Geophysics

- **Data**

Two sets of data on CDs acquired by Aeroquest International were received by courier from the client:

Air gravity and
Aeromagnetics.

These sets of data were supplied in proprietary formats that were subsequently converted into ASCII format.

The data provided had little explanation of the various columns in each data set. Only five elements were used in the interpretation:

1. Easting and
2. Northing in zone 29, WGS 27,
3. Gravity values under the CBgr100-267 column,
4. MLevfinalMag , and the
5. Terrain Elevation from the magnetic data.

- **Results**

The Aeroquest data sets were imported into Golden Software Surfer 7. Maps were generated with scales of mostly 1:137000

Gravity

A contour map of the air gravity was created in Surfer using the default parameters of 100 vertical lines and 58 horizontal lines. The map is presented in Fig 8: CBgr100 Air Gravity. The black lines show the gravity lineaments which could be faults but are intended to outline the extent of the sedimentary basin. The areas in blue are interpreted as sedimentary basin with the sediment contour shown in a yellow dash line, and the orange color is interpreted as igneous metamorphic terrain.

The air gravity in milligals (or Gammas) was converted into depth by assigning a depth associated with each gravity value along a selected line of slice. This association was established using a gravity model along the line trending in the NE direction as shown in Fig 8. This model was created using a gravity and magnetic forward modeling program called GM-SYS. This model is shown in Fig 9: GM-SYS Gravity Model.

The map showing the Bouguer gravity was converted into depth as shown in Fig 10 Gravity as Depth. The deepest portion of the basin is on the order of 6 km, in keeping with the suspected general depth to basement in the area.

Magnetics

The most time consuming job is the interpretation of the magnetic data.

A map showing the final magnetic intensity was generated in Surfer with similar parameters as for the gravity map.

This map is shown in Fig 11: mLev Final Magnetic, with magnetic lineaments shown in black dotted lines. These lineaments represent magnetized faults and probably diabase intrusions since diabase has been detected in the F1 and F2 wells.

It should be noted that the magnetics trends generally WNW and ENE with magnetic intensity rising from the NE to the SW. These trends are perpendicular to the gravity trends.

Figure 12: GM-SYS Magnetic Model is an attempt to model the magnetics on a line running approximately through wells F1, F2 and B. It is assumed that the magnetics have not been reduced to the pole or the equator.

The inducing magnetic field is trending 345 degrees and is inclined at 15 degrees to the horizontal.

In Fig 12: GM-SYS Magnetic Model, a model from GM-SYS, the general depth is on the order 6 km, similar to that as found on the gravity model. The magnetic data from the map is too coarse for near surface interpretation.

The more dense rocks are the dolerite and mafic rocks.
The igneous and mafic rocks usually have a higher magnetic susceptibility than the sedimentary rocks.

The dense and magnetic material were emplaced during a pull apart of the basin.

The initial interpretation of the magnetics was performed at a very large sample spacing. This made it very difficult to determine any near surface features.

In order to map the near surface magnetic features, it was necessary to resample the original aeromagnetic data, which was recorded every 6.8 meters on a line spacing of 10 km.

The flight lines have been resampled every 50th data point making the cell size 300 meters. A more detailed interpretation of the magnetics is scheduled in the near future.

A digital terrain model can be created from the elevation of the aircraft in GPS and the distance to the ground from the radar. The resulting terrain model is given in Figure 13: Aeromag Digital Terrain, along with the outline of the sedimentary basin. It is interesting to note that the basin outline has little correlation with the digital terrain model.

- **Preliminary Geological Interpretation of the Aeromag and Gravity maps**

Based on the above discussions, a preliminary geological interpretation of the Aeromag and Gravity maps are presented in Figures 14 and 15.

The pattern of isolines on the Aeromag map of Fig 14: AeroMagnetic Map, show WSW to ENE orientation in the middle part of the area and almost E to W orientation in the southernmost part of the map. This orientation is similar to the regional strike of the sedimentary rock.

The Air Gravity map shows significantly different pattern of isolines joining points of the same value as shown in Fig 15: Air Gravity Map. They seem to follow one of the two dominant directions:

(1) First approximately N-S, and
(2) Second SWS to ENE.

The second direction seems to be following prominent geomorphic features of the area: the Fina Marginal Escarpment and the Niger River Valley. Both probably developed along major faults of the area.

A comprehensive and more reliable interpretation of the geophysical images will be possible after next phase of the geological exploration in the area.

Other methods

Characterisation of the potential plays and reservoirs and their position within the petroleum system of the area will require other geoscientific techniques of study.

Petrophysics should be applied to better characterize the lithology, porosity, permeability and other properties of the potential reservoir. The help of an experienced geochemist is recommended in order to identify the source rocks and the shallow occurrence of hydrogen gas.

Recommendations

To find hydrogen:

1. Two passes of RADARSAT are recommended, one beaming north and the other beaming south . RADARSAT should cut through the foliage and give excellent indication of the surface structure. This is intended to give color delineation of trapping mechanisms.

2. A surface geology rock sampling program is necessary for modeling.

3. A surface geochemical survey for hydrogen should be implemented to determine the next drilling locations.

4. There are several shallow geophysical methods, such as hammer seismic, electro-magnetics, or ground penetrating radar, which could be used to determine the structure of the near surface within 100m.

5. A campaign of visiting nearby villages should be made to discuss hydrogen gas occurrences in water well drilling.

6. Drill 10 step out wells around Bourakebougou.

To find oil and methane gas:

1. Study and Integrate LandSat images as in Figure 16: Landsat.

2. Four 2D seismic lines should be shot across the basins in order to determine the depth and structure of the sedimentary rock within the basin. Vibroseis would likely be the more functional than explosives.

