Our company carried out hydrocarbon (HC) exploration work in Nigeria.

At the request of the client, and in accordance with confidentiality requirements, the official name and exact location of the exploration area are not disclosed in this report.

For the purposes of documentation and internal reference, the exploration site has been symbolically designated as the **"XXX Area."**

SAMPLE OF REPORT

"Geoelectric survey of X X X Area block by Frequency-Resonance Method of Satellite Data Processing and Interpretation"

ABSTRACT

Object of study – X X X Area block - marginal oil field, Nigeria.

Purpose - processing and interpretation (decoding) of remote sensing (RS) data within the area of Area Block in order to detect and map the zones of possible oil and gas accumulations in the area of research and detail prospecting and detailed vertical scanning in one anomaly zone.

Research method – the express-technology of "direct" exploration of hydrocarbon accumulations (HC) by the remote and geoelectric methods. The technology involves the remote sensing data processing, the ground-based geoelectric methods of FSPEF and VERS. Aerial survey by the FSPEF method enables us to find and map the anomalies of "deposit" type (DTA). The intervals and depth of anomalous polarized layers (APL) of "gas deposit" or "oil deposit" type are determined within the boundaries of mapped anomalies DTA by VERS sounding method.

The method of remote sensing data frequency-resonance processing is, in fact, the direct method for hydrocarbon accumulations prospecting and exploration. The anomalies, mapped by this method, can (and should) be considered as the projections to the surface of the prognosis hydrocarbon deposits in the cross-section.

Within the surveyed areas: a) the contours of the five anomalous zones are obtained; b) the central points of the anomalous zones were set; c) in each APL of "Oil-Gas" type the values of reservoir pressure are estimated;

The results of these studies suggest the possibility and feasibility of the "satellite technology" using for the preliminary assessment of the hydrocarbon potential of the study area at the initial stage of prospecting and for the detailed examination of detected anomalous zones. The conducted investigations have been shown that areas of possible oil and gas accumulations in the poorly studied and remote regions can be detected and mapped by frequency-resonance method of remote sensing data processing and interpretation.

REMOTE SENSING SOUNDING OF EARTH, SATELLITE IMAGE, PROCESSING, INTERPRETATION, ANOMALY OF DEPOSIT TYPE, OIL, GAS, ANOMALOUS POLARIZED LAYER, STRUCTURE

CONTENT

1. INITIAL DATA FOR WORK

Area Information

The client requested an assessment of the hydrocarbon potential of the Area marginal oil field in Nigeria.

The Area field, recognized as Nigeria's first producing marginal field, is located in the central part of the prolific Niger Delta. The field lies in shallow offshore waters at a depth of approximately 30 feet, about ten miles west of the onshore Forcados Terminal.

Survey area: (Fig.1.). The area of the search site is 43.3 km2, in Table shown coordinates of area.

Point	X*	Y*
1	304627,00000	148003,703125
2	312442,59375	140996,000000
3	316850,90625	145773,203125
4	309544,68750	148600,796875
5	304609,40625	148003,703125

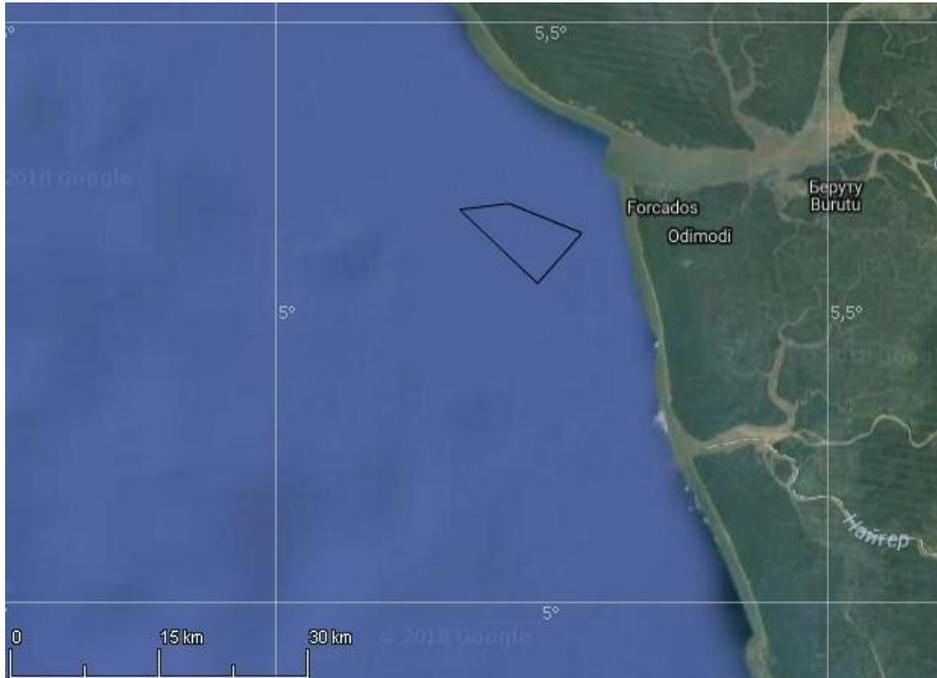*Coordinate projection: Minna / Nigeria West Belt

Fig.1.1. *Map of area*

A regional survey was requested over the Area Block, where oil production is currently ongoing.

The objective of the survey was:

- To evaluate the hydrocarbon potential of the block at a regional scale.

It should be noted that no additional geological or production data were provided by the client. We did not conduct any independent data search and performed what we refer to as "blind processing."

The only information available was that within the Area Block there are producing wells (Area 1 and possibly Area 2) with moderate oil production rates. We were not provided with the exact locations of productive wells. Therefore, the results presented below should be considered as obtained under blind processing conditions.

Proposed Work Stages
Stage 1 – Regional Studies

At this stage, the search areas were evaluated for the presence of hydrocarbon accumulations. The research was carried out in the following sequence:

1. Identification and mapping of linear tectonic fracture zones (tectonically weakened zones);
2. Registration of anomalous responses at resonance frequencies of gas, oil, and condensate to detect anomalies of the following types:
   - "Gas deposit"
   - "Oil reservoir"
   - "Gas-condensate deposit"
3. Delineation of anomaly contours and determination of their areal extent;
4. Determination of reservoir pressure intervals for oil and gas within each identified anomalous zone;

5. Construction of maps of anomalous areas using isolines of maximum reservoir pressure values for each zone.

Processing was performed at a scale of **1:25,000**.

This scale allows reliable detection of anomalous objects with dimensions greater than approximately **0.25 × 0.25 km**.

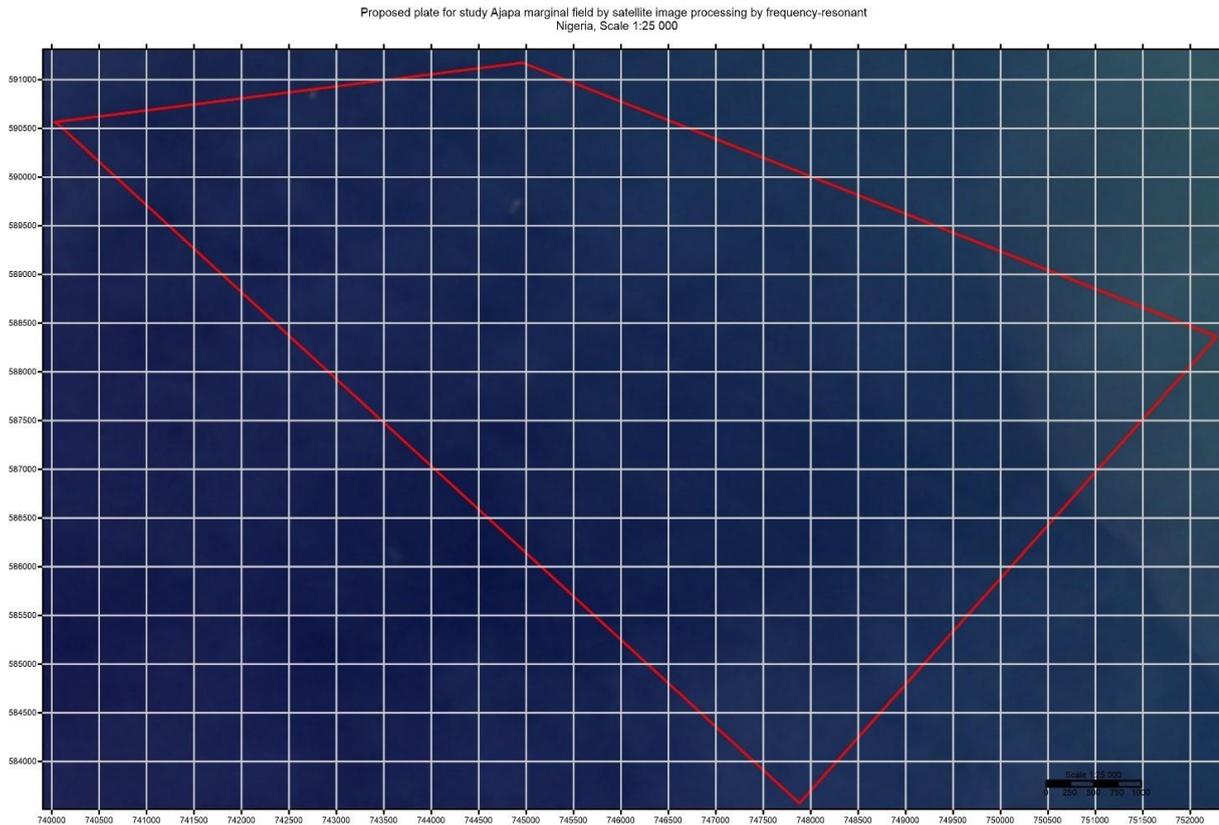A single map sheet at a scale of 1:25,000 fully covers the Area Block (Figs. 1–2).

Proposed plate for study Ajapa marginal field by satellite image processing by frequency-resonant
Nigeria, Scale 1:25 000

Fig.2. Plate for Area marginal field.

Further work will be determined based on the results of Stage 1. For the anomalous zones identified during the regional study, detailed investigations may be carried out for each selected zone.

Stage 2 – Detailed Studies of Selected Anomalous Zones

At this stage, the following tasks are performed:

1. Detection and tracing of tectonically weakened zones and faults that could not be identified at smaller scales.
2. Refinement of anomalous zone contours, recalculation of their areas, and determination of oil–water contact boundaries.
3. Construction of detailed maps of anomalous areas using isolines of maximum reservoir pressure values.
4. Vertical scanning of the geological section at the point of maximum reservoir pressure to determine the depth intervals of anomalous polarized layers (APL) of the following types:
    o "Oil"

- o "Gas"
- o "Water"
- o "Water + Gas"
- o "Solid rocks"

As a result of scanning, vertical columns of APL are constructed.

5. Several profiles are laid through the point of maximum anomaly value. Additional vertical scanning points are placed along these profiles. Based on the scanning results, vertical columns and geological–geophysical cross-sections of APL are constructed.
6. For the thickest APL layers, formation pressure is estimated. An APL layer is considered promising if the estimated formation pressure exceeds the hydrostatic pressure at the corresponding depth.
7. Construction of maps of total thickness of APL of the "oil deposit" and "gas deposit" types.
8. Estimation of volumes of hydrocarbon reservoirs.
9. If a prospective APL layer is traced at all scanning points, it may be considered a marker horizon. In this case, a structural depth map of the reservoir can be constructed.
10. Based on the structural map, assumptions can be made regarding the type of hydrocarbon trap (anticlinal, tectonically sealed, or lithologically limited).
11. Further analysis of Stage 2 results allows determination of the optimal scope of geoelectric field studies. If necessary, recommendations may be made for conducting seismic surveys along specific profiles or across the entire anomalous zone.

