

Institute of Geological Sciences  
Hydrogeological Department  
Report No. WD/73/11

Jalu-Tazerbo Project  
Sirte Basin  
Libyan Arab Republic

Phase 2 Area

Geological Studies

Preliminary Assessment of Post-Oligocene Sediments  
in Region North of Latitude  $27^{\circ} 20'N$

by

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June 1973

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JALU - TAZERBO PROJECT

SIRTE BASIN

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GEOLOGICAL STUDIES

PRELIMINARY ASSESSMENT OF POST-OLIGOCENE  
SEDIMENTS IN REGION NORTH OF LATITUDE 27° 20'N

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## INTRODUCTION

This report presents a preliminary assessment of the Post-Oligocene Geology of the northern part of the Jalu - Tazerbo Project, Phase 2 Area. The Phase 2 Area extends from latitude  $25^{\circ}\text{N}$  to latitude  $28^{\circ}\text{N}$  and from longitude  $21^{\circ}45'\text{E}$ . The region covered in this report comprises that part of the Phase 2 Area lying to the north of latitude  $27^{\circ}20'\text{N}$ . The northern boundary of the region is contiguous with the Phase 1 Area between latitudes  $21^{\circ}\text{E}$  and  $22^{\circ}\text{E}$ .

This report consists essentially of a series of maps (Figs 1-8) with a brief accompanying text. It covers the extension of the type of geological studies made in the Phase 1 Area to the northern part of the Phase 2 Area. For fuller details of the methods used, reference should be made to the earlier report on the geology of the Phase 1 Area (Benfield 1972).

## SOURCES OF DATA

As in the Phase 1 Area, the principal source of geological data has been the logs of the wildcat and production wells drilled by the oil companies. The region covered by this report lies entirely within Concession 65, where exploration was carried out by the B.P. Exploration Company up to 1971 and by the Arabian Gulf Exploration Company thereafter. Logs from a total of 24 wells have been examined in the investigations reported on here.

Photogeological map information on the surface geology was only available for the western boundary of the region. Nevertheless it proved useful in defining an approximate limit to the outcrop of Post-Middle-Miocene sediments.

## GENERAL STRATIGRAPHY

Studies of the well-log information have shown that the basic stratigraphic subdivisions defined in the Phase 1 Area can be extended to the northern region of the Phase 2 Area. Thus the Post-Oligocene sediments may be divided

between a Post-Middle-Miocene sequence above and a Lower and Middle Miocene sequence below. The former can be subdivided, as in the Phase 1 Area, into an upper unit of generally poorly consolidated sands with occasional thin clays and a lower unit comprised mainly of clayey sands, with some sandy limestones, sandstones and clays.

TABLE I

STRATIGRAPHY OF POST-OLIGOCENE SEDIMENTS, NORTHERN REGION, PHASE 2 AREA

POST-MIDDLE-MIOCENE	UPPER SANDS	Coarse unconsolidated sands grading to calcareous sandstones in part, with rare thin clayey sands and clays.
	LOWER SANDS AND CLAYS	Clayey sandstones and sands, clays, with some sandy limestones.
LOWER AND MIDDLE MIOCENE		Interbedded sands and sandstones to the south-west; limestones and clays, with evaporites to the north-east.

POST-MIDDLE-MIOCENE

The outcrop of Post-Middle-Miocene sediments covers all but the south-west corner of the region (Fig 1). The configuration of the base of the Post-Middle-Miocene, coincident with that of the base of the Lower Sands and Clays (Fig 1), is basically simple in form. It is highest in the south-west, and slopes uniformly to the north-east. The structure contours generally strike north-west to south-east but are modified by north-easterly deepening "valleys".

The base of the Upper Sands (Fig 2) has essentially the same configuration as that of the Post Middle Miocene.

The thickness of the Lower Sands and Clays is variable (Fig 3). Values are least to the south-west and greatest to the south-east. Isopachs again show a pattern of northeasterly deepening "valleys".

### LOWER AND MIDDLE MIOCENE

A general assessment of the whole of the Lower and Middle Miocene - defined for this purpose as the sediments lying between the base of the Post-Middle-Miocene above and the top of the thick unit of sands and sandstones immediately overlying the Eocene below - indicates that at least two major intervals of clayey sediments occur within it. These intervals are of the order of 150-200 feet in thickness in the south-west of the region and expand to the north-east. However the areal variation of these clays appears to be complex and a full assessment will require more detailed investigation than has been possible at this stage.

Lithological variation within the upper 500 feet of the Lower and Middle Miocene has been assessed in some detail using lithofacies analysis. The raw data for these studies has been obtained from thickness measurements of the lithological units delimited on the Final Logs prepared for each well site by British Petroleum Ltd (Table II).

The regional distribution of values for the percentage thickness of this unit occupied by sands and sandstones (Fig 4) shows that values greater than 50 per cent cover the whole of the south-western half of the region. Values decrease to the north-east and are less than 10 per cent around AAL-65.