3. Revisiting the core at Didieni is needed to study the boundary layers.

4. Surface geology in the wider regional extent is needed for lithology control.

5. Completion of the geological model.

6. Re-entry into the F1 and F2 wells for wireline logging is important for lithology control.

7. A Drilling rig equipped with Blow Out Preventers is required to further search Bloc 25.

8. Production Testing equipment is required after completions.

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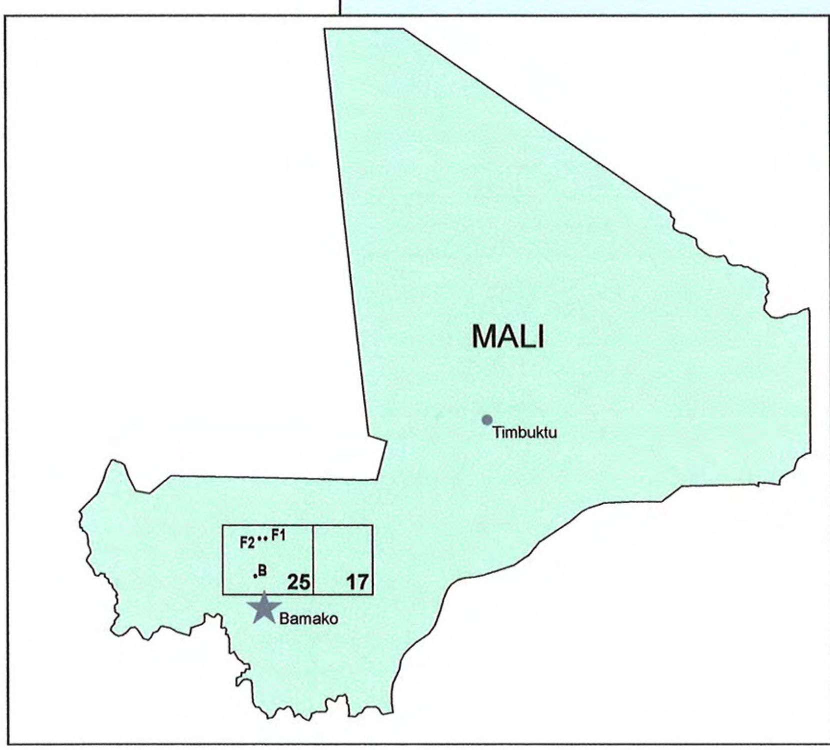
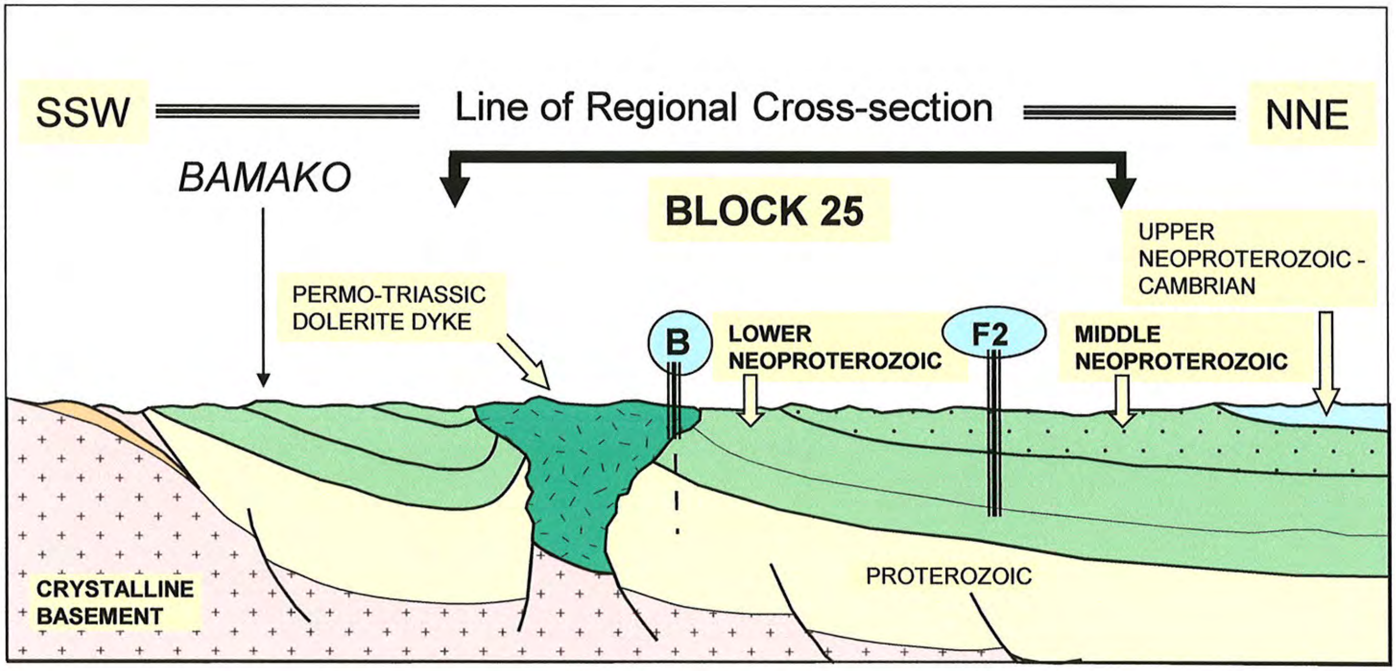
FIGURES

Area of Interest



PETROMA INC. CANADA
BLOCKS 25 AND 17 **MALI** **ORIENTATION MAP**
FEB. 2011 JOB No. 5197 FIGURE No. 1

Chapman Petroleum Engineering Ltd.



PETROMA INC. CANADA

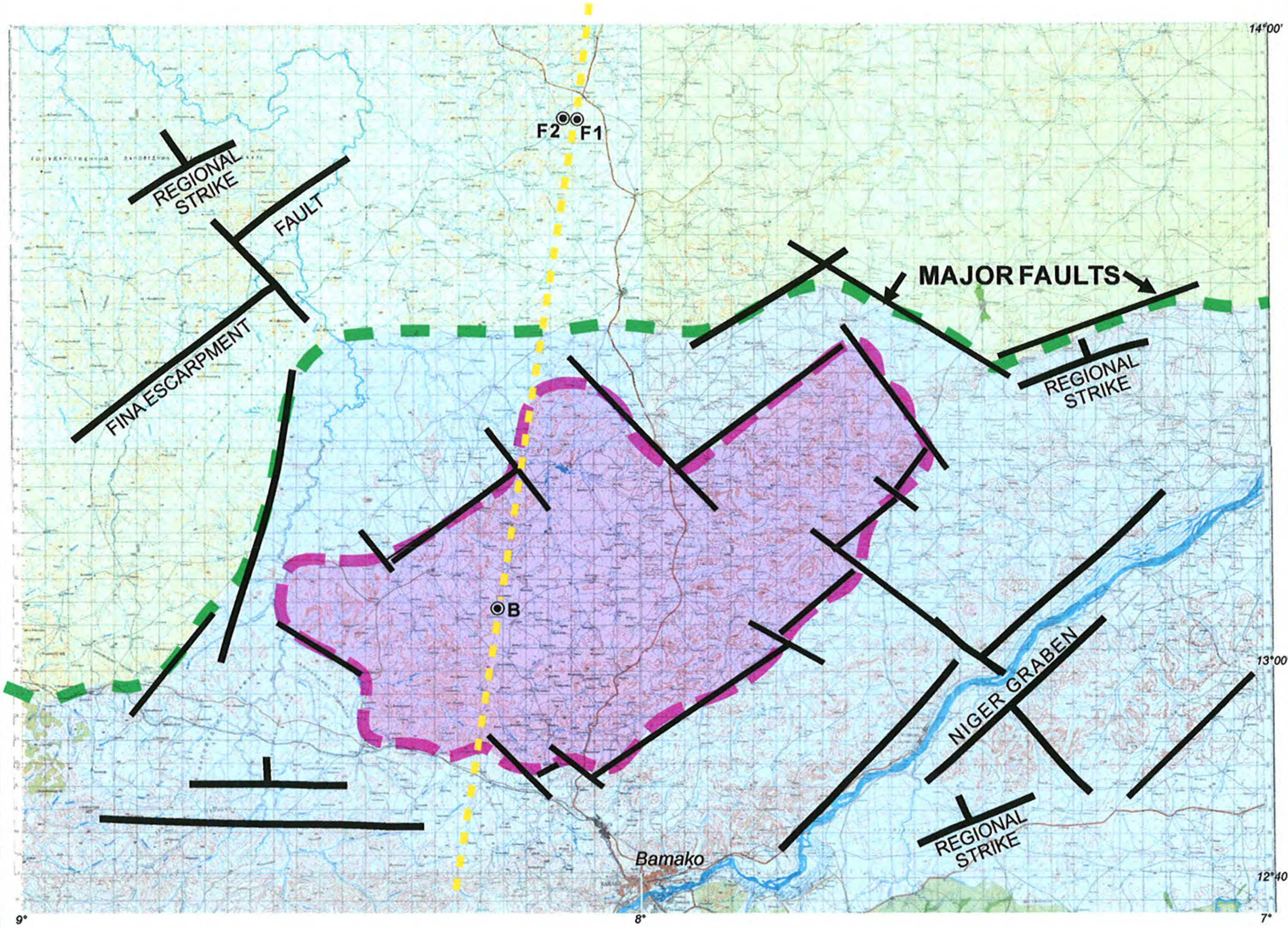
BAMAKO AREA

TAOUDENNI BASIN, MALI

HYPOTHETICAL GEOLOGICAL MODEL

FEB. 2011 JOB No. 5197 FIGURE No. 2

Chapman Petroleum Engineering Ltd.



PAzb - UPPER PRECAMBRIAN

PAza - LOWER PRECAMBRIAN

Δ Mz - POLERITE

PROPOSED SURFACE GEOLOGY ROCK SAMPLING ROUTE

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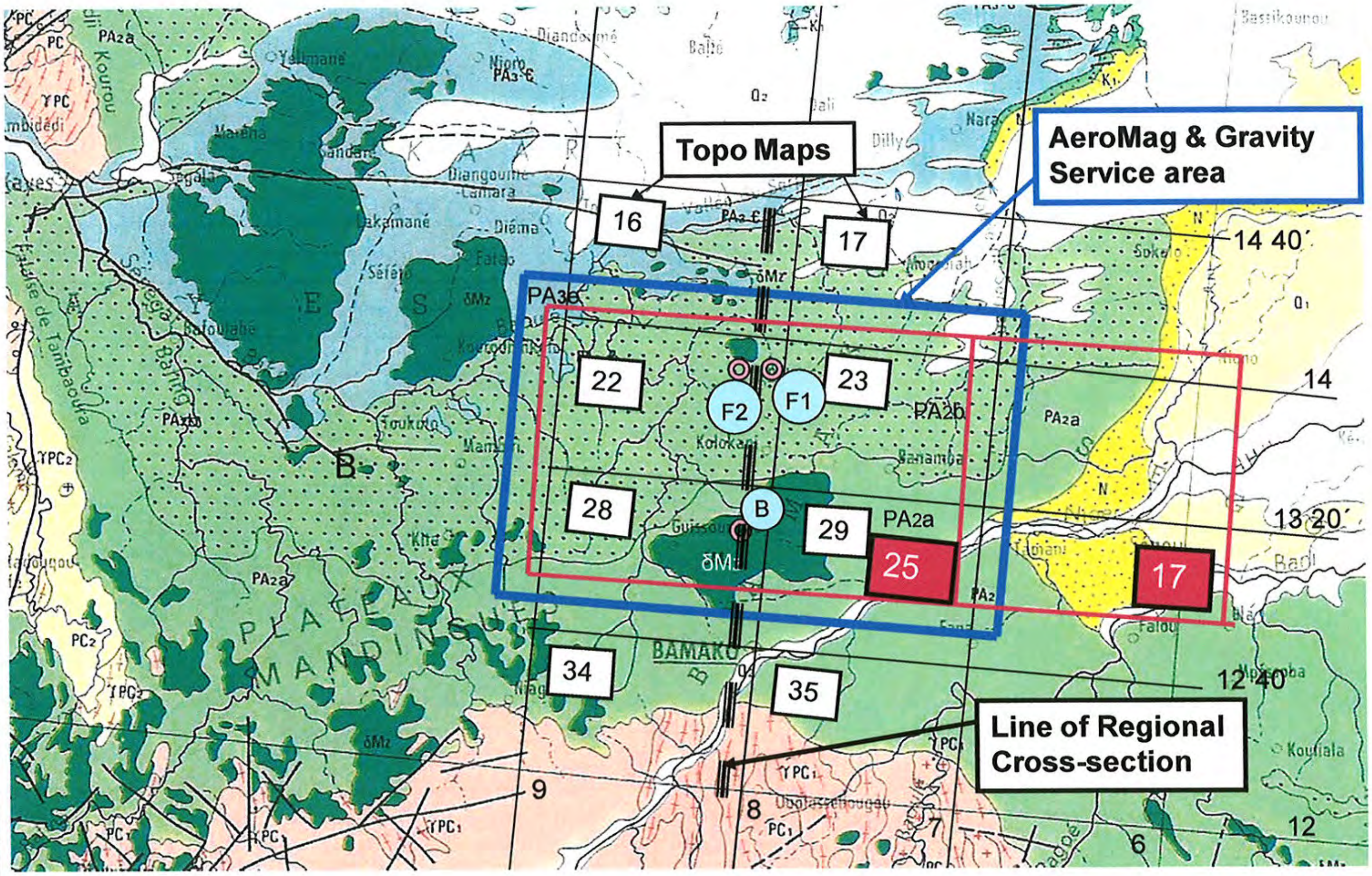
BAMAKO AREA

TAOUDENNI BASIN, MALI

BASE MAP

FEB. 2011 **JOB No. 5197** **FIGURE No. 3**

Chapman Petroleum Engineering Ltd.

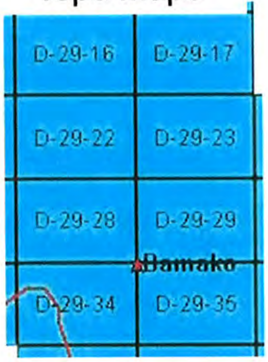


PA2a (Lower Neoproterozoic)

PA2b (Middle Neoproterozoic)

PA3e (Upper Neoproterozoic)

Topo Maps



PETROMA INC. CANADA

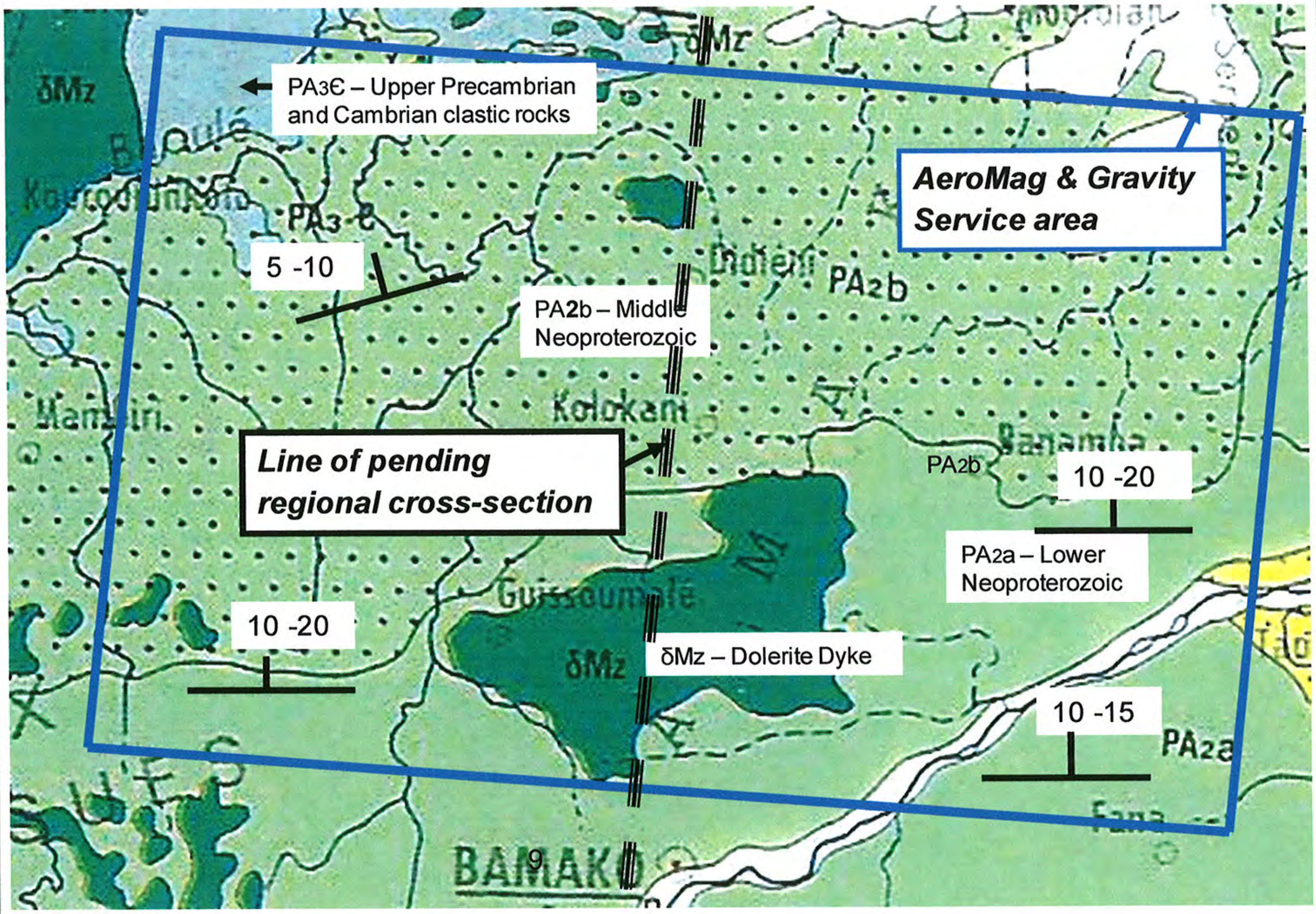
BLOCK 25 & 17

TAODENNI BASIN, MALI

PETROLEUM EXPLORATION OF BAMAKO AREA INDEX MAP

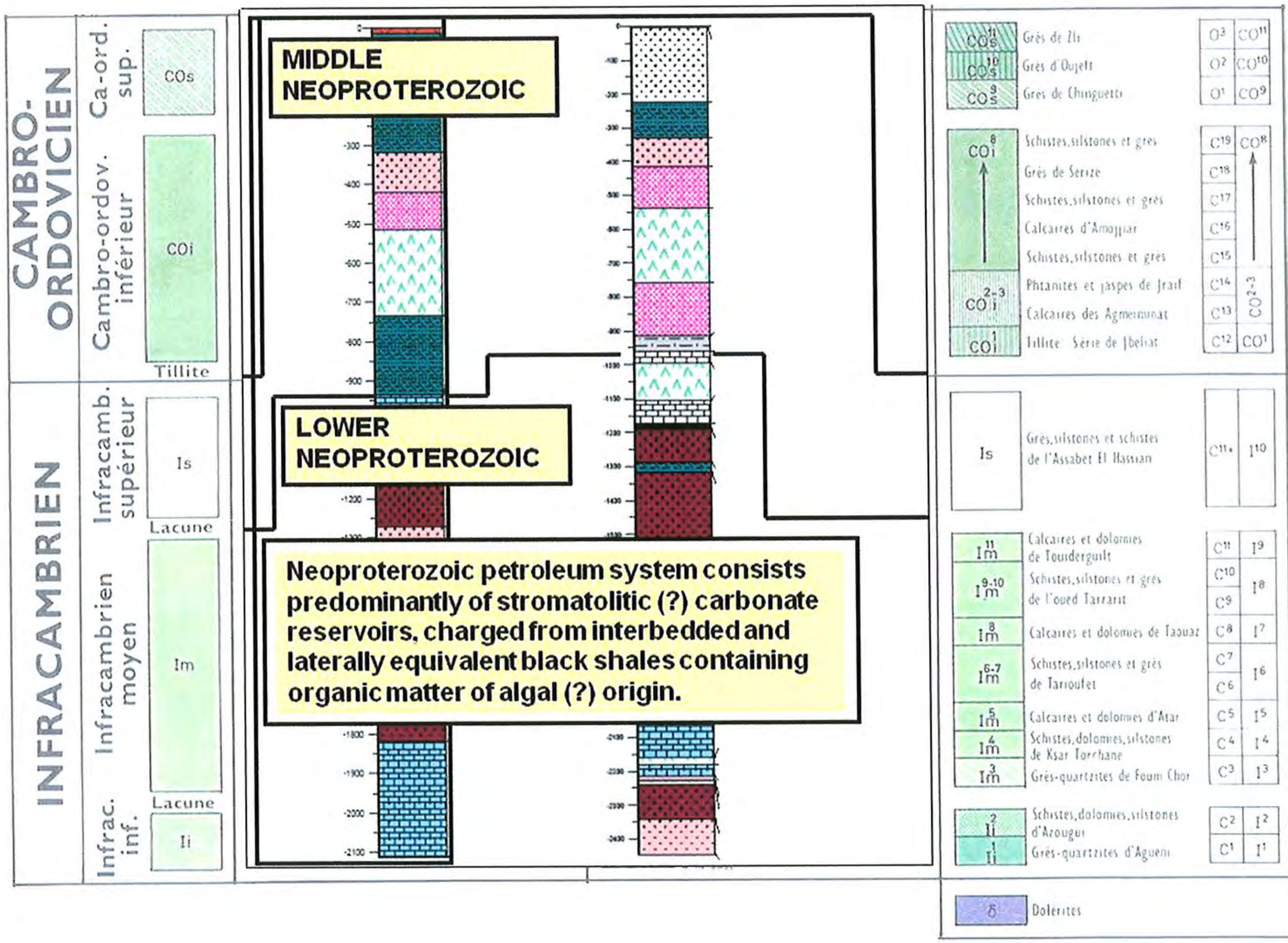
FEB. 2011 **JOB No. 5197** **FIGURE No. 4**

Chapman Petroleum Engineering Ltd.



PETROMA INC. CANADA		
BAMAKO AREA TAOUDENNI BASIN, MALI **MAJOR GEOLOGICAL BOUNDARIES AND REGIONAL STRIKE/DIP**		
FEB. 2011	JOB No. 5197	FIGURE No. 5

Chapman Petroleum Engineering Ltd.



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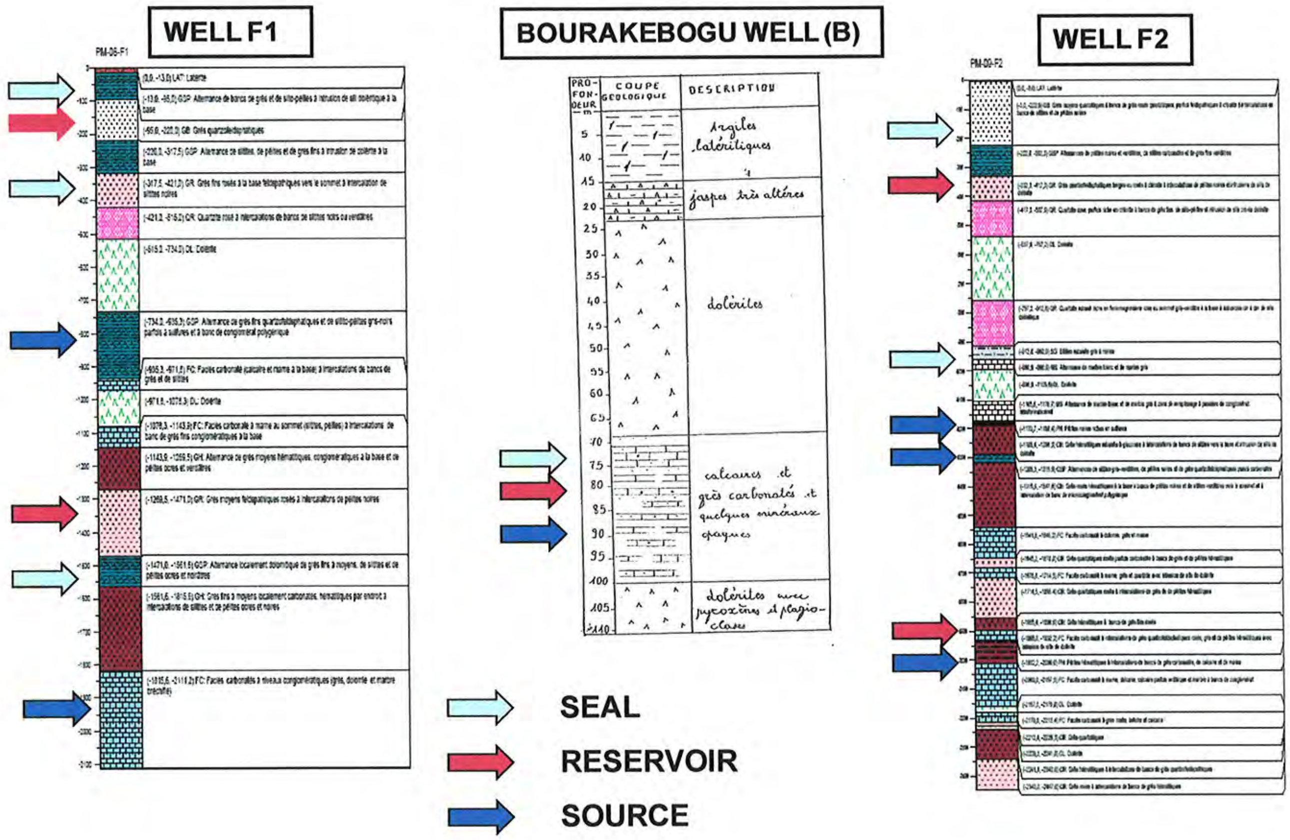
BAMAKO AREA

TAOUDENNI BASIN, MALI

STRATIGRAPHIC CHART

FEB. 2011 JOB No. 5197 FIGURE No. 6

Chapman Petroleum Engineering Ltd.