Field Work

Based on Stage 2 results, the most promising anomalous zones are selected for ground-based measurements. Surveys of isolated (local) areas are conducted using ground geoelectric methods:

- FSPEF (Formation of Short-Pulsed Electromagnetic Field)
- VERS (Vertical Electric-Resonance Sounding)

During Field Work, the Following Activities Are Carried Out:

1. Detection and tracing of small tectonic faults that may divide anomalies into separate structural blocks.
2. Clarification of block dimensions and oil–water contact boundaries.
3. Coverage of anomaly areas with a network of vertical sounding points. At each point, depth intervals of APL of the following types are identified and specified:
   - o "Oil"
   - o "Gas"
   - o "Gas + Water"
   - o "Water"
4. Estimation of formation pressure for each hydrocarbon reservoir.
5. Construction of vertical columns and geological–geophysical cross-sections for the projected field.
6. Construction of maps showing total APL thickness of "oil" and "gas" types, as well as maps of thickness for the most promising reservoirs.
7. Construction of structural maps for selected marker horizons.
8. Evaluation of overall potential oil and gas resources.
9. Determination of optimal locations for exploratory wells.
10. Correlation of detected APL intervals with lithological elements of the geological cross-section at recommended drilling points.

Estimated Timeframe

- Field work duration: **15–20 days**

- Data processing and report preparation: **20–30 days**

1. MOBILE EXPRESS TECHNOLOGY FOR "DIRECT" PROSPECTING AND EXPLORATION OF OIL AND GAS ACCUMULATIONS USING GEOELECTRIC AND REMOTE SENSING METHODS

Principal Features of the Technology

The application of this technology during prospecting for oil and gas reservoirs, ore minerals, and aquifers significantly accelerates the exploration process and increases its overall efficiency.

Technology Components and Equipment

The technology includes:

- A specialized method for satellite data processing and interpretation;
- Areal mapping using the Formation of Short-Pulsed Electromagnetic Field (FSPEF) method;
- The Vertical Electric-Resonance Sounding (VERS) method;
- Computer-assisted measurement instrumentation for field observations;
- Software for data acquisition, processing, and interpretation;
- Established procedures for conducting field observations.

The original FSPEF and VERS methods are based on the study of geoelectric parameters of the subsurface in pulsed transient geoelectric fields, as well as in the quasi-stationary electric field of the Earth and its spectral characteristics above hydrocarbon (HC) reservoirs.

The possibility of conducting FSPEF surveys from vehicles or aircraft allows rapid examination of large areas within short time periods.

Detailed descriptions of the features and techniques of the technology are available in numerous publications.

Operational Capabilities of the Technology

The technology allows:

- Assessment of oil and gas prospectivity of investigated areas using specialized satellite data processing;
- Detection and mapping of "deposit-type anomalies" (DTA) that may correspond to hydrocarbon accumulations in the geological cross-section;
- Determination of bedding depths and thicknesses of anomalous polarized layers (APL) of "oil," "gas," "water," and related types;
- Rapid reconnaissance surveys of large-scale and hard-to-access oil- and gas-bearing territories;
- Detailed investigation of selected anomalous zones to determine optimal drilling locations, estimate potential hydrocarbon reserves, and support decisions regarding further geological and geophysical work;
- Detection and mapping of gas-enriched zones within coal seams and host rocks;
- Mapping of salt domes and salt layers;
- Investigation of supra-salt and sub-salt hydrocarbon reservoirs;
- Mapping of fractured zones and hydrocarbon accumulations within fractured crystalline basement rocks;
- Offshore oil and gas prospecting from marine vessels;
- Detection and mapping of geoelectric anomalous zones of the "uranium mineralization zone" type, including determination of depth and thickness of anomalous polarized layers using VERS sounding;

- Identification and tracing of underground water flows of natural and anthropogenic origin, and mapping of water-saturated reservoirs.

Features of Frequency-Resonance Processing of Remote Sensing Data

1. Modern remote sensing data processing methods are developed within the framework of the "substantial" paradigm of geological and geophysical studies. The essence of this paradigm is the *direct* search for specific substances such as oil, gas, gold, silver, platinum, zinc, iron, water, etc.

Examples include CCSC "s other exclusive research partners, Tomko," and "Poisk." According to published sources, geophysical methods based on this paradigm demonstrate higher efficiency compared to traditional indirect approaches.

2. According to published descriptions, the "Tomko" technology is based on advances in astrophysics, electromagnetic theory, mathematics, and modern computing.

The theoretical concept suggests that atoms and molecules possess characteristic electromagnetic field distributions determined by their chemical composition and spatial lattice structure. A large volume of homogeneous material may generate a collective electromagnetic response proportional to its concentration.

Under this hypothesis, the electromagnetic signature of a substance at depth may be detectable at the surface, enabling identification via satellite imagery.

3. The "Poisk" technology is also described in specialized publications. These materials emphasize the possibility of mineral prospecting based on resonance phenomena.
4. In contrast to quantum-optical filtering used in the "Tomko" approach, the method applied in this report uses frequency-resonanc

Remote Sensing Data and Resolution Considerations

Multispectral imagery from various satellites is used for frequency-resonance processing, primarily those available in the public domain.

- For reconnaissance surveys of large areas (scales of 1:50,000 and smaller), Landsat-5 and Landsat-7 imagery with a spatial resolution of 30 m/pixel can be used.
- For detecting smaller objects, higher-resolution imagery (2.5–1 m/pixel) is required, and processing should be performed at larger scales.

Satellite images are processed using a square grid of 1 cm × 1 cm on the working map. This determines the positional accuracy of anomaly contours.

- At a scale of 1:100,000, 1 cm corresponds to 1,000 meters.
  → Contour accuracy: ±1,000 m
- At a scale of 1:20,000, 1 cm corresponds to 200 meters.
  → Contour accuracy: ±200 m

The central parts of anomalies are determined with higher precision through interpolation of all positive anomaly values.

Vertical Electric-Resonance Scanning (VERSc)

Vertical electric-resonance scanning (VERSc) is performed using satellite data. This method allows estimation of potential depth intervals of search objects.

The accuracy of VERSc depends on:

- Geological conditions
- Availability of nearby well data for calibration

Typically, the accuracy of VERSc depth estimation does not exceed 50–70%.

Assessment of Fluid Pressure in Reservoirs

Within frequency-resonance remote sensing technology, a key methodological element is the estimation of maximum fluid pressure values in reservoirs.

This method provides several advantages:

1. Significant narrowing of hydrocarbon prospecting areas and optimal selection of exploratory well locations.
2. Preliminary estimation of hydrocarbon occurrence depth.
3. Exclusion of anomalous zones lacking elevated pressure values from priority drilling targets.

The maximum fluid pressure value is a complex parameter dependent on:

- Gas pressure within the fluid or free gas phase
- Rock porosity
- Gas saturation

At the edges of anomalous zones, a decrease in this parameter is typically observed. In areas without gas presence, reservoir pressure is not defined and is considered zero.

"Deposit-Type" Anomalies as Surface Projections of Hydrocarbon Accumulations

Since the early development of mobile direct-prospecting methods, the term "Deposit-Type Anomaly" (DTA) has been used to designate anomalies mapped by these techniques.

Over time, the terminology has evolved. Expressions such as:

- "Hydrocarbon deposit anomaly"
- "Oil reservoir anomaly"
- "Gas accumulation anomaly"
- "Condensate accumulation anomaly"
- "Aquifer anomaly"
- "Uranium deposit anomaly"
- "Gold deposit anomaly"

have been applied in publications and reports.

These anomalies are detected using:

- Frequency-resonance remote sensing data processing
- Ground-based FSPEF geoelectric surveys

The VERS method determines depth and thickness of anomalous polarized layers (APL) in the geological cross-section.

Thus, APLs are classified as:

- "Oil-type"
- "Gas-type"
- "Condensate-type"
- "Water-type"
- "Uranium-type"
- "Gold-type"

Some researchers (e.g., proponents of the "Tomko" technology) refer to such anomalies as "projected hydrocarbon deposits," implying direct detection of accumulations.

Similarly, frequency-resonance and FSPEF methods may reasonably define mapped anomalies as surface projections of hydrocarbon accumulations.

In this context, VERS sounding may be interpreted as identifying projected hydrocarbon reservoir layers rather than simply APLs.

Overall, frequency-resonance remote sensing processing combined with FSPEF and VERS can be considered direct prospecting methods for hydrocarbons and ore minerals.

Technology Testing and International Applications

The frequency-resonance processing method and its practical application have been developed experimentally across regions with diverse tectonic and structural conditions.

Applications include:

- Ukraine – gas, oil, coal, water, uranium, gold
- Russia – oil, gas, gas hydrates, diamonds, gold
- Kazakhstan – oil, gas, gold, zinc
- Turkey – oil, gas, gold, platinum
- Colombia – oil, gas, coal
- Antarctica – gas hydrates, oil, glaciers
- Mongolia – oil, gas, uranium
- Libya – oil and gas (offshore and onshore)
- Norway – offshore oil and gas
- Gulf of Mexico – oil, gas hydrates
- Vietnam – titanomagnetite
- Cambodia – oil, gas, gold, rubies

and many others.

Recommendations for Improving Information Content

1. To improve accuracy, it is advisable to determine resonance frequencies directly from samples (e.g., oil from the target area).
2. During work within licensed blocks, it is recommended to provide:
   - Samples of the searched substance
   - Well data (location, depths, formation pressures)
   - Seismic and structural maps
   - Geological and geophysical models

Integration of a priori geological and geophysical data significantly increases result reliability.

3. The cost of remote sensing frequency-resonance processing is significantly lower than both mobile geoelectric and conventional geophysical methods, making it highly suitable as a complementary screening tool.

Improved Method for Reservoir Pressure Estimation (2015 Development)

In 2015, during hydrocarbon assessment in the United States, an enhanced pressure-estimation methodology was developed.

Previously:

- Frequency scanning stopped when no anomalous response was detected.

Improved approach:

- The full depth range (e.g., surface to 6 km) is analyzed.
- Scanning continues even when anomalies are absent at intermediate intervals.
- This allows identification of multiple hydrocarbon-bearing horizons at different depths.

The improved method enhances:

- Detection of predicted deposits
- Approximate depth estimation
- Multi-horizon reservoir modeling

Stages of Prospecting by Mobile Direct Methods
Stage 1 – Regional Studies

- Frequency-resonance analysis at scales 1:200,000–1:150,000
- Processing time per map: 2–3 days

Stage 2 – Detailed Studies

- Scale: 1:60,000–1:15,000
- Detailed structural refinement
- Vertical scanning
- Reservoir pressure estimation
- Structural map construction
- Trap type interpretation

Time per anomalous zone: 4–5 days

Stage 3 – Field Geoelectric Works

- FSPEF and VERS surveys
- Fault detection
- Reservoir delineation
- Resource estimation
- Well location optimization

Field duration: 15–20 days
Data processing and reporting: 20–30 days

Table 2.1

Resonance frequencies of water of different salinity

Number	Mineralized water	Mineralization (g/dm^3)	Resonance frequencies, kHz
1	Structured (Alpine sources)	< 0.1	**717.6**
2	Weakly mineralized (Morshynskiye sources)	0.1 -0.4	**643.8**
3	Average mineralization	0.5 - 1.0	**615.7**
4	Strong mineralization	5.0 – 15.0	**551.5**

1. For frequency-resonance processing the multispectral imagery is used from diffe

2. STAGE 1: PROCESSING OF THE REGIONAL AREA WITHIN THE AREA BLOCK
Scale 1:25,000

Processing and interpretation of satellite imagery covering the regional study area (Fig. 1.2) were carried out in a sequential manner.

For optimal results, and in agreement with the client, the study area was printed on a dedicated working map at a scale of **1:25,000**. At this scale, structural features and anomalous zone geometry can be identified with an accuracy of approximately **±500 meters**.

Sequence of Work
Step 1 – Structural Analysis

Detection and tracing of tectonically weakened zones (faults) were performed across the survey area.

Step 2 – Registration of Hydrocarbon Anomalies

Anomalous responses were recorded at resonance frequencies corresponding to:

- Oil
- Gas
- Condensate

Step 3 – Reservoir Pressure Assessment

Within the contours of detected and mapped "oil-type" anomalies, maximum values of reservoir fluid pressure were estimated.

Results of Regional Processing (Scale 1:25,000)

Based on the obtained results, a map of anomalous zones within the Area Block was constructed (Fig. 3.1).

Structural Features

- **7 fault zones** were identified within the study area.

Hydrocarbon Anomalies

- **5 anomalous zones** were identified.
- Their characteristics are presented in Table 3.1.

From the spatial distribution, several anomalous zones appear to be structurally controlled by fault systems, suggesting the presence of **tectonic traps**.

