1.3.3 El Akouat – Argoub Adama prospect

(1) Geology

The stratigraphy The El Akhouat-Argoub Adama prospect comprises, in its ascending order, the Triassic, Cretaceous, Tertiary and Quaternary systems. The geological plan and cross sections of the prospect are shown in Figure 126.

The Triassic system distributed from the north to the south part of the prospect is composed of gypsum, clay, dolomite, marl, limestone, argillite and meta-sandstone.

The Cretaceous system comprises, in stratigraphically ascending order, sandstone and marl of Aptian, limestone and argillite of Albian, limestone and marl of Cenomanian, limestone of Turonian, marl of Coniacian, marl of Santonian, limestone of Campanian and marl of Maastrichtian. In the western side of the Triassic diapir, all Cretaceous formations from Aptian to Maastrichtian are exposed continuously, then both Aptian and Albian formations contact with the Triassic diapir. In the eastern side of the Triassic diapir, the Cretaceous formations from Cenomanian to Maastrichtian are exposed intermittently like a window, then Cenomanian, Turonian and Santonian formations contact with the Triassic diapir.

The Tertiary system comprises, in stratigraphically ascending order, Eocene limestone and marl, and Oligocene, Miocene and Pliocene sandstones. These Tertiary rocks distribute only in the northern part of the prospect surrounding the Cretaceous and Triassic systems.

The Quaternary system extending in lowland area comprises alluvial deposits, such as calcareous conglomerate, gravel, sand and mud, and alluvial soils.

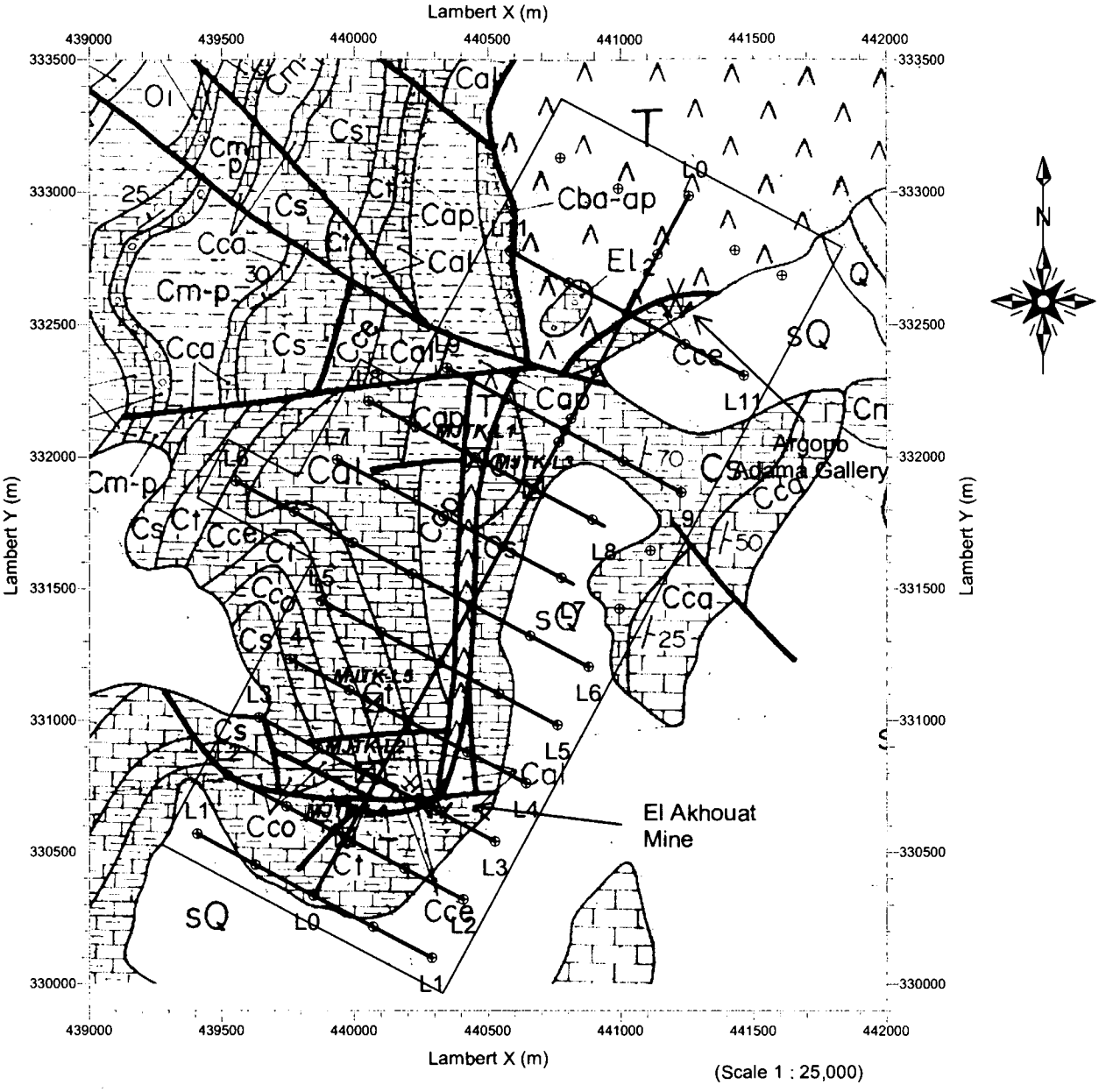
The largest geological structures within the prospect are a diapir, the N-S striking fault and the lateral faults running in the WNW-ESE to E-W directions are also well developed. The diapir comprised the Triassic system takes a wedge form trending in the NE-SW to N-S direction. The N-S striking fault controlls the distribution of the Triassic system.