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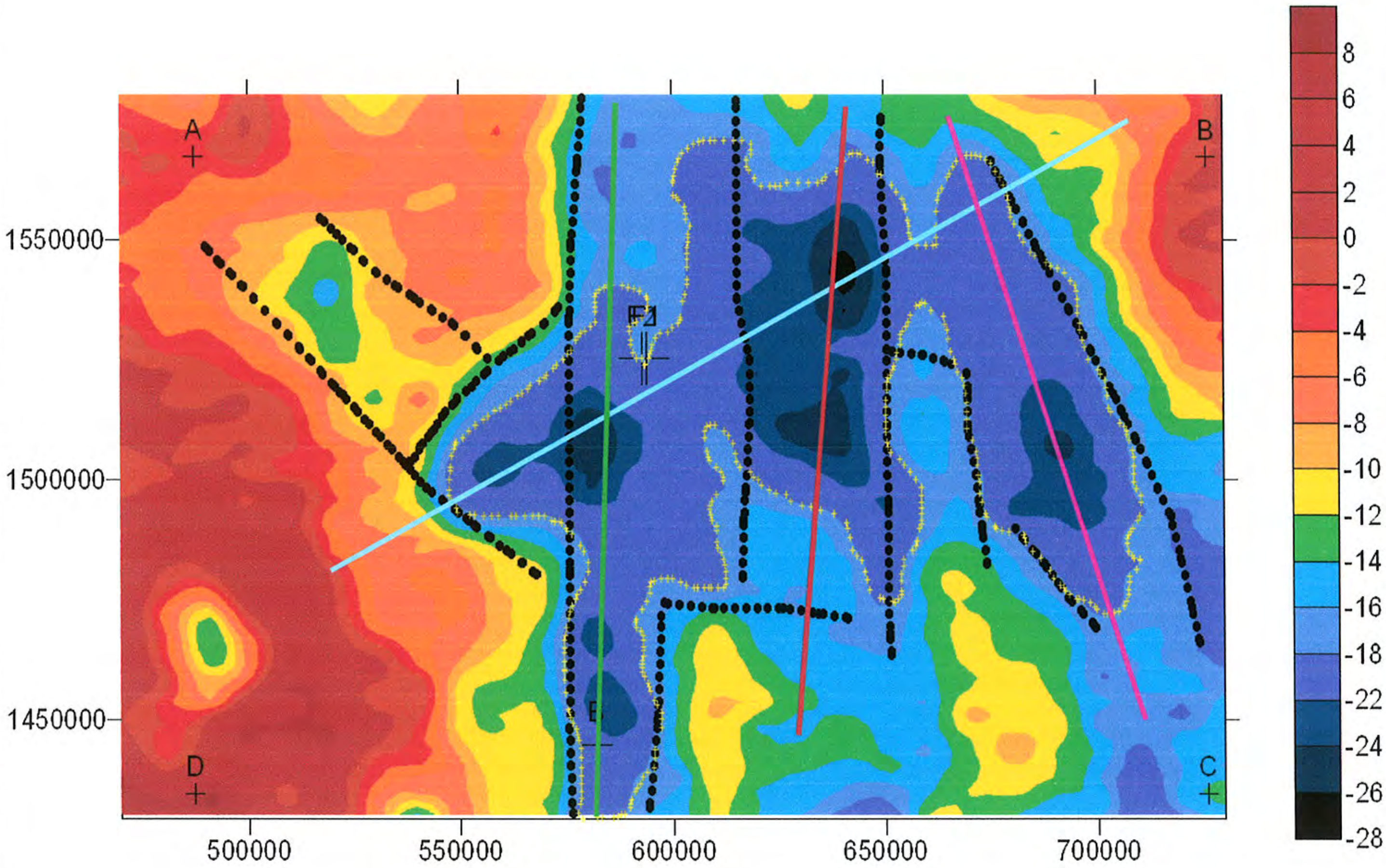
BAMAKO AREA

TAOUDENNI BASIN, MALI

POTENTIAL PETROLEUM SOURCE, RESERVOIR AND SEAL ROCK

FEB. 2011 JOB No. 5197 FIGURE No. 7

Chapman Petroleum Engineering Ltd.



OBSERVED SEDIMENTS

OBSERVED LINEAMENTS

FIRST PROPOSED 2D SEISMIC LINE «57»

SECOND PROPOSED 2D SEISMIC LINE «63»

THIRD PROPOSED 2D SEISMIC LINE «71»

FOURTH PROPOSED 2D SEISMIC LINE «NET»

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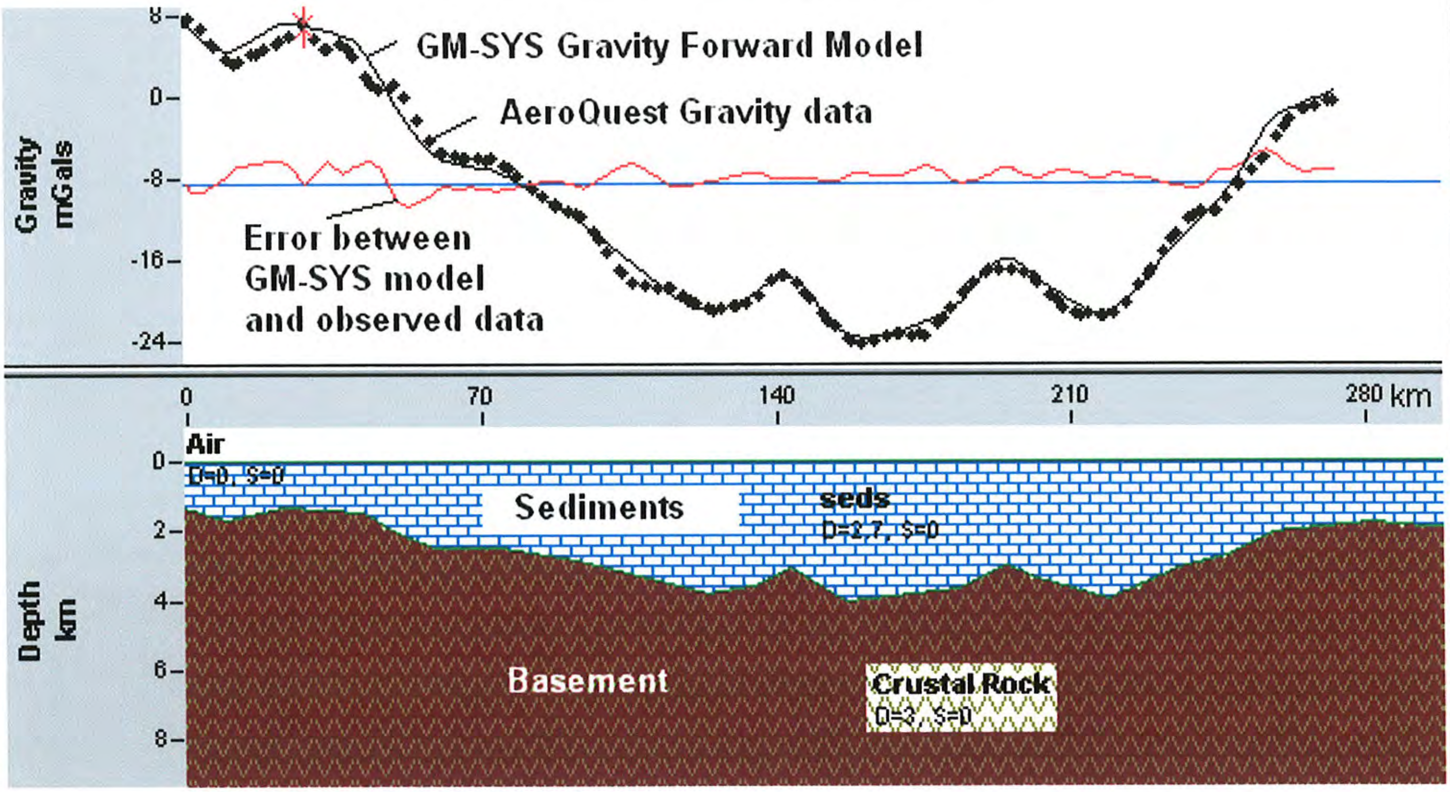
BAMAKO AREA

TAOUDENNI BASIN, MALI

CBgr100_267
AIR GRAVITY

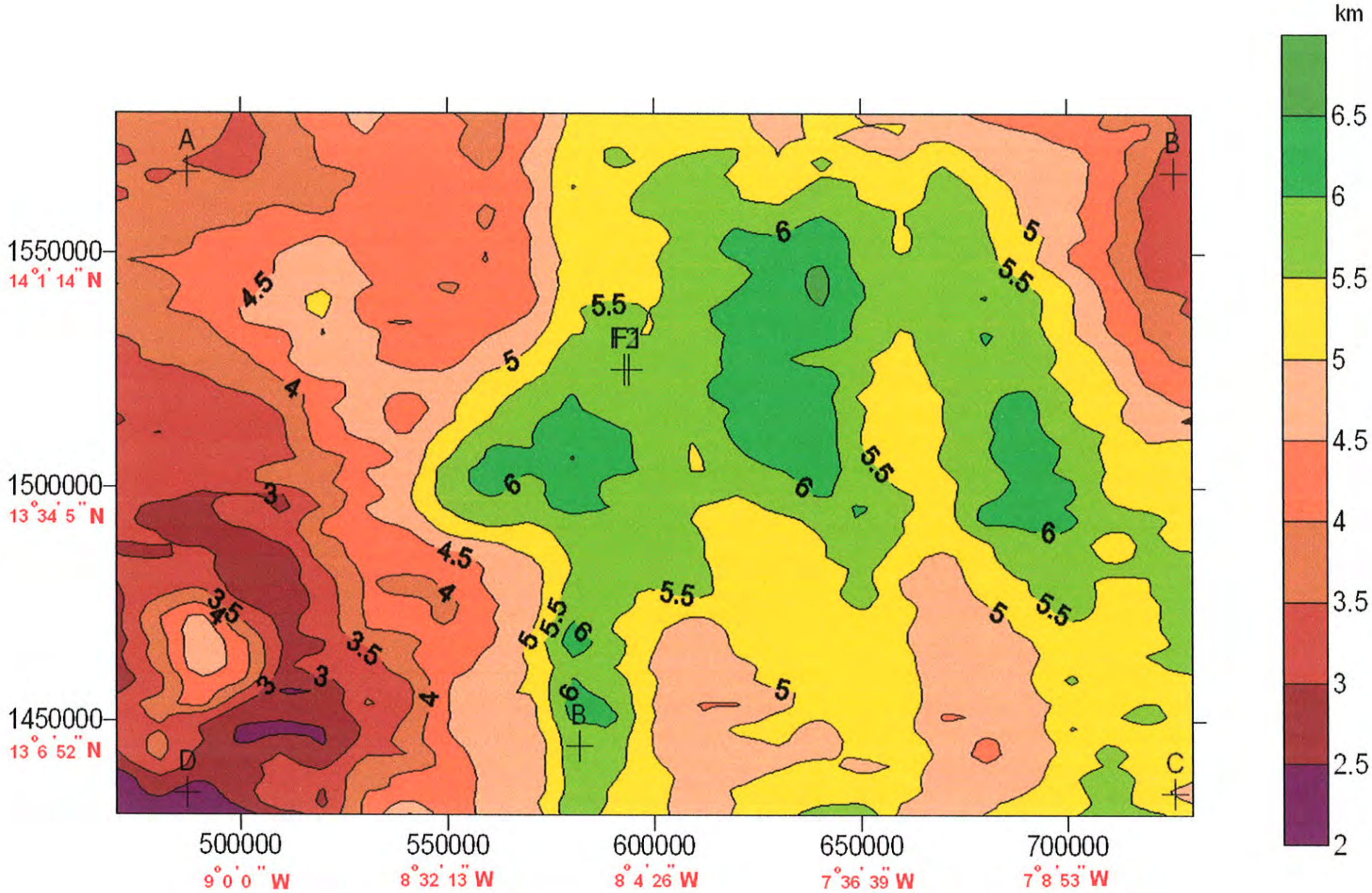
FEB. 2011 **JOB No. 5197** **FIGURE No. 8**

Chapman Petroleum Engineering Ltd.



PETROMA INC. CANADA
BAMAKO AREA **TAOUDENNI BASIN, MALI** **GM-SYS** **GRAVITY MODEL**
FEB. 2011 **JOB No. 5197** **FIGURE No. 9**

Chapman Petroleum Engineering Ltd.



PETROMA INC. CANADA

BLOCK 25

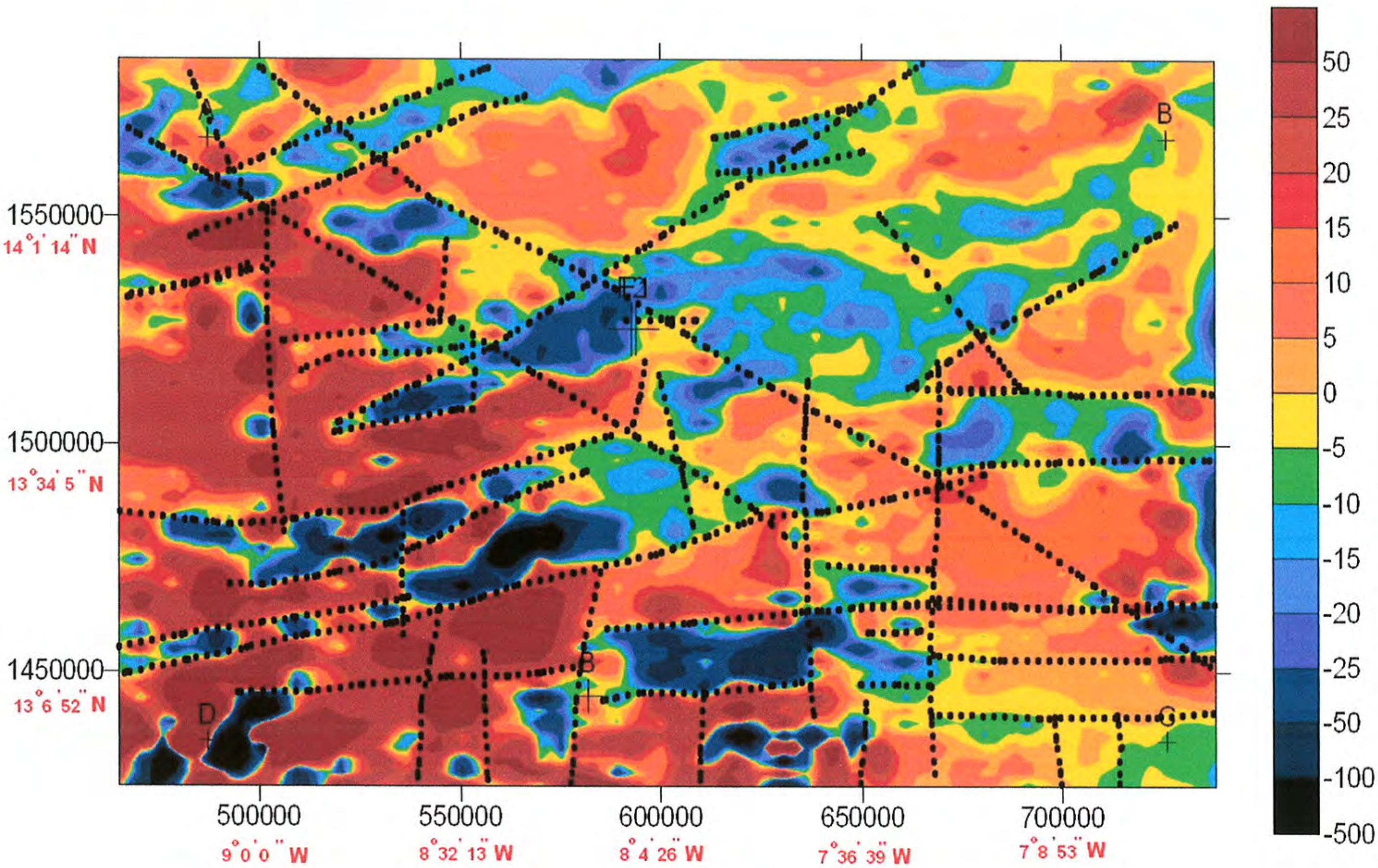
TAOUDENNI BASIN, MALI

GRAVITY AS DEPTH

C.I. = 0.5 km

FEB. 2011 JOB No. 5197 FIGURE No. 10

Chapman Petroleum Engineering Ltd.