The anomalous zones were registered at oil and gas resonance frequencies. No anomalous responses were detected at condensate frequencies.

- Anomalies **Oil+Gas-1 to Oil+Gas-4** are located within the Area Block.
- Anomaly **Oil+Gas-5** is located outside the block, in the southwestern corner of the working plate.

Reservoir Pressure Interpretation

Out of the five identified anomalous zones:

- **3 zones** show maximum anomalous reservoir pressure values exceeding **55 MPa**.
  According to our interpretation, such pressure values indicate the possibility of productive hydrocarbon flows at depths greater than approximately **5,000 meters**.
- The remaining **2 zones** show maximum anomalous reservoir pressure values around **22 MPa**, suggesting potential productive horizons at depths up to approximately **2,200 meters**.

Interpretation of Isoline Map (Fig. 3.1)

The isolines shown in Figure 3.1 are presented in conventional units.

These values represent the integrated results of reservoir pressure interval measurements and may be interpreted as the **maximum cumulative thickness (in meters) of hydrocarbon-bearing layers** within each anomalous zone. **Table 3.1**

Anomaly №	Anomaly	Anomaly maximum coordinates, UTM 31N, WGS1984		Maximum Pressure, MPa	Anomaly area, km²
		X	Y		
1	Oil+Gas-1	744975	589660	56	6,9
2	Oil+Gas -2	750578	587218	55.5	4,33
3	Oil+Gas -3	746859	587723	22.35	1,95
4	Oil+Gas -4	747927	584980	22.4	1,57
5	Oil+Gas -5	742179	585941	55.7	4,8

Map of geoelectric anomalous zones of "Oil and gas deposit" in the search area Ajapa Block in Nigeria
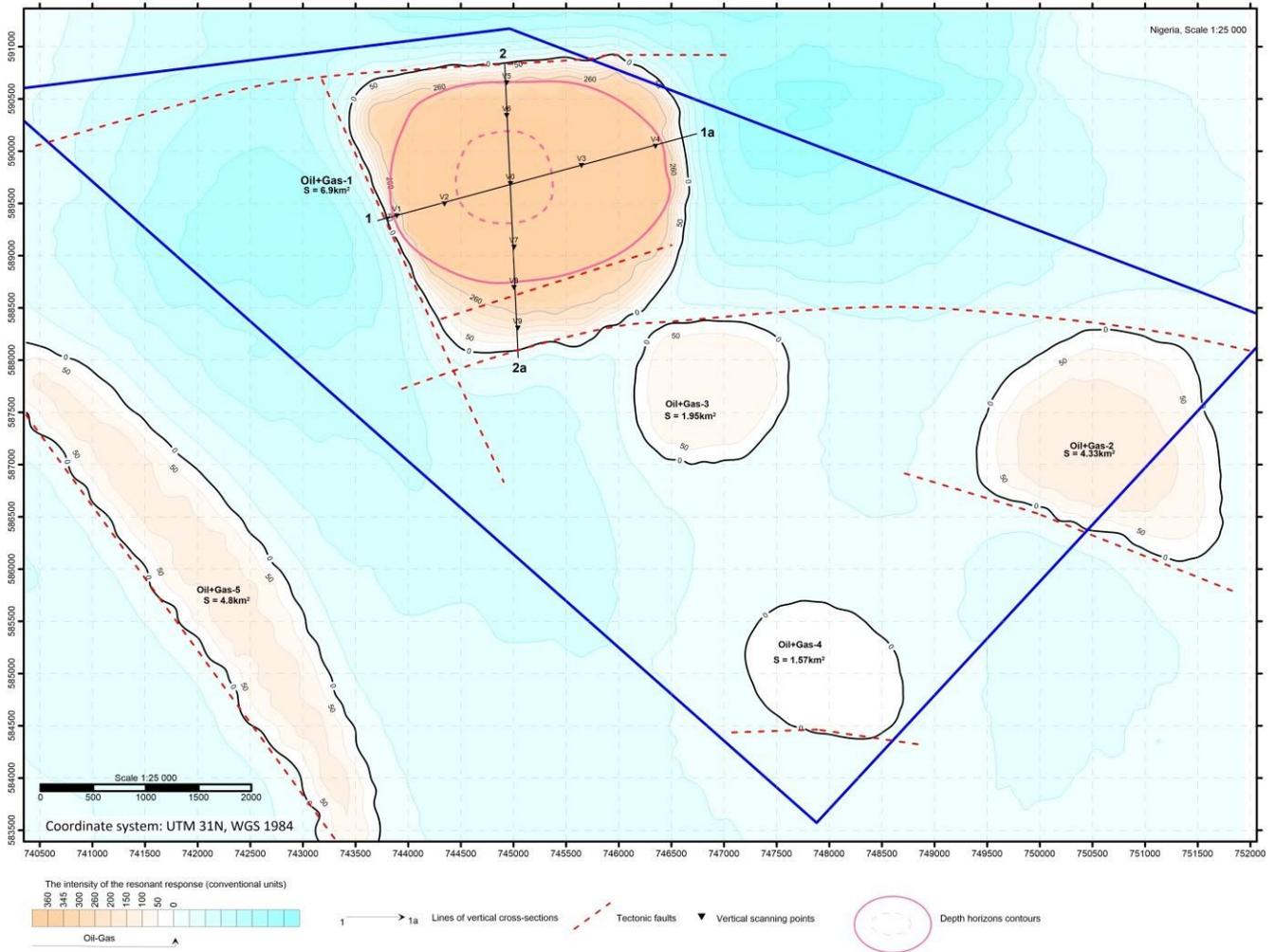(According to the frequency-resonance analysis of satellite images)

Fig 3.1.

During the reservoir pressure determination, additional measurements and interpretative analysis were carried out. This allowed us to identify prospective pressure intervals (expressed in conventional pressure units) within each anomalous zone.

Assuming, with a reasonable degree of approximation, that reservoir pressure is equal to hydrostatic pressure, these pressure values may be converted into depth estimates.

The hydrostatic pressure–depth relationship may be expressed as:

$$P = \rho g h$$

where:

- **P** – hydrostatic pressure,
- **ρ** – fluid density,
- **g** – gravitational acceleration,
- **h** – depth.

Under this assumption, higher measured reservoir pressure corresponds to greater burial depth.

Based on the analysis, three prospective intervals (Horizon 1–3) have been identified within the study area. The characteristics of these horizons for each anomalous zone are presented below.

Anomalous zone «Oil-Gas-1»

Interval name	Pressure, MPa	Response intensity, conventional meters	Total, conventional meters
Horizon 1	7.10 – 7.30	20	260
	8.90 – 9.20	30	
	9.60 – 11.70	210	
Horizon 2	28.80 – 23.50	70	85
	24.25 – 24.50	15	
Horizon 3	55.85 – 56.00	15	15

Anomalous zone «Oil-Gas-2»

Interval name	Pressure, MPa	Response intensity, conventional meters	Total, conventional meters
Horizon 1	9.65 – 10.15	45	45
Horizon 2	22.35 – 22.9	55	55
Horizon 3	55.40 – 55.5	10	10

Anomalous zone «Oil-Gas-3»

Interval name	Pressure, MPa	Response intensity, conventional meters	Total, conventional meters
Horizon 1	8.95 – 9.15	20	65
	9.80 – 10.25	45	
Horizon 2	22.20 – 22.35	15	15
Horizon 3	-	-	-

Anomalous zone «Oil-Gas-4»

Interval name	Pressure, MPa	Response intensity, conventional meters	Total, conventional meters
Horizon 1	9.80 – 10.15	35	35
Horizon 2	22.20 – 22.40	20	20
Horizon 3	-	-	-

Anomalous zone «Oil-Gas-5»

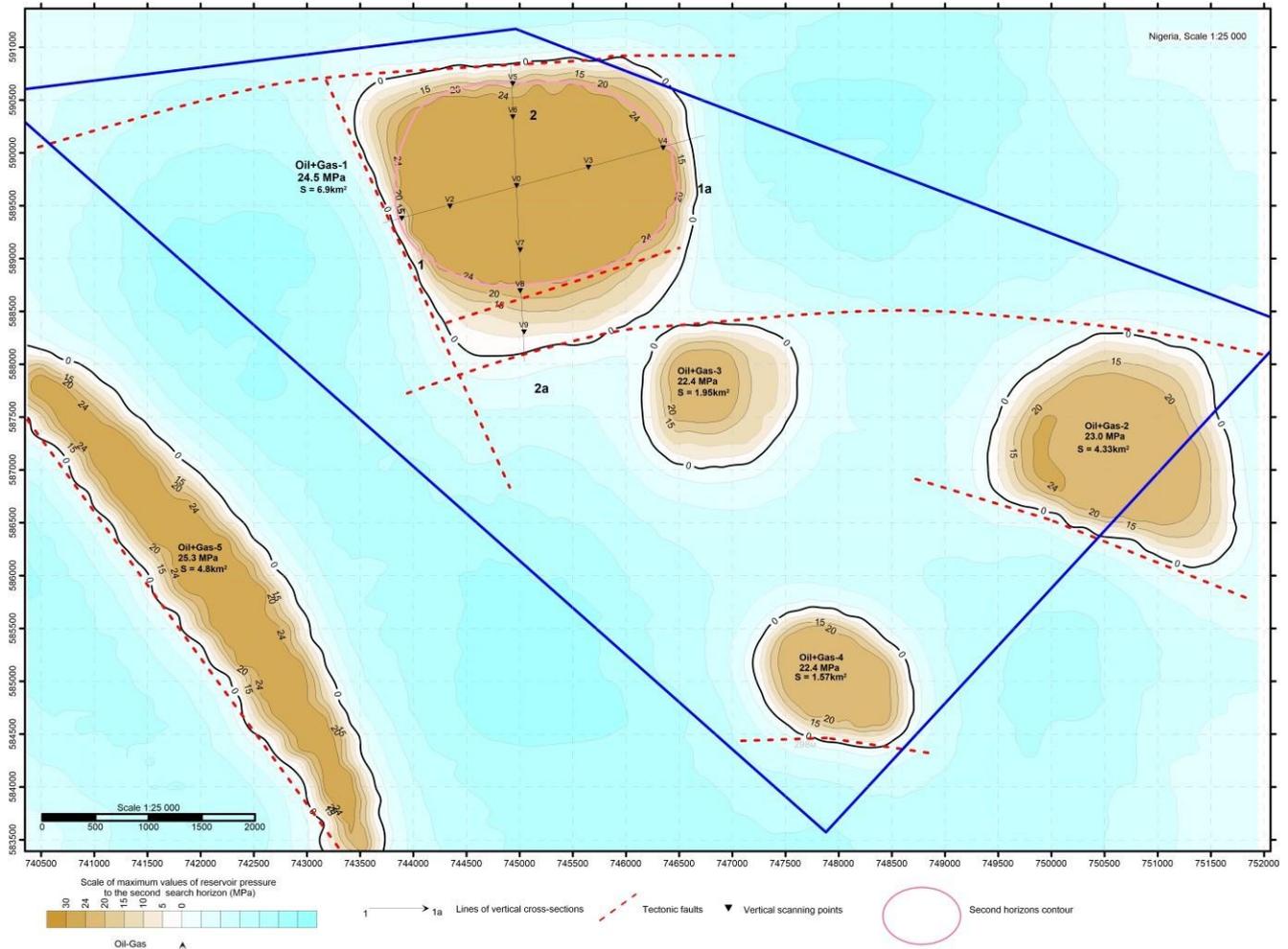| Interval name	Pressure, MPa	Response intensity, conventional meters	Total, conventional meters
Horizon 1	8.40 – 8.70	30	40
	17.15 – 17.25	10	
Horizon 2	24.80 – 25.30	50	50
Horizon 3	55.60 – 55.70	10	10

Fig 3.2.

This stage of research also allowed us to define approximate boundaries of the identified anomalous intervals.

In Figure 3.1, this approach is illustrated for the anomalous zone **"Oil-Gas-1."**

- The **pink contours** represent depth horizon boundaries.
- The **outer contour** corresponds to the upper horizon and coincides with the full extent of the anomalous zone.
- The **solid line** delineates the middle (Horizon 2).
- The **dashed line** outlines the lower horizon (Horizon 3).