Two points should be noted. First, that even where the percentage thickness of sand is high, dominantly clayey sequences up to 150 feet in thickness occur. Second, the north-easterly projecting lobe of increased sand thickness in the Sarir field area may possibly reflect misidentification of sandy limestones as sandstones in the BP Final Logs.

TABLE II

LITHOFACIES DATA FOR UPPER 500 FEET OF LOWER AND MIDDLE MIOCENE,  
NORTHERN REGION, PHASE 2 AREA

Wildcat Well No	Percentage sand/sandstone	Percentage Limestone/Dolomite	Percentage Clay/Shale
A1-65	54	4	42
A2-65	37	26	37
A3-65	71	2	27
B1-65	68	0	32
C1-65	28	2	70
L1-65	11	22	67
N1-65	70	0	30
V1-65	57	19	24
X1-65	75	5	20
Y1-65	48	7	45
Z1-65	57	11	32
AA1-65	0	48	52
DD1-65	50	16	34
FF1-65	0	56	44
GG1-65	74	0	26
HH1-65	23	44	33
JJ1-65	4	32	64
KK1-65	15	45	40
LL1-65	68	0	32

Percentage thickness values for limestone and dolomites (Fig 5) over the same interval clearly indicate an increasingly marine influence to the north-east. The south-westerly lobe of higher carbonate percentage reaching as far as A2-65 should be noted. A similar trend to increasingly marine conditions towards the north-east is shown by the distribution of percentage thickness values for clay and shale (Fig 6). This is further emphasised by the distribution of boreholes in which gypsum/anhydrite bearing beds have been recorded within the upper 500 feet of the Lower and Middle Miocene (Fig 7).

## HYDROGEOLOGICAL IMPLICATIONS

### a) Post-Middle-Miocene Sediments

1. The rise in elevation of the Upper Sands aquifer to the west and south-west results in decreased values for the saturated thickness (Fig 8). Clearly development of the Upper Sands aquifer will be concentrated in the centre and east of the area.

2. Little information is available in the centre of the area. Consideration should be given to siting exploration boreholes to the north of LLI-65 and between LLI-65 and TI-65.

### b) Lower and Middle Miocene

1. The area of maximum sand thickness in the south-west coincides with the area of decreased saturated thickness of the Upper Sands. Thus it would be logical to develop the Lower and Middle Miocene in this area.

2. In developing the Lower and Middle Miocene consideration should be given to the presence of thick clays and clayey horizons which will subdivide the aquifer. Exploration should aim at investigating possible differences in aquifer properties and hydrochemistry between these subdivisions.

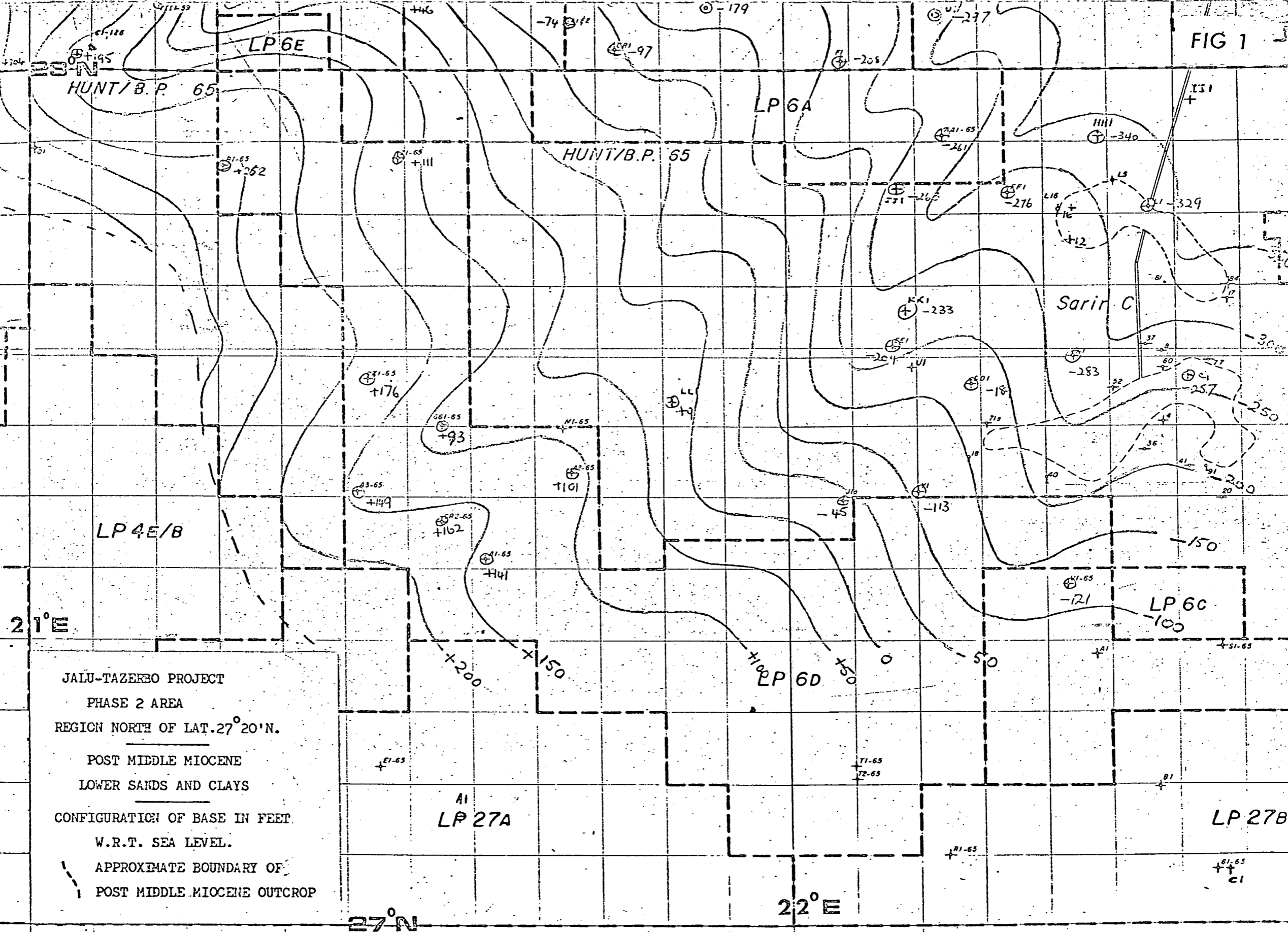
3. Information is lacking in the area between A2-65 and TI-65 and the siting of exploration wells in this area should be considered.

### REFERENCE

BENFIELD A.C.            1972    Post-Oligocene sediments, Jalo  
Region, Sirte Basin, Libya

IGS, Hydrogeological Department.    Unpublished  
Report WD/72/5





JALU-TAZERBO PROJECT  
 PHASE 2 AREA  
 REGION NORTH OF LAT. 27° 20' N.  
 POST MIDDLE MIOCENE  
 LOWER SANDS AND CLAYS  
 CONFIGURATION OF BASE IN FEET  
 W.R.T. SEA LEVEL.  
 APPROXIMATE BOUNDARY OF  
 POST MIDDLE MIOCENE OUTCROP

27° N

22° E

21° E

Sarin C

HUNT/B.P. 65

HUNT/B.P. 65

LP 6E

LP 6A

LP 4E/B

LP 6C  
-100

LP 6D  
+50

LP 27A

LP 27B

HUNT/B.P. 65

HUNT/B.P. 65

LP 4E/B

LP 6E

LP 6A

Sarir C

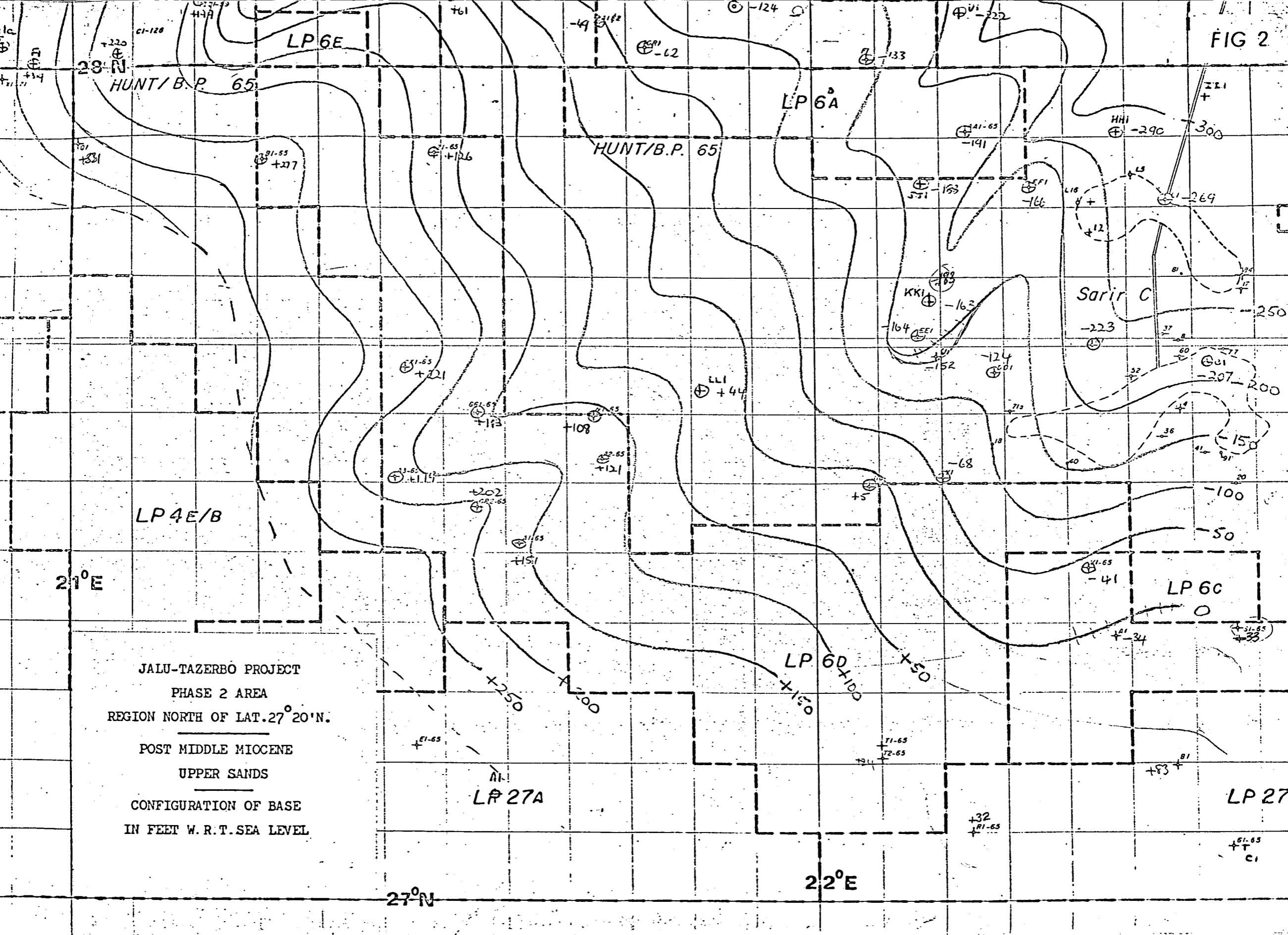
LP 6C

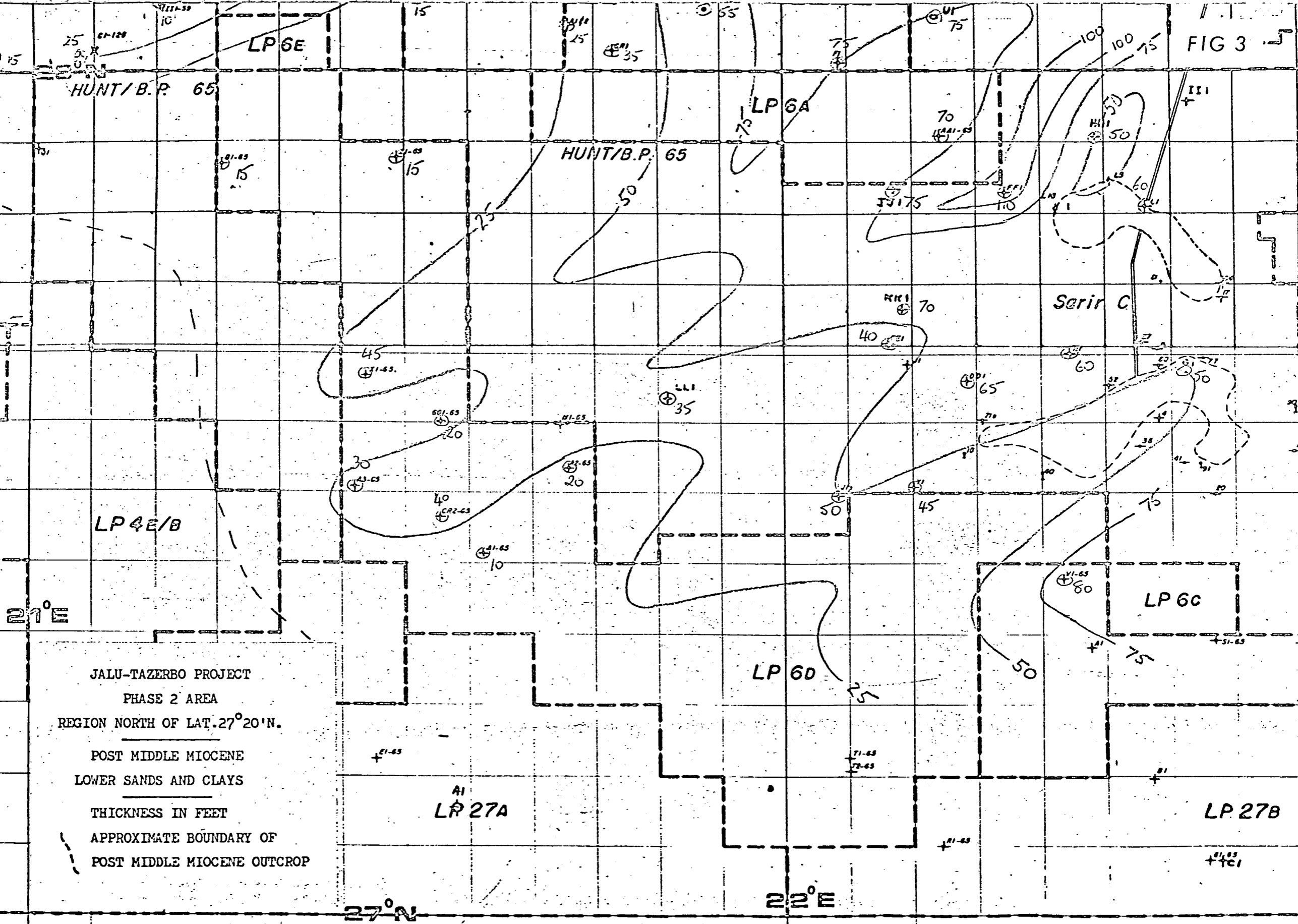
LP 6D

LP 27A

LP 27B

JALU-TAZERBO PROJECT  
PHASE 2 AREA  
REGION NORTH OF LAT. 27° 20' N.  
POST MIDDLE MIOCENE  
UPPER SANDS  
CONFIGURATION OF BASE  
IN FEET W. R. T. SEA LEVEL





JALU-TAZERBO PROJECT  
PHASE 2 AREA  
REGION NORTH OF LAT. 27° 20' N.  
POST MIDDLE MIOCENE  
LOWER SANDS AND CLAYS  
THICKNESS IN FEET  
APPROXIMATE BOUNDARY OF  
POST MIDDLE MIOCENE OUTCROP

