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3D Seismic Filed Survey Becharaji Area in Gujarat

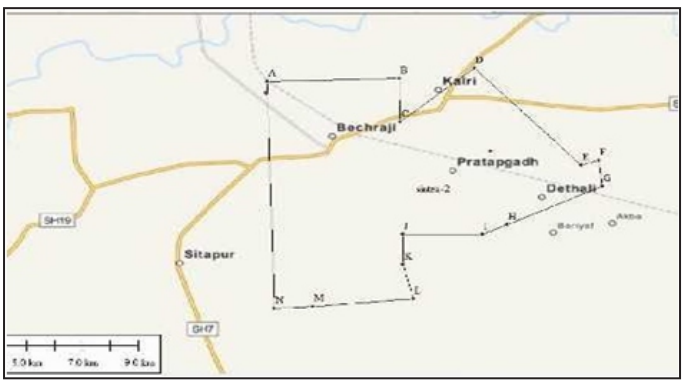
P.Sankara Rao
Geophysicist,
Cyient Ltd.

Introduction:

The survey area under Becharaji Block 2 covers 68 Sq Km consisting of 14 receiver lines of geophones and hydrophones. The source and receiver geometry generates full fold coverage of 49 with a bin size of 20m x 20m. The receiver line interval is 360m, receiver group interval is 40m, and source line interval is 480m while the shot point interval 40m. The entire project block is made up of 5 swaths with each swath consisting of 14 receiver lines.

Brief work site description:

Becharaji is a small town, a place in Mehsana district of Gujarat. Becharaji field located to the west of Mehsana Horst in Northern Block of Cambay Basin produces from Kalol pays of Middle Eocene age. The field discovered in 1987. Mehsana Block, the northern block of Cambay Basin is bounded by Kutch uplift in the west and Aravali Hills in the east. The Cambay Basin is an N-S trending rift bounded on eastern and western margins by N-S trending faults Northern part of Cambay basin is mainly affected by extensional tectonics.



Block map where the survey is carried out

The block falls in the northern part of the Ahmedabad- Mehsana tectonic block, having a large no of oil & gas fields of which the prominent are Kalol, Jotna, Sobhasan, Becharaji and Balol. Lanwa & south Patan fields lies to the east and west of block respectively. Deltaic sands of Kalol formation, thin layers of sand and silt within the Cambay shale & conglomerate beds with sandy layers in the olpad formation, which constitute the reservoir rock in the Mehsana tectonic block, however, forms the main reservoir rocks in almost all the oil fields located in the tectonic block.Kalol sands forms the main horizon in the area with many additional zones of reservoir development in Cambay shale and olpad formation and in oligo-miocene formation. Most of the reservoir sands are deposits of delta environment. Cambay shale is the prolific source sequences which have good Organic carbon content and have also undergone adequate thermal maturity. Bulk of the hydrocarbons in Cambay Basin has been sourced by Cambay shale with some contribution also coming from olpad formation and from oligoccene sequence. The kerogen is mostly of type-III.

Topographic Survey:

Introduction:

The Topographic Surveys, one of the main constituents of any seismic campaign to fix ground co-ordinates as per the theoretical designed parameters were conducted.

Technical parameters and lay down of seismic profiles Arrangements of points of reception and excitation:

At lay down of a seismic profile pickets of excitation and reception pickets were established perpendicularly each other. The distance between the next points of reception was 40 m. The distance between two receiver lines is 360m and source line interval is 480m.

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Numbering of Pickets:

Numbering of pickets for points of reception (Receivers) and for excitation points (Shot) included eight categories. First four categories comes under the line number, following four comes under picket number. For convenience of orientation to drillers, line supervisers and workers with/group on excitation pickets tags of white colour, and on receiver pickets – tags of red colour were established.

Lay Down of Profiles:

On lay down of seismic profiles 4nos complete sets of GPS mobile receiver and 2 base stations GPS as a reference point established most conveniently located for working on a concrete pillar have daily been involved.