Further analysis demonstrated that the lower horizon is associated exclusively with an anomalous polarized layer (APL) of the "Gas" type. Its relatively small spatial extent and significant depth (below 5,000 meters) suggest limited commercial attractiveness. Therefore, this horizon is considered low-priority at the current stage of evaluation.

Taking this into account, Figure 3.2 presents isolines of maximum reservoir pressure for only the first two horizons. This map provides an integrated view of the hydrocarbon potential across the entire Area Block.

It should be emphasized that the regional scale of investigation provides a generalized representation of anomalous zone boundaries. In subsequent detailed studies, individual anomalous zones may be subdivided into smaller structural blocks, and their contours may be refined.

Conclusion for Stage 1

Within the Area Block, four anomalous zones associated with APLs of the "Oil and Gas" type were identified.

The largest anomalous zone, **"Oil-Gas-1,"** covers an area of approximately **6.9 km²** and contains three prospective hydrocarbon-bearing horizons in the geological section. This zone also exhibits the strongest resonance response within the block.

Based on open-source information, this zone coincides with the location of the **Area-1 well**, which is characterized by high oil production rates. According to the agreed work plan, detailed investigations should therefore focus on this most promising anomalous zone. The results of detailed processing for this zone are presented in the next section (Stage 2).

The remaining three anomalous zones also have relatively large areal extents; however, their overall anomalous responses are significantly lower. Accordingly, the expected commercial reserves in these zones are likely to be smaller than in the Oil-Gas-1 zone.

An important additional conclusion is the identification of a deeper horizon associated with "Gas" frequencies. Within the Area Block, this lower horizon is present only in the anomalous zones **Oil-Gas-1** and **Oil-Gas-2**, which increases their strategic importance.

The fifth anomalous zone, **"Oil-Gas-5,"** is located outside the Area Block and, according to our interpretation, may be associated with the Ogedeh field. Its significant area and the presence of a third horizon indicate favorable potential. However, the anomalous response within this zone is uneven, suggesting possible tectonic fragmentation. The regional scale of the present study does not allow confirmation of this structural complexity.

1. STAGE 2. RESULTS OF DETAILED PROCESSING OF THE "OIL-GAS-1" ANOMALOUS ZONE
1.1 Results of Vertical Scanning (Depth Interval 600–5,700 meters)

As part of the present study, and under the first contract, our company proposed conducting a detailed investigation of the most promising anomalous zone identified during Stage 1 — the **"Oil-Gas-1"** zone.

It should be emphasized that the study was conducted under *blind processing conditions*, as no geological or production data were provided for calibration.

About Calibration

The calibration process involves:

- Comparing intervals of resonant responses with actual oil- and gas-saturated intervals from wells;
- Correlating real petrophysical parameters (e.g., porosity of reservoir sandstones, formation pressure, thickness of productive layers) with resonant responses.

Calibration significantly increases the reliability of interpretation for known reference points and allows extrapolation to areas with unknown parameters.

Due to the absence of calibration data, the results presented below should be considered preliminary.

Vertical Electro-Resonance Scanning (VERSc)

It was proposed to conduct vertical electro-resonance scanning at **10 points** within the anomalous zone.

At one selected point (V0), located in the center of the "Oil-Gas-1" anomaly (Fig. 3.1), a full-depth scan was performed from the surface to the maximum expected hydrocarbon occurrence depth.

In this project, scanning was conducted over the interval:

600–5,700 meters

During scanning at oil, gas, and water resonance frequencies, intervals of resonant responses were identified and classified into four groups of anomalously polarized layers (APL):

- APL "Oil"
- APL "Gas"
- APL "Water"
- Intermediate intervals ("Other")

For each interval:

1. Reservoir pressure was estimated;
2. The coefficient **D** was calculated, representing the difference between hydrostatic pressure and estimated reservoir pressure;
3. For intervals with positive anomalous reservoir pressure, the porosity parameter was estimated (currently applicable primarily to sandstone reservoirs).

Technical Limitations

Ideally, detailed processing of each anomalous zone requires preparation of a new large-scale working plate (typically 1:15,000).

However, due to budget constraints and lack of calibration data, detailed plate processing was not performed. Instead, the regional plate (Fig. 1.2) was used for this operation.

Results at Point V0

The results of vertical electro-resonance scanning at point V0 are presented in **Table 4.1**.

Within the depth interval of 600–5,700 meters:

- **24 anomalous intervals** were identified:
    - 12 APL "Gas"
    - 2 APL "Oil"
    - 10 APL "Water"

Additionally, an estimate of basement depth was obtained:

- **Basement depth: 5,685 meters**

This estimate was derived using granitoid resonance frequencies. However, the absence of calibration introduces considerable uncertainty into this parameter.

Graphical Representation

The full-depth scanning results at point V0 are shown in **Figure 4.1**.

Because the vertical scale of Figure 4.1 is relatively small, selected depth intervals were enlarged and presented separately for improved clarity:

- 600–1,150 meters (Fig. 4.2)
- 2,000–2,350 meters (Fig. 4.3)
- 5,200–5,700 meters (Fig. 4.4)

These detailed views allow better visualization of the structure and distribution of APL intervals within the geological section.

Central point V0 of «Oil-Gas-1» anomaly
Coordinates (UTM31N, WGS 1984): X = 744972, Y = 589688
(Scanning intervals: 600-5700 m)

Table 4.1.

№	APL	Roof meters	Bottom (meters)	Thickness meters	Pressure, MPa	D*, MPa	Porosity %	Note
1g	Gas	688	692	4	6.5	-0.40		
1w	Water	692	697	5	-----	----		
2g	Gas	722	726	4	6.6	-0.64		
2w	Water	726	729	3	----	----		
3g	Gas	863	869	6	8.00	-0.65		
3w	Water	869	677	8	----	-----		
1-g	**Gas**	**890**	**891**	**1**	**11.0**	**+2.10**	**18**	
1-o	**Oil**	**891**	**919**	**28**	**11.0**	**+1.95**	**18**	**Horizon «Oil» M-1**
1-w	**Water**	**919**	**927**	**8**	**----**	**----**	**18**	
4g	Gas	990	1003	13	10.0	0.0		
4w	Water	1003	1007	4	------	-----		
5g	Gas	1027	1039	12	10.15	-0.18		
5w	Water	1039	1048	9	------	------		
6g	Gas	1105	1134	29	11.0	-0.2		
6w	Water	1134	1135	1	-------	------		
7g	Gas	2076	2084	8	20.3	-0.5		
8g	Gas	2271	2287	16	22.4	-0.4		
8w	Water	2287	2294	7	-----	----		
2-o	**Oil**	**2304**	**2314**	**10**	**23.5**	**+0.4**	**14**	**Horizon «Oil» M-2**
2-w	Water	-	-	-	-	-	-	
9g	**Gas**	**5284**	**5294**	**10**	**53.7**	**+0.8**	**12**	**Horizon «Gas» -1**
10g	**Gas**	**5395**	**5409**	**14**	**54.3**	**+0.3**	**12**	**Horizon «Gas» -2**
10w	Water	5409	5412	3	----	----		
11g	Gas	5510	5529	19	54.7	-0.5		
	Basement	5685						

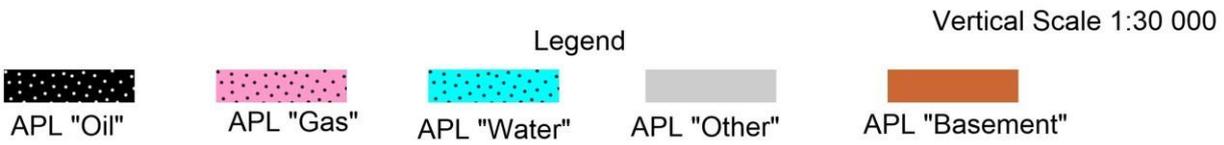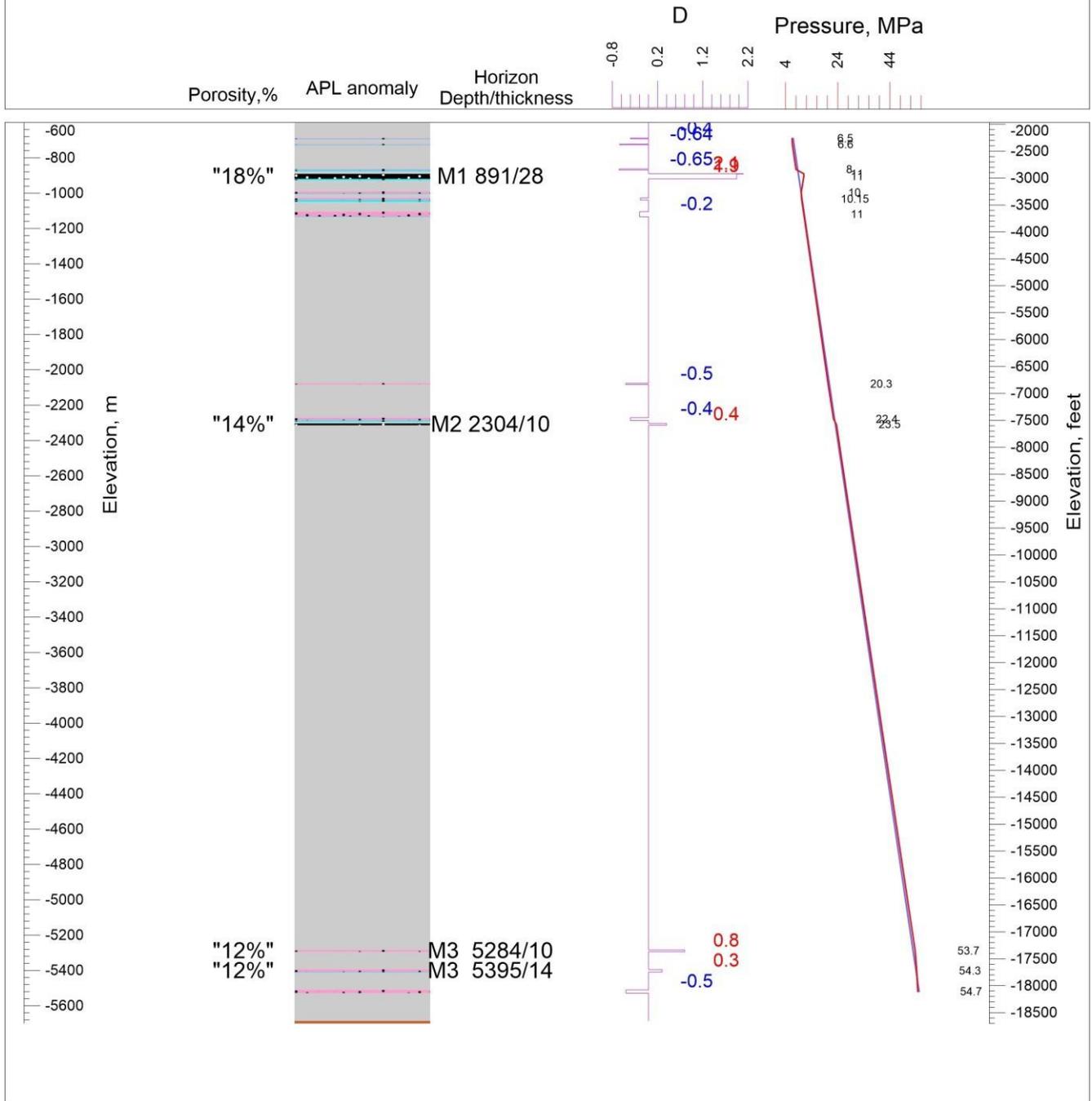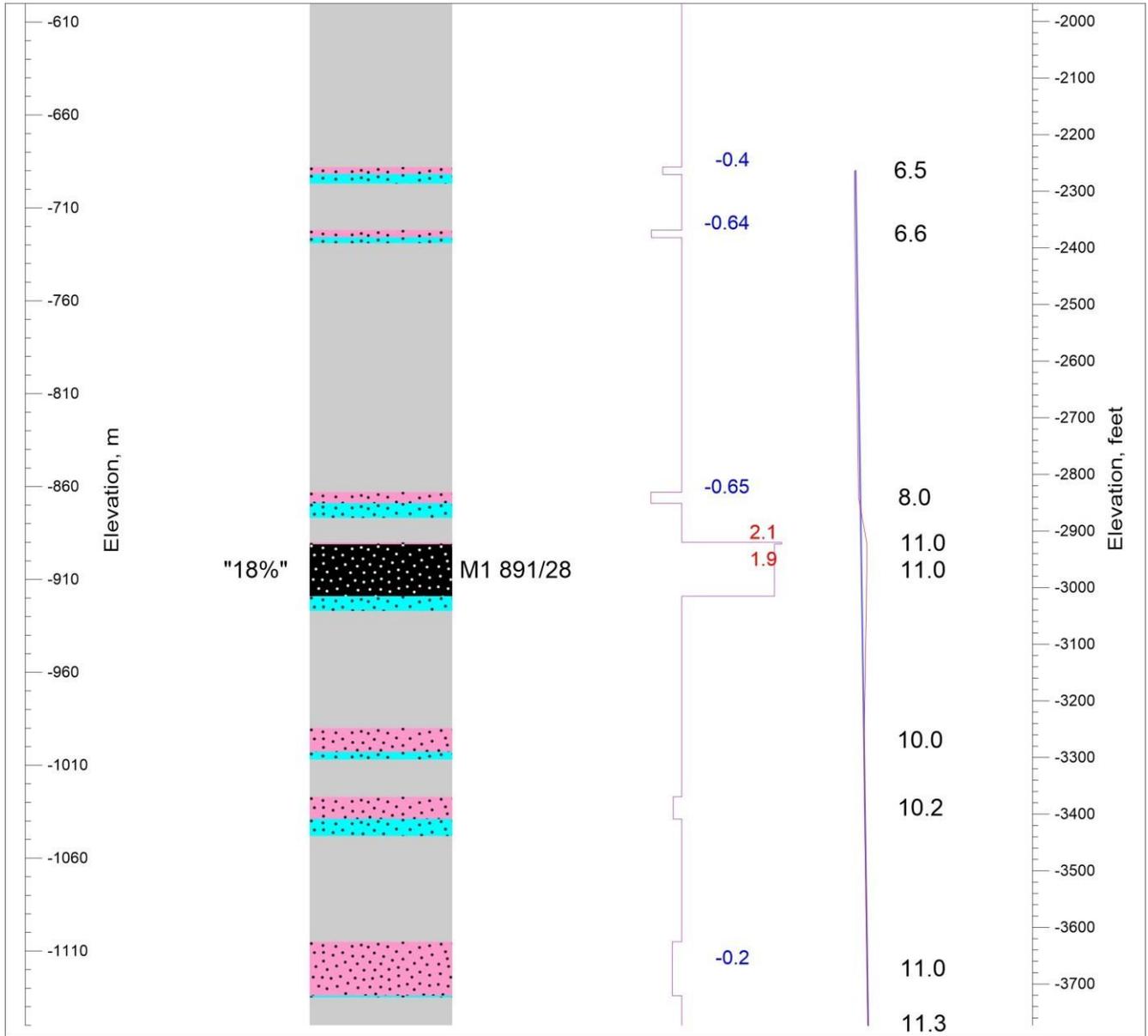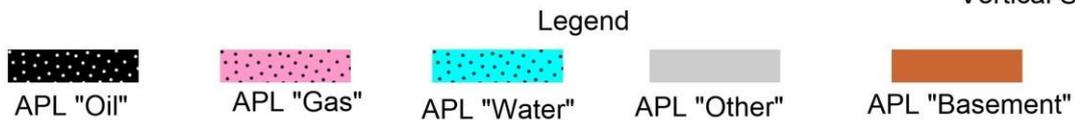***D** − The difference between reservoir and hydrostatic pressure