(2) Gravity survey

The layout of all survey lines and stations in this prospect, which were laid from the first year to the current year, is shown in Figure 127

①Gravity Distribution of the Prospect (Figure 128)

This prospect is located in the northeastern end of the large high gravity anomaly extending in the southwestern side. This high gravity anomaly continues a series of high gravity anomalies lining along the Djebel ech Chied hills. In the distribution zone of the Cretaceous systems of this prospect high gravity anomaly above -5 mgal extends in the N-S direction. Gravity value decreases from the high anomaly towards the plain area in the eastern side covered with the Quaternary system. The El Akhouat old mine



LEGEND

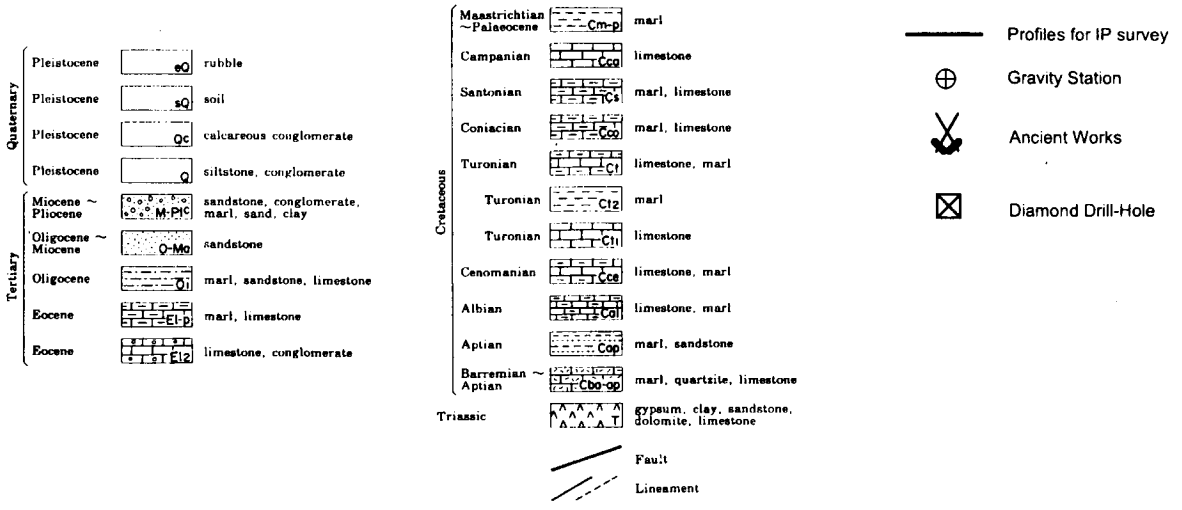
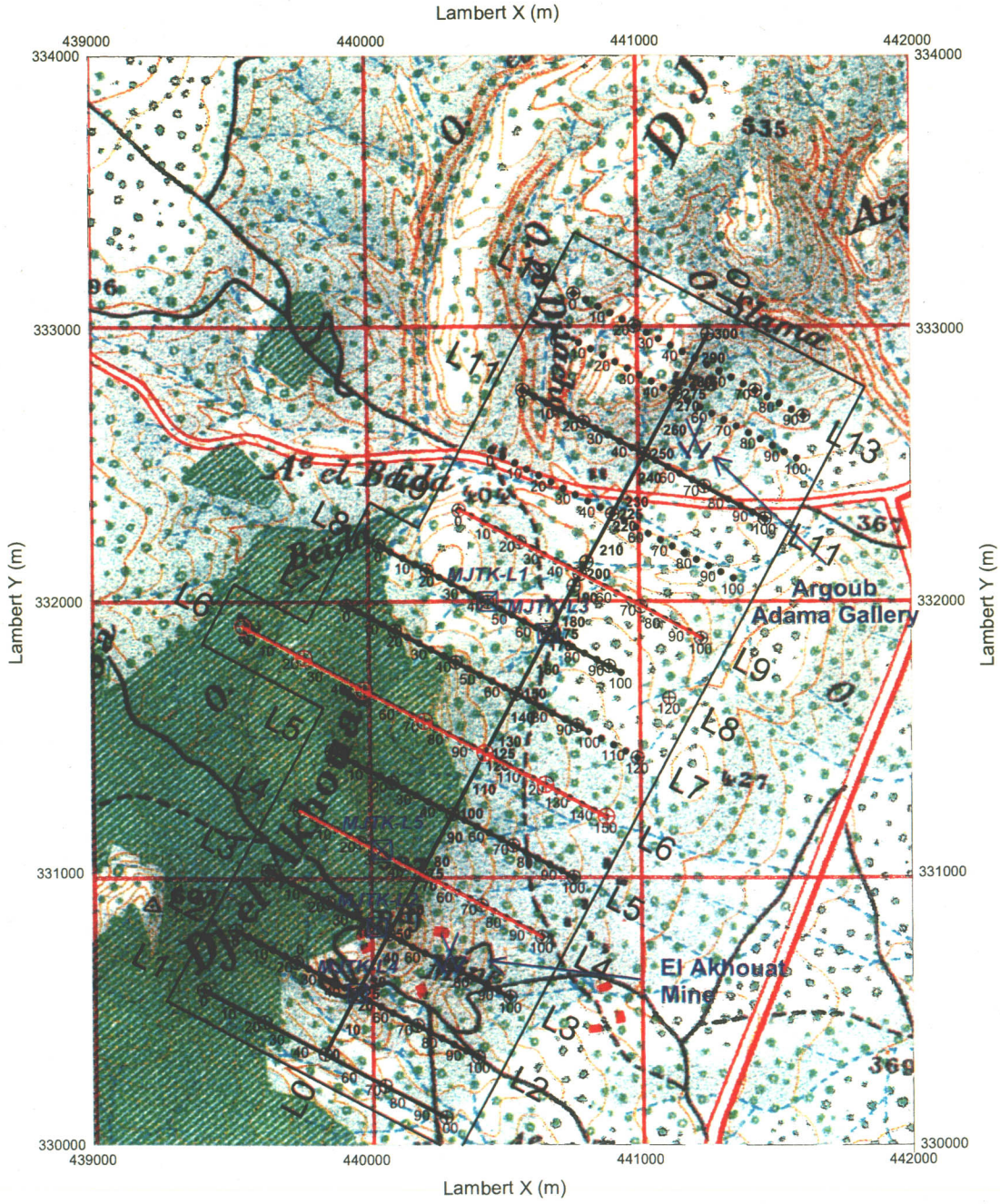


Figure 126 Geological map of El Akhouat-Argoub Adama prospect



Legend

⊕ : Gravity Survey Station (1999-2000)

— : IP survey Line (1999-2000)

• : Magnetic Survey Station

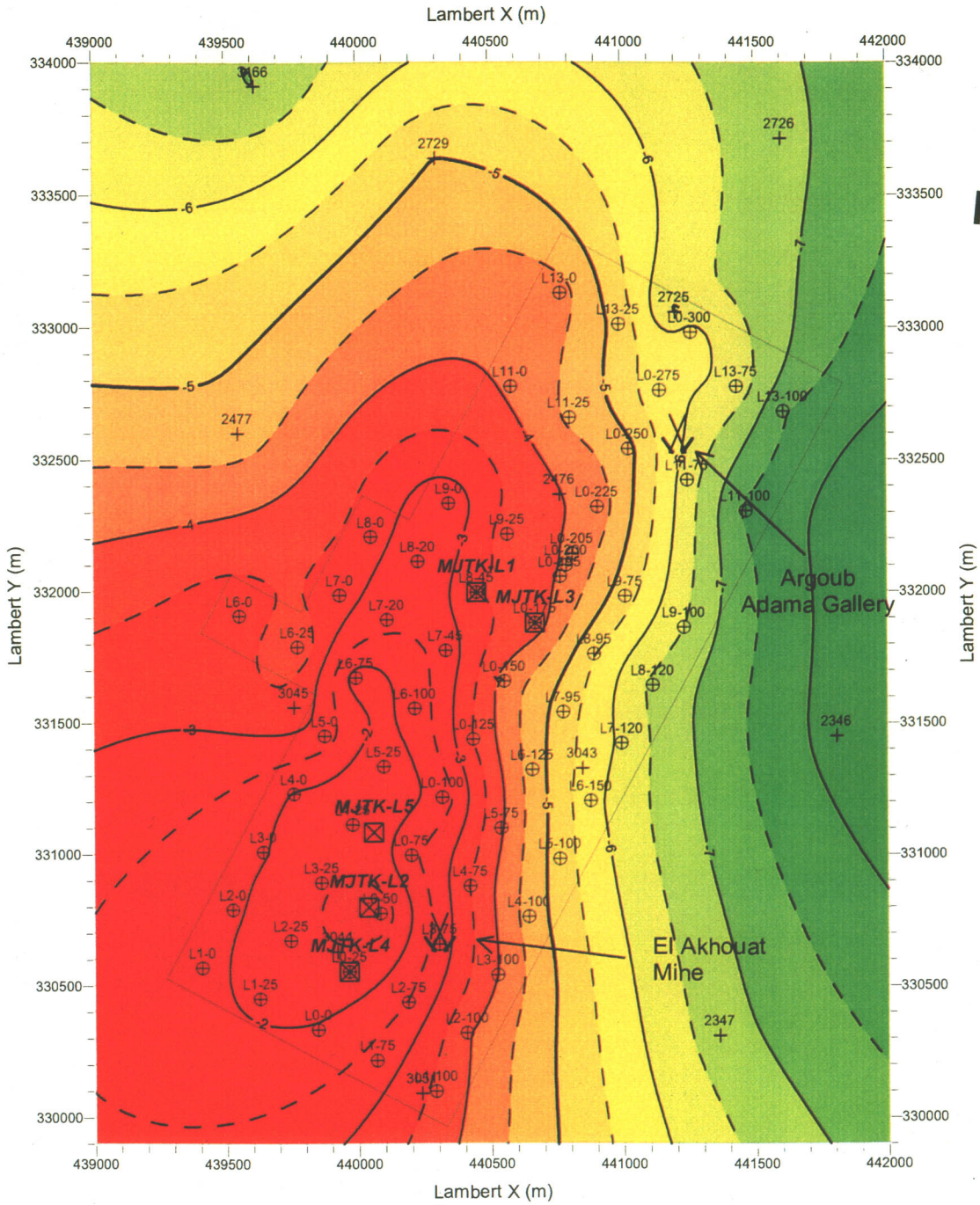
□ : Survey Area

✕ : Closed Mine

⊕ : Gravity Survey Station (2001)

— : IP survey Line (2001)

Figure 127
Layout of geophysical survey line in El Akhouat-Argoub Adama prospect
Scale 1 : 25,000
February, 2002



Bouguer Anomaly (Unit: mgal)

-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0

Legend

⊕ : Gravity Station

\+ : Existed Gravity Station

□ : Survey Area

: Closed Mine

⊠ Diamond Drill-Hole

Figure 128
Bouguer anomaly map in El Akhouat-Argoub Adama prospect (Density : 2.33g/cm3)
Scale 1 : 25,000
February, 2002

in the southern part of the prospect is located in the eastern marginal part of the high gravity anomaly. The Argoub Adama gallery in the northern part lies in the northeastwards extension part of the high gravity anomaly. The Triassic system running longitudinally from the north to the south is corresponded to the relative low gravity anomaly in the northern part. The steep gravity gradient in the southern part makes the gravitational features, which may reflect the Triassic system, ambiguous.

②Residual Gravity Anomaly (Figure 129)

Residual gravity high beyond 1 mgal extending in the N-S direction in the western part of the prospect is approximately corresponded to the distribution of the Cretaceous systems. The El Akhouat old mine is located in the southeastern edge of the residual gravity high, and the Argoub-Adama gallery lies in the northeastern edge. Inside this residual gravity high the N-S striking high anomaly of residual gravity exceeding 1.2 mgal lies. Small high anomalies of residual gravity exceeding 1.2 mgal distribute around the station L0-50 and the L0-22.

③Cross Section Analysis

The geophysical survey of the prospect was carried out partly in 2 lines of the L6 and the L9 in the central part in order to follow up the previous survey. The results of the cross section analysis using the gravity and magnetic surveys are described below.

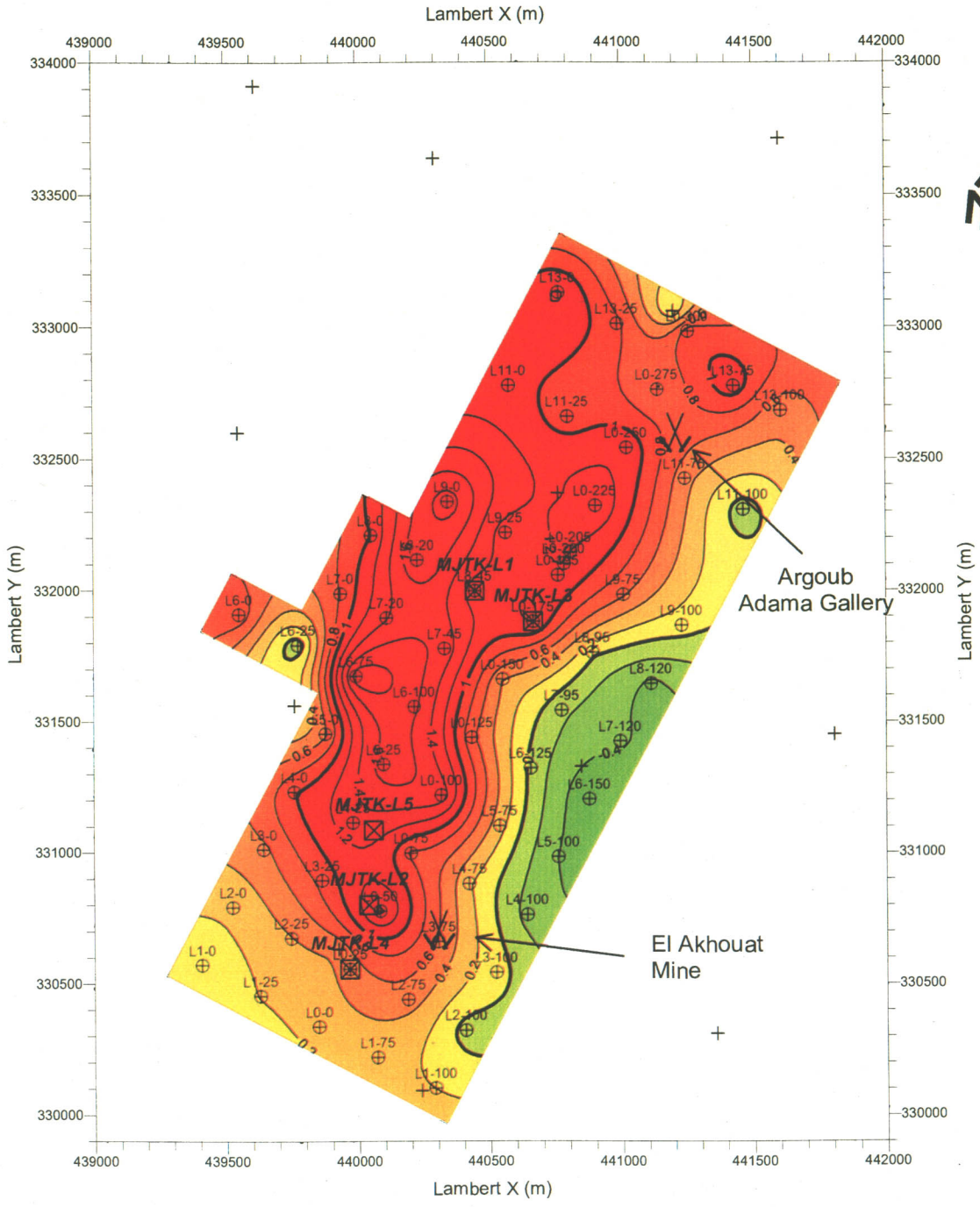
Three layers model is assumed. Each layer from the lowermost to the upper most is the Triassic system with density difference of 0.00 g/cm^3 as a gravity basement, the Cretaceous limestone with density difference of 0.10 through 0.40 g/cm^3, the Quaternary system 0.20 g/cm^3.

・L6 Cross Section (Figure 130)

This section crosscuts the central part of the prospect from the northwest to the southeast. The gravity basement rises up to around 300 m above sea level in southeastern side of the station L6-90, and is exposed partly on the ground surface around the station L6-120. The top of the gravity basement in the northwestern side of the station L6-90 undulates and the averaged depth is approximately 200m above sea level. For example, it rises to about 400m above sea level around the station L6-70 in the central hill part of the section and descends to around 100 m below sea level in the northwestern neighboring side. A low-density layer with density difference of -0.10 g/cm^3 overlies the rise of the gravity basement between the station L6-20 and 40 in the northwestern part. A low-density layer with density difference of -0.10 g/cm^3 extending in the southeastern end of the section may reflect the Tertiary systems or the Quaternary systems

・L9 Cross Section (Figure 131)

This section runs from the northwest to the southeast in the northern plain area of the prospect. This section is estimated as a stratified two layers model, which the



Residual Gravity (Unit: mgal)

-2 -1.6 -1.2 -0.8 -0.4 0 0.4 0.8 1.2 1.6 2

Legend

⊕ : Gravity Station

\+ : Existed Gravity Station

□ : Survey Area

: Closed

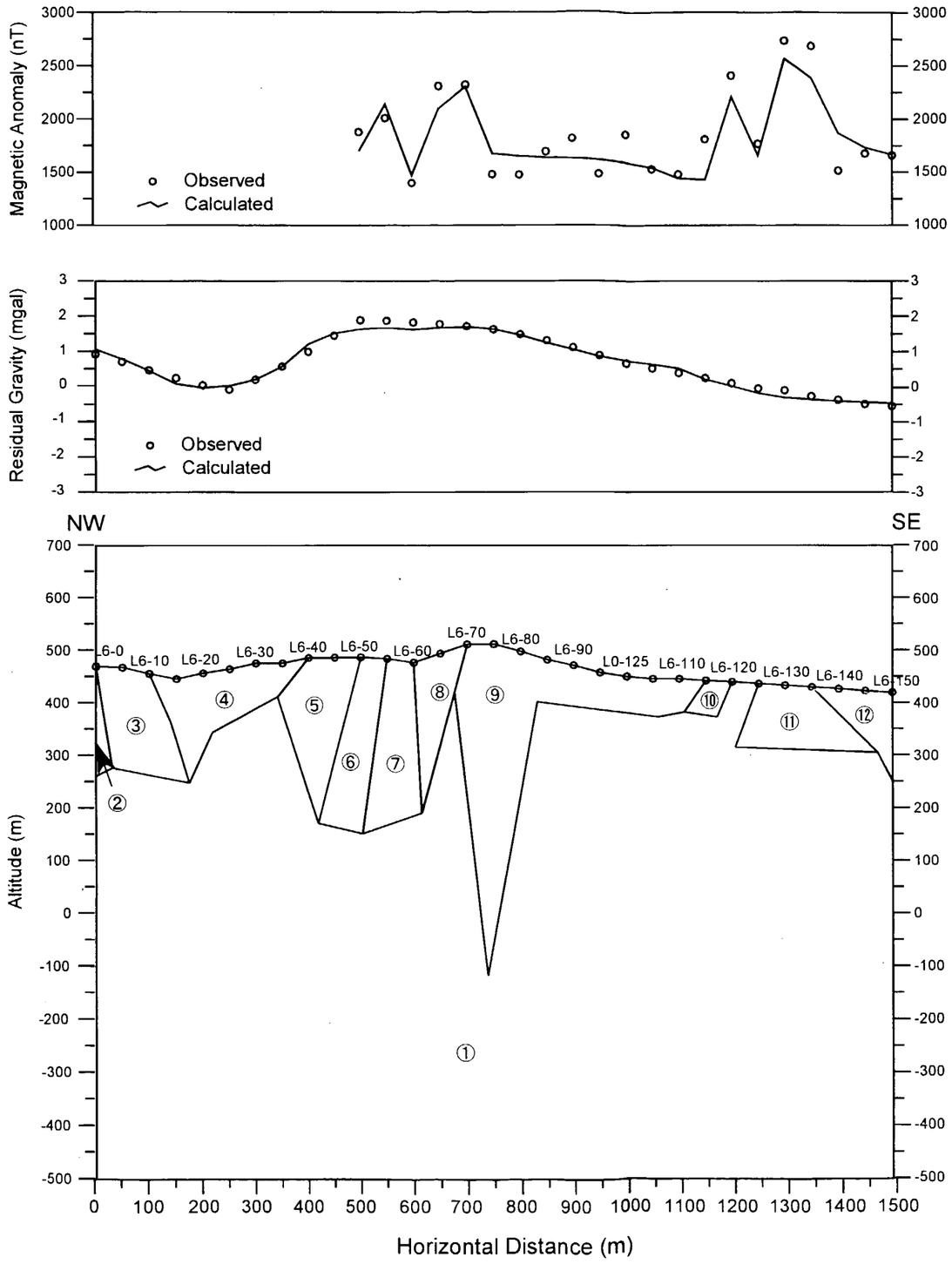
⊠ Diamond Drill-Hole

Figure 129

Residual gravity map
in El Akhouat-Argoub Adama prospect

Scale 1 : 25,000

February, 2002



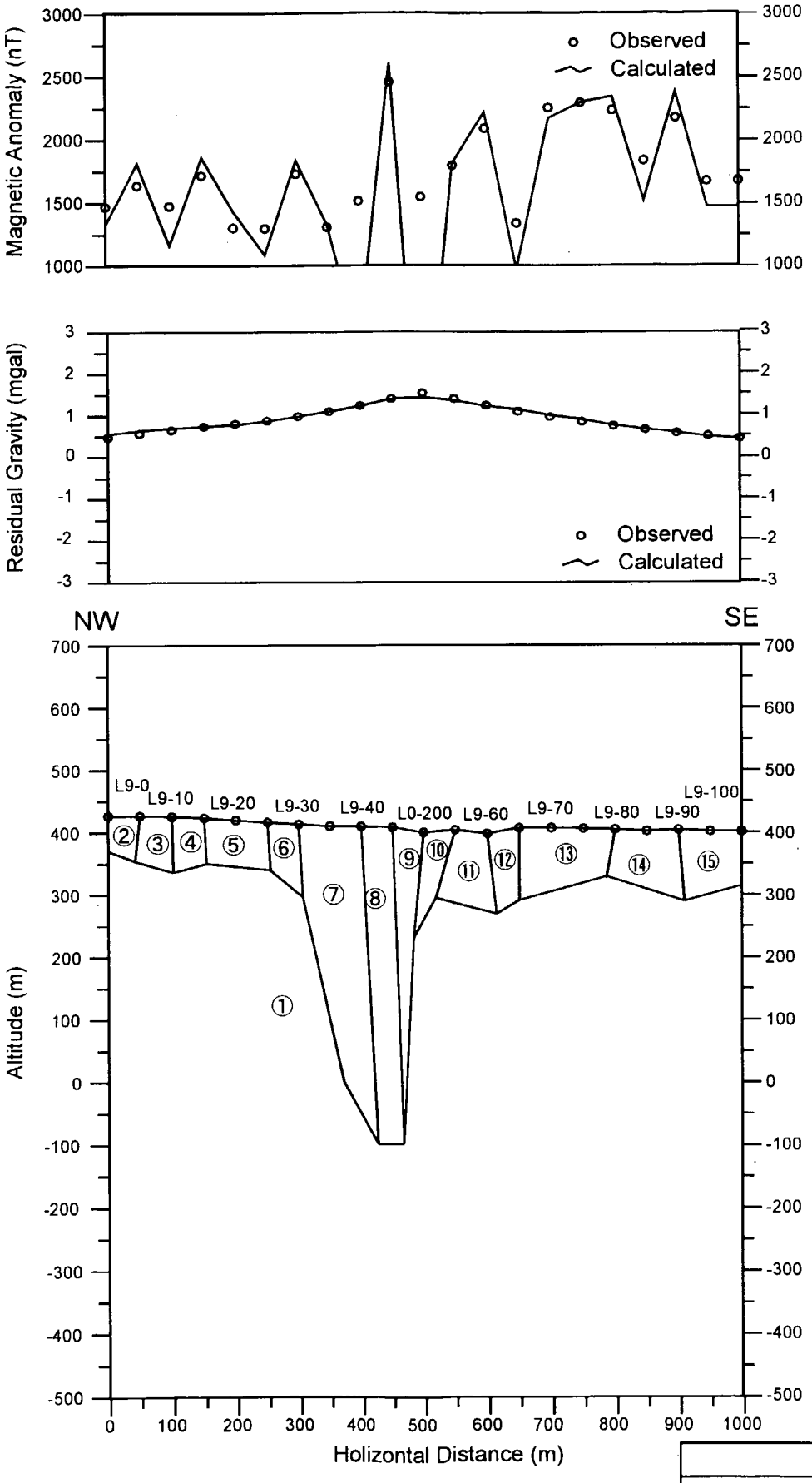
	Density Difference (g/cm^3)	Magnetic Susceptibility (cgsemu)
①	0.00	0.000
②	0.15	0.000
③	0.05	0.000
④	-0.20	0.000
⑤	0.20	0.000
⑥	0.20	0.002
⑦	0.20	0.000
⑧	0.20	0.001
⑨	0.20	0.000
⑩	0.00	0.003
⑪	-0.10	0.003
⑫	-0.10	0.000

Figure 130

Result of 2-D gravimetric and magnetic analysis (Line L6)

Scale : 10,000

February, 2002



	Density Difference (g/cm^3)	Magnetic Susceptibility (cgsemu)
①	0.00	0.000
②	0.25	0.001
③	0.25	0.000
④	0.25	0.001
⑤	0.25	0.000
⑥	0.25	0.001
⑦	0.25	0.000
⑧	0.30	0.003
⑨	0.40	0.000
⑩	0.40	0.005
⑪	0.35	0.008
⑫	0.35	0.005
⑬	0.30	0.008
⑭	0.22	0.002
⑮	0.15	0.000

Figure 131

Result of 2-D gravimetric and magnetic analysis (Line L9)

Scale : 10,000

December, 2000

high-density layer with density difference of 0.15 through 0.40 g/cm^3 corresponded to the Cretaceous systems overlies the gravity basement assumed as the Triassic system. The top depth of the gravity basement is around 300 m above sea level in general, and it descends to around 100 m below sea level between the station L9-30 and L0-200 in the central part.

⑥Interpreted gravity map

The interpreted gravity map composed of the valid anomalies of residual gravity, the 0 mgal/km contour of first vertical differential gravity and the contours of Bouguer anomaly overlaid geological maps shown in Figure 132.

The high gravity extends from the south northwards along the N-S striking contact zone between the Cretaceous systems and the Triassic systems. In the eastern side of the contact zone gravity value tends to decrease eastwards. A high anomaly of gravity beyond -2 mgal, which the El Akhouat old mine is located in the eastern marginal part of, lies in the southern part of the high gravity.

A high anomaly of residual gravity exceeding 1.2 mgal extends in the N-S trending in the western part of the prospect. This high anomaly is corresponded to the Cretaceous systems distributing the eastern side of the Triassic system. The northern part of this high anomaly is partly shifted eastwards along the E-W striking fault running through the station L9-0. The southern end of the high anomaly is cut by the E-W striking fault running through the station L0-75. A small high anomaly of residual gravity beyond 1.2 mgal lies between two E-W striking faults. In the northern part of the prospect there is a small high anomaly of residual gravity beyond 1.2 mgal. The Argoub Adama gallery is located in the northeastern side of this small anomaly.

The contour line of vertical first derivative of 0 mgal/km, which reflects a fault and a boundary of geological units, is surrounding the high anomaly of residual gravity in the western part of the prospect. Small areas surrounded the contour line of vertical first derivative of 0 mgal/km around the station L8-45 and the L0-75 are corresponded to the faults.

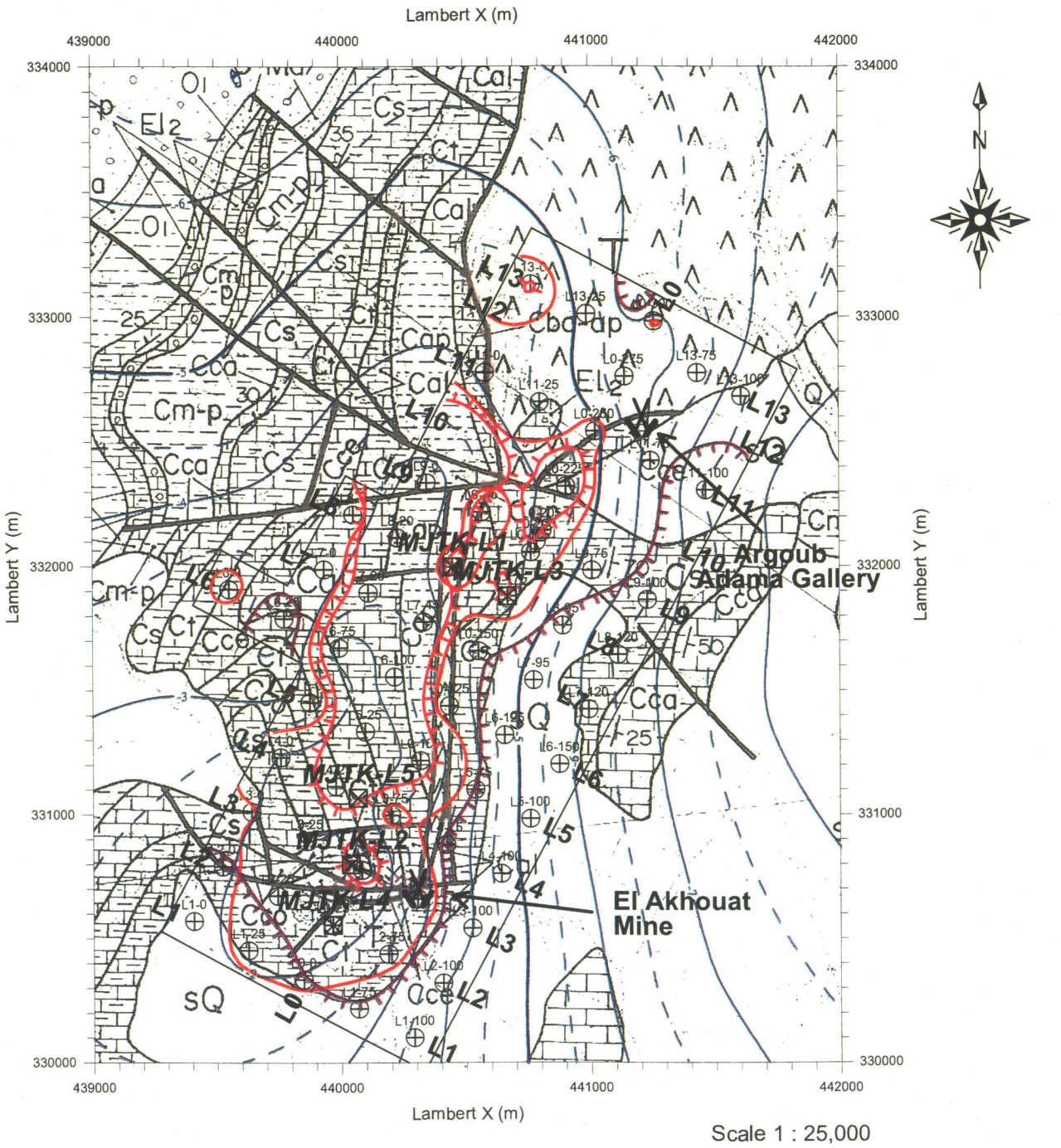
(2) IP survey

① Pseudo-section of apparent resistivity and observed chargeability

Characteristics of apparent resistivity and observed chargeability in the section L4, L6 and L9 applied the IP survey in the current program are described below.

・L4 Cross Section (Figure 133)

This section crosscuts the hill in southern part of the prospect from the northwest to the southeast. Apparent resistivity in the section indicates high exceeding 100 Ωm as a whole. A low anomaly of apparent resistivity below 50 Ωm, whose top is located in the shallow part around the station L4-70, stretches in two directions towards the



Legend

Residual Gravity > 1.2mgal

Residual Gravity < 0.3mgal

First Vertical Derivative Gravity = 0 mgal/km

Profiles for IP and Gravity survey

Profiles for Gravity survey

Stations

Ancient Works

: Diamond Drill-Hole

Bouguer Anