UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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Technical Letter
Dribble-5
November 6, 1961

Federal Center, Denver 25, Colorado

Mr. James E. Reeves
Assistant Manager for Test Operations
Albuquerque Operations Office
U. S. Atomic Energy Commission
P. O. Box 5400
Albuquerque, New Mexico

Dear Mr. Reeves:

Transmitted herewith are two copies of

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TECHNICAL LETTER: DRIBBLE-5

VELOCITY CROSS SECTION 1, EXTENDING SOUTHWEST
FROM TATUM DOME, LAMAR COUNTY, MISSISSIPPI

By

R. A. Black and D. H. Eargle

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Additional copies have been distributed as indicated below.

Sincerely yours,

W. S. Twenhofel

W. S. Twenhofel
Program Supervisor, Dribble
Special Projects Branch

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FROM TATUM DOME, LAMAR COUNTY, MISSISSIPPI

By

R. A. Black and D. H. Eargle

The Tatum salt dome, Lamar County, Mississippi, is the proposed site for a series of experiments, code name Dribble, in the Vela Uniform program for improving the detection of underground nuclear explosions. Interpretation of the seismic data that will be obtained during the Dribble experiments requires knowledge of vertical and lateral variations in the seismic velocity of the rocks surrounding Tatum dome and knowledge of changes in thickness of rock units that have anomalously high or low seismic velocities. To obtain the velocity data, oil companies known to be operating in the Tatum dome area and companies that had drilled deep holes for oil exploration within a 25-mile radius of Tatum dome were contacted for information concerning velocity surveys made in this area. As a result, velocity data were obtained on a "company confidential" basis for 25 wells within a 25-mile radius of Tatum dome. Technical Letter Dribble-2 (Black and Twenhofel, July 1961) lists the wells for which velocity

data were obtained, provides information as to depth logged and type of velocity survey made, and shows the locations of the wells with respect to Tatum dome. Of these velocity surveys, 15 were made with continuous-velocity equipment and 10 were made with conventional well geophones.

The continuous-velocity logs were selected as most useful in determining vertical and lateral changes in seismic velocity of the rocks surrounding Tatum dome. One of the wells in which a continuous-velocity survey was made, the Humble No. 1 Hibernia well, is approximately 1 mile southeast of the center of Tatum dome. To show lateral and vertical changes in the velocity of the rocks in the vicinity of the salt dome, eight velocity cross sections will be prepared, using the Humble No. 1 Hibernia well as a hub and radiating to the southeast, southwest, west, northwest, and northeast to other wells in which continuous-velocity surveys were made. Velocity cross section 1 extends from the Humble No. 1 Hibernia well to the Magnolia No. 2-W Crosby well approximately $25\frac{1}{2}$ miles to the southwest (fig. 1). This cross section was selected as the first one to be prepared because it contains four wells for which continuous-velocity surveys are available, whereas the other cross sections will include only two or three continuous-velocity logs. Velocity cross sections 2 and 3 are in preparation, and the remaining five cross sections will be prepared at a later date.

FIGURE 1 - MAP OF PARTS OF MISSISSIPPI AND LOUISIANA SHOWING LOCATION OF VELOCITY CROSS SECTIONS

The method used to prepare this cross section, and the ones to be subsequently prepared, is as follows. All of the continuous-velocity logs were first examined to determine vertical-velocity layering. Interval-velocity logs were then prepared from the continuous-velocity logs, using intervals of 100 feet or more in thickness for which reasonably constant velocities were indicated on the continuous-velocity logs; some units of less than 100 feet in thickness have been included where they represent persistent stratigraphic units. These interval-velocity logs were then compared with the electrical logs of the respective wells to determine which of the velocity units could be identified on the electrical logs. Units or layers of both high and low velocity, which could be correlated on both the interval-velocity and electrical logs, were selected for use in preparing velocity cross sections to show vertical and lateral changes in velocity and thickness of the rock units surrounding Tatum dome. No attempt was made to force the velocity intervals to coincide with stratigraphic contacts, although in many instances they do coincide.

The position of velocity cross section 1 is shown on figure 1. The numbers on the wells are those assigned to the wells in Technical Letter Dribble-2. In addition to the wells for which continuous-velocity logs were obtained the line of the section crosses or is close to nine wells for which electrical logs are available. The cross section on

figure 2 shows the continuous-velocity logs and the electrical logs for the 13 wells on or adjacent to the line of the section. The zones marked by hatched and stippled patterns on this cross section are high and low velocity zones, respectively, that can be correlated on both the continuous-velocity and the electrical logs.

Interval-velocity logs prepared from continuous-velocity logs of four wells along cross section 1 are shown on figure 3. The stratigraphic contacts shown beside each log were determined from the electrical logs of the respective wells, and are the same stratigraphic units on Stratigraphic Table 1 in Technical Letter Dribble-4 (Eargle, August 1961).

No velocity zones were found in the Pascagoula and Hattiesburg Clays or in the upper part of the Catahoula Sandstone that could be correlated over the entire area covered by the available velocity surveys. In general this interval is one of low seismic velocity. The stratigraphic sequence beginning at the top of the Heterostegina zone of the Catahoula Sandstone and ending at the top of the Wilcox Group is composed of a sequence of limestones of relatively high seismic velocity separated by clays and sands of relatively low seismic velocity. The stratigraphic contacts shown by the electrical logs correlate well with velocity discontinuities, and the respective zones of high and low velocity can be correlated throughout the area within a 25-mile radius of Tatum dome.