The results of vertical scanning in point V0 of Oil-Gas-1 anomaly zone of Ajapa Block, Nigeria
By frequency resonant satellite image processing

Interval 600-5700m

D

Pressure, MPa

-0.8 0.2 1.2 2.2   4 24 44

Porosity,%   APL anomaly   Horizon Depth/thickness

Elevation, m

Elevation, feet

"18%"   M1 891/28
-0.64
-0.65 2.9
-0.2

6.5
6.6
8 11
10.15
11

"14%"   M2 2304/10
-0.5
-0.4 0.4

20.3
22.4
23.5

"12%"   M3 5284/10
"12%"   M3 5395/14
0.8
0.3
-0.5

53.7
54.3
54.7

Vertical Scale 1:30 000

Legend

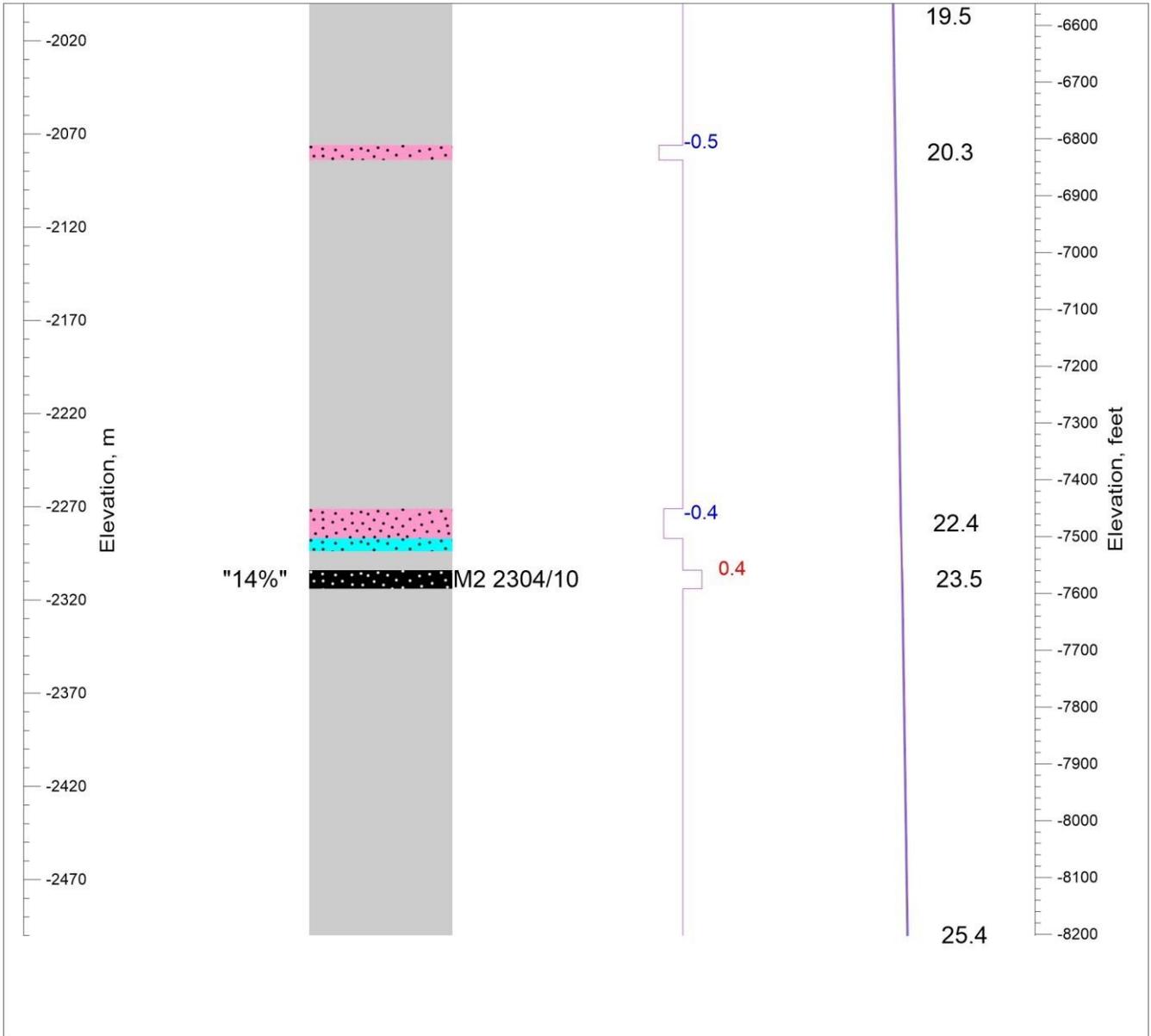APL "Oil"   APL "Gas"   APL "Water"   APL "Other"   APL "Basement"

Fig 4.1.

20

The results of vertical scanning in point V0 of Oil-Gas-1 anomaly zone of Ajapa Block, Nigeria
By frequency resonant satellite image processing
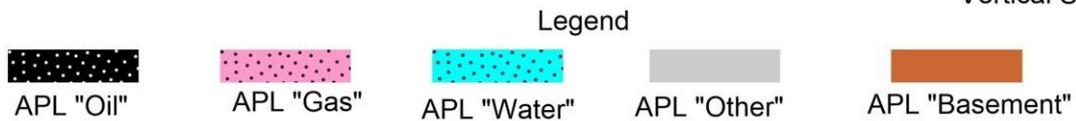
Interval 600-1150 m

Fig 4.2.

21

Fig.4.3.

The results of vertical scanning in point V0 of Oil-Gas-1 anomaly zone of Ajapa Block, Nigeria By frequency resonant satellite image processing
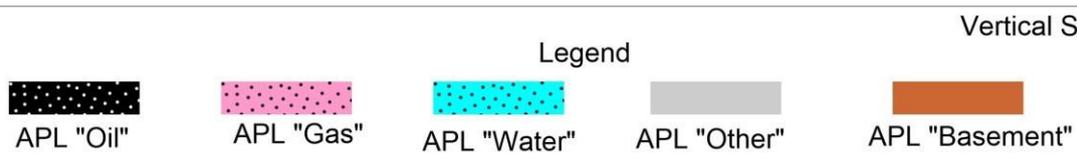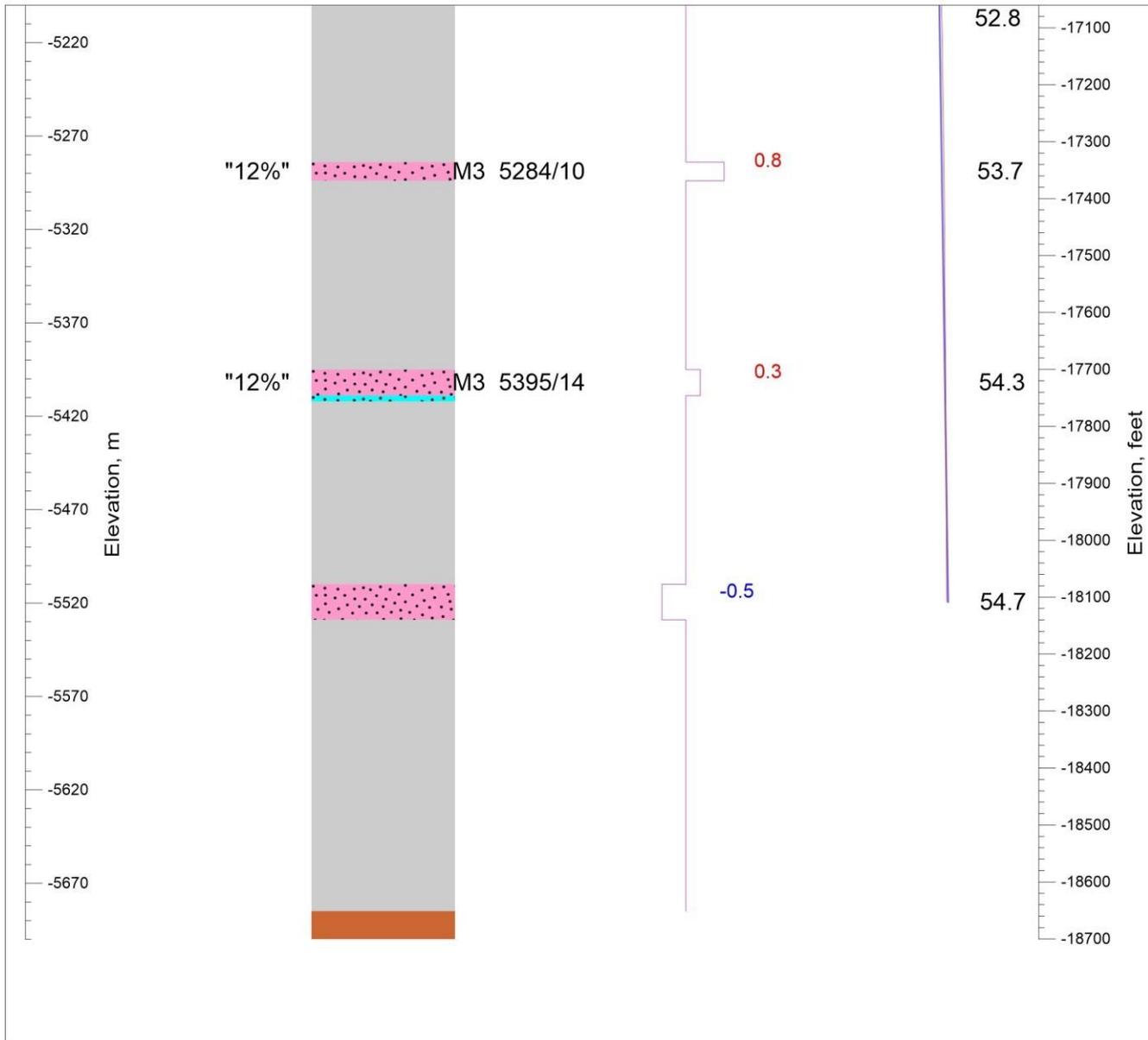
Interval 5200-5700 m

Fig.4.4.