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BAMAKO AREA

TAOUDENNI BASIN, MALI

MLEV FINAL

MAGNETIC LINEAMENTS

FEB. 2011 **JOB No. 5197** **FIGURE No. 11**

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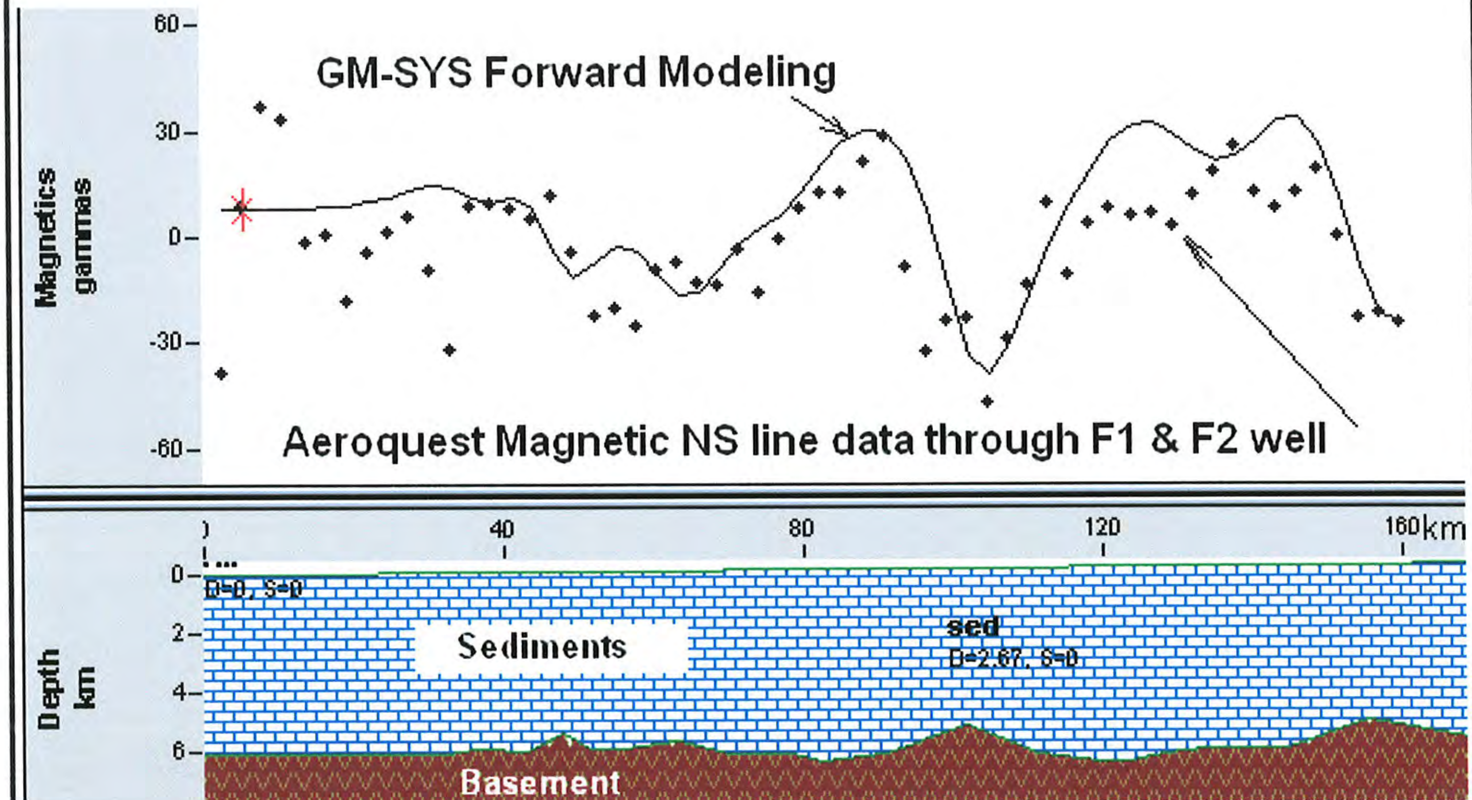

