141.7	19.9113	49122.5	49129.0	-73.106
s 746	2000.81513	576.010	49182.8	19.9116	49122.5	49129.0	-32.006
s 747	2000.81513	575.395	49095.3	19.9118	49122.5	49129.0	-119.506
s 748	2000.81514	574.853	48887.9	19.9123	49122.5	49130.0	-327.907
s 749	2000.81514	574.723	48968.4	19.9127	49122.5	49130.0	-247.407
s 750	2000.81515	575.094	49063.5	19.9128	49122.5	49129.0	-151.307
s 751	2000.81515	574.878	48868.0	19.9130	49122.5	49130.0	-347.807
s 752	2000.81515	574.995	48717.6	19.9132	49122.5	49130.0	-498.208
s 753	2000.81516	575.198	48941.2	19.9135	49122.5	49129.0	-273.608
s 754	2000.81516	575.243	48833.9	19.9136	49122.5	49129.0	-380.908
s 755	2000.81516	575.308	48756.4	19.9138	49122.5	49129.0	-458.408
s 756	2000.81516	575.390	48846.4	19.9140	49122.5	49129.0	-368.408
s 757	2000.81517	575.686	48983.4	19.9142	49122.5	49129.0	-231.409
s 758	2000.81517	576.321	49001.2	19.9144	49122.5	49129.0	-213.609
s 759	2000.81517	576.323	48991.4	19.9145	49122.5	49129.0	-223.409
s 760	2000.81517	576.240	48628.5	19.9147	49122.5	49129.0	-586.309
s 761	2000.81518	576.334	48610.8	19.9149	49122.5	49129.0	-604.009
s 762	2000.81518	576.401	48840.4	19.9150	49122.5	49129.0	-374.409
s 763	2000.81518	576.759	48672.7	19.9153	49122.5	49129.0	-542.110
s 764	2000.81519	576.487	48958.8	19.9155	49122.5	49129.0	-256.010
s 765	2000.81519	576.300	48891.6	19.9157	49122.5	49129.0	-323.210

s 766	2000.81519	576.126	48959.6	19.9158	49122.5	49129.0	-255.210
s 767	2000.81519	576.144	48862.5	19.9160	49122.5	49129.0	-352.310
s 768	2000.81520	575.301	48585.4	19.9162	49122.5	49129.0	-629.411
s 769	2000.81525	575.758	48925.7	19.9202	49122.5	49129.0	-289.115
s 770	2000.81526	575.655	48724.0	19.9210	49122.5	49129.0	-490.815
s 771	2000.81527	575.177	48800.5	19.9212	49122.5	49129.0	-414.316
s 772	2000.81527	575.145	48701.1	19.9214	49122.5	49129.0	-513.716
s 773	2000.81527	574.952	48697.7	19.9216	49122.5	49130.0	-518.116
s 774	2000.81527	574.855	48936.6	19.9217	49122.5	49130.0	-279.216
s 775	2000.81528	574.848	48862.7	19.9219	49122.5	49130.0	-353.116
s 776	2000.81528	574.737	48835.4	19.9221	49122.5	49130.0	-380.417
s 777	2000.81528	574.852	48706.8	19.9223	49122.5	49130.0	-509.017
s 778	2000.81529	574.977	48845.0	19.9226	49122.5	49130.0	-370.817
s 779	2000.81529	575.666	48632.7	19.9229	49122.5	49129.0	-582.117
s 780	2000.81529	576.495	48602.3	19.9231	49122.5	49129.0	-612.517
s 781	2000.81530	576.421	48613.0	19.9233	49122.5	49129.0	-601.818
s 782	2000.81530	576.017	48695.7	19.9235	49122.5	49129.0	-519.118
s 783	2000.81530	575.452	48896.9	19.9238	49122.5	49129.0	-317.918
s 784	2000.81531	574.955	48578.0	19.9241	49122.5	49130.0	-637.818
s 785	2000.81532	574.899	48785.7	19.9245	49122.5	49123.0	-423.119
s 786	2000.81532	574.779	48877.2	19.9247	49122.5	49123.0	-331.619
s 787	2000.81532	574.916	48801.1	19.9249	49122.5	49123.0	-407.719
s 788	2000.81532	574.718	48819.0	19.9251	49122.5	49123.0	-389.819
s 789	2000.81533	574.967	48801.2	19.9254	49122.5	49123.0	-407.620
s 790	2000.81533	574.697	48949.2	19.9256	49122.5	49123.0	-259.620
s 792	2000.81534	575.308	49089.7	19.9260	49122.5	49123.0	-119.120
s 793	2000.81534	576.139	48768.1	19.9263	49122.5	49123.0	-440.721
s 794	2000.81534	576.151	48965.4	19.9266	49122.5	49123.0	-243.421
s 795	2000.81535	576.122	48627.0	19.9268	49122.5	49123.0	-581.821
s 796	2000.81535	575.996	49049.1	19.9270	49122.5	49123.0	-159.721
s 797	2000.81536	575.161	49072.0	19.9274	49122.5	49123.0	-136.822

s 798	2000.81536	575.152	49045.8	19.9276	49122.5	49123.0	-163.022
s 799	2000.81536	575.179	48987.1	19.9278	49122.5	49123.0	-221.722
s 800	2000.81536	576.111	48841.7	19.9280	49122.5	49123.0	-367.122
s 801	2000.81537	575.865	48944.8	19.9282	49122.5	49123.0	-264.023
s 802	2000.81537	575.860	49069.3	19.9284	49122.5	49123.0	-139.523
s 803	2000.81537	575.748	48895.6	19.9285	49122.5	49123.0	-313.223
s 804	2000.81538	575.679	48845.5	19.9287	49122.5	49123.0	-363.323
s 805	2000.81538	575.570	49003.4	19.9289	49122.5	49123.0	-205.423
s 806	2000.81538	575.499	48801.8	19.9290	49122.5	49123.0	-407.023
s 807	2000.81538	575.500	48966.6	19.9292	49122.5	49123.0	-242.224
s 808	2000.81539	575.573	48854.7	19.9294	49122.5	49123.0	-354.124
s 809	2000.81539	575.621	48868.1	19.9295	49122.5	49125.0	-342.724
s 810	2000.81539	575.794	48853.6	19.9297	49122.5	49125.0	-357.224
s 811	2000.81539	578.521	48745.4	19.9300	49122.5	49123.0	-463.424
s 812	2000.81554	576.102	48965.1	19.9401	49122.4	49125.0	-245.734
s 813	2000.81554	576.687	48922.7	19.9402	49122.4	49119.0	-282.135
s 814	2000.81555	577.465	48661.7	19.9406	49122.4	49119.0	-543.135
s 815	2000.81555	577.266	49070.1	19.9409	49122.4	49119.0	-134.735
s 816	2000.81555	577.493	49145.5	19.9411	49122.4	49119.0	-59.336
s 817	2000.81556	577.386	48951.0	19.9413	49122.4	49119.0	-253.836
s 818	2000.81556	577.276	49304.4	19.9415	49122.4	49119.0	99.564
s 819	2000.81556	577.181	49221.6	19.9417	49122.4	49119.0	16.764
s 820	2000.81559	577.601	48909.1	19.9439	49122.4	49117.0	-293.738
s 822	2000.81566	575.079	48662.9	19.9481	49122.4	49123.0	-545.943
s 823	2000.81570	575.326	48622.5	19.9509	49122.4	49123.0	-586.345
line 23 0ft	2000.99871	574.496	49006.1	32.6421	49109.7	49112.0	-204.437
line 23 20ft	2000.99871	574.480	49023.4	32.6423	49109.7	49112.0	-187.137
line 23 40ft	2000.99872	574.528	49043.8	32.6425	49109.7	49112.0	-166.737
line 23 60ft	2000.99872	574.512	49058.4	32.6426	49109.7	49112.0	-152.137
line 23 80ft	2000.99872	574.554	49051.2	32.6426	49109.7	49112.0	-159.337
line 23 100ft	2000.99872	574.576	49022.2	32.6427	49109.7	49112.0	-188.337

line 23 120ft	2000.99873	574.592	49002.1	32.6432	49109.7	49112.0	-208.438
line 23 140ft	2000.99873	574.598	48999.6	32.6434	49109.7	49112.0	-210.938
line 23 160ft	2000.99873	574.605	48990.9	32.6435	49109.7	49112.0	-219.638
line 23 180ft	2000.99873	574.474	48974.5	32.6436	49109.7	49112.0	-236.038
line 23 200ft	2000.99873	574.427	48984.9	32.6438	49109.7	49112.0	-225.638
line 23 220ft	2000.99875	573.261	48982.2	32.6451	49109.7	49112.0	-228.340
line 23 240ft	2000.99876	573.306	48915.7	32.6452	49109.7	49112.0	-294.840
line 23 260ft	2000.99876	573.473	48773.0	32.6453	49109.7	49112.0	-437.540
line 23 280ft	2000.99876	573.717	48725.6	32.6455	49109.7	49112.0	-484.940
line 23 300ft	2000.99876	574.467	48655.8	32.6456	49109.7	49112.0	-554.740
line 23 320ft	2000.99877	574.594	48612.7	32.6459	49109.7	49112.0	-597.840
lin 23 340ft	2000.99877	573.916	48646.0	32.6461	49109.7	49112.0	-564.540
line 23 360ft	2000.99877	574.105	48974.5	32.6462	49109.7	49112.0	-236.041
line 23 380ft	2000.99877	574.186	49029.4	32.6463	49109.7	49112.0	-181.141
line 23 400ft	2000.99877	574.258	49047.0	32.6465	49109.7	49112.0	-163.541
line 23 420ft	2000.99878	574.136	49073.5	32.6468	49109.7	49112.0	-137.041
line 23 440ft	2000.99878	574.154	49034.7	32.6469	49109.7	49112.0	-175.841
line 23 460ft	2000.99878	573.997	48963.7	32.6471	49109.7	49112.0	-246.842
line 23 480ft	2000.99878	574.153	48962.2	32.6472	49109.7	49112.0	-248.342
line 23 500ft	2000.99879	574.181	49083.2	32.6473	49109.7	49112.0	-127.342
line 23 520ft	2000.99879	574.219	49175.6	32.6476	49109.7	49112.0	-34.942
line 23 540ft	2000.99879	574.266	49139.3	32.6477	49109.7	49112.0	-71.242
line 23 560ft	2000.99879	574.330	49082.0	32.6479	49109.7	49112.0	-128.542
line 23 580ft	2000.99880	574.433	49083.4	32.6480	49109.7	49112.0	-127.142
line 23 600ft	2000.99880	574.483	49134.3	32.6480	49109.7	49112.0	-76.242
line 24 0ft	2000.99889	573.401	48983.3	32.6546	49109.7	49112.0	-227.249
line 24 50ft	2000.99889	573.413	49006.8	32.6547	49109.7	49112.0	-203.749
line 24 100ft	2000.99889	573.428	48940.7	32.6548	49109.7	49112.0	-269.849
line 24 150ft	2000.99890	573.388	48969.0	32.6551	49109.7	49112.0	-241.550
line 24 200ft	2000.99890	573.429	48971.2	32.6552	49109.7	49112.0	-239.350
line 24 250ft	2000.99890	573.441	48761.3	32.6555	49109.7	49112.0	-449.250