The results obtained from the vertical scanning at point V0 allowed us to establish criteria for conducting scanning at the remaining nine points within the anomalous zone.

First, it was determined that performing full-interval scanning (600–5,700 m) at each additional point is not necessary. Instead, it is sufficient to trace the main prospective horizons identified at V0:

- **M-1**
- **M-2**
- **M-3** (corresponding primarily to Gas-1 and Gas-2 intervals)

Focusing on these key horizons significantly optimizes the workflow while preserving the essential geological information required for structural modeling.

The locations of the vertical scanning points (see Table 4.2) were arranged across the anomalous zone in such a way as to ensure adequate spatial coverage. This configuration enables the construction of **two geological–geophysical cross-sections** along Profiles 1 and 2 (see Fig. 3.1).

Such an arrangement provides:

- Lateral tracing of the identified prospective horizons;
- Evaluation of structural continuity;
- Identification of possible tectonic segmentation;
- Refinement of depth and thickness variations within the anomalous zone.

Table 4.2.

Point	X, UTM31N,WGS1984	Y, UTM31N,WGS1984
V1	743891	589380
V2	744344	589495
V3	745647	589863
V4	746348	590047
V5	744936	590654
V6	744936	590340
V7	745005	589082
V8	745005	588694
V9	745040	588306

The scan results for points V1-V9 are shown below.

Point V0

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	891	919	28
1-w	Water	919	927	8
2-o «M-2»	Oil	2304	2314	10
2-w	Water	-	-	-

Point V1

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	927	930	3
1-w	Water	930	944	14
2-o «M-2»	Oil	2350	2354	4
2-w	Water	2354	2360	6

Point V2

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	910	930	20
1-w	Water	930	947	17
2-o «M-2»	Oil	2330	2340	10
2-w	Water	----	-----	-----

Point V3

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	904	921	17
1-w	Water	921	937	16
2-o «M-2»	Oil	2311	2317	6
2-w	Water	2317	2321	4

Point V4

1-o «M-1»	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	925	935	10
1-w	Water	935	948	13
2-o «M-2»	Oil	2321	2323	2
2-w	Water	2323	2331	8

Point V5

1-o «M-1»	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	931	939	8
1-w	Water	939	943	4
2-o «M-2»	Oil	----	----	----
2-w	Water	2325	2333	8

Point V6

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	920	934	14
1-w	Water	934	949	15
2-o «M-2»	Oil	2314	2319	5
2-w	Water	2319	2325	6

Point V7

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	910	927	17
1-w	Water	927	941	14
2-o «M-2»	Oil	2314	2316	2
2-w	Water	2316	2320	4

Point V8

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	938	952	14
1-w	Water	952	967	15
2-o «M-2»	Oil	-----	-----	-----
2-w	Water	2327	2329	2

Point V9

№	APL	Roof (meters)	Bottom (meters)	Thicknes meters
1-o «M-1»	Oil	944	952	8
1-w	Water	952	967	15
2-o «M-2»	Oil	----	----	----
2-w	Water	2335	2337	2

As shown by the scanning results, the third horizon (M3 – Gas) was not detected at any of the additional scanning points. Furthermore, the M2 horizon was not identified at points **V5, V8, and V9**.

This information made it possible to refine the structural interpretation and plot the contours of the three prospective horizons on Figure 3.1.

Construction of Geological–Geophysical Cross-Sections

The identified depth intervals of the prospective horizons enabled the construction of two geological–geophysical profiles crossing the anomalous zone "Oil-Gas-1":

- **Figures 4.5–4.6** – Profile 1–1a
  - Fig. 4.5: Upper horizon M1
  - Fig. 4.6: Lower horizon M2
- **Figures 4.7–4.8** – Profile 2–2a
  - Fig. 4.7: Upper horizon M1
  - Fig. 4.8: Lower horizon M2

These cross-sections provide a lateral view of horizon continuity, thickness variation, and structural configuration within the anomalous zone.

Thickness Distribution and Structural Interpretation

From the obtained results:

- The **M1 horizon** exhibits the greatest thickness, reaching a maximum of **28 meters at point V0**.
- The **M2 horizon** has a maximum thickness of approximately **10 meters**.

The geometry of both horizons, as shown in the constructed cross-sections, suggests that the structure of the anomalous zone is consistent with an **anticlinal trap type**.

The upward convex shape of the horizons and the concentration of maximum thickness near the central part of the anomaly (V0) support the interpretation of structural uplift and potential hydrocarbon accumulation within an anticlinal closure.
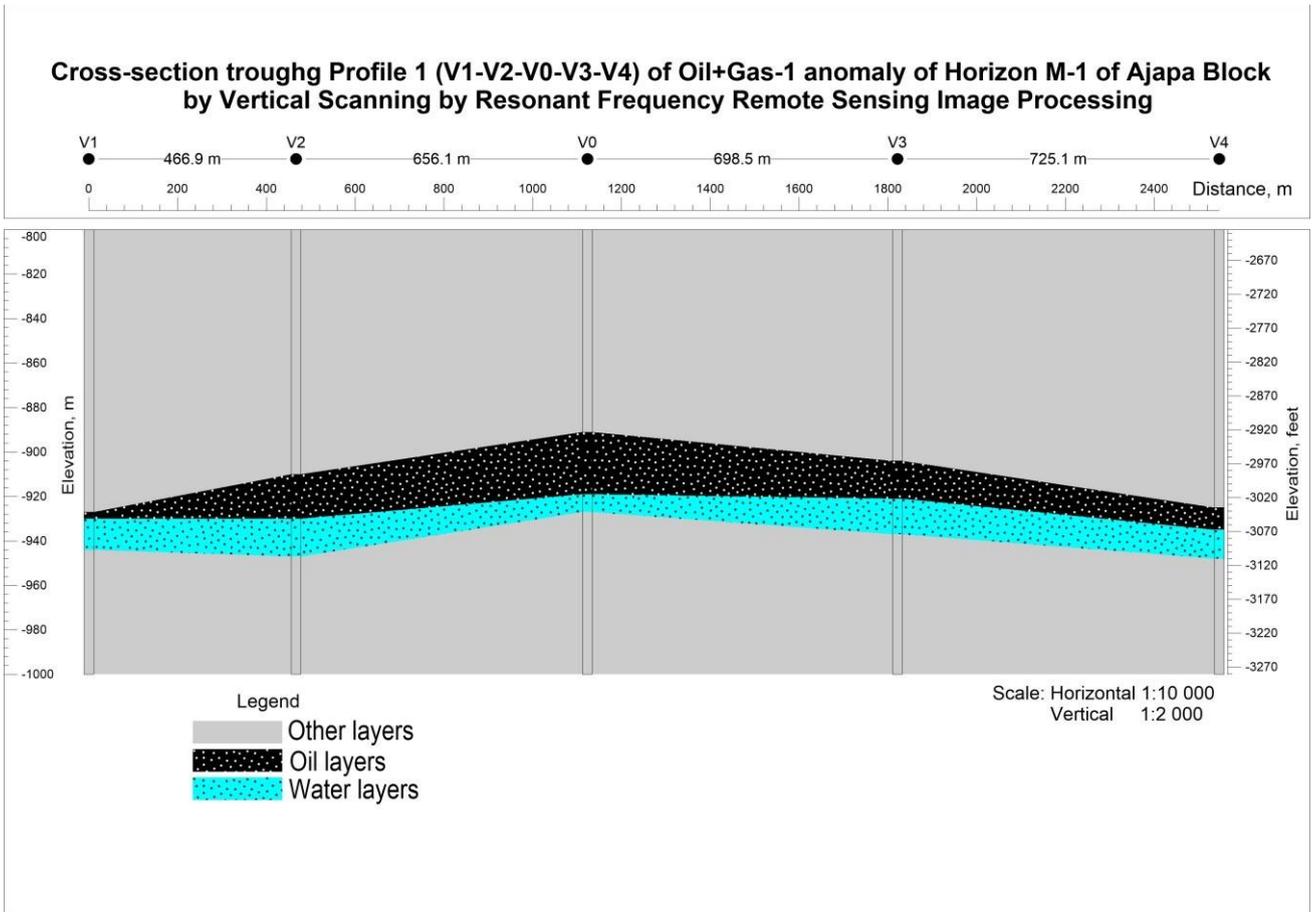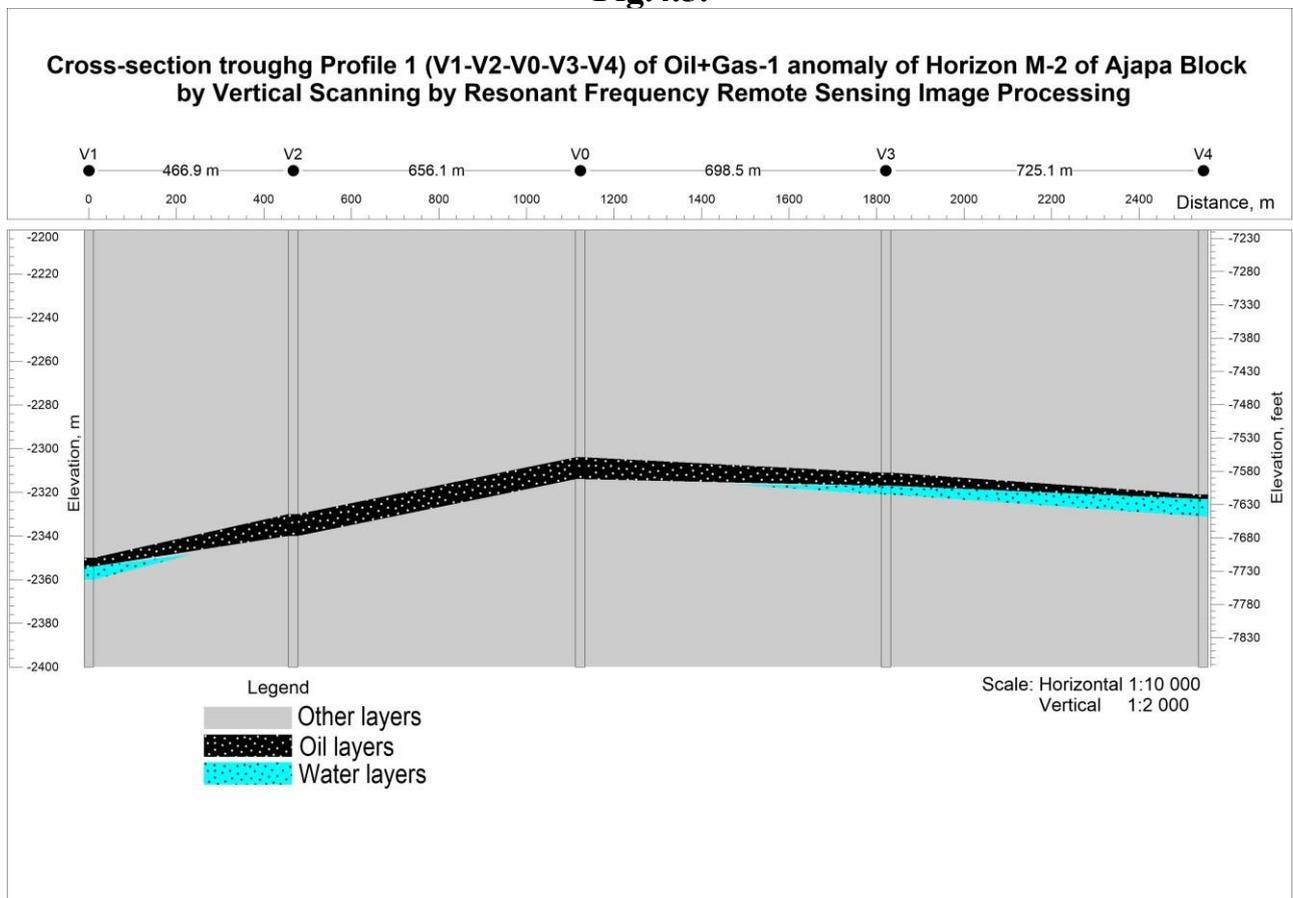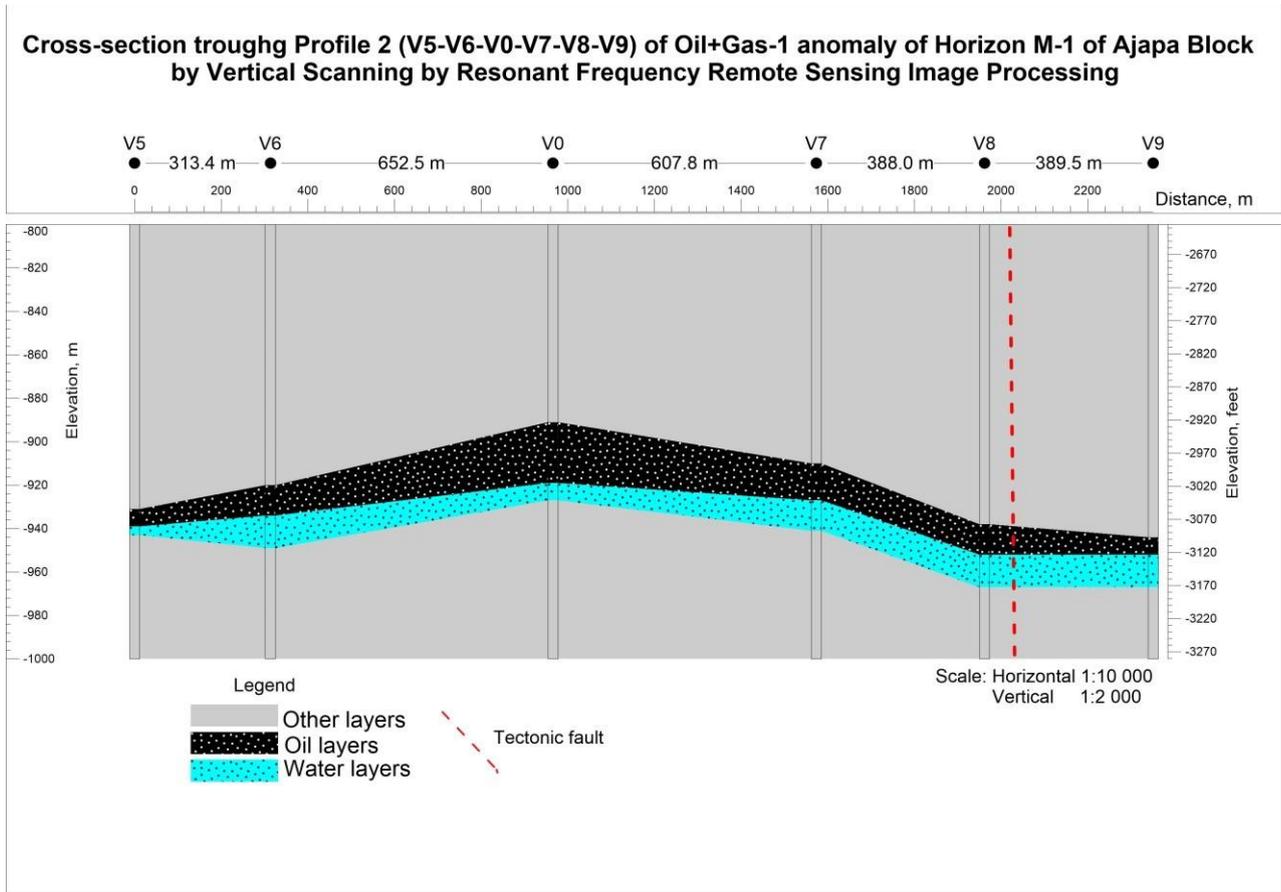
Fig.4.5.