The structure of each brigade included 1 topographer and 3 assistants to the topographer. To each brigade the separate vehicle was allotted. Before the beginning of works on CF Card the project of working profiles was loaded. To mark the points in the field were used picket of bamboo in height of 1.5m. Lay down of profiles was carried out in mode of Real Time Kinematic (RTK). Base station and Rovers are used in a format of Positioning Data link system.

As much as possible Proposed planned deviation from the plot at a point record not more than 0.3м. For positioning of the satellite aerial on a point 2 meter aluminum pole was used. Primary data was processed by program Leica Geo Office. In jungle and dense area where GPS can't work due to unavailability of satellites we used Total station (trimble-5602) for layout of points.

GPS-01

SPHEROID/GRID: Everest 1830 **PROJECTION: Lambert One**
AREA: Anwarpura

NORTHING	647351.786		LAT	23° 34' 15.93112" N
EASTING	2528212.67		LONG	71° 53' 34.93762" E
ELEVATION	33.8132		HIGHT	33.8132

Description:

GPS Pillar No-01 has been erected on the mark engraved near Anwarpura village. This pillar is situated approximately 1.5 km away in south west direction from Anwarpura village. The road on which this pillar is fixed leads to Mujpur village. This Pillar is erected at 09th April 2012 in presence of Sri Thakur Jayanti, resident of Vill- Anwarpura, Post- Manwarpura, Dist- Patan.

GPS-04

SPHEROID/GRID: Everest 1830 **PROJECTION: Lambert One**
AREA: Monud Village

NORTHING	664403.4		LAT	23° 43' 48.31985" N
EASTING	2565660		LONG	72° 15' 27.97087" E
ELEVATION	85.517		HIGHT	85.5174 M

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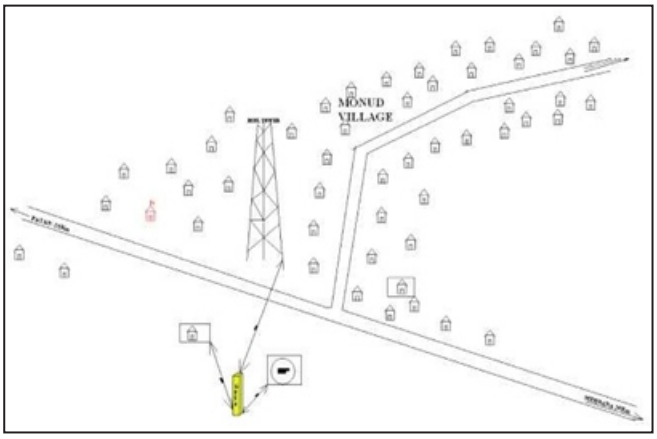
Description:

GPS Pillar No-04 has been erected on the marken-graved near Monud village. This pillar is situated on the SW direction of Mehsana - Patan road near Monud village. Mehsana is approximately 20 km far from this pillar. It is very close to trifurcation from Mehsana-Patan & Monud village road. This Pillar was erected at 09th April 2012.



MODHERA BM-04

SPHEROID/GRID: Everest 1830 **PROJECTION: Lambert One**

AREA: Modhera Village

NORTHING	648190.9	**LAT**	23° 34' 55.54102" N
EASTING	2553179	**LONG**	72° 08' 15.26494" E
ELEVATION	55.636	**HIGHT**	55.6358

Description:

Modhera BM is situated on the mark engraved near Modhera village. This pillar is situated approximately 250 mts in the North East direction from Modhera Sun Temple. This is very close to trifurcation of Becheraji-Patan and Sun Temple road. This Pillar was erected at 09th April 2012.

GPS-CHANDRUMANA

SPHEROID/GRID: Everest 1830 **PROJECTION: Lambert One**

AREA: CHANDRUMANA

NORTHING	666455.79		**LAT**	23° 44' 43.39946" N
EASTING	2540540.52		**LONG**	72° 00' 39.56358" E
ELEVATION	60.485		**HIGHT**	60.4847

Description:

GPS CHANDRUMANA has been erected on the mark engraved at Chandrumana village near big pond's boundary. This pillar is situated in the north left corner of pond, there is a big Banyan tree. This pillar is situated approximately 200 mts in the west direction of Chandrumana village and about 12 km west of Chanasama town. This Pillar was erected at 10th April 2012.

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1.Minimum safety distance of shot points from following objects:

Objects	Distance in mt.
Uninhabited structures (wooden shelter, fence/wall)	40
House, school, temple,	150
Oil well, oil/gas pipe lines	150
Concrete pipe(water, sewage etc)	50
Steel pipe (water, sewage etc)	50
Bridge	60
Water well	60
High Power line, radio/TV	300
Railway line	60
Concrete canal	100
Earthen canal	50
Cemetery	100

The local co-ordinates of the block assigned by SOGL are given below:

LATITUDE			LONGITUDE		
DEG	MIN	SEC	DEG	MIN	SEC
23	31	14	72	1	22
23	31	18	72	3	54
23	30	20	72	3	55
23	31	31	72	5	20
23	29	22	72	7	23
23	29	28.8	72	7	43.2
23	28	54.3	72	7	47
23	28	2.5	72	5	58
23	27	49	72	5	30
23	27	49	72	3	58
23	27	09	72	3	58
23	26	23	72	4	10
23	26	13.48	72	2	14.7
23	26	10	72	1	30
23	31	14	72	1	22

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Seismic design:

Before the beginning of field works, designers had developed some designs for 3D seismic survey in working area blocks.

Key parameters of seismic shooting:

	RECIEVER INTERVAL	40 m
	RECIEVER LINE INTERVAL	360 m
	RECIEVER GEOPHONES PER	12 (1 IN CASE OF HYDROPHONE)
	NO OF RECIEVER LINES	14
	ACTIVE CHANNELS PER LINE	168 (W 96 + 72 E)
	TOTAL LIVE CHANNELS PER SHOT	2352
	SOURCE INTERVAL	40 m
	SOURCE LINE INTERVAL	480 m
	TOTAL SOURCE POINT PER SALVO	63
	BIN SIZE	20 m X 20 m
	ENERGY SOURCE	EXPLOSIVE
	UPHOLE SURVEY	Min 1.2 Km X 1.2 Km
	Avg. SHOT HOLE DEPTH	30 m(+/-2m)
	SAMPLING RATE	2ms
	RECORD LENGTH	6 sec
	MIN OFFSET	28 m
	MIN- MAX OFFSET	3628 m
	MAX-MIN OFFSET	4772m
	MAX OFFSET	5235m
	INLINE FOLD	7
	CROSS LINE FOLD	7
	NOMINAL FOLD	49
	SOURCE LINE DIRECTION	NS
	RECIEVER LINE DIRECTION	EW
	RECIEVER LINE BEARING	90
	SHOOTING GEOMETRY	ASSYMETRIC SPLIT SPREAD
	ASPECT RATIO	0.75
GEOPHYSICAL ATTRIBUTES	XLINE DIMENSION OF PATCH=# OF RECIEVER LINE *RLI=14 *360 =5040 INLINE DIMENSION OF THE PATCH=# OF THE RECIEVER STATION * RECIEVER INTERVAL=168 * 40=6720 m	

During 3D survey the following planning and QC procedures were performed:

- Planning of 3D area swaths, consider area infrastructure: changing RP SP positions (offsets);

- Giving to surveyors a task to lay out receiver and source points in accordance with preplanned project;

- Daily correcting the real RP/SP positions as surface conditions required, calculating real fold and bin attributes;

- Giving the senior observer tasks for acquisition in the form of SPS-files;

- Downloading practical, pegged and recorded RPs and SPs to the data base MESA and control of pegging, drilling and recording operations

Preparing and checking final SPS-files and prepare brute stack for processing and delivery to the Client. In general, project nominal fold – 49 was obtained over the whole exploration area. Some deviations from nominal fold were registered on areas where SP replacements were done. Full fold coverage, Offsets and azimuths distributions were under daily control. General fold map, azimuths and offsets distributions over the surveyed area are shown in the tables below.

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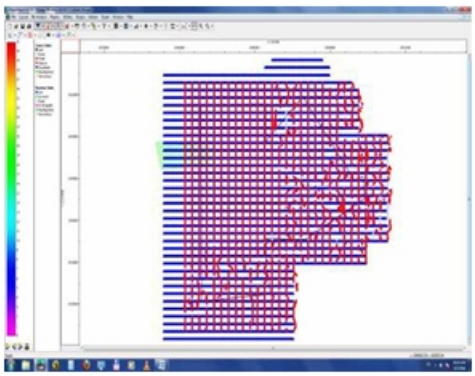
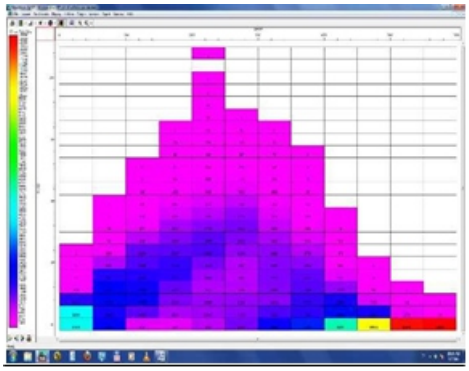
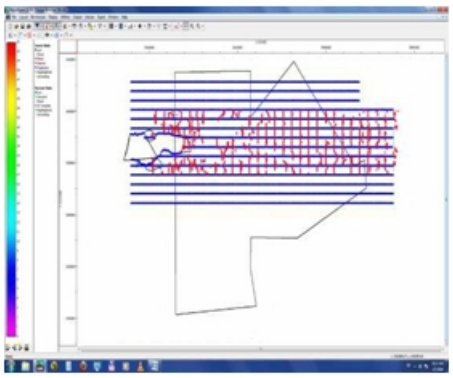


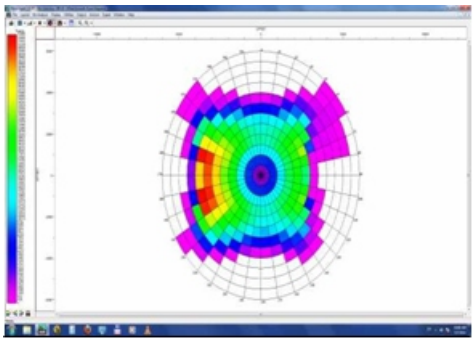
receiver and source Theoretical layout



Offset Distribution



Practical layout of block receiver point



3D data Recording equipment and software:

3D seismic data were acquired wit use of recording system (fig 2c&2d) and appropriate field equipment.

Work station Aram Aries (Xeon™ CPU 2.8 Hz 1.07 Hz, HD 180Gb, Ram 2Gb
Aram-Aries PC-Quad Line Interface
Aram-Aries Impulse Software
Monitor of the work station
Cartridge Tape Drive LTO2
Notebook
ISYS-V-12 Plotter
Air conditioner
Uninterrupted power supply
Diesel-generator 7 kW

Fig.2c

fig.2d

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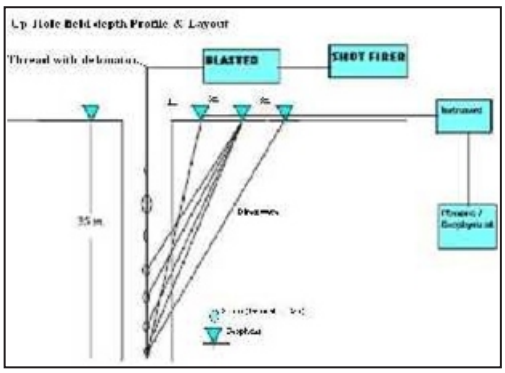
UPHOLE survey:

UPHOLE studies were used for the static correction computation ,Lithology identification & depth optimization.