line 24 300ft	2000.99891	573.626	48710.8	32.6557	49109.7	49112.0	-499.750
line 24 350ft	2000.99891	573.883	48875.4	32.6560	49109.7	49112.0	-335.150
line 24 400ft	2000.99891	573.938	49018.9	32.6561	49109.7	49112.0	-191.651
line 24 450ft	2000.99892	574.166	48897.7	32.6564	49109.7	49112.0	-312.851
line 24 500ft	2000.99892	574.291	48743.7	32.6566	49109.7	49112.0	-466.851
line 24 550ft	2000.99892	574.261	48729.6	32.6569	49109.7	49112.0	-480.951
line 24 600ft	2000.99893	574.272	48787.8	32.6570	49109.7	49112.0	-422.751
line 24 650ft	2000.99893	574.286	49003.4	32.6572	49109.7	49112.0	-207.152
line 24 700ft	2000.99893	574.341	48936.9	32.6574	49109.7	49112.0	-273.652
line 24 750ft	2000.99894	574.449	48959.0	32.6577	49109.7	49112.0	-251.552
line 24 800ft	2000.99894	574.505	49052.6	32.6578	49109.7	49112.0	-157.952
line 24 850ft	2000.99894	574.555	48802.6	32.6581	49109.7	49112.0	-407.953
line 24 900ft	2000.99894	574.621	48772.5	32.6582	49109.7	49112.0	-438.053
line 25 0ft	2000.99898	577.836	48996.3	32.6607	49109.7	49117.0	-219.255
line 25 50ft	2000.99898	577.551	48757.9	32.6608	49109.7	49117.0	-457.655
line 25 100ft	2000.99898	577.746	48840.8	32.6609	49109.7	49117.0	-374.755
line 25 150ft	2000.99899	578.450	48836.2	32.6611	49109.7	49117.0	-379.356
line 25 200ft	2000.99899	578.774	48767.9	32.6612	49109.7	49117.0	-447.656
line 25 250ft	2000.99899	578.794	48647.8	32.6615	49109.7	49117.0	-567.756
line 25 300ft	2000.99899	579.006	48620.9	32.6616	49109.7	49117.0	-594.656
line 25 350ft	2000.99900	578.330	49003.4	32.6619	49109.7	49117.0	-212.156
line 25 400ft	2000.99900	577.997	49118.0	32.6620	49109.7	49117.0	-97.556
line 25 450ft	2000.99900	576.585	48685.9	32.6624	49109.7	49117.0	-529.657
line 25 500ft	2000.99900	575.743	48747.2	32.6625	49109.7	49117.0	-468.357
line 25 550ft	2000.99901	575.967	48795.9	32.6628	49109.7	49117.0	-419.657
line 25 600ft	2000.99901	576.144	48827.6	32.6629	49109.7	49117.0	-387.957
line 25 650ft	2000.99902	576.049	48885.8	32.6632	49109.7	49117.0	-329.758
line 25 700ft	2000.99902	576.024	48820.7	32.6633	49109.7	49117.0	-394.858
line 25 750ft	2000.99902	575.875	48738.8	32.6636	49109.7	49117.0	-476.758
line 25 800ft	2000.99902	575.844	48537.9	32.6637	49109.7	49117.0	-677.658
line 25 850ft	2000.99903	575.785	48501.7	32.6639	49109.7	49117.0	-713.858

line 25 900ft	2000.99903	575.760	48571.5	32.6640	49109.7	49117.0	-644.058
line 26 0ft	2000.99906	568.568	49016.0	32.6662	49109.7	49115.0	-197.561
line 26 50ft	2000.99906	568.587	49051.5	32.6663	49109.7	49115.0	-162.061
line 26 100ft	2000.99906	569.092	49065.0	32.6664	49109.7	49115.0	-148.561
line 26 150ft	2000.99907	569.397	49154.7	32.6667	49109.7	49115.0	-58.861
line 26 200ft	2000.99907	569.609	49193.8	32.6668	49109.7	49115.0	-19.761
line 26 250ft	2000.99907	569.574	49276.8	32.6671	49109.7	49115.0	63.239
line 26 300ft	2000.99907	569.254	49195.7	32.6672	49109.7	49115.0	-17.862
line 26 350ft	2000.99908	569.344	49271.6	32.6674	49109.7	49115.0	58.038
line 26 400ft	2000.99908	569.434	49251.5	32.6675	49109.7	49115.0	37.938
line 26 450ft	2000.99908	569.137	48653.5	32.6679	49109.7	49115.0	-560.062
line 26 500ft	2000.99908	569.205	48780.5	32.6680	49109.7	49115.0	-433.062
line 26 550ft	2000.99909	569.340	48676.0	32.6682	49109.7	49115.0	-537.563
line 26 600ft	2000.99909	569.368	48563.2	32.6684	49109.7	49115.0	-650.363
line 26 650ft	2000.99909	569.428	48534.2	32.6686	49109.7	49115.0	-679.363
line 26 700 ft	2000.99910	569.358	48618.3	32.6688	49109.7	49115.0	-595.263
line 26 750ft	2000.99910	569.327	48707.6	32.6690	49109.7	49115.0	-505.963
line 26 800ft	2000.99910	569.300	48728.3	32.6691	49109.7	49115.0	-485.263
line 29 0ft	2001.00408	576.106	49154.1	33.0146	49109.4	49110.0	-54.809
line 29 50ft	2001.00408	575.927	48544.5	33.0147	49109.4	49110.0	-664.409
line 29 100ft	2001.00409	575.893	48462.1	33.0148	49109.4	49110.0	-746.809
line 29 150ft redo	2001.00409	575.877	48373.1	33.0151	49109.4	49110.0	-835.809
line 29 200ft	2001.00409	575.791	48810.0	33.0153	49109.4	49110.0	-398.910
line 29 250ft	2001.00410	575.534	48754.3	33.0155	49109.4	49110.0	-454.610
line 29 300ft	2001.00410	575.473	48820.6	33.0156	49109.4	49110.0	-388.310
line 29 350ft	2001.00410	575.514	49026.7	33.0158	49109.4	49110.0	-182.210
line 29 400ft	2001.00410	575.530	48836.7	33.0159	49109.4	49110.0	-372.210
line 29 450ft	2001.00410	575.639	48423.3	33.0161	49109.4	49110.0	-785.610
line 29 500ft	2001.00411	575.729	48420.5	33.0162	49109.4	49110.0	-788.411
line 29 550ft	2001.00411	574.974	48429.4	33.0164	49109.4	49110.0	-779.511
line 29 600ft	2001.00411	575.022	48488.3	33.0165	49109.4	49110.0	-720.611

line 29 650ft	2001.00411	575.230	48572.5	33.0168	49109.4	49110.0	-636.411
line 29 700ft	2001.00412	575.207	48725.2	33.0169	49109.4	49110.0	-483.711
line 29 750ft	2001.00412	575.314	48761.8	33.0171	49109.4	49110.0	-447.112
line 29 800ft	2001.00412	575.420	48711.4	33.0173	49109.4	49110.0	-497.512
line 29 850ft	2001.00413	575.583	48938.4	33.0176	49109.4	49110.0	-270.512
line 29 900ft	2001.00413	575.651	48440.7	33.0177	49109.4	49110.0	-768.212
line 29 950ft	2001.00413	575.702	48650.4	33.0180	49109.4	49110.0	-558.512
line 29 1000ft	2001.00413	575.716	48893.4	33.0181	49109.4	49110.0	-315.512
line 29 1050ft	2001.00414	575.599	48657.3	33.0183	49109.4	49110.0	-551.613
line 29 1100ft	2001.00414	575.810	48634.6	33.0184	49109.4	49110.0	-574.313
line 29 1150ft	2001.00414	575.877	48492.4	33.0187	49109.4	49110.0	-716.513
line 29 1200ft	2001.00414	575.912	48348.8	33.0188	49109.4	49112.0	-862.113
line 29 1250ft	2001.00415	575.945	48158.6	33.0190	49109.4	49112.0	-1052.313
line 29 1350ft	2001.00416	576.972	48254.6	33.0198	49109.4	49112.0	-956.314
line 29 1400ft redo	2001.00416	578.556	48626.1	33.0201	49109.4	49112.0	-584.815
line 29 1450ft	2001.00417	579.333	48409.5	33.0204	49109.4	49112.0	-801.415
line 29 1600ft	2001.00418	578.399	49013.5	33.0213	49109.4	49112.0	-197.416
line 29 1650ft	2001.00418	578.532	48784.5	33.0216	49109.4	49112.0	-426.416
line 29 1700ft	2001.00419	578.313	48678.0	33.0217	49109.4	49112.0	-532.916
line 29 1750ft	2001.00419	577.562	48301.1	33.0220	49109.4	49112.0	-909.816
line 29 1800ft	2001.00419	578.220	48781.4	33.0221	49109.4	49112.0	-429.516
line 29 1850ft	2001.00419	578.935	48805.3	33.0223	49109.4	49112.0	-405.617
line 29 1900ft	2001.00420	579.037	48646.4	33.0225	49109.4	49112.0	-564.517
line 29 1950ft	2001.00420	579.025	49184.4	33.0227	49109.4	49112.0	-26.517
line 29 2000ft	2001.00420	578.797	49423.5	33.0228	49109.4	49112.0	212.583
line 29 2050ft	2001.00421	578.288	49344.2	33.0231	49109.4	49112.0	133.282
line 29 2100ft redo	2001.00421	578.640	49124.0	33.0234	49109.4	49112.0	-86.918
line 29 2150ft	2001.00421	577.121	48276.7	33.0237	49109.4	49112.0	-934.218
line 29 2200ft	2001.00422	576.814	48820.2	33.0238	49109.4	49112.0	-390.718
line 29 2250ft	2001.00422	576.466	48365.0	33.0241	49109.4	49112.0	-845.918
line 29 2300ft	2001.00422	576.552	48825.0	33.0242	49109.4	49112.0	-385.919