Fig.4.6.

Cross-section troughg Profile 2 (V5-V6-V0-V7-V8-V9) of Oil+Gas-1 anomaly of Horizon M-1 of Ajapa Block by Vertical Scanning by Resonant Frequency Remote Sensing Image Processing

Fig.4.7.

Cross-section troughg Profile 2 (V5-V6-V0-V7-V8-V9) of Oil+Gas-1 anomaly of Horizon M-2 of Ajapa Block by Vertical Scanning by Resonant Frequency Remote Sensing Image Processing
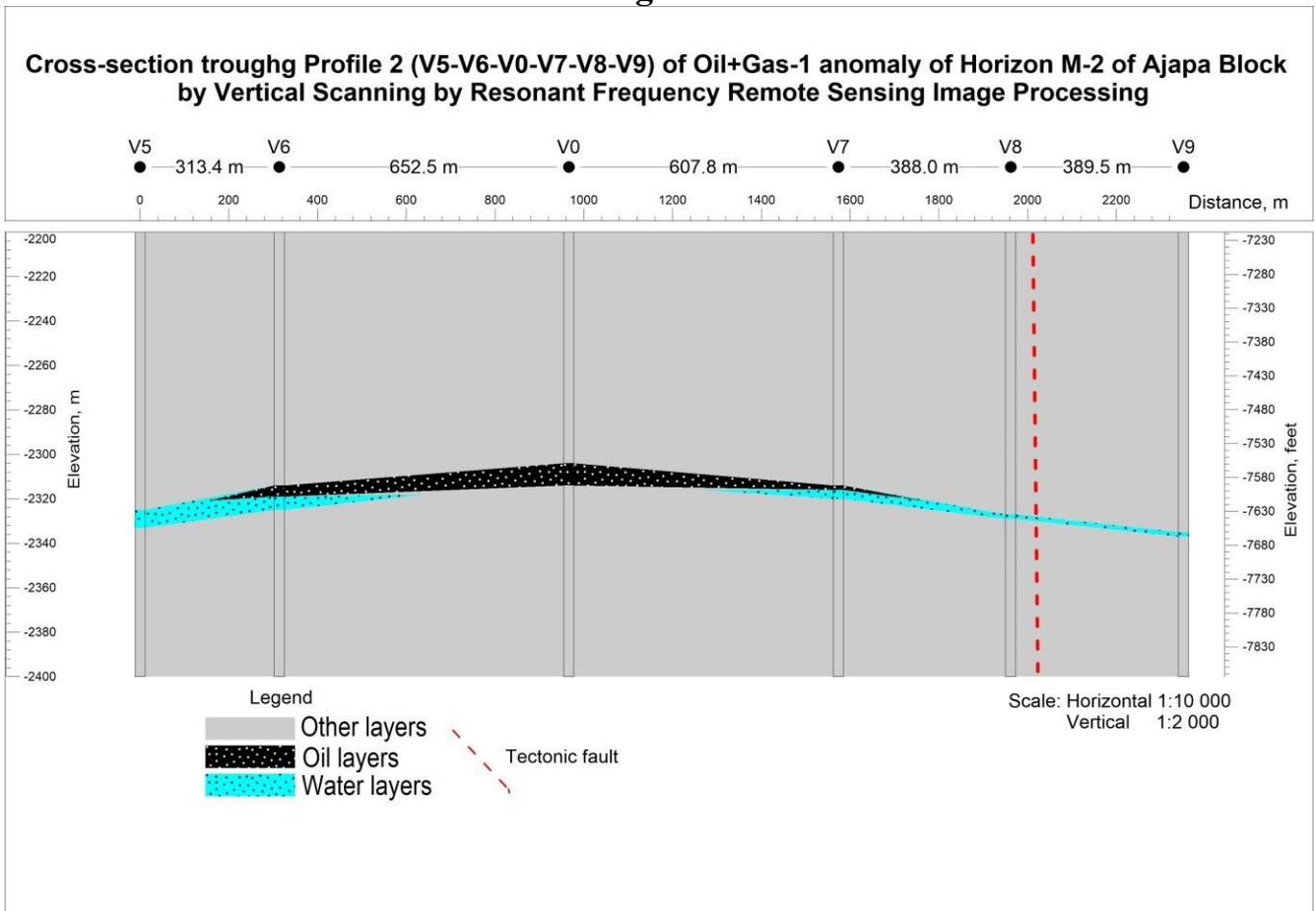
Fig.4.8.

4.2 Construction of a Model of Prospective Horizons for the "Oil-Gas-1" Anomalous Zone and Estimation of Reservoir Volumes

The data obtained from vertical scanning can be used for various types of structural and volumetric modeling. Using interpolation methods, it is possible to construct:

- Structural maps of the prospective horizons;
- Thickness (isopach) maps of hydrocarbon-bearing reservoirs;
- Depth contour maps;
- Volumetric models of potential accumulations.

However, considering that all results contain a certain degree of uncertainty due to the absence of calibration data, we present here a demonstrative approach to estimating the potential volume of the expected deposit.

Thickness (Isopach) Maps of Prospective Horizons

Based on the vertical scanning results at points **V0–V9**, thickness maps (isopach maps) were constructed for the two main prospective horizons:

- **Horizon M1**
- **Horizon M2**

These maps are presented in **Figures 4.9 and 4.10**, respectively.

The constructed thickness distributions reflect:

- Spatial variation of reservoir thickness;
- Concentration of maximum thickness near the structural crest (point V0);
- Gradual thinning toward the flanks of the anomalous zone.

Estimation of Reservoir Volume (Conceptual Approach)

The reservoir volume may be estimated using the standard volumetric approach:

$$V = A \times h$$

where:

- **V** – bulk reservoir volume,
- **A** – area of structural closure,
- **h** – average effective reservoir thickness.

Further refinement may include correction for porosity and hydrocarbon saturation:

$$V_h c = A \times h \times \varphi \times S_h$$

where:

- φ – porosity,
- S_h – hydrocarbon saturation.

Because calibration data are unavailable, the present calculations are indicative and intended to demonstrate the methodological capability rather than provide certified reserve estimates.

Fig. 4.9.