27° N

22° E

21° E

LP 6E

LP 6A

HUNT/B.P. 65

HUNT/B.P. 65

Sarir C

LP 4E/B

LP 6D

LP 6C

LP 27A

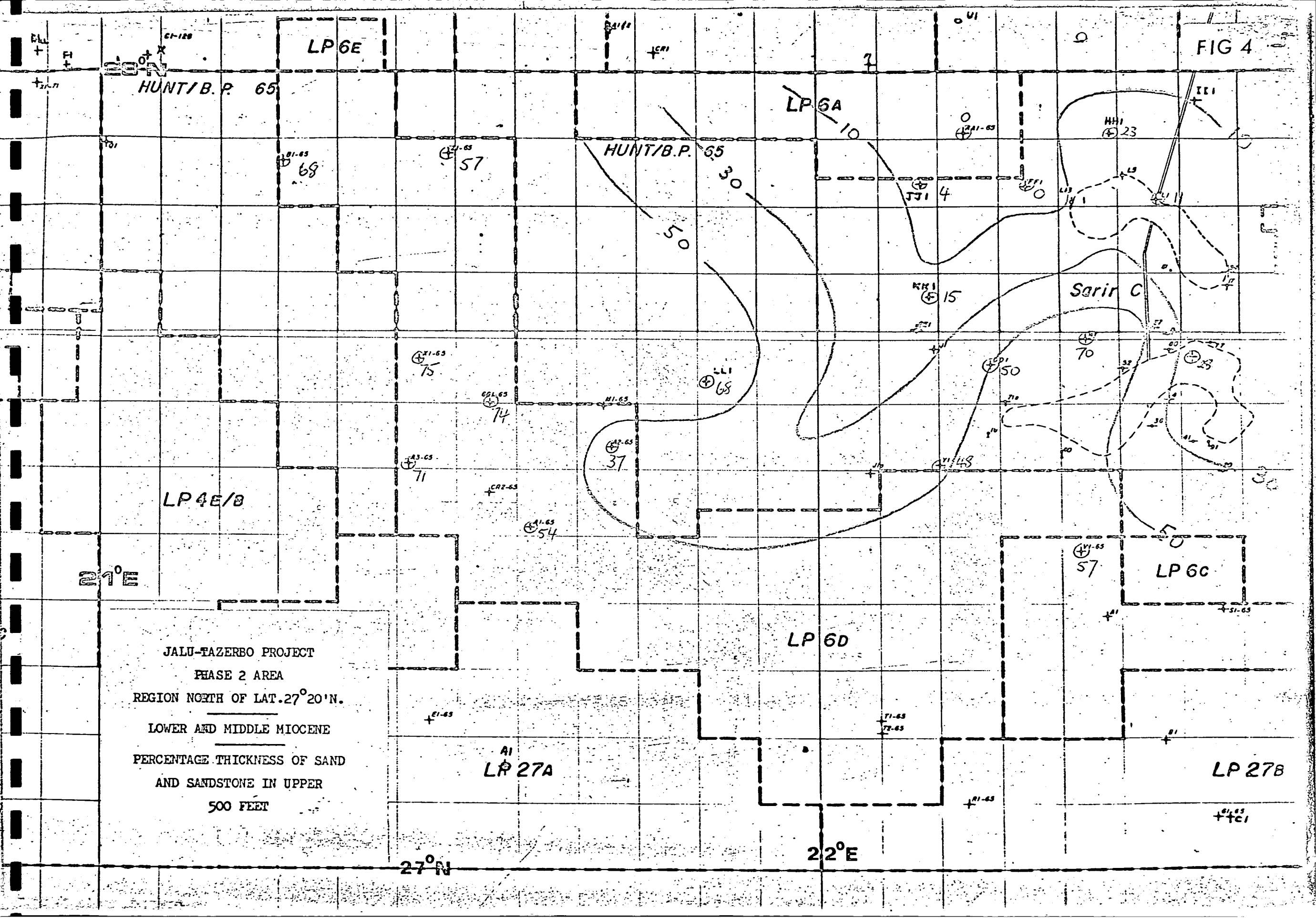
LP 27B

21°E

22°E

27°N

JALU-TAZERBO PROJECT  
 PHASE 2 AREA  
 REGION NORTH OF LAT. 27°20'N.  
 LOWER AND MIDDLE MIOCENE  
 PERCENTAGE THICKNESS OF SAND  
 AND SANDSTONE IN UPPER  