line 29 2350ft	2001.00422	576.734	49462.5	33.0244	49109.4	49112.0	251.581
line 29 2400ft	2001.00423	576.840	49355.0	33.0245	49109.4	49112.0	144.081
line 29 2450ft	2001.00423	577.086	49271.8	33.0248	49109.4	49112.0	60.881
line 29 2500ft redo	2001.00423	577.445	48851.9	33.0250	49109.4	49112.0	-359.019
line 29 2550ft	2001.00424	577.212	48593.4	33.0253	49109.4	49112.0	-617.520
line 29 2600ft redo	2001.00424	576.898	48266.6	33.0255	49109.4	49112.0	-944.320
line 29 2650ft	2001.00424	576.905	48653.2	33.0258	49109.4	49112.0	-557.720
line 29 2700ft	2001.00425	576.949	49004.7	33.0259	49109.4	49112.0	-206.220
line 29 2750ft	2001.00425	577.056	48952.2	33.0261	49109.4	49112.0	-258.720
line 29 2800ft	2001.00425	577.133	49027.1	33.0262	49109.4	49112.0	-183.821
line 29 2850ft	2001.00425	577.144	49028.1	33.0264	49109.4	49112.0	-182.821
line 29 2900ft	2001.00425	577.088	48739.4	33.0265	49109.4	49112.0	-471.521
line 29 2950ft	2001.00426	577.501	49040.1	33.0267	49109.4	49112.0	-170.821
line 29 3000ft	2001.00426	577.364	49457.1	33.0268	49109.4	49112.0	246.179
line 30 0ft	2001.00439	576.941	48628.0	33.0362	49109.4	49110.0	-580.931
line 30 50ft	2001.00440	577.007	48713.7	33.0363	49109.4	49110.0	-495.231
line 30 100ft	2001.00440	577.006	48642.0	33.0367	49109.3	49110.0	-566.931
line 30 150ft	2001.00440	577.010	48577.6	33.0368	49109.3	49110.0	-631.331
line 30 200ft	2001.00441	577.057	48767.8	33.0370	49109.3	49110.0	-441.131
line 30 250ft	2001.00441	577.061	48825.7	33.0371	49109.3	49110.0	-383.232
line 30 300ft	2001.00441	577.092	48362.9	33.0374	49109.3	49110.0	-846.032
line 30 350ft	2001.00441	577.040	48474.0	33.0375	49109.3	49110.0	-734.932
line 30 400ft	2001.00442	577.083	48646.6	33.0378	49109.3	49110.0	-562.332
line 30 450ft	2001.00442	577.077	49024.3	33.0379	49109.3	49110.0	-184.632
line 30 500ft	2001.00442	576.506	48940.9	33.0381	49109.3	49110.0	-268.033
line 30 550ft	2001.00442	576.492	48872.6	33.0383	49109.3	49110.0	-336.333
line 30 600ft	2001.00443	576.452	48700.3	33.0385	49109.3	49110.0	-508.633
line 30 650ft	2001.00443	576.529	48568.9	33.0386	49109.3	49110.0	-640.033
line 30 700ft	2001.00443	576.932	48348.9	33.0389	49109.3	49110.0	-860.033
line 30 750ft	2001.00443	577.113	48401.3	33.0390	49109.3	49110.0	-807.633
line 30 800ft	2001.00444	577.421	49114.4	33.0393	49109.3	49110.0	-94.534

line 30 850ft	2001.00444	577.534	49003.3	33.0394	49109.3	49110.0	-205.634
line 30 900ft	2001.00444	577.272	48983.3	33.0397	49109.3	49110.0	-225.634
line 30 950ft	2001.00445	577.350	49125.8	33.0398	49109.3	49104.0	-77.134
line 34 0ft	2001.00705	578.070	48575.8	33.2207	49109.2	49112.0	-635.315
line 34 40ft	2001.00706	577.974	48477.4	33.2209	49109.2	49112.0	-733.715
line 34 100ft	2001.00706	577.974	48346.1	33.2210	49109.2	49112.0	-865.015
line 34 150ft	2001.00706	577.707	48776.1	33.2213	49109.2	49112.0	-435.016
line 34 200ft	2001.00706	577.564	48825.0	33.2214	49109.2	49112.0	-386.116
line 34 250ft	2001.00707	577.509	49303.1	33.2216	49109.2	49112.0	91.984
line 34 300ft	2001.00707	577.505	48441.1	33.2217	49109.2	49112.0	-770.016
line 34 350ft	2001.00707	577.382	49381.3	33.2220	49109.2	49112.0	170.184
line 34 400ft	2001.00707	577.270	48777.6	33.2221	49109.2	49112.0	-433.516
line 34 450ft	2001.00708	577.201	48970.2	33.2223	49109.2	49112.0	-240.917
line 34 500ft	2001.00708	577.066	48663.2	33.2224	49109.2	49112.0	-547.917
line 34 550ft	2001.00708	576.871	48547.8	33.2227	49109.2	49112.0	-663.317
line 34 600ft	2001.00708	576.797	48873.2	33.2228	49109.2	49112.0	-337.917
line 34 650ft	2001.00709	576.793	49369.5	33.2230	49109.2	49112.0	158.383
line 34 700ft	2001.00709	576.768	49763.5	33.2231	49109.2	49112.0	552.382
line 34 750ft	2001.00709	576.868	48782.5	33.2234	49109.2	49112.0	-428.618
line 34 800ft	2001.00710	576.888	48965.0	33.2235	49109.2	49112.0	-246.118
line 34 850ft	2001.00710	577.078	48662.6	33.2237	49109.2	49112.0	-548.518
line 34 900ft	2001.00710	577.092	48661.2	33.2238	49109.2	49112.0	-549.918
line 34 950ft	2001.00710	577.267	49229.2	33.2241	49109.2	49112.0	18.082
line 34 1000ft	2001.00711	577.294	49312.7	33.2242	49109.2	49112.0	101.581

TABLE A2. SEISMIC LINE 1, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	27.0
3	60	29.8
4	90	38.6
5	120	41.4
6	150	46.2
7	180	53.0
8	210	58.6
9	240	65.0
10	270	68.2
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1789

 $V_1 = 1.70$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 44.54 m

TABLE A3. SEISMIC LINE 1, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	n.a.
2	300	n.a.
3	270	n.a.
4	240	79.8
5	210	73.4
6	180	69.8
7	150	61.8
8	120	57.8
9	90	n.a.
10	60	n.a.
11	30	n.a.
12	0	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1853

 $V_1 = 1.65$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 55.35 m

TABLE A4. SEISMIC LINE 1, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	30	20.2
2	0	0.0
3	30	7.0
4	60	26.6
5	90	41.0
6	120	43.4
7	150	47.0
8	180	53.8
9	210	59.8
10	240	73.4
11	270	110.2
12	300	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1600

 $V_1 = 1.91 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 47.35 m

TABLE A5. SEISMIC LINE 1, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	360	n.a.
2	330	n.a.
3	300	158.6
4	270	80.2
5	240	74.6
6	210	69.4
7	180	62.2
8	150	59.4
9	120	49.4
10	90	49.4
11	60	39.8
12	30	31.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1800

 $V_1 = 1.69 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 50.50 m

TABLE A6. SEISMIC LINE 1, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	25.8
3	60	45.4
4	90	56.2
5	120	80.2
6	150	87.0
7	180	82.6
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.5800

 $V_1 = 0.53 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 19.94 m

TABLE A7. SEISMIC LINE 1, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	113.0
2	300	85.4
3	270	83.4
4	240	76.6
5	210	71.4
6	180	67.4
7	150	65.8
8	120	2.2
9	90	1.8
10	60	43.8
11	30	1.0
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1440

 $V_1 = 2.12 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 78.11 m

TABLE A8. SEISMIC LINE 1, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	30	24.6
2	0	0.0
3	30	5.0
4	60	23.0
5	90	47.8
6	120	50.6
7	150	63.0
8	180	n.a.
9	210	n.a.
10	240	n.a.
11	270	n.a.
12	300	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.4539

 $V_1 = 0.67$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.45 m

TABLE A9. SEISMIC LINE 1, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	360	n.a.
2	330	n.a.
3	300	n.a.
4	270	n.a.
5	240	90.6
6	210	87.8
7	180	76.6
8	150	n.a.
9	120	n.a.
10	90	55.4
11	60	n.a.
12	30	25.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2448

 $V_1 = 1.25$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 47.15 m

TABLE A10. SEISMIC LINE 2, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	n.a.
2	30	1.4
3	60	24.6
4	90	26.2
5	120	28.6
6	150	31.0
7	180	54.6
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slopes = 0.7733, 0.0720

 $V_1 = 0.39$ km/s $V_2 = 4.23$ km/s

Depth to basalt bedrock = 3.97 m

TABLE A11. SEISMIC LINE 2, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	n.a.
2	300	n.a.
3	270	108.2
4	240	115.0
5	210	88.6
6	180	90.2
7	150	49.0
8	120	n.a.
9	90	n.a.
10	60	40.6
11	30	2.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.4115

 $V_1 = 0.74$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 32.81 m

TABLE A12. SEISMIC LINE 2, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	30	23.4
2	0	0.0
3	30	13.0
4	60	19.8
5	90	33.0
6	120	42.2
7	150	81.4
8	180	n.a.
9	210	n.a.
10	240	109.8
11	270	n.a.
12	300	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3480

 $V_1 = 0.88$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.73 m

TABLE A13. SEISMIC LINE 2, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	360	n.a.
2	330	n.a.
3	300	99.8
4	270	140.6
5	240	103.8
6	210	108.6
7	180	97.4
8	150	n.a.
9	120	n.a.
10	90	63.8
11	60	31.8
12	30	23.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.5029

 $V_1 = 0.61$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 36.62 m

TABLE A14. SEISMIC LINE 6, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.8
3	20	16.6
4	30	27.8
5	40	40.6
6	50	55.0
7	60	57.0
8	70	n.a.
9	80	n.a.
10	90	79.0
11	100	86.6
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8858

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.60 m

TABLE A15. SEISMIC LINE 6, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	80.2
2	100	69.4
3	90	66.6
4	80	62.6
5	70	57.0
6	60	43.8
7	50	37.4
8	40	n.a.
9	30	n.a.
10	20	15.4
11	10	5.0
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7377

 $V_1 = 0.41$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.87 m

TABLE A16. SEISMIC LINE 7, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	25.4
3	60	45.8
4	90	72.6
5	120	81.8
6	150	119.4
7	180	137.0
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7701

 $V_1 = 0.40$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 24.44 m

TABLE A17. SEISMIC LINE 7, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	240	116.2
2	210	111.8
3	180	100.6
4	150	96.2
5	120	94.2
6	90	88.2
7	60	80.2
8	30	n.a.
9	0	0.0
10	30	n.a.
11	60	n.a.
12	90	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1924

 $V_1 = 1.58$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 84.49 m

TABLE A18. SEISMIC LINE 7, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	39.0
3	60	51.8
4	90	63.4
5	120	68.2
6	150	71.0
7	180	74.6
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1213

 $V_1 = 2.51$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 99.86 m

TABLE A19. SEISMIC LINE 7, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	240	86.6
2	210	83.0
3	180	68.6
4	150	65.4
5	120	63.8
6	90	57.8
7	60	50.2
8	30	31.0
9	0	0.0
10	30	30.2
11	60	n.a.
12	90	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2700

 $V_1 = 1.13$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 39.96 m

TABLE A20. SEISMIC LINE 7, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	n.a.
2	300	167.4
3	270	162.2
4	240	159.8
5	210	149.8
6	180	139.4
7	150	103.8
8	120	n.a.
9	90	n.a.
10	60	5.1
11	30	n.a.
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2280