**Map of reservoir M2 thickness of APL "Oil" type of Oil-gas-1 anomalous zone
in the search area of Block Ajapa in Nigeria
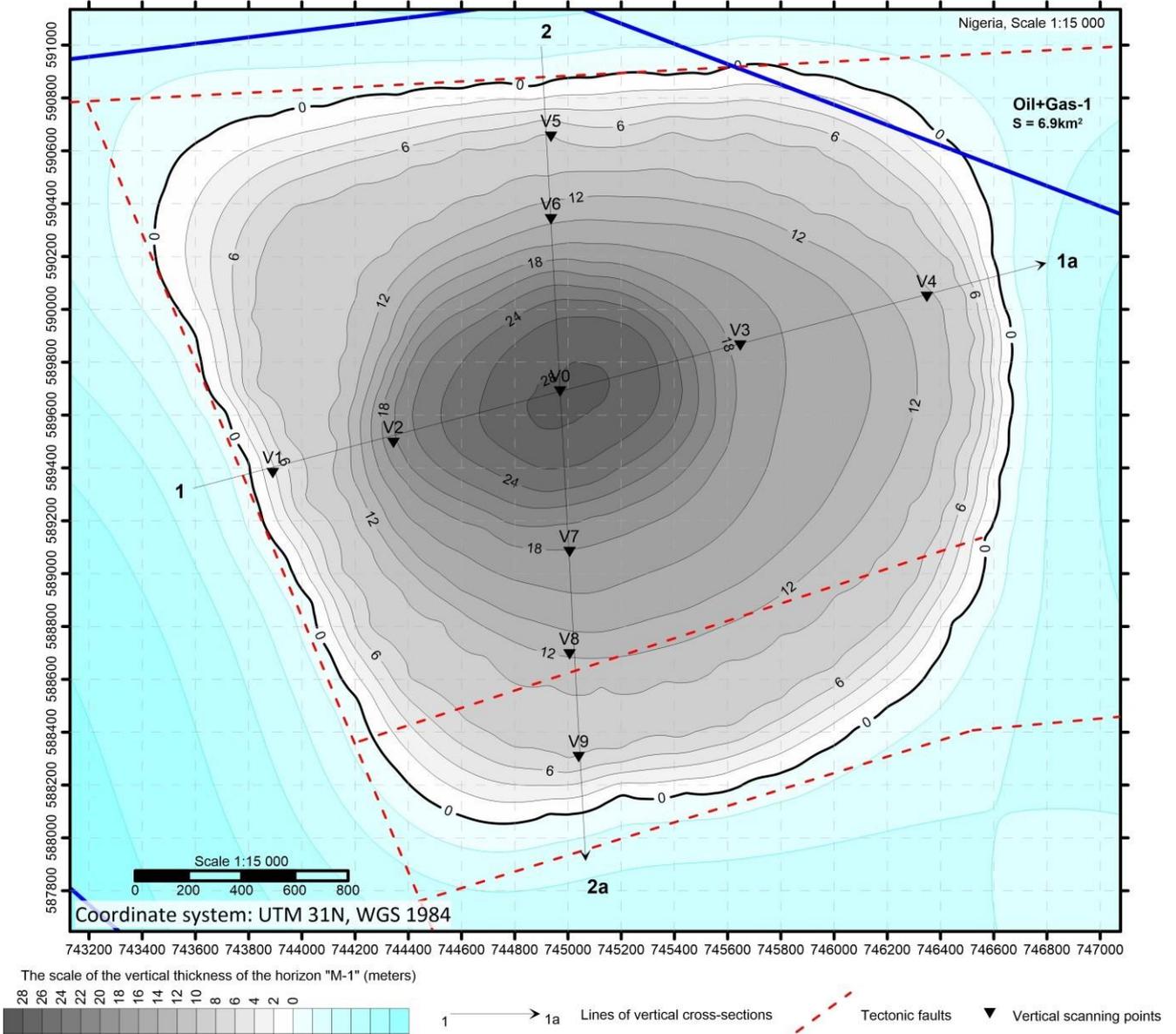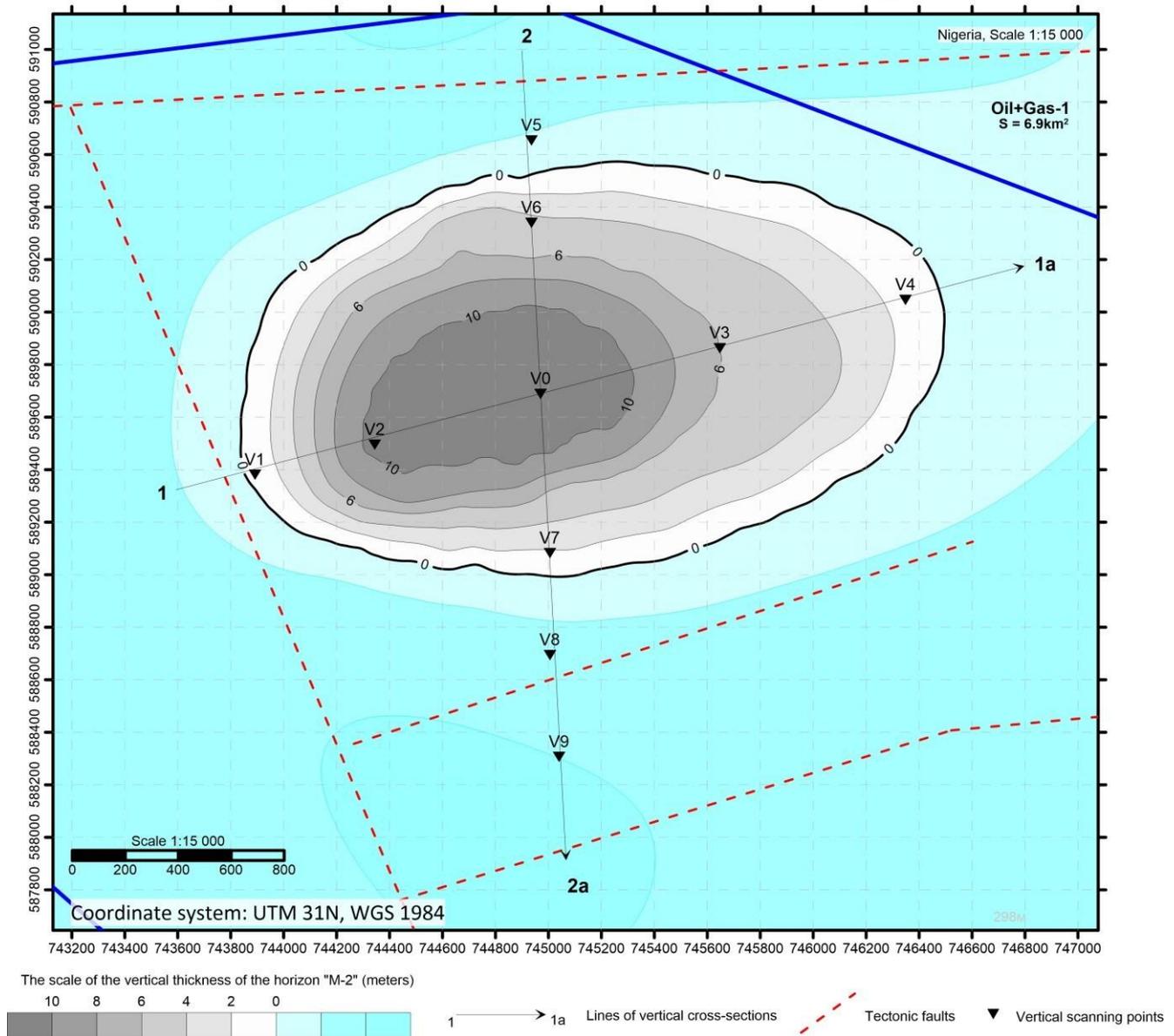(According to the data of vertical electroresonance scanning)**

Fig. 4.10.

TVolumetric Estimation of Prospective Horizons

The constructed models allow reservoir volumes to be calculated using our proprietary software.

Based on the structural and thickness maps:

- **Horizon M1** – Bulk reservoir volume: **80.88 million m³**
- **Horizon M2** – Bulk reservoir volume: **16.76 million m³**

Porosity values obtained from vertical scanning:

- **M1 porosity (φ): 18%**
- **M2 porosity (φ): 14%**

According to open-source data, the oil density for this region corresponds to approximately **40° API**, which was used to convert hydrocarbon pore volume into estimated recoverable oil mass.

Using the volumetric approach:

$$Oil in place \approx V \times \varphi$$

(with conversion to mass based on oil density),

the preliminary resource estimates are:

- **M1 ≈ 12 million tonnes of oil**
- **M2 ≈ 1.94 million tonnes of oil**

These values represent approximate in-place resource estimates and should be regarded as preliminary due to the absence of calibration data.

Conclusion for Stage 2

1. As a demonstration, detailed processing was performed for the anomalous zone **"Oil-Gas-1."**
2. Detailed plate processing at a scale of 1:15,000 was not performed; therefore, tectonic zones and anomaly contours were not refined. In the absence of calibration data, such refinement would not significantly increase interpretation reliability.
3. A full-depth vertical scan was performed at the central point of the anomalous zone (V0).
   - 24 anomalous intervals were identified:
     - 12 APL "Gas"
     - 2 APL "Oil"
     - 10 APL "Water"
   - Estimated basement depth: **5,685 m**
   - Parameters (depth intervals, thickness, pressure, porosity) are presented in Table 4.1.
   - Two promising oil horizons (M1 and M2) and one gas horizon (M3) were identified.
4. Targeted vertical scanning was subsequently conducted at 9 additional points.
   - Horizon **M1** was identified at all scanning points.
   - Horizon **M2** was not detected at points V5, V8, and V9.
   - Horizon **M3 (Gas)** was not confirmed at any additional scanning points.
     These results allowed refinement of the horizon contours shown in Figure 3.1.
5. Based on scanning results from 10 points, two geological–geophysical cross-sections were constructed. The structural configuration of the deposit, according to these data, corresponds to an **anticlinal trap type**. Thickness maps for horizons M1 and M2 were also constructed.
6. Based on the integrated dataset, a preliminary volumetric estimate of oil resources was calculated:
   - **M1 ≈ 12 million tonnes of oil**
   - **M2 ≈ 1.94 million tonnes of oil**

These estimates are preliminary and intended to demonstrate the modeling capability of the applied technology. Confirmation requires calibration data and drilling validation.

CONCLUSIONS AND RECOMMENDATIONS

1. As a result of the regional and detailed investigations conducted within the Area Block using the direct-prospecting technology of frequency-resonance processing and interpretation of remote sensing (RS) data, substantial additional information has been obtained regarding the hydrocarbon potential of the identified anomalous zones. In particular:

    a) The contours of anomalous zones and the positions of tectonically weakened (fault) zones were refined and specified.

    b) Maximum reservoir pressure values within the anomalies were estimated, and central points of maximum pressure were identified.

    c) At the central point of the Oil-Gas anomaly, vertical scanning of the geological section within the depth interval of 600–5,700 m allowed determination of the depth and thickness of anomalously polarized layers (APL) of the "oil," "gas," and "water" types. For the most promising APLs of "oil" and "gas" type, reservoir pressure and porosity values were estimated.

    d) Based on scanning results, the most promising APLs of the "oil" type were identified — specifically those where estimated reservoir pressure exceeded conditional hydrostatic pressure, indicating potential for commercial oil inflows.

    e) For the identified promising APLs, additional vertical scanning was performed at nine supplementary points to trace lateral continuity.

    f) Based on the integrated dataset, a preliminary estimate of hydrocarbon resources was made for the anomalous zone Oil-Gas-1.

Recommendations

1. Considering that the current results were obtained under blind processing conditions (without calibration data), we recommend reprocessing the identified anomalous zones with the provision of:
    o Well data (location, depth, productive intervals);
    o Reservoir pressure measurements;
    o Petrophysical parameters;
    o Any available seismic or geological data.

    Calibration would significantly improve interpretation accuracy and reliability of reserve estimates.

2. It is proposed to conduct detailed processing of the Oil-Gas-1 anomalous zone at a scale of 1:15,000. This would allow:
    o Refinement of reservoir boundaries;
    o Detailed mapping of tectonic zones;
    o Repeated vertical scanning with calibration support;
    o Improved estimation of oil reserves.
3. If there is interest in other anomalous zones, similar detailed processing can be performed for them to determine:
    o Structural configuration;
    o Parameters of prospective horizons;
    o Preliminary reserve estimates.

4. At the next stage (Stage 3), and in consultation with the client, it is recommended to conduct ground-based geoelectric surveys using FSPEF and VERS methods over the most promising anomalies. VERS sounding would allow:
   - Assessment of depths and thicknesses of productive horizons;
   - Estimation of lateral extent of reservoirs;
   - Calculation of reservoir volumes;
   - Preliminary evaluation of oil and gas resource potential.
5. The frequency-resonance method of remote sensing data processing may be considered a direct method for hydrocarbon prospecting. The mapped anomalies can be interpreted as surface projections of predicted hydrocarbon accumulations in the geological section. This enables:
   - Targeted selection of exploration well locations;
   - Improved resource estimation within surveyed structures;
   - More informed decision-making regarding further exploration and drilling.
6. The applied frequency-resonance technology is a mobile and direct method suitable for exploration of oil, gas, condensate, water, gold, uranium, and other mineral resources. A key methodological component is the estimation of maximum reservoir fluid pressure, which:
   - Narrows the search area;
   - Assists in estimating depth of hydrocarbon occurrence;
   - Allows exclusion of low-potential anomalies from priority drilling targets.
7. The cost and time required for remote sensing data processing are significantly lower than those associated with conventional geophysical or field-based geoelectric surveys. Therefore, integration of this technology into traditional exploration workflows is highly efficient, particularly at reconnaissance stages and in large or difficult-to-access areas.

1.