 500 FEET



LP 6E

LP 6A

HUNT/B.P. 65

HUNT/B.P. 65

LP 4E/B

Sarir C

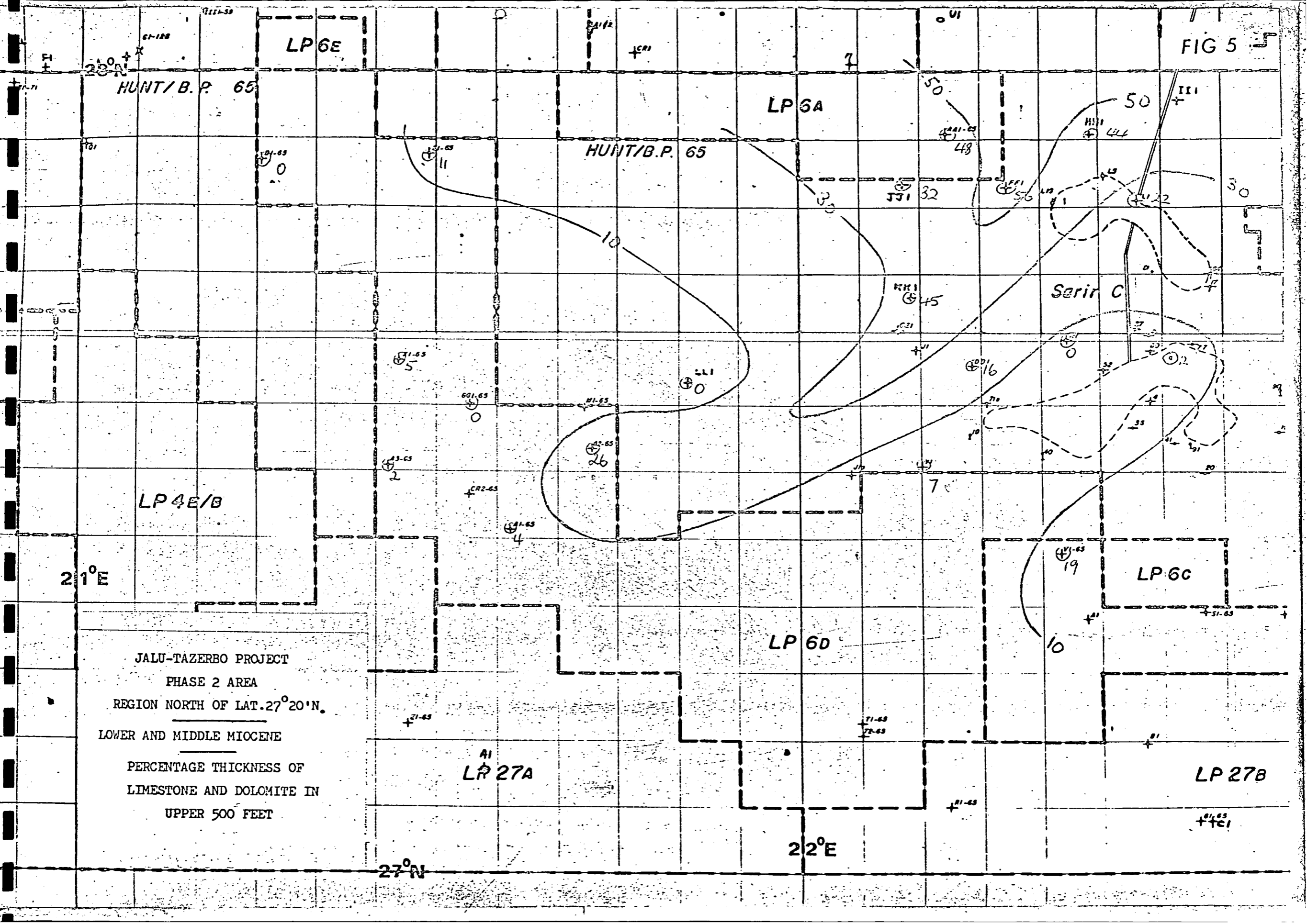
LP 6C

LP 6D

A1  
LP 27A

LP 27B

JALU-TAZERBO PROJECT  
 PHASE 2 AREA  
 REGION NORTH OF LAT. 27° 20' N.  
 LOWER AND MIDDLE MIOCENE  
 PERCENTAGE THICKNESS OF  
 LIMESTONE AND DOLOMITE IN  
 UPPER 500 FEET