 $V_1 = 1.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 102.43 m

TABLE A21. SEISMIC LINE 7, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	240	99.8
2	210	98.2
3	180	69.4
4	150	58.2
5	120	52.6
6	90	46.6
7	60	23.8
8	30	n.a.
9	0	0.0
10	30	52.6
11	60	n.a.
12	90	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT

Slope = 0.1933

 $V_1 = 1.58$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 40.06 m

TABLE A22. SEISMIC LINE 7, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	158.6
2	300	155.4
3	270	153.0
4	240	147.0
5	210	129.0
6	180	73.4
7	150	32.2
8	120	1.4
9	90	n.a.
10	60	54.2
11	30	n.a.
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.0933

 $V_1 = 0.52$ km/s $V_2 = 3.27$ km/s

Depth to basalt bedrock = 33.76 m

TABLE A23. SEISMIC LINE 7, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	24.2
3	60	50.6
4	90	73.4
5	120	93.4
6	150	102.6
7	180	113.0
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3267

 $V_1 = 0.93$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 47.51 m

TABLE A24. SEISMIC LINE 7, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	30.2
3	60	40.6
4	90	52.6
5	120	52.2
6	150	49.8
7	180	62.2
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.1800

 $V_1 = 1.69$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 45.23 m

TABLE A25. SEISMIC LINE 8, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.4
3	20	17.0
4	30	25.8
5	40	36.2
6	50	45.4
7	60	52.6
8	70	n.a.
9	80	n.a.
10	90	74.6
11	100	80.2
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8128

 $V_1 = 0.38$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.63 m

TABLE A26. SEISMIC LINE 8, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	86.2
2	100	73.8
3	90	60.2
4	80	59.0
5	70	52.6
6	60	47.8
7	50	41.4
8	40	n.a.
9	30	n.a.
10	20	14.6
11	10	4.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.7514

 $V_1 = 0.41$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.82 m

TABLE A27. SEISMIC LINE 8, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	19.0
3	20	16.6
4	30	24.2
5	40	29.8
6	50	30.2
7	60	33.0
8	70	n.a.
9	80	n.a.
10	90	38.2
11	100	42.2
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2048

 $V_1 = 1.49$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 27.68 m

TABLE A28. SEISMIC LINE 8, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	47.8
2	100	44.2
3	90	40.6
4	80	44.6
5	70	41.4
6	60	35.4
7	50	32.2
8	40	0.2
9	30	0.2
10	20	16.6
11	10	7.8
12	0	0.0

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.4226

 $V_1 = 0.72$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.37 m

TABLE A29. SEISMIC LINE 9, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	8.2
3	20	17.0
4	30	25.0
5	40	33.0
6	50	41.0
7	60	52.6
8	70	n.a.
9	80	n.a.
10	90	57.0
11	100	65.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.6239

 $V_1 = 0.49$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.07 m

TABLE A30. SEISMIC LINE 9, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	61.8
2	100	57.4
3	90	66.6
4	80	61.4
5	70	58.4
6	60	54.6
7	50	44.6
8	40	n.a.
9	30	n.a.
10	20	15.4
11	10	7.4
12	0.	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3900

 $V_1 = 0.78 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 23.75 m

TABLE A31. SEISMIC LINE 10, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	8.2
3	20	16.6
4	30	26.6
5	40	35.0
6	50	43.0
7	60	51.0
8	70	n.a.
9	80	n.a.
10	90	57.8
11	100	72.2
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7413

 $V_1 = 0.41 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 13.30 m

TABLE A32. SEISMIC LINE 10, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	81.8
2	100	77.8
3	90	70.6
4	80	56.6
5	70	47.0
6	60	33.0
7	50	41.0
8	40	n.a.
9	30	n.a.
10	20	15.0
11	10	7.0
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.7527

 $V_1 = 0.41$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.89 m

TABLE A33. SEISMIC LINE 11, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	14.2
3	20	14.2
4	30	17.4
5	40	22.6
6	50	23.0
7	60	25.0
8	70	n.a.
9	80	n.a.
10	90	37.0
11	100	43.8
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.1200

 $V_1 = 2.54$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 34.14 m

TABLE A34. SEISMIC LINE 11, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	57.0
2	100	54.2
3	90	49.0
4	80	39.0
5	70	33.8
6	60	30.2
7	50	25.8
8	40	n.a.
9	30	n.a.
10	20	17.4
11	10	6.2
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.5219

 $V_1 = 0.58$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.28 m

TABLE A35. SEISMIC LINE 12, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	8.2
3	20	16.6
4	30	24.6
5	40	33.4
6	50	42.6
7	60	50.6
8	70	n.a.
9	80	n.a.
10	90	66.2
11	100	68.6
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2400

 $V_1 = 1.27$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 40.83 m

TABLE A36. SEISMIC LINE 12, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	61.0
2	100	54.2
3	90	41.8
4	80	35.8
5	70	49.0
6	60	33.8
7	50	30.2
8	40	n.a.
9	30	n.a.
10	20	23.8
11	10	6.2
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.5451

 $V_1 = 0.56$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.79 m

TABLE A37. SEISMIC LINE 12, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	5.8
3	20	16.6
4	30	24.2
5	40	35.4
6	50	35.8
7	60	39.0
8	70	n.a.
9	80	n.a.
10	90	50.2
11	100	59.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3631

 $V_1 = 0.84$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.54 m

TABLE A38. SEISMIC LINE 12, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	63.0
2	100	61.8
3	90	61.8
4	80	48.6
5	70	45.8
6	60	43.4
7	50	41.8
8	40	n.a.
9	30	n.a.
10	20	15.4
11	10	6.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3611

 $V_1 = 0.84$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.50 m

TABLE A39. SEISMIC LINE 12, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	17.4
3	20	n.a.
4	30	27.0
5	40	34.6
6	50	39.0
7	60	43.0
8	70	n.a.
9	80	n.a.
10	90	49.0
11	100	53.4
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2462

 $V_1 = 1.24$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 29.75 m

TABLE A40. SEISMIC LINE 12, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	77.4
2	100	75.8
3	90	75.4
4	80	61.0
5	70	52.2
6	60	39.8
7	50	36.2
8	40	n.a.
9	30	n.a.
10	20	17.0
11	10	7.4
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1000

 $V_1 = 3.05$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 170.11 m

TABLE A41. SEISMIC LINE 12, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.8
3	20	16.6
4	30	26.2
5	40	35.0
6	50	43.0
7	60	50.6
8	70	n.a.
9	80	n.a.
10	90	52.6
11	100	53.8
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope₁ = 0.8593, Slope₂ = 0.0769 $V_1 = 0.35$ km/s $V_2 = 3.96$ km/s

Depth to basalt bedrock = 8.18 m

TABLE A42. SEISMIC LINE 12, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	50.6
2	100	47.8
3	90	43.8
4	80	39.4
5	70	40.6
6	60	36.6
7	50	36.2
8	40	n.a.
9	30	n.a.
10	20	17.4
11	10	6.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2457

 $V_1 = 1.24$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 27.47 m

TABLE A43. SEISMIC LINE 12, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	15.8
3	20	21.4
4	30	29.8
5	40	35.4
6	50	39.4
7	60	42.2
8	70	n.a.
9	80	n.a.
10	90	50.6
11	100	51.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2447

 $V_1 = 1.25$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 28.37 m

TABLE A44. SEISMIC LINE 12, SHOT 11

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	57.4
2	100	47.4
3	90	45.4
4	80	43.0
5	70	41.8
6	60	36.6
7	50	35.8
8	40	n.a.
9	30	n.a.
10	20	26.6
11	10	9.0
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2621

 $V_1 = 1.16$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 24.10 m

TABLE A45. SEISMIC LINE 12, SHOT 12

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.8
3	20	16.6
4	30	24.2
5	40	34.6
6	50	38.2
7	60	40.6
8	70	n.a.
9	80	n.a.
10	90	44.6
11	100	47.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1881

 $V_1 = 1.62$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 34.91 m

TABLE A46. SEISMIC LINE 12, SHOT 13

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	47.8
2	100	45.8
3	90	40.6
4	80	40.6
5	70	39.0
6	60	38.6
7	50	37.8
8	40	n.a.
9	30	n.a.
10	20	16.2
11	10	7.0
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope₁ = 0.7600, Slope₂ = 0.0686V₁ = 0.40 km/sV₂ = 4.44 km/s

Depth to basalt bedrock = 6.92 m

TABLE A47. SEISMIC LINE 12, SHOT 14

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	6.6
3	20	22.6
4	30	24.6
5	40	25.4
6	50	32.2
7	60	35.0
8	70	n.a.
9	80	n.a.
10	90	35.0
11	100	35.8
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1702

V₁ = 1.79 km/sV₂ = 3.87 km/s

Minimum depth to basalt bedrock = 28.21 m

TABLE A48. SEISMIC LINE 12, SHOT 15

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	44.6
2	100	40.2
3	90	35.4
4	80	35.8
5	70	34.2
6	60	31.4
7	50	31.0
8	40	n.a.
9	30	n.a.
10	20	15.0
11	10	16.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2251

 $V_1 = 1.35$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 25.98 m

TABLE A49. SEISMIC LINE 12, SHOT 16

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	8.6
3	20	16.6
4	30	30.2
5	40	37.4
6	50	32.6
7	60	33.4
8	70	n.a.
9	80	n.a.
10	90	49.0
11	100	52.2
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4259

 $V_1 = 0.72$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.14 m

TABLE A50. SEISMIC LINE 12, SHOT 17

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	53.4
2	100	37.0
3	90	35.4
4	80	34.6
5	70	32.2
6	60	31.0
7	50	30.2
8	40	n.a.
9	30	n.a.
10	20	16.6
11	10	7.8
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1417

 $V_1 = 2.15$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 37.69 m

TABLE A51. SEISMIC LINE 12, SHOT 18

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.8
3	20	15.4
4	30	24.2
5	40	29.4
6	50	30.2
7	60	31.4
8	70	n.a.
9	80	n.a.
10	90	35.0
11	100	41.4
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1143

 $V_1 = 2.67$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 51.37 m

TABLE A52. SEISMIC LINE 12, SHOT 19

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	37.4
2	100	35.8
3	90	33.8
4	80	32.6
5	70	31.8
6	60	31.4
7	50	29.0
8	40	n.a.
9	30	n.a.
10	20	21.4
11	10	6.2
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1639

 $V_1 = 1.86 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 30.48 m

TABLE A53. SEISMIC LINE 12, SHOT 20

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	7.4
3	20	23.0
4	30	28.6
5	40	35.8
6	50	39.4
7	60	40.6
8	70	n.a.
9	80	n.a.
10	90	39.8
11	100	41.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope₁ = 0.9280, Slope₂ = 0.0845 $V_1 = 0.33 \text{ km/s}$ $V_2 = 3.61 \text{ km/s}$