The unit comprising the Wilcox Group and the upper part of the Midway Group has many distinct velocity zones, but, except for the Salt Mountain Limestone, these zones cannot be correlated from well to well along velocity section 1. The stratigraphic contact between the Wilcox-Upper Midway and the Porters Creek Clay is not marked by a velocity discontinuity that can be correlated from well to well along the line of the section, but the basal part of the Porters Creek Clay contains a zone of low seismic velocity that can be correlated on all logs.

The chalk sequence shows a generally high seismic velocity, and, although only one well on this cross section (the Cities Service No. C-1 Crosby) penetrates the complete chalk section, a characteristic velocity pattern is shown on all of the other logs penetrating the chalk. On most of the continuous-velocity logs that penetrate the entire chalk sequence two high-velocity zones and one low-velocity zone can be readily identified in the chalk sequence. These zones cannot, however, be correlated on the electrical logs.

The base of the chalk is readily identified by the top of the low-velocity zone, identical with the McShan formation, as shown on the interval-velocity logs. The top of the lower Tuscaloosa is marked on all of the continuous-velocity logs that penetrate these rocks by a distinct velocity discontinuity, and the massive sand is generally indicated by a somewhat higher seismic-velocity zone.

Velocity cross section 1, prepared from the interval-velocity logs shown in figure 3 and from electrical logs, is shown in figure 4. The areas marked by the hatched and stippled patterns are zones of anomalously high and low seismic velocity, respectively, which can be identified on the electrical logs and can be correlated from well to well along the line of the section. The numbers along the wells in which continuous-velocity logs were run indicate the interval velocity. The name and location of each well used on cross section 1, and other pertinent data for each well, are given on Table 1.

Table 1.--Well Data for Cross Section 1

Explanation of Data	
Well Number:	Well Name (company, well number, lease name)
	Location: section, township, range, location in section County
	Elevation Datum: KB-Kelly bushing, DF-derrick floor, in feet above sea level
	Total Depth of Well: TD, in feet below elevation datum
CVL-7:	Humble Oil & Refining Co. No. 1 Hibernia Bank & Trust Co. Location: sec. 13, T. 2 N., R. 16 W., 1646.2'N, 2307'W. of SE cor. sec. Lamar County KB 345 TD 6013
CVL-18:	Cities Service Production Co. No. C-1 Crosby Location: sec. 7, T. 2 S., R. 16 W., 1320' N & E of SW cor. sec. Pearl River County KB 217 TD 9548
CVL-21:	Magnolia Petroleum Co. No. 1-W Crosby et al. Location: sec. 10, T. 3 S., R. 17 W., 400'N & 100'W of SE cor. sec. Pearl River County DF 139 (sonic) KB 149 (electrical) TD 6953
CVL-23	Magnolia Petroleum Co. No. 2-W Crosby et al. Location: sec. 22, T. 3 S., R. 17 W., 2300'N & 2100'E of SW cor. sec. Pearl River County KB 198 TD 7114
EL-1:	Discovery Oil & Gas Co. No. 1 Crosby Lumber Co. Location: sec. 27, T. 2 S., R. 17 W., 330'S & 660'E of NW cor. NW $\frac{1}{4}$ NE $\frac{1}{4}$ Pearl River County KB 200 TD 10,520
EL-2:	Rimrock & Tidelands Inc., et al. No. 1 Crosby, Inc., et al. Location: sec. 6, T. 2 S., R. 16 W., 330'N & E of SW cor. NW $\frac{1}{4}$ SE $\frac{1}{4}$ Pearl River County KB 195 TD 9551

Table 1.--Well Data for Cross Section 1--Continued

EL-3:	Roeser & Pendleton No. 1 Southern Minerals Location: sec. 25, T. 1 S., R. 17 W. Pearl River County KB 245	TD 9554
EL-4:	Marshall R. Young No. 1 Phoenix Minerals Location: sec. 8, T. 1 S., R. 16 W., center SE $\frac{1}{4}$ SW $\frac{1}{4}$ Pearl River County KB 245	TD 9348
EL-5:	Phillips Petroleum Co. No. 1 Paper Co. Location: sec. 5, T. 1 S., R. 16 W., 660' fr. E. & 2300' fr. N of sec. Pearl River County KB 289	TD 12,015
EL-6:	Jett Drilling Co., Inc. No. 1 Dixie Minerals Corp. Location: sec. 28, T. 1 N., R. 16 W., 585'S & 520'W of NE cor. SE $\frac{1}{4}$ SE $\frac{1}{4}$ Lamar County KB 333	TD 9360
EL-7:	Placid Oil Co. No. 4 R. Batson Location: sec. 22, T. 1 N., R. 16 W., SE $\frac{1}{4}$ NW $\frac{1}{4}$ Lamar County KB 317	TD 5784
EL-8:	Crusader Oil & Gas Co. & Jett Drilling Co. No. 1 Phoenix Minerals Corp. Location: sec. 10, T. 1 N., R. 16 W., 660' fr. E & N of NE $\frac{1}{4}$ NE $\frac{1}{4}$ Lamar County KB 395	TD 9509
EL-9:	Roger Lacy No. 1 J. T. Rayburn Location: sec. 35, T. 2 N., R. 16 W., NW $\frac{1}{4}$ SE $\frac{1}{4}$ Lamar County KB 393	TD 8189