Item (1) C. .2) Seismic Survey

A description of the headings for the columnar survey data and weathering correction data is provided below:

Symbol	Description
RODLOC	Rod location
ELEVRD	Elevation of the rod
ELEV. ANG	Elevation angle from the transit rod
FAZ	Foresite azimuth
DISTANCE	Distance
XLOC	X Distance from origin
YLOC	Y Distance from origin
DSCRPT	Description
ATP	Location of transit or shot point

Under "DATUM", the sequential numbers refer to the geophone positions. The second column lists elevations of the positions. The third column contains total corrections to datum.

The weathering factor (line 9) refers to an aerated shallow subsurface section between the water table and surface which varies in thickness and due to aeration is low velocity material. This characteristic of the shallow subsurface is a natural occurrence and makes reflectance events appear crooked.

The formula used for the weathering correction is as follows:

$$T_R + T_W = T_C \text{ , where}$$

T_R = Time in subsurface weathered zone

T_W = Time in weathered layer

T_C = Total correction for specific geophone

The total correction for a specific geophone is the sum of the time in the subsurface weathered zone plus the time in the

weathered layer. It was assumed that the weathered layer is equal to .5 (one-half) of the difference between elevation and datum. The distance of the weathered layer is divided by the velocity in the weathered layer to achieve the time in the weathered layer. And, the distance of the subsurface weathered zone is divided by the velocity of the subsurface weathered zone to achieve the time in the subsurface weathered zone.

$$T_R = \frac{D}{V_R} \text{ and } T_W = \frac{D}{V_W}$$

and, $T_R + T_W = T_C$ Total correction for specific geophone.

The last page of tabulations is a velocity analysis. A description of the columnar headings appears below:

Symbol	Description
TD	Reflection time
VRMS	Root Mean Square Velocity
VAVE	Average velocity
DEPTH	Depth
AVE. DENS	Average density from average velocity
HYDR. PRESS.	(Depth) X (.465) = pounds per square inch of Hydrostatic pressure
DINT	Depth Interval
VINT	Interval Velocity
INT. DENS.	Interval Density
PHI	Average porosity of Interval
F.P.	Formation pressure
DELTA T	Interval transit time in microseconds per foot
MUD WT	Drilling weight required to keep hole open
VZ	Linear increase in velocity with depth
VK	Linear increase in velocity with time

Please note that the correct datum plane elevation is 6,000 feet and not 0 (zero) feet as it is indicated on the last page of the tabulations.

Technical Memorandum
Research Department
Union Oil Company of California
Union Research Center, Brea, California

UNION 76

Memo: E&PE 77-32M

From: W. R. Fillippone

Date: April 18, 1977

Division: Exploration and Production Research

Project: 627-68711

Subject: SEISMIC SURVEY, COVE FORT, UTAH

SUMMARY

During the period from November 9 to November 17, 1976, the research seismic equipment was used to conduct a seismic survey of nine lines in the Cove Fort Area, Utah. Four lines were near the Union No. 1 Well in the NENE Section 29, T25S, R6W, Millard County, Utah, two were near the townsite of Cove Fort, and three were near Sulphurdale, three miles south of Cove Fort. The data are extremely poor, dips are steep, and correlation to lithology is unreliable. (deletion, 1)*

Poor performance of the energy source used resulted from the high altitude (>6000 feet [1829 meters]) and lack of multiplicity of fold, (deletion, 2)*

Dips range from flat to vertical and some are overturned. Five reflection events were selected and correlated from line to line, but much doubt is expressed for their correlations and continuities. No recommendation can be made for a drill site location based on the seismic interpretation. All data were corrected to a datum plane of 6000 feet (1829 meters) above sea level.

INTERPRETATION OF THE LINES

Line 1 has a direction generally S15°W from the SW corner of Section 21, T25S, R6W. It has a total length of 4180 feet (1274 meters). The dip component is approximately 65° southerly on all horizons. Line 2 extends approximately S65°W from this same section corner and has a general dip component of 10° southwest.

* See page 5 for reasons for text deletions.

The resolution of the shallowest (A) horizon shows a depth of 1400 feet (427 meters) in the southeast quarter of Section 20 and a dip of 55°, S18°E.

Line 3 is a continuation of Line 2 with a general direction of S55°W. Dip components are 12° southwest along the east half and 4° southwest along the west half.

Line 4 has a general direction of S18°E. The dip component along the south half of the line is 13° northwest and 5° southeast for the north half of the line.

Resolution of these dips for horizon (A) at the intersection of these two lines shows a dip of 20°, N60°W at a depth of 2369 feet (722 meters) in the center of Section 29, and a dip of 7°, S49°E at a depth of 2745 feet (837 meters) at the northwest corner of Section 29.

Line 7 is along the west side of Section 30 and runs S12°E. The dip component along this line in the shallow section is 68° northwest. At the north end of the line, a strong southerly component is present but cannot be resolved for lack of a cross component.

Line 8 extends along the Cove Fort Road along the south line of Section 30, has a general direction of N75°W, and a dip component of 36°. Resolution of the dips at the intersection of Lines 7 and 8 for the (A) horizon shows a dip of 76°, N21°W at a depth of 1552 feet (473 meters) at the center of Section 31. Dips from deeper events are vertical and south of this section.

Line 9 is along the road west of Sulphurdale and extends N20°E to tie Lines 10 and 11. The dip component along Line 9 is 38° northeast.

Line 10 extends S79E from the south end of Line 9 and has a dip component of 25° southeast. Resolution of Lines 9 and 10 at horizon (A) shows a dip of 43°, N47°E at a depth of 3957 feet (1206 meters) in the northeast quarter of Section 14, T26S, R7W.

Line 11 extends S75°E from the north end of Line 9 and has a dip component of 35° southeast. Resolution of Lines 9 and 11 at horizon (A) shows a dip of 56°, N60°E at a depth of 4637 feet (1413 meters) in the northeast quarter of Section 11.

Correlative events on the southeast ends of Lines 10 and 11 equivalent to horizon (A) show dips of 23° and 24°, N60°W, at depths of 1739 and 2093 feet (530 and 638 meters), respectively. Projection of this event to the surface suggests it is the top of the Tbc volcanics if the faults have no significant throw.

RECORD SECTIONS

Line 1 composite record section Shot Point 1 has prominent reflection events at 0.4 (A), 0.87 (B), 1.03 (C), 1.21 (D), and 1.45 (E) which have a southerly component of 0.360 second to Shot Point 39. Relatively flat events occur

in the central part of the line from SP 12, traces 1-24. An event at 0.120 second would have a depth of 950 feet (290 meters) below the surface. Strong dips at SP 39 have a north component of 0.530 second per spread or 67° northerly at a depth of 1049 feet (320 meters). The (deletion, 3)*line 1 exhibits these same trends, though all of the data in this area are poorly continuous.

Lines 2 and 3 show a gentle westerly component in very poor data by any source. It is not possible to define any faulting but correlation from east to west does not confirm any major faulting.

Line 4 appears to be gently synclinal, but has some strong events dipping southerly 73° from the north end of the line at a depth of 985 feet (300 meters). Both energy source type sections agree.

Line 8 has many short segments of reflection events which dip strongly west except for very shallow events to 0.5 second which may be adversely affected by the normal move out correlation. These events are probably reflected refractions from the highway nearby. The(deletion, 4)*Line 8 has a number of events which show strong easterly trends, and some nearly flat events in the shallow section. The two sections show agreement only if the low dip segments are picked exclusively.

Line 7 also has flat dips in the shallow section to 0.5 second but all deeper events dip strongly northward.

Line 9 is on alluvial fill with large weathering problems but the reflection events all appear to dip strongly to the north at 40 degrees, though the normal moveout has an abnormal affect on those events, indicating they are at least not in the plane of the record section. Some short segments can be picked that are nearly horizontal.

Lines 10 and 11 show components that dip generally eastward below 0.8 second. Some short segments are nearly horizontal and some in the shallow section on the east ends of the lines show strong west components at 24° dip. One can pick segments on all three lines near Sulphurdale to show that the events under the lines are nearly horizontal to a depth of 6000 feet (1829 meters).

(deletion, 5)*

(deletion, 6)*

* See page 5 for reason for text deletions.

PROCESSING

Velocity analyses were run on several lines, but because of the steep dip it was difficult to find agreement. A composite velocity analysis yielded a function of VZ = 8852 + 1.12 Z ft/sec (2698 + 1.12 Z m/sec) for normal moveout and depth calculations. Datum was chosen at 6000 feet (1829 meters) above sea level and all traces and shot points were corrected to the flat datum using 2500 feet (762 meters) per second for the weathering velocity and 10,000 feet (3048 meters) per second for the datum correction velocity. Weathering was assumed to be one half the depth from surface to datum since no adequate calculation from refraction breaks was possible. True dips were calculated from components of intersecting lines. All elevations were calculated from transit survey notes tied to the BM at Cove Fort with an elevation of 5998 feet (1828 meters) above sea level. Trace interval was 110 feet (33.5 meters). Twenty-four trace spreads were shot off-end. Nine geophones per trace, fifteen feet (five meters) apart were used. Individual shots were vertically stacked, normal moveout was removed, and datum time corrections were applied. The traces were filtered using a band pass filter from 10-35 Hertz, down 36 db at 5 and 40 Hertz.

ENERGY SOURCES

(deletion, 7)*

Three shots were taken at each shot point and were vertically stacked. The air wave is visible across the record traveling at 1130 feet (344 meters) per second. Shots were made at 100, 165, and 220 feet (33.5, 50, and 67 meters) from the closest trace at each end of the spread and vertically stacked at 165 feet (50 meters) from the center of the end trace. Attempts were made to attenuate the air wave by shooting at 7-foot (two-meter) intervals but little improvement was noted. The air wave is rich in frequencies above 40 Hertz.

(deletion, 8)*

Logistics. Five men from Research and three local laborers were employed to conduct the survey. DFS III instruments in the research recording truck were used recording 24 channels of data on 0.5-inch (12.7 mm) magnetic tape. A step van transported cables, geophones and the energy sources to Cove Fort for field use. Two cars were used for auxiliary transportation and elevation surveying. The weather was cold each morning, with rain on one day, and snow on another. The men were housed in Beaver, Utah, about 30 miles south of Cove Fort. The data were processed at the Union Research Center on a 370/155 IBM computer.

W. R. Fillippone

WRF/vsd

* See page 5 for reason for text deletions.

Appendix A

Reasons For Text Deletions

Deletion, 1	Refers to energy source
Deletion, 2	Refers to oil and gas work in another area
Deletion, 3	Refers to energy source
Deletion, 4	Refers to energy source
Deletion, 5	Refers to oil and gas work in another state
Deletion, 6	Refers to oil and gas work in another area
Deletion, 7	Refers to energy source
Deletion, 8	Refers to energy source