Depth to basalt bedrock = 5.34 m

TABLE A54. SEISMIC LINE 12, SHOT 21

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	37.8
2	100	37.0
3	90	36.6
4	80	35.0
5	70	33.4
6	60	32.6
7	50	31.0
8	40	n.a.
9	30	n.a.
10	20	16.6
11	10	7.8
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1157

 $V_1 = 2.64$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 52.41 m

TABLE A55. SEISMIC LINE 12, SHOT 22

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	1.4
3	20	16.6
4	30	25.0
5	40	29.4
6	50	33.0
7	60	42.2
8	70	n.a.
9	80	n.a.
10	90	45.8
11	100	46.6
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3120

 $V_1 = 0.98$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 19.55 m

TABLE A56. SEISMIC LINE 12. SHOT 23

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	39.8
2	100	43.4
3	90	39.0
4	80	35.8
5	70	31.4
6	60	28.6
7	50	25.8
8	40	n.a.
9	30	n.a.
10	20	25.0
11	10	7.8
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3531

 $V_1 = 0.86$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.73 m

TABLE A57. SEISMIC LINE 12. SHOT 24

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	6.6
3	20	15.8
4	30	21.4
5	40	23.8
6	50	26.2
7	60	28.6
8	70	n.a.
9	80	n.a.
10	90	29.8
11	100	31.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1252

 $V_1 = 2.44$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 36.22 m

TABLE A58. SEISMIC LINE 12, SHOT 25

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	36.6
2	100	34.6
3	90	33.0
4	80	23.4
5	70	27.0
6	60	26.2
7	50	23.0
8	40	n.a.
9	30	n.a.
10	20	15.4
11	10	5.8
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2086

 $V_1 = 1.46$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 22.05 m

TABLE A59. SEISMIC LINE 12, SHOT 26

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	6.6
3	20	21.8
4	30	25.8
5	40	28.6
6	50	29.4
7	60	29.4
8	70	n.a.
9	80	n.a.
10	90	31.4
11	100	39.0
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1833

 $V_1 = 1.66$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 28.66 m

TABLE A60. SEISMIC LINE 12, SHOT 27

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	48.6
2	100	45.8
3	90	43.4
4	80	41.0
5	70	38.2
6	60	37.4
7	50	32.6
8	40	n.a.
9	30	n.a.
10	20	15.4
11	10	4.6
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2320

 $V_1 = 1.31$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 27.90 m

TABLE A61. SEISMIC LINE 12, SHOT 28

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	12.6
3	20	17.8
4	30	19.4
5	40	19.0
6	50	21.4
7	60	27.0
8	70	n.a.
9	80	n.a.
10	90	32.6
11	100	34.6
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2136

 $V_1 = 1.43$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.52 m

TABLE A62. SEISMIC LINE 12, SHOT 29

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	39.0
2	100	32.2
3	90	35.8
4	80	31.8
5	70	28.6
6	60	27.8
7	50	28.6
8	40	n.a.
9	30	n.a.
10	20	17.8
11	10	9.4
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1743

 $V_1 = 1.75$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 29.74 m

TABLE A63. SEISMIC LINE 13, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.4
3	30	18.6
4	40	21.4
5	50	25.0
6	60	27.0
7	70	29.4
8	80	n.a.
9	90	n.a.
10	100	36.6
11	110	38.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2550

 $V_1 = 1.20$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.82 m

TABLE A64. SEISMIC LINE 13, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	41.0
2	110	38.2
3	100	39.4
4	90	35.8
5	80	35.4
6	70	34.2
7	60	33.0
8	50	n.a.
9	40	n.a.
10	30	27.4
11	20	19.4
12	10	14.6

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1427

 $V_1 = 2.14$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 40.42 m

TABLE A65. SEISMIC LINE 13, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.4
2	20	17.8
3	30	23.8
4	40	26.2
5	50	25.8
6	60	27.0
7	70	28.2
8	80	n.a.
9	90	n.a.
10	100	33.0
11	110	34.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1442

 $V_1 = 2.11$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 32.23 m

TABLE A66. SEISMIC LINE 13, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	37.4
2	110	36.2
3	100	35.0
4	90	34.2
5	80	33.0
6	70	31.0
7	60	29.0
8	50	n.a.
9	40	n.a.
10	30	19.4
11	20	17.4
12	10	15.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2114

 $V_1 = 1.44$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 21.72 m

TABLE A67. SEISMIC LINE 14, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	13.0
3	30	14.6
4	40	15.0
5	50	19.8
6	60	25.4
7	70	26.2
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope₁ = 0.2949 $V_1 = 1.03$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 11.10 m

TABLE A68. SEISMIC LINE 14, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	29.0
4	90	28.2
5	80	27.4
6	70	22.6
7	60	19.0
8	50	n.a.
9	40	n.a.
10	30	16.6
11	20	10.2
12	10	8.2

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope₁ = 0.2804, Slope₂ = 0.0800V₁ = 1.09 km/sV₂ = 3.81 km/s

Depth to basalt bedrock = 11.91 m

TABLE A69. SEISMIC LINE 14, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.4
2	20	10.6
3	30	13.0
4	40	15.0
5	50	16.6
6	60	19.8
7	70	23.8
8	80	n.a.
9	90	n.a.
10	100	27.8
11	110	35.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2777

V₁ = 1.10 km/sV₂ = 3.87 km/s

Minimum depth to basalt bedrock = 15.53 m

TABLE A70. SEISMIC LINE 14, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	35.0
2	110	30.6
3	100	28.2
4	90	23.8
5	80	24.2
6	70	23.8
7	60	24.2
8	50	n.a.
9	40	n.a.
10	30	21.8
11	20	16.6
12	10	7.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1514

 $V_1 = 2.01$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 30.12 m

TABLE A71. SEISMIC LINE 15, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	5.4
2	20	12.2
3	30	22.2
4	40	25.4
5	50	27.8
6	60	30.6
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	43.0
11	110	47.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3095

 $V_1 = 0.99$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 19.73 m

TABLE A72. SEISMIC LINE 15, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	58.6
2	110	55.0
3	100	54.2
4	90	49.4
5	80	45.4
6	70	42.2
7	60	43.8
8	50	n.a.
9	40	n.a.
10	30	20.2
11	20	15.4
12	10	11.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4452

 $V_1 = 0.68$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.10 m

TABLE A73. SEISMIC LINE 15, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	14.2
3	30	21.4
4	40	24.6
5	50	27.4
6	60	29.4
7	70	29.8
8	80	n.a.
9	90	n.a.
10	100	43.4
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.4040

 $V_1 = 0.75$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.67 m

TABLE A74. SEISMIC LINE 15, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	53.8
2	110	50.2
3	100	48.6
4	90	46.2
5	80	48.6
6	70	39.8
7	60	36.2
8	50	n.a.
9	40	n.a.
10	30	21.4
11	20	15.0
12	10	8.2

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4335

 $V_1 = 0.70$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.86 m

TABLE A75. SEISMIC LINE 16, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	11.0
3	20	25.4
4	30	41.8
5	40	46.2
6	50	49.4
7	60	n.a.
8	70	n.a.
9	80	n.a.
10	90	n.a.
11	100	n.a.
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3800

 $V_1 = 0.80$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.64 m

TABLE A76. SEISMIC LINE 16, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	n.a.
2	100	n.a.
3	90	75.4
4	80	73.0
5	70	70.2
6	60	61.4
7	50	57.4
8	40	n.a.
9	30	n.a.
10	20	42.2
11	10	n.a.
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4760

 $V_1 = 0.64$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 22.18 m

TABLE A77. SEISMIC LINE 16, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	10	31.0
3	20	38.2
4	30	44.2
5	40	53.8
6	50	n.a.
7	60	n.a.
8	70	n.a.
9	80	n.a.
10	90	n.a.
11	100	n.a.
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7440

 $V_1 = 0.41$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 10.44 m

TABLE A78. SEISMIC LINE 16, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	110	n.a.
2	100	n.a.
3	90	n.a.
4	80	n.a.
5	70	80.2
6	60	73.0
7	50	68.6
8	40	n.a.
9	30	n.a.
10	20	49.4
11	10	n.a.
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.6086

 $V_1 = 0.50$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.87 m

TABLE A79. SEISMIC LINE 17, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	5.4
2	20	9.4
3	30	17.0
4	40	21.8
5	50	26.6
6	60	27.8
7	70	30.2
8	80	n.a.
9	90	n.a.
10	100	39.8
11	110	44.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3900

 $V_1 = 0.78$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.34 m

TABLE A80. SEISMIC LINE 17, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	54.6
4	90	53.4
5	80	52.2
6	70	50.6
7	60	45.0
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	17.4
12	10	13.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1320

 $V_1 = 2.31$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 67.25 m

TABLE A81. SEISMIC LINE 17, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	4.6
2	20	13.0
3	30	22.6
4	40	29.4
5	50	39.8
6	60	49.8
7	70	55.4
8	80	n.a.
9	90	n.a.
10	100	77.4
11	110	82.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7847

 $V_1 = 0.39$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.44 m

TABLE A82. SEISMIC LINE 17, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	94.2
3	100	84.2
4	90	73.8
5	80	61.8
6	70	56.6
7	60	47.4
8	50	n.a.
9	40	n.a.
10	30	29.0
11	20	13.4
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8364

 $V_1 = 0.36$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.66 m

TABLE A83. SEISMIC LINE 18, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.4
3	30	24.6
4	40	30.2
5	50	32.6
6	60	35.0
7	70	43.4
8	80	n.a.
9	90	n.a.
10	100	61.4
11	110	64.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.5768

 $V_1 = 0.53$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.92 m

TABLE A84. SEISMIC LINE 18, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	62.2
2	110	59.4
3	100	55.0
4	90	55.0
5	80	53.8
6	70	50.6
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	n.a.
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2137

 $V_1 = 1.43 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 40.48 m

TABLE A85. SEISMIC LINE 18, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	3.4
2	20	14.2
3	30	21.4
4	40	30.6
5	50	35.8
6	60	42.6
7	70	45.4
8	80	n.a.
9	90	n.a.
10	100	59.0
11	110	60.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.5738

 $V_1 = 0.53 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 13.93 m

TABLE A86. SEISMIC LINE 18, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	71.4
4	90	67.0
5	80	50.2
6	70	52.6
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	n.a.
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7274

 $V_1 = 0.42$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.39 m

TABLE A87. SEISMIC LINE 18, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.4
3	30	24.2
4	40	30.2
5	50	37.0
6	60	44.6
7	70	47.8
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	49.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7112

 $V_1 = 0.43$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 29.91 m

TABLE A88. SEISMIC LINE 18, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	55.8
4	90	52.2
5	80	50.6
6	70	47.0
7	60	37.0
8	50	n.a.
9	40	n.a.
10	30	25.4
11	20	16.6
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2800