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BAMAKO AREA

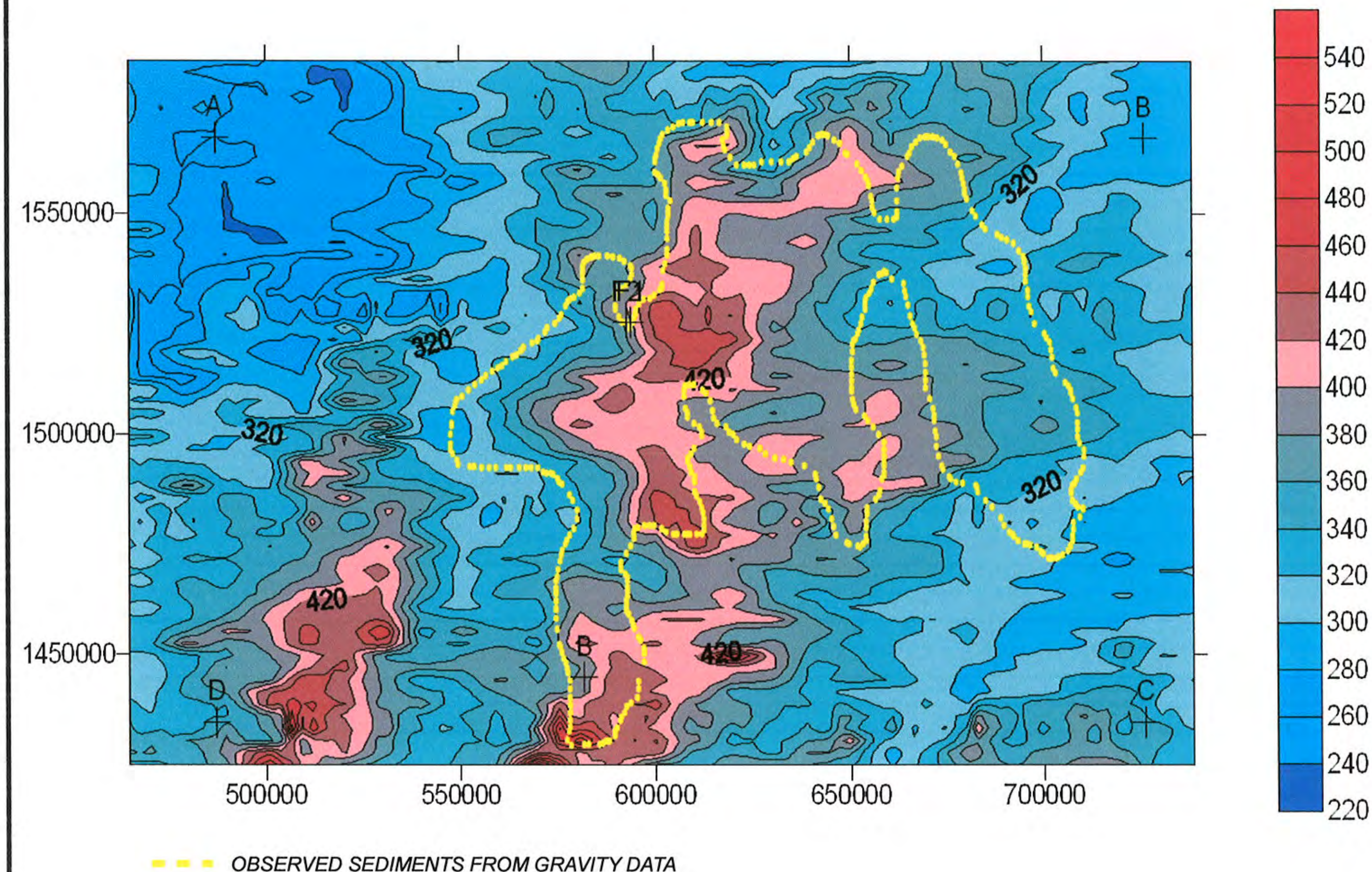
TAOUDENNI BASIN, MALI

GM-SYS

MAGNETIC MODEL

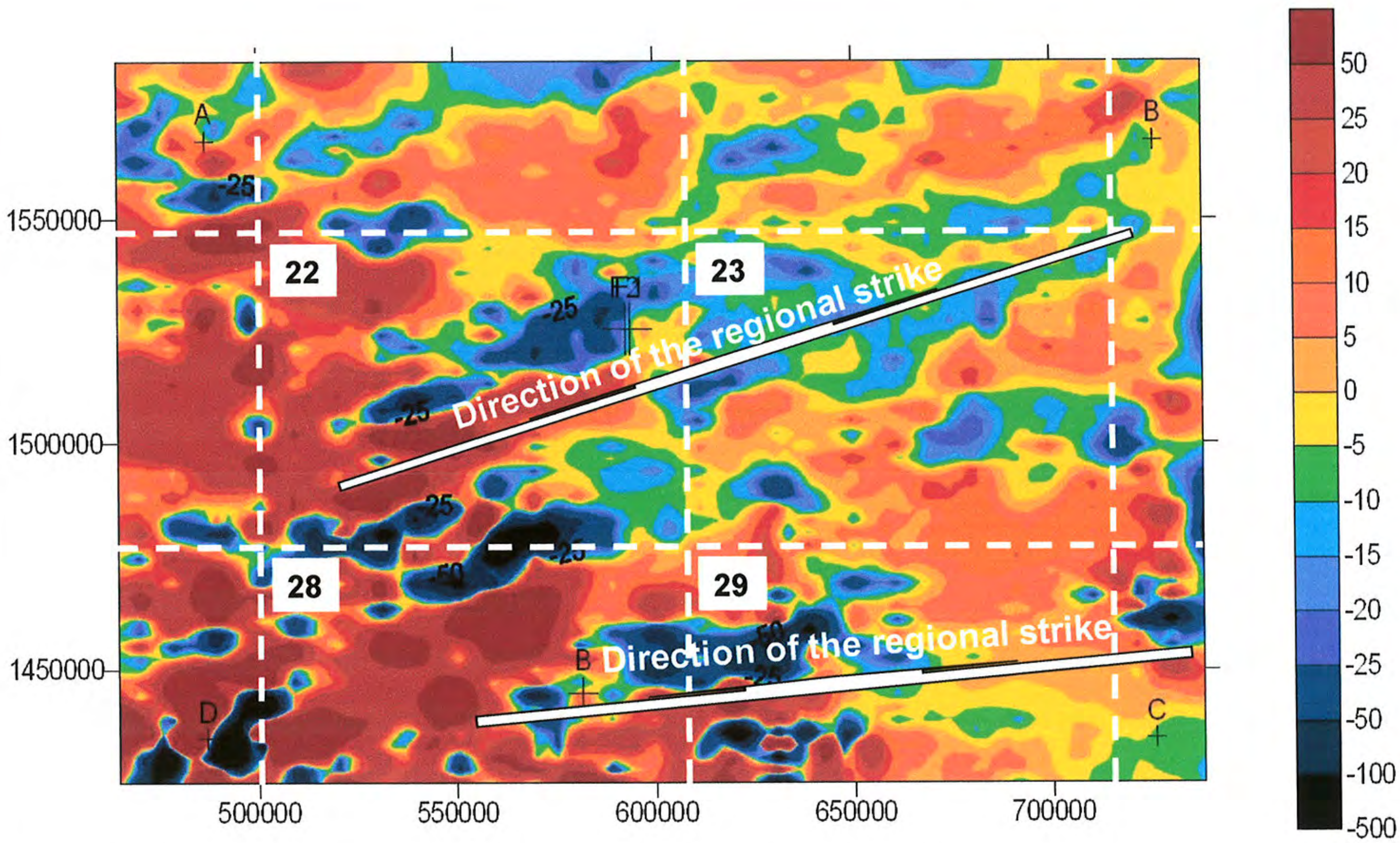
FEB. 2011 JOB No. 5197 FIGURE No. 12

Chapman Petroleum Engineering Ltd.



PETROMA INC. CANADA
BAMAKO AREA **TAOUDENNI BASIN, MALI** **AEROMAG DIGITAL TERRAIN MODEL**
FEB. 2011 **JOB No. 5197** **FIGURE No. 13**

Chapman *Petroleum Engineering Ltd.*



Areas of the topo map sheets and numbers are indicated by the white dashed lines.

PETROMA INC. CANADA

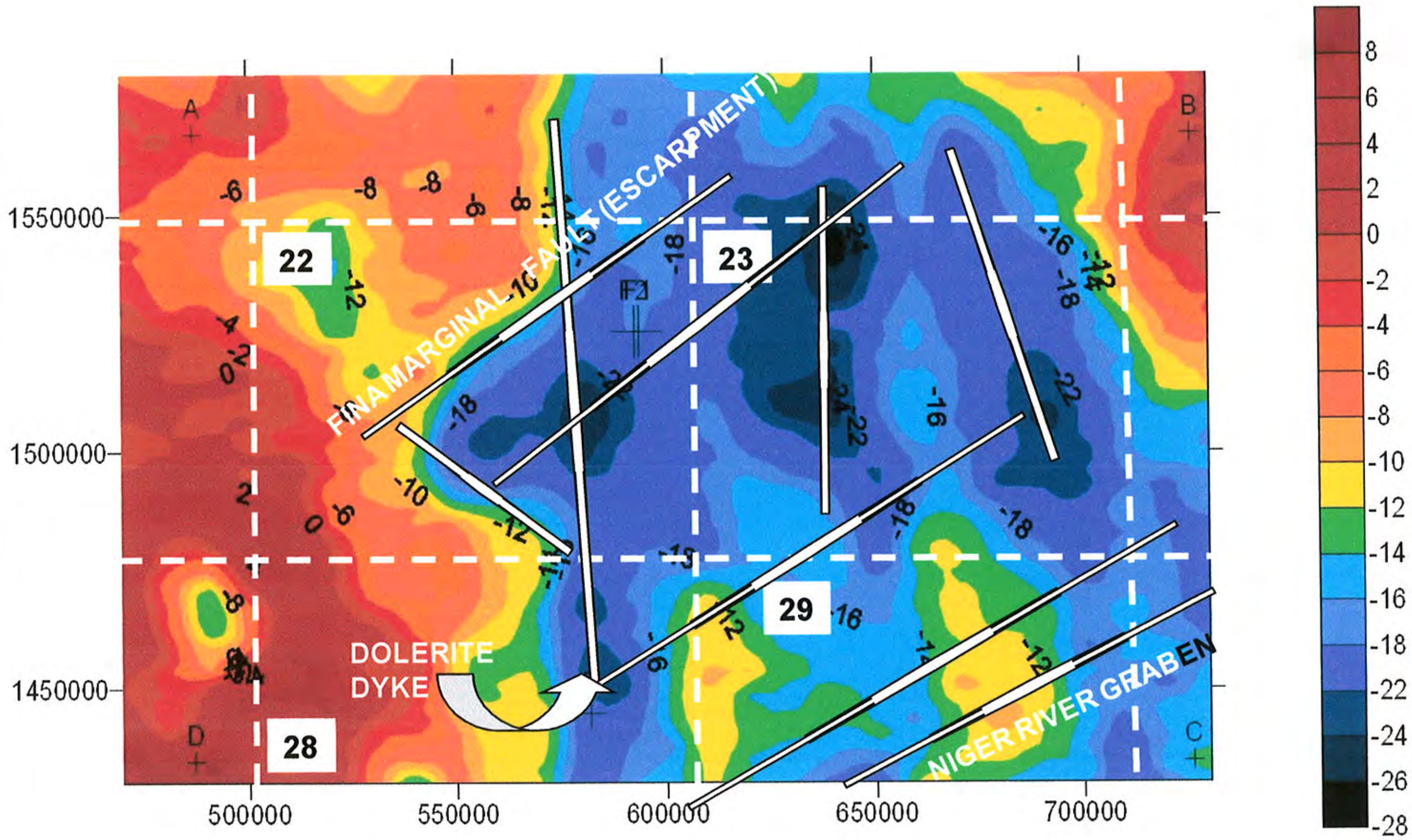
BAMAKO AREA

TAOUDENNI BASIN, MALI

PRELIMINARY GEOLOGICAL INTERPRETATION OF THE AEROMAG MAP

FEB. 2011 **JOB No. 5197** **FIGURE No. 14**

Chapman Petroleum Engineering Ltd.



Areas of the topo map sheets and numbers are indicated by the white dashed lines.

PETROMA INC. CANADA
BAMAKO AREA **TAOUDENNI BASIN, MALI** **PRELIMINARY GEOLOGICAL INTERPRETATION OF THE AIR GRAVITY MAP**
FEB. 2011 JOB No. 5197 FIGURE No. 15

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MALI

LANDSET MAP

FEB. 2011 **JOB No. 5197** **FIGURE No. 16**