HUNT/B.P. 65

LP 6E

LP 6A

HUNT/B.P. 65

LP 4E/B

Sarir C

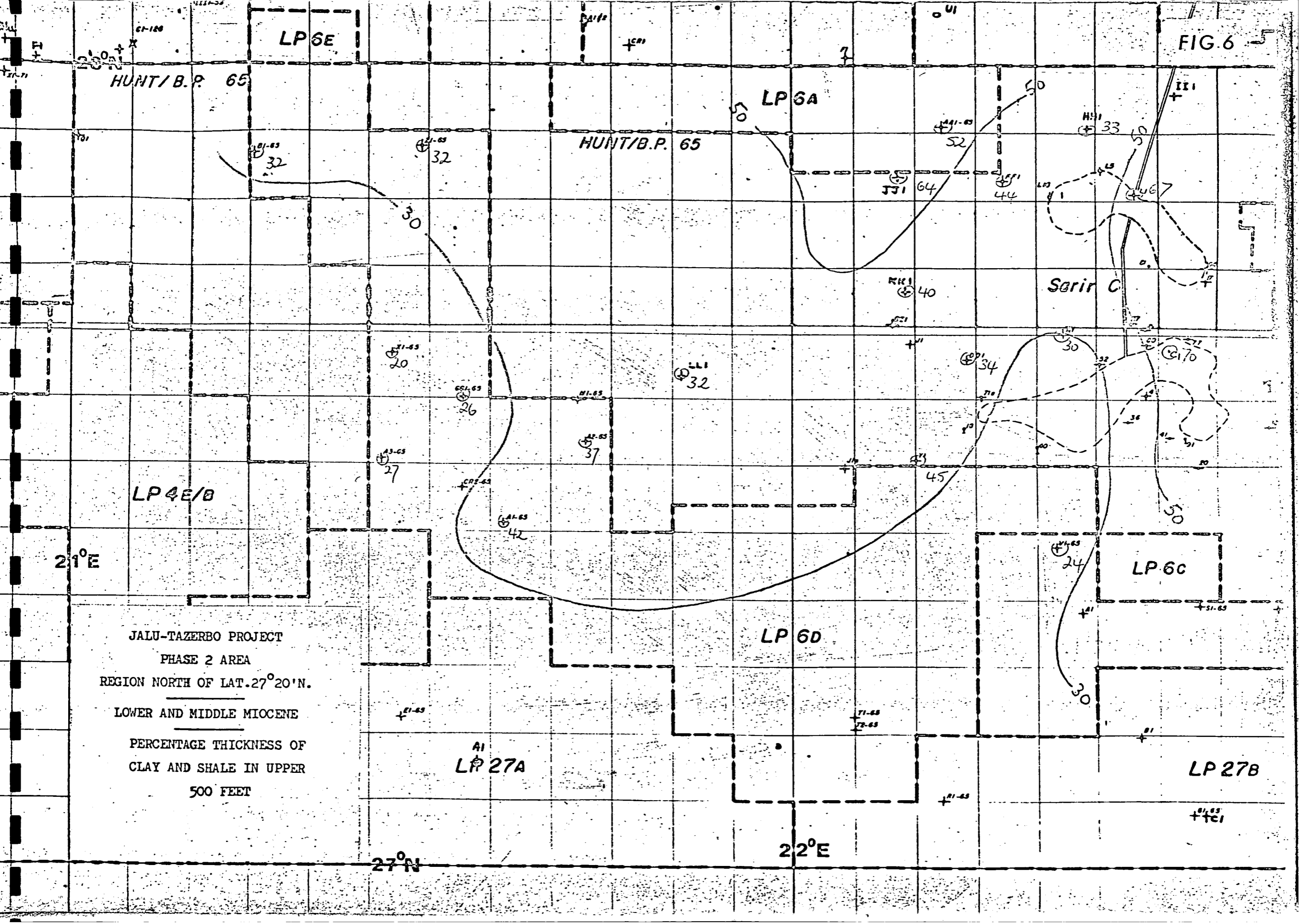
LP 6C

LP 6D

A1  
LP 27A

LP 27B

JALU-TAZERBO PROJECT  
 PHASE 2 AREA  
 REGION NORTH OF LAT. 27° 20' N.  
 LOWER AND MIDDLE MIOCENE  
 PERCENTAGE THICKNESS OF  
 CLAY AND SHALE IN UPPER  
 500 FEET