 $V_1 = 1.09$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 89.18 m

TABLE A89. SEISMIC LINE 18, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.4
3	30	24.6
4	40	34.2
5	50	36.6
6	60	39.4
7	70	48.2
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4667

 $V_1 = 0.65$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 46.40 m

TABLE A90. SEISMIC LINE 18, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	45.4
4	90	40.6
5	80	37.8
6	70	35.8
7	60	35.0
8	50	n.a.
9	40	n.a.
10	30	23.0
11	20	16.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2600

 $V_1 = 1.17$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.08 m

TABLE A91. SEISMIC LINE 18, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	15.8
3	30	25.4
4	40	33.8
5	50	40.2
6	60	42.2
7	70	44.2
8	80	n.a.
9	90	n.a.
10	100	49.0
11	110	50.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1663

 $V_1 = 1.83$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 43.23 m

TABLE A92. SEISMIC LINE 18, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	45.4
4	90	43.0
5	80	41.8
6	70	37.8
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	25.0
11	20	15.8
12	10	13.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2973

 $V_1 = 1.03$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 19.95 m

TABLE A93. SEISMIC LINE 18, SHOT 11

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.0
3	30	26.2
4	40	35.0
5	50	43.4
6	60	48.6
7	70	51.4
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2800

 $V_1 = 1.09$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 26.03 m

TABLE A94. SEISMIC LINE 18, SHOT 12

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	47.4
3	100	43.8
4	90	42.2
5	80	39.0
6	70	36.6
7	60	35.0
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	23.8
12	10	19.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2628

 $V_1 = 1.16$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.55 m

TABLE A95. SEISMIC LINE 18, SHOT 13

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	16.6
3	30	25.8
4	40	31.8
5	50	35.8
6	60	37.8
7	70	41.8
8	80	n.a.
9	90	n.a.
10	100	37.8
11	110	41.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3200

 $V_1 = 0.95$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.83 m

TABLE A96. SEISMIC LINE 18, SHOT 14

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	36.2
2	110	36.6
3	100	35.8
4	90	36.6
5	80	36.2
6	70	35.4
7	60	32.6
8	50	n.a.
9	40	n.a.
10	30	24.6
11	20	15.4
12	10	7.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.2429

 $V_1 = 1.26$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 19.84 m

TABLE A97. SEISMIC LINE 18, SHOT 15

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.8
3	30	25.0
4	40	33.4
5	50	35.8
6	60	35.8
7	70	38.2
8	80	n.a.
9	90	n.a.
10	100	39.4
11	110	41.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1001

 $V_1 = 3.05$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 80.80 m

TABLE A98. SEISMIC LINE 18, SHOT 16

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	n.a.
4	90	n.a.
5	80	n.a.
6	70	35.8
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	15.0
12	10	13.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.3826

 $V_1 = 0.80$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 12.33 m

TABLE A99. SEISMIC LINE 18, SHOT 17

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	5.8
2	20	13.4
3	30	28.2
4	40	29.0
5	50	31.4
6	60	34.6
7	70	35.4
8	80	n.a.
9	90	n.a.
10	100	37.0
11	110	37.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1284

 $V_1 = 2.37$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 43.80 m

TABLE A100. SEISMIC LINE 18, SHOT 18

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	49.0
2	110	46.2
3	100	41.0
4	90	34.6
5	80	31.4
6	70	26.2
7	60	23.4
8	50	n.a.
9	40	n.a.
10	30	11.4
11	20	8.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.4105

 $V_1 = 0.74$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.96 m

TABLE A101. SEISMIC LINE 19, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	n.a.
2	20	20.2
3	30	32.2
4	40	33.8
5	50	n.a.
6	60	n.a.
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.1600

 $V_1 = 1.91$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 33.55 m

TABLE A102. SEISMIC LINE 20, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	5.8
2	20	13.4
3	30	15.0
4	40	13.4
5	50	17.4
6	60	n.a.
7	70	19.8
8	80	n.a.
9	90	n.a.
10	100	31.4
11	110	33.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2268

 $V_1 = 1.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.73 m

TABLE A103. SEISMIC LINE 20, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	43.4
2	110	36.6
3	100	35.8
4	90	34.2
5	80	32.2
6	70	n.a.
7	60	30.2
8	50	n.a.
9	40	n.a.
10	30	22.6
11	20	17.8
12	10	13.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2200

 $V_1 = 1.39$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 25.19 m

TABLE A104. SEISMIC LINE 20, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	10.2
3	30	18.2
4	40	25.8
5	50	27.4
6	60	32.2
7	70	34.6
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3120

 $V_1 = 0.98$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 14.69 m

TABLE A105. SEISMIC LINE 20, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	47.0
2	110	46.2
3	100	45.8
4	90	45.4
5	80	45.0
6	70	42.2
7	60	40.2
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	13.4
12	10	13.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.3384

 $V_1 = 0.90$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.39 m

TABLE A106. SEISMIC LINE 20, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	16.6
3	30	24.6
4	40	29.8
5	50	33.4
6	60	37.4
7	70	40.6
8	80	n.a.
9	90	n.a.
10	100	49.4
11	110	49.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3146

 $V_1 = 0.97$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.59 m

TABLE A107. SEISMIC LINE 20, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	55.0
2	110	53.8
3	100	51.0
4	90	50.2
5	80	48.2
6	70	45.4
7	60	43.0
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	n.a.
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1986

 $V_1 = 1.54$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 38.08 m

TABLE A108. SEISMIC LINE 20, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.2
2	20	21.8
3	30	31.8
4	40	37.8
5	50	39.4
6	60	41.8
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	49.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1586

 $V_1 = 1.92$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 44.67 m

TABLE A109. SEISMIC LINE 20, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	47.4
4	90	45.8
5	80	41.4
6	70	39.0
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	16.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2960

 $V_1 = 1.03$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 21.12 m

TABLE A110. SEISMIC LINE 20, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.6
2	20	16.2
3	30	32.2
4	40	35.4
5	50	43.8
6	60	48.6
7	70	51.4
8	80	n.a.
9	90	n.a.
10	100	63.0
11	110	68.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.4453

 $V_1 = 0.68 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 20.85 m

TABLE A111. SEISMIC LINE 20, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	48.2
3	100	46.2
4	90	n.a.
5	80	45.0
6	70	41.8
7	60	39.0
8	50	n.a.
9	40	n.a.
10	30	17.8
11	20	9.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1693

 $V_1 = 1.80 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 40.22 m

TABLE A112. SEISMIC LINE 21, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.6
2	20	12.2
3	30	16.6
4	40	24.2
5	50	28.6
6	60	33.8
7	70	40.6
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	53.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4960

 $V_1 = 0.61$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.80 m

TABLE A113. SEISMIC LINE 21, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	109.4
2	110	98.2
3	100	90.2
4	90	79.8
5	80	71.8
6	70	62.6
7	60	52.6
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	9.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9054

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.89 m

TABLE A114. SEISMIC LINE 21, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	15.4
3	30	25.0
4	40	31.8
5	50	38.2
6	60	44.2
7	70	53.4
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7607

 $V_1 = 0.40$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 9.65 m

TABLE A115. SEISMIC LINE 21, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	108.2
2	110	99.0
3	100	85.0
4	90	79.4
5	80	70.2
6	70	61.0
7	60	51.8
8	50	n.a.
9	40	n.a.
10	30	24.6
11	20	15.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9003

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.78 m

TABLE A116. SEISMIC LINE 21, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	14.6
3	30	25.0
4	40	33.8
5	50	43.0
6	60	51.8
7	70	61.0
8	80	n.a.
9	90	n.a.
10	100	87.8
11	110	98.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9024

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.25 m

TABLE A117. SEISMIC LINE 21, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	109.4
2	110	99.0
3	100	89.8
4	90	81.0
5	80	71.8
6	70	62.2
7	60	53.8
8	50	n.a.
9	40	n.a.
10	30	22.2
11	20	16.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9229

 $V_1 = 0.33$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.57 m

TABLE A118. SEISMIC LINE 21, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.4
2	20	17.0
3	30	25.0
4	40	35.0
5	50	44.6
6	60	54.6
7	70	62.6
8	80	n.a.
9	90	n.a.
10	100	90.2
11	110	100.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9202

 $V_1 = 0.33$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.29 m

TABLE A119. SEISMIC LINE 21, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	104.6
2	110	96.6
3	100	86.6
4	90	76.6
5	80	67.8
6	70	57.8
7	60	49.4
8	50	n.a.
9	40	n.a.
10	30	21.4
11	20	13.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8963

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.24 m

TABLE A120. SEISMIC LINE 21, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	3.4
2	10	9.4
3	20	19.4
4	30	29.4
5	40	35.8
6	50	44.6
7	60	53.8
8	70	n.a.
9	80	n.a.
10	90	80.2
11	100	84.2
12	110	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8567

 $V_1 = 0.36 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 13.64 m

TABLE A121. SEISMIC LINE 21, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	101.8
2	110	93.4
3	100	85.0
4	90	74.6
5	80	67.8
6	70	59.0
7	60	49.4
8	50	n.a.
9	40	n.a.
10	30	24.2
11	20	15.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8568

 $V_1 = 0.36 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 16.50 m

TABLE A122. SEISMIC LINE 22, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.8
3	30	27.4
4	40	34.6
5	50	43.4
6	60	55.0
7	70	67.0
8	80	n.a.
9	90	n.a.
10	100	90.6
11	110	98.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9130

 $V_1 = 0.33 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 15.07 m

TABLE A123. SEISMIC LINE 22, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	68.6
4	90	67.0
5	80	65.4
6	70	61.8
7	60	52.2
8	50	n.a.
9	40	n.a.
10	30	23.8
11	20	16.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1600

 $V_1 = 1.91 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 66.47 m

TABLE A124. SEISMIC LINE 22, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	15.8
3	30	24.6
4	40	32.6
5	50	43.8
6	60	51.0
7	70	59.8
8	80	n.a.
9	90	n.a.
10	100	88.2
11	110	97.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8940

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.19 m

TABLE A125. SEISMIC LINE 22, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	107.4
2	110	97.4
3	100	89.0
4	90	81.8
5	80	71.4
6	70	58.6
7	60	53.0
8	50	n.a.
9	40	n.a.
10	30	26.2
11	20	17.4
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8958

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.73 m

TABLE A126. SEISMIC LINE 27, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	14.6
3	30	18.6
4	40	20.6
5	50	21.8
6	60	25.8
7	70	28.2
8	80	n.a.
9	90	31.4
10	100	32.6
11	110	36.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2152

 $V_1 = 1.42$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.96 m

TABLE A127. SEISMIC LINE 27, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	29.8
2	110	29.4
3	100	27.0
4	90	24.6
5	80	22.6
6	70	21.8
7	60	19.4
8	50	n.a.
9	40	15.8
10	30	15.4
11	20	15.0
12	10	9.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1627

 $V_1 = 1.87$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 21.79 m

TABLE A128. SEISMIC LINE 27, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	14.2
3	30	17.8
4	40	19.8
5	50	20.2
6	60	21.0
7	70	23.8
8	80	n.a.
9	90	n.a.
10	100	25.4
11	110	29.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.1400

 $V_1 = 2.18$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 26.78 m

TABLE A129. SEISMIC LINE 27, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	32.6
2	110	30.6
3	100	32.2
4	90	29.8
5	80	28.2
6	70	26.2
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	18.6
11	20	17.4
12	10	7.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1821

 $V_1 = 1.67$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 21.09 m

TABLE A130. SEISMIC LINE 27, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.6
2	20	14.6
3	30	20.6
4	40	24.2
5	50	25.4
6	60	28.2
7	70	27.8
8	80	n.a.
9	90	n.a.
10	100	32.6
11	110	35.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1683

 $V_1 = 1.81$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 27.81 m

TABLE A131. SEISMIC LINE 27, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	39.8
2	110	36.6
3	100	34.2
4	90	32.2
5	80	29.8
6	70	30.2
7	60	30.2
8	50	n.a.
9	40	n.a.
10	30	26.6
11	20	16.6
12	10	8.2

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1563

 $V_1 = 1.95$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 34.27 m

TABLE A132. SEISMIC LINE 27, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.2
2	20	18.2
3	30	22.2
4	40	25.4
5	50	26.2
6	60	31.0
7	70	35.0
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	47.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3179

 $V_1 = 0.96$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.97 m

TABLE A133. SEISMIC LINE 27, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	54.6
2	110	54.2
3	100	53.8
4	90	52.6
5	80	50.6
6	70	49.4
7	60	45.4
8	50	n.a.
9	40	n.a.
10	30	26.2
11	20	16.6
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1443

 $V_1 = 2.11$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 56.92 m

TABLE A134. SEISMIC LINE 27, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.2
2	20	17.0
3	30	25.8
4	40	37.4
5	50	42.2
6	60	47.0
7	70	49.4
8	80	n.a.
9	90	n.a.
10	100	53.0
11	110	56.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.2426

 $V_1 = 1.26$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 31.85 m

TABLE A135. SEISMIC LINE 27, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	55.8
2	110	55.4
3	100	56.6
4	90	51.4
5	80	47.4
6	70	43.4
7	60	41.8
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	17.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3760

 $V_1 = 0.81$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.20 m

TABLE A136. SEISMIC LINE 27, SHOT 11

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.6
2	20	19.8
3	30	29.0
4	40	33.4
5	50	38.2
6	60	40.6
7	70	43.8
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3680

 $V_1 = 0.83$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.24 m

TABLE A137. SEISMIC LINE 27, SHOT 12

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	58.6
2	110	n.a.
3	100	n.a.
4	90	44.6
5	80	43.8
6	70	42.6
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	29.4
11	20	19.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.3343

 $V_1 = 0.91$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.06 m

TABLE A138. SEISMIC LINE 27, SHOT 13

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.6
2	20	18.2
3	30	29.0
4	40	36.2
5	50	36.6
6	60	40.6
7	70	44.6
8	80	n.a.
9	90	n.a.
10	100	46.2
11	110	49.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1882

 $V_1 = 1.62$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 36.69 m

TABLE A139. SEISMIC LINE 27, SHOT 14

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	57.8
2	110	50.6
3	100	49.4
4	90	49.0
5	80	44.2
6	70	40.6
7	60	38.6
8	50	n.a.
9	40	n.a.
10	30	25.8
11	20	17.4
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.2957

 $V_1 = 1.03$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 25.86 m

TABLE A140. SEISMIC LINE 27, SHOT 15

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.0
2	20	17.0
3	30	27.4
4	40	31.8
5	50	35.0
6	60	36.6
7	70	39.8
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2960

 $V_1 = 1.03$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.32 m

TABLE A141. SEISMIC LINE 27, SHOT 16

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	48.2
2	110	46.2
3	100	43.8
4	90	39.8
5	80	39.0
6	70	36.6
7	60	35.0
8	50	n.a.
9	40	n.a.
10	30	27.8
11	20	20.6
12	10	13.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1680

 $V_1 = 1.81$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 33.60 m

TABLE A142. SEISMIC LINE 27, SHOT 17

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	2.2
2	20	11.0
3	30	17.4
4	40	21.0
5	50	25.0
6	60	32.2
7	70	32.6
8	80	n.a.
9	90	n.a.
10	100	39.4
11	110	42.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3051

 $V_1 = 1.00$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.55 m

TABLE A143. SEISMIC LINE 27, SHOT 18

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	n.a.
4	90	49.4
5	80	n.a.
6	70	37.8
7	60	33.8
8	50	n.a.
9	40	n.a.
10	30	23.8
11	20	19.4
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4082

 $V_1 = 0.75$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.10 m

TABLE A144. SEISMIC LINE 28, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.4
2	20	12.6
3	30	16.6
4	40	25.8
5	50	28.2
6	60	31.4
7	70	33.0
8	80	n.a.
9	90	n.a.
10	100	39.8
11	110	41.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2268

 $V_1 = 1.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.75 m

TABLE A145. SEISMIC LINE 28, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	49.4
2	110	49.4
3	100	52.2
4	90	51.8
5	80	51.0
6	70	49.0
7	60	48.2
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	18.6
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1080

 $V_1 = 2.82$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 91.46 m

TABLE A146. SEISMIC LINE 28, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.6
2	20	18.2
3	30	26.2
4	40	35.8
5	50	45.0
6	60	53.8
7	70	63.0
8	80	n.a.
9	90	n.a.
10	100	89.8
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9004

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.92 m

TABLE A147. SEISMIC LINE 28, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	104.6
2	110	99.0
3	100	89.8
4	90	80.2
5	80	71.0
6	70	61.4
7	60	52.6
8	50	n.a.
9	40	n.a.
10	30	25.8
11	20	17.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8924

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.32 m

TABLE A148. SEISMIC LINE 28, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.4
2	20	18.2
3	30	27.4
4	40	36.2
5	50	45.0
6	60	53.0
7	70	62.6
8	80	n.a.
9	90	n.a.
10	100	89.4
11	110	98.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8893

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.41 m

TABLE A149. SEISMIC LINE 28, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	106.6
2	110	97.8
3	100	87.8
4	90	78.6
5	80	70.2
6	70	61.4
7	60	47.8
8	50	n.a.
9	40	n.a.
10	30	23.8
11	20	15.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9030

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 16.46 m

TABLE A150. SEISMIC LINE 28, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.0
2	20	18.2
3	30	27.0
4	40	36.6
5	50	44.6
6	60	54.6
7	70	63.0
8	80	n.a.
9	90	n.a.
10	100	90.6
11	110	98.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8981

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.26 m

TABLE A151. SEISMIC LINE 28, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	107.0
2	110	97.4
3	100	89.0
4	90	79.8
5	80	75.0
6	70	68.6
7	60	63.4
8	50	n.a.
9	40	n.a.
10	30	n.a.
11	20	n.a.
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8649

 $V_1 = 0.35$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.26 m

TABLE A152. SEISMIC LINE 28, SHOT 9

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.8
2	20	17.4
3	30	27.8
4	40	35.0
5	50	43.0
6	60	48.2
7	70	52.6
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.7669

 $V_1 = 0.40$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 9.41 m

TABLE A153. SEISMIC LINE 28, SHOT 10

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	108.2
2	110	98.6
3	100	90.2
4	90	81.0
5	80	72.2
6	70	64.2
7	60	55.0
8	50	n.a.
9	40	n.a.
10	30	34.2
11	20	19.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.8751

 $V_1 = 0.35$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.27 m

TABLE A154. SEISMIC LINE 28, SHOT 11

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.6
2	20	19.8
3	30	36.6
4	40	42.6
5	50	45.8
6	60	53.8
7	70	57.0
8	80	n.a.
9	90	n.a.
10	100	65.4
11	110	71.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.4164

 $V_1 = 0.73$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.54 m

TABLE A155. SEISMIC LINE 28, SHOT 12

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	62.6
2	110	59.8
3	100	57.4
4	90	52.6
5	80	n.a.
6	70	38.2
7	60	35.4
8	50	n.a.
9	40	n.a.
10	30	26.6
11	20	19.0
12	10	15.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.4424

 $V_1 = 0.69$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.61 m

TABLE A156. SEISMIC LINE 28, SHOT 13

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	14.6
3	30	24.2
4	40	30.2
5	50	33.4
6	60	33.8
7	70	37.8
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	45.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2145

 $V_1 = 1.42 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 28.07 m

TABLE A157. SEISMIC LINE 28, SHOT 14

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	51.4
2	110	49.8
3	100	48.2
4	90	45.4
5	80	43.0
6	70	41.4
7	60	38.6
8	50	n.a.
9	40	n.a.
10	30	25.8
11	20	16.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2157

 $V_1 = 1.41 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 31.84 m

TABLE A158. SEISMIC LINE 28, SHOT 15

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.4
3	30	27.4
4	40	34.2
5	50	37.8
6	60	39.8
7	70	42.2
8	80	n.a.
9	90	n.a.
10	100	46.6
11	110	48.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1883

 $V_1 = 1.62$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 35.24 m

TABLE A159. SEISMIC LINE 28, SHOT 16

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	64.2
2	110	62.2
3	100	57.8
4	90	52.2
5	80	50.2
6	70	49.4
7	60	42.6
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	17.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3500

 $V_1 = 0.87$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 24.47 m

TABLE A160. SEISMIC LINE 28, SHOT 17

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.0
3	30	26.6
4	40	33.0
5	50	36.2
6	60	38.2
7	70	38.6
8	80	n.a.
9	90	n.a.
10	100	43.8
11	110	49.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1683

 $V_1 = 1.81$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 36.82 m

TABLE A161. SEISMIC LINE 28, SHOT 18

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	57.4
2	110	55.4
3	100	53.0
4	90	45.8
5	80	44.6
6	70	41.4
7	60	39.4
8	50	n.a.
9	40	n.a.
10	30	25.4
11	20	16.6
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3229

 $V_1 = 0.94$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.34 m

TABLE A162. SEISMIC LINE 28, SHOT 19

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.2
2	20	18.6
3	30	28.6
4	40	37.4
5	50	46.2
6	60	49.8
7	70	51.4
8	80	n.a.
9	90	n.a.
10	100	47.4
11	110	48.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.2600

 $V_1 = 1.17$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 28.23 m

TABLE A163. SEISMIC LINE 28, SHOT 20

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	83.4
2	110	74.2
3	100	67.0
4	90	61.4
5	80	55.4
6	70	51.4
7	60	43.8
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	18.2
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.6501

 $V_1 = 0.47$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.47 m

TABLE A164. SEISMIC LINE 28, SHOT 21

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.4
2	20	19.4
3	30	27.8
4	40	36.6
5	50	41.4
6	60	47.8
7	70	50.2
8	80	n.a.
9	90	n.a.
10	100	51.0
11	110	53.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1576