Uphole survey was carried out with 3 channels (Geophones) by using SM-24 geophones, Seistronix-RAS 24 instrument with 35m depth profile having source at different depths with a rope togenerate the sound wave energy and data had been recorded in the computer/ lap tap with RAS-24software installation.

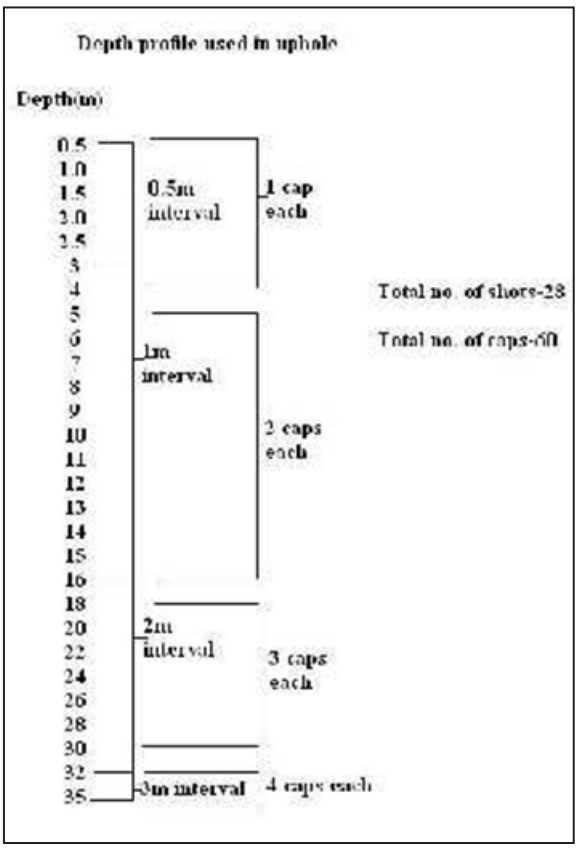
The field equipment used as same as used in the LVL survey. Uphole field layout has been represented by the following fig. in which total 3 geophones were used with3m distance interval on the surface.

These geophones were connected by therefraction cablehaving 12 takeouts and this cable was connected with the Seistronix RAS-24instrument and connected with lap tap having the RAS-24 software installed with the help of USBcable to the instrument.



Uphole field depth profile has been used in this project as shown bellows. A rope/ thread had been used for loading the hole with detonators connected at different depths with one end of shooting wire and the second end used to connect with the BLASTER which could be fired by the shot firer with the command of the Uphole Observer.

The Depth profile used in the field is as follows.



Parameters used in the RAS-24 for uphole survey:

Geophone	CD-24
Sampling interval	0.25 ms
Recording length	0.5 s
Stack Count	1 per each shot
Channels	6
Gain	24 db
LF	0 Hz
HF	500 Hz
Format	SEG-D

Field equipment for UPHOLE crew: The equipments were used for the UPHOLE spread in the field as bellows:

a. Seistronix RAS-24 instrument, b. One refraction cable with takeouts connected with geophones
c. Geophones (CD-24), d. Trigger cable, e. Seistronix RAS -24 USB interface, f. Detonators (Source)

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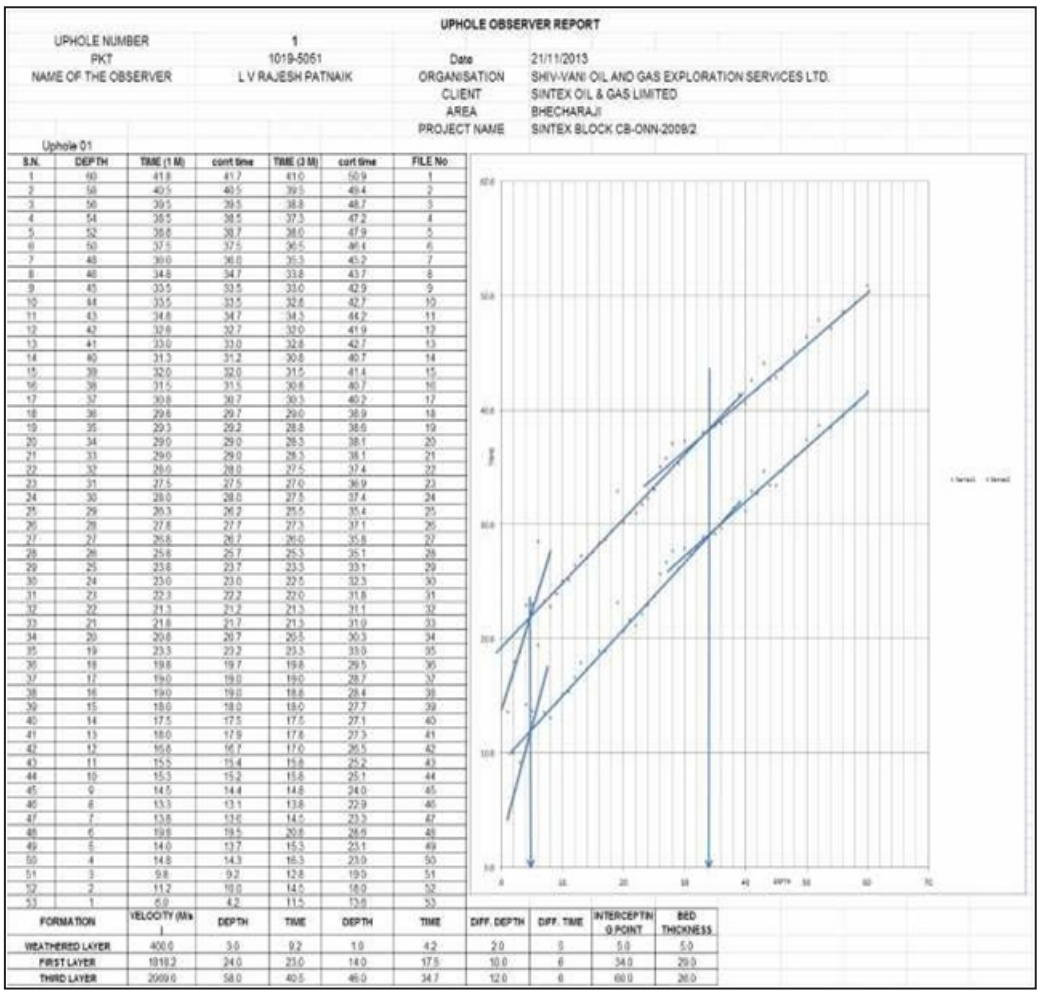
g. Data out cable. 12 V batteries, i. USB cables which can be connected with the computer/lap tap j. LAPTOP with RAS-24 software installation k. RAS-24 software The computation of velocities, thickness of different layers and interpretation has been done from field uphole data by using the depth (m)-travel time (ms) plot. The velocities have been compared with the lithology which has collected during the field data recording. The lithological samples have been collected from the field (during the drilling) during the data record in the field.

Interpretation of uphole data:



UPHOLE OBSERVER REPORT

UPHOLE NUMBER	1		
PKT	1019-5061	Date	21/11/2013
NAME OF THE OBSERVER	L V RAJESH PATNAIK	ORGANISATION	SHIV-VANI OIL AND GAS EXPLORATION SERVICES LTD.
		CLIENT	SINTEX OIL & GAS LIMITED
		AREA	BHECHARAJI
		PROJECT NAME	SINTEX BLOCK CB-ONN-2009/2

Uphole 01

S.N.	DEPTH	TIME (1 M)	cort time	TIME (3 M)	cort time	FILE No
1	60	41.8	41.7	41.0	50.9	1
2	58	40.5	40.5	39.5	49.4	2
3	56	39.5	39.5	38.8	48.7	3
4	54	38.5	38.5	37.5	47.2	4
5	52	38.8	38.7	38.0	47.9	5
6	50	37.5	37.5	36.5	46.4	6
7	48	36.0	36.0	35.5	45.2	7
8	46	34.8	34.7	33.8	43.7	8
9	45	33.5	33.5	33.0	42.9	9
10	44	33.5	33.5	32.8	42.7	10
11	43	34.8	34.7	34.5	44.2	11
12	42	32.8	32.7	32.0	41.9	12
13	41	33.0	33.0	32.8	42.7	13
14	40	31.3	31.2	30.8	40.7	14
15	39	32.0	32.0	31.5	41.4	15
16	38	31.5	31.5	30.8	40.7	16
17	37	30.8	30.7	30.5	40.2	17
18	36	29.8	29.7	29.0	38.9	18
19	35	29.3	29.2	28.8	38.6	19
20	34	29.0	29.0	28.5	38.1	20
21	33	29.0	29.0	28.5	38.1	21
22	32	28.0	28.0	27.5	37.4	22
23	31	27.5	27.5	27.0	36.9	23
24	30	28.0	28.0	27.5	37.4	24
25	29	26.3	26.2	25.5	35.4	25
26	28	27.8	27.7	27.3	37.1	26
27	27	26.8	26.7	26.0	35.8	27
28	26	25.8	25.7	25.3	35.1	28
29	25	23.8	23.7	23.5	33.1	29
30	24	23.0	23.0	22.5	32.3	30
31	23	22.3	22.2	22.0	31.8	31
32	22	21.3	21.2	21.3	31.1	32
33	21	21.8	21.7	21.3	31.0	33
34	20	20.8	20.7	20.5	30.3	34
35	19	23.3	23.2	23.3	33.0	35
36	18	19.8	19.7	19.8	29.5	36
37	17	19.0	19.0	19.0	28.7	37
38	16	19.0	19.0	18.8	28.4	38
39	15	18.0	18.0	18.0	27.7	39
40	14	17.5	17.5	17.5	27.1	40
41	13	18.0	17.9	17.8	27.3	41
42	12	16.8	16.7	17.0	26.5	42
43	11	15.5	15.4	15.8	25.2	43
44	10	15.3	15.2	15.6	25.1	44
45	9	14.5	14.4	14.8	24.0	45
46	8	13.3	13.1	13.8	22.9	46
47	7	13.8	13.6	14.5	23.3	47
48	6	19.8	19.5	20.8	26.6	48
49	5	14.0	13.7	15.3	25.1	49
50	4	14.8	14.3	16.3	23.9	50
51	3	9.8	9.2	12.8	19.9	51
52	2	11.2	10.0	14.0	18.0	52
53	1	6.0	4.2	11.5	13.6	53

FORMATION	VELOCITY (M/s)	DEPTH	TIME	DEPTH	TIME	DIFF. DEPTH	DIFF. TIME	INTERCEPTN G POINT	BED THICKNESS
WEATHERED LAYER	400.0	3.0	9.2	1.0	4.2	2.0	5	5.0	5.0
FIRST LAYER	1018.2	24.0	23.0	14.0	17.5	10.0	8	34.0	29.0
THIRD LAYER	2069.6	58.0	40.5	46.0	34.7	12.0	6	60.0	26.0

The above fig. represents the uphole data interpretation with three layer. From the total uphole points data, obtained the study of minimum 2 layer case to maximum 3 layer case with different lithology. This uphole data results from the total project has been used for the static correction computation.

Results:

* In case of first profile the first layer average velocity 400m/s corresponds to soil. The second layer velocity 1400 m/s corresponds to weathered layer. The third layer velocity 2200m/s corresponds to semi weathered rock for the first profile.

* In case of second profile the first layer velocity450 m/s represents the soil. The second layer velocity 1250m/s represent the weathered rock and the third layer velocity 2500 m/s represents the semi weathered rock for the second profile.

Conclusion:

* Through this Research work I have got good experience in refraction dataprocessing using manual interpretation methods and by using Seisimagersoftware. This depth section with velocities helps in differentiating different geological layers.

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* Seismic refraction data was interpreted through different methods like time-term inversion using SeisImager software and also manually. Depth sections are prepared in each method and results were compared.

* In all the profiles it is found that there is deeper bedrock

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