LP 6E

LP 6A

HUNT/B.P. 65

Sarir C

LP 4E/B

LP 6C

LP 6D

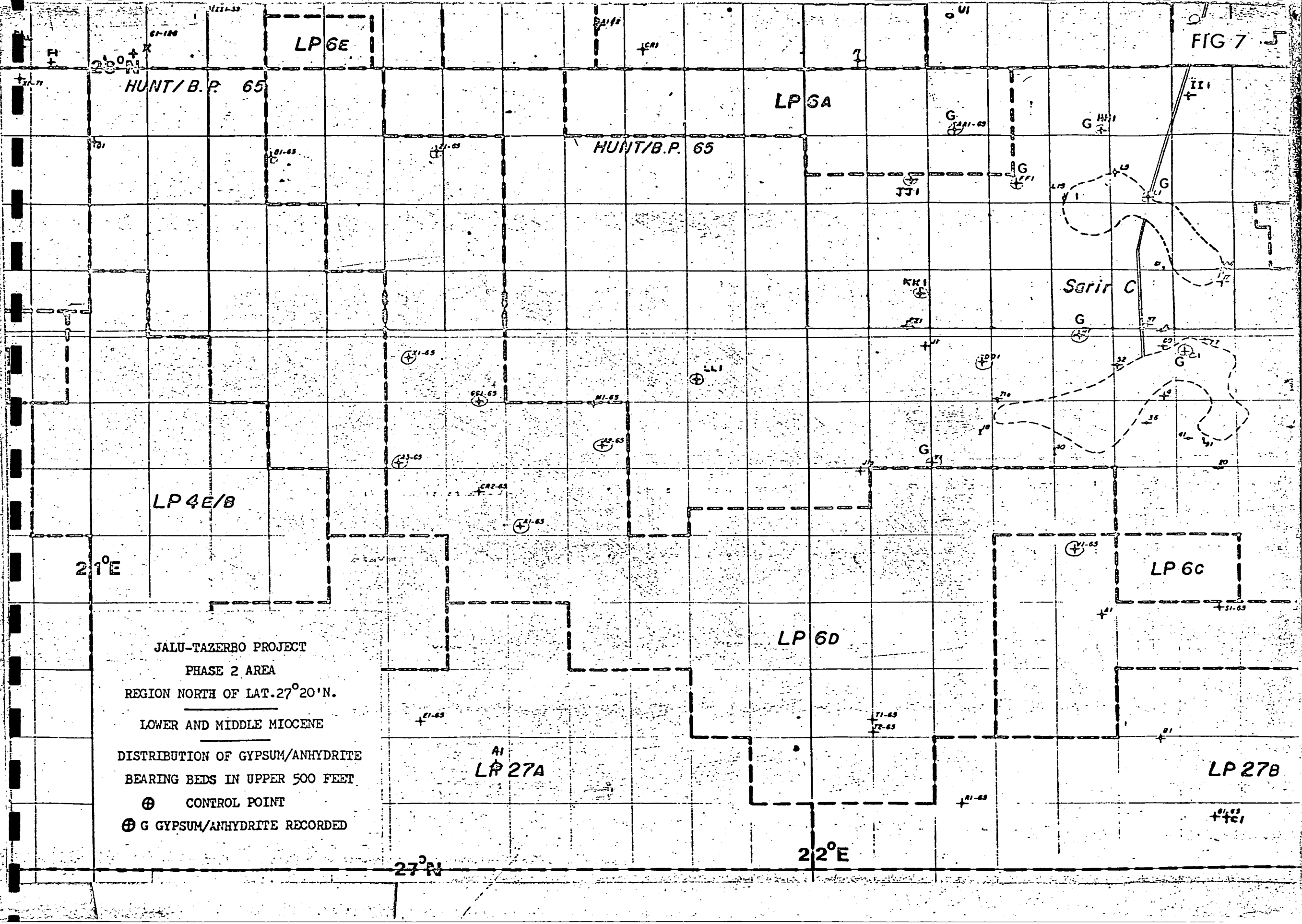
LP 27A

LP 27B

JALU-TAZERBO PROJECT  
PHASE 2 AREA  
REGION NORTH OF LAT. 27°20'N.  
LOWER AND MIDDLE MIOCENE

DISTRIBUTION OF GYPSUM/ANHYDRITE  
BEARING BEDS IN UPPER 500 FEET

⊕ CONTROL POINT  
⊕ G GYPSUM/ANHYDRITE RECORDED



LP 6E

LP 6A

HUNT/B.P. 65

HUNT/B.P. 65

Sarir C

LP 6E/B

LP 6C

LP 6D

A1  
LP 27A

LP 27B

JALU-TAZERBO PROJECT  
 PHASE 2 AREA  
 REGION NORTH OF LAT. 27° 20' N.  
 POST MIDDLE MIOCENE  
 UPPER SANDS  
 SATURATED THICKNESS IN FEET  
 APPROXIMATE BOUNDARY OF  
 POST MIDDLE MIOCENE OUTCROP