 $V_1 = 1.93$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 50.41 m

TABLE A165. SEISMIC LINE 28, SHOT 22

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	53.8
2	110	51.8
3	100	50.2
4	90	48.2
5	80	46.2
6	70	45.4
7	60	45.0
8	50	n.a.
9	40	n.a.
10	30	26.2
11	20	15.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1543

 $V_1 = 1.98$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 50.95 m

TABLE A166. SEISMIC LINE 28, SHOT 23

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.8
2	20	18.6
3	30	27.8
4	40	37.4
5	50	42.6
6	60	45.4
7	70	47.4
8	80	n.a.
9	90	n.a.
10	100	50.6
11	110	53.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1567

 $V_1 = 1.95 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 49.89 m

TABLE A167. SEISMIC LINE 28, SHOT 24

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	53.0
2	110	50.6
3	100	48.6
4	90	46.2
5	80	42.2
6	70	40.6
7	60	37.0
8	50	n.a.
9	40	n.a.
10	30	27.4
11	20	17.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2844

 $V_1 = 1.07 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 24.29 m

TABLE A168. SEISMIC LINE 28, SHOT 25

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.0
2	20	17.4
3	30	26.2
4	40	35.8
5	50	n.a.
6	60	n.a.
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	62.2
11	110	67.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.4437

 $V_1 = 0.69$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.37 m

TABLE A169. SEISMIC LINE 28, SHOT 26

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	51.4
2	110	47.8
3	100	45.4
4	90	43.0
5	80	41.8
6	70	40.2
7	60	39.8
8	50	n.a.
9	40	n.a.
10	30	31.4
11	20	23.0
12	10	17.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2030

 $V_1 = 1.50$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 34.18 m

TABLE A170. SEISMIC LINE 28, SHOT 27

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	18.6
3	30	28.2
4	40	34.6
5	50	38.6
6	60	43.4
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	49.4
11	110	52.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2332

 $V_1 = 1.31$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 30.51 m

TABLE A171. SEISMIC LINE 28, SHOT 28

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	64.6
2	110	61.0
3	100	55.8
4	90	51.4
5	80	49.0
6	70	47.4
7	60	43.4
8	50	n.a.
9	40	n.a.
10	30	29.4
11	20	21.0
12	10	13.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.3486

 $V_1 = 0.87$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 24.76 m

TABLE A172. SEISMIC LINE 28, SHOT 29

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.0
2	20	18.2
3	30	29.4
4	40	38.6
5	50	39.0
6	60	41.4
7	70	43.0
8	80	n.a.
9	90	n.a.
10	100	45.4
11	110	46.2
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1121

 $V_1 = 2.72$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 71.74 m

TABLE A173. SEISMIC LINE 28, SHOT 30

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	49.0
2	110	46.6
3	100	44.2
4	90	41.4
5	80	39.0
6	70	37.0
7	60	33.8
8	50	n.a.
9	40	n.a.
10	30	25.8
11	20	17.4
12	10	7.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2500

 $V_1 = 1.22$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 25.41 m

TABLE A174. SEISMIC LINE 31, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.2
2	20	13.4
3	30	19.0
4	40	23.0
5	50	26.6
6	60	27.0
7	70	29.8
8	80	n.a.
9	90	n.a.
10	100	39.8
11	110	42.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2872

 $V_1 = 1.06$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 18.73 m

TABLE A175. SEISMIC LINE 31, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	48.2
2	110	50.6
3	100	51.8
4	90	50.6
5	80	46.2
6	70	41.8
7	60	38.2
8	50	n.a.
9	40	n.a.
10	30	26.6
11	20	23.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3912

 $V_1 = 0.78$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 17.31 m

TABLE A176. SEISMIC LINE 31, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.0
2	20	18.2
3	30	28.2
4	40	36.6
5	50	43.4
6	60	46.6
7	70	n.a.
8	80	n.a.
9	90	n.a.
10	100	n.a.
11	110	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3200

 $V_1 = 0.95$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 20.58 m

TABLE A177. SEISMIC LINE 31, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	n.a.
2	110	n.a.
3	100	67.8
4	90	n.a.
5	80	57.4
6	70	51.0
7	60	n.a.
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	17.0
12	10	12.6

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.6586

 $V_1 = 0.46$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 13.97 m

TABLE A178. SEISMIC LINE 31, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.0
2	20	16.6
3	30	25.8
4	40	33.8
5	50	43.8
6	60	52.6
7	70	62.6
8	80	n.a.
9	90	n.a.
10	100	89.4
11	110	98.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9067

 $V_1 = 0.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.18 m

TABLE A179. SEISMIC LINE 32, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	4.6
2	20	10.2
3	30	14.2
4	40	17.8
5	50	20.6
6	60	19.8
7	70	22.6
8	80	n.a.
9	90	n.a.
10	100	22.6
11	110	23.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope₁ = 0.4820, Slope₂ = 0.0800 $V_1 = 0.63$ km/s $V_2 = 3.81$ km/s

Depth to basalt bedrock = 4.81 m

TABLE A180. SEISMIC LINE 32, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	28.2
2	110	31.0
3	100	33.4
4	90	31.8
5	80	30.6
6	70	29.0
7	60	25.8
8	50	n.a.
9	40	n.a.
10	30	20.2
11	20	13.4
12	10	6.6

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1924

 $V_1 = 1.58 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 22.16 m

TABLE A181. SEISMIC LINE 32, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.4
3	30	21.4
4	40	23.8
5	50	24.6
6	60	27.0
7	70	28.2
8	80	n.a.
9	90	n.a.
10	100	31.4
11	110	33.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1382

 $V_1 = 2.21 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 33.74 m

TABLE A182. SEISMIC LINE 32, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	42.2
2	110	38.2
3	100	37.0
4	90	32.6
5	80	31.4
6	70	30.2
7	60	27.8
8	50	n.a.
9	40	n.a.
10	30	21.4
11	20	17.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.2274

 $V_1 = 1.34$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 23.40 m

TABLE A183. SEISMIC LINE 32, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	6.6
2	20	17.8
3	30	22.2
4	40	27.8
5	50	31.4
6	60	41.4
7	70	46.6
8	80	n.a.
9	90	n.a.
10	100	39.0
11	110	47.8
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.4640

 $V_1 = 0.66$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 9.15 m

TABLE A184. SEISMIC LINE 32, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	54.6
2	110	53.8
3	100	52.6
4	90	51.4
5	80	53.0
6	70	53.4
7	60	53.4
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	19.0
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=D)

Slope = 0.8646

 $V_1 = 0.35$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 8.62 m

TABLE A185. SEISMIC LINE 33, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	10.2
2	20	15.4
3	30	19.0
4	40	22.2
5	50	23.4
6	60	23.8
7	70	23.8
8	80	n.a.
9	90	n.a.
10	100	27.8
11	110	30.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1214

 $V_1 = 2.51$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 36.20 m

TABLE A186. SEISMIC LINE 33, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	37.0
2	110	36.6
3	100	36.2
4	90	35.4
5	80	33.0
6	70	29.4
7	60	27.0
8	50	n.a.
9	40	n.a.
10	30	24.2
11	20	18.6
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1494

 $V_1 = 2.04$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 33.08 m

TABLE A187. SEISMIC LINE 33, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	7.8
2	20	17.4
3	30	26.2
4	40	27.0
5	50	29.8
6	60	30.6
7	70	33.8
8	80	n.a.
9	90	n.a.
10	100	41.4
11	110	43.0
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.2226

 $V_1 = 1.37$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 25.14 m

TABLE A188. SEISMIC LINE 33, SHOT 4

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	48.2
2	110	49.0
3	100	47.8
4	90	46.6
5	80	45.0
6	70	43.8
7	60	43.8
8	50	n.a.
9	40	n.a.
10	30	27.0
11	20	17.0
12	10	7.8

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.1320

$V_1 = 2.31$ km/s

$V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 58.05 m

TABLE A189. SEISMIC LINE 33, SHOT 5

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	9.8
2	20	18.2
3	30	27.4
4	40	36.6
5	50	45.0
6	60	50.2
7	70	52.2
8	80	n.a.
9	90	n.a.
10	100	55.4
11	110	57.4
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope = 0.1341

$V_1 = 2.27$ km/s

$V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 68.46 m

TABLE A190. SEISMIC LINE 33, SHOT 6

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	85.0
2	110	82.2
3	100	77.4
4	90	73.0
5	80	69.4
6	70	67.0
7	60	54.6
8	50	n.a.
9	40	n.a.
10	30	27.8
11	20	17.8
12	10	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.3794

 $V_1 = 0.80$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 31.03 m

TABLE A191. SEISMIC LINE 33, SHOT 7

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	10	8.2
2	20	17.8
3	30	27.0
4	40	35.8
5	50	45.4
6	60	54.2
7	70	63.0
8	80	n.a.
9	90	n.a.
10	100	92.2
11	110	98.6
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9107

 $V_1 = 0.33$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 15.11 m

TABLE A192. SEISMIC LINE 33, SHOT 8

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	120	109.4
2	110	99.4
3	100	92.2
4	90	86.6
5	80	70.6
6	70	63.4
7	60	54.6
8	50	n.a.
9	40	n.a.
10	30	27.4
11	20	17.4
12	10	9.4

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=A)

Slope = 0.9172

 $V_1 = 0.33 \text{ km/s}$ $V_2 = 3.87 \text{ km/s}$

Minimum depth to basalt bedrock = 16.67 m

TABLE A193. SEISMIC LINE 35, SHOT 1

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	0	0.0
2	30	26.2
3	60	53.0
4	90	79.4
5	120	82.2
6	150	84.6
7	180	90.6
8	210	n.a.
9	240	n.a.
10	270	n.a.
11	300	n.a.
12	330	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=B)

Slope₁ = 0.8333, Slope₂ = 0.0867 $V_1 = 0.37 \text{ km/s}$ $V_2 = 3.52 \text{ km/s}$

Depth to basalt bedrock = 13.18 m

TABLE A194. SEISMIC LINE 35, SHOT 2

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	330	n.a.
2	300	n.a.
3	270	125.4
4	240	n.a.
5	210	n.a.
6	180	117.0
7	150	109.4
8	120	n.a.
9	90	n.a.
10	60	55.0
11	30	n.a.
12	0	0.0

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.0933

 $V_1 = 3.27$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 317.56 m

TABLE A195. SEISMIC LINE 35, SHOT 3

Geophone	Distance from Source (ft)	Arrival Time (ms)
1	210	n.a.
2	180	n.a.
3	150	111.0
4	120	107.4
5	90	80.6
6	60	63.4
7	30	45.0
8	0	0.0
9	30	n.a.
10	60	n.a.
11	90	n.a.
12	120	n.a.

n.a.=not available.

CALCULATIONS FOR SHOT (GRADE=C)

Slope = 0.1200

 $V_1 = 2.54$ km/s $V_2 = 3.87$ km/s

Minimum depth to basalt bedrock = 167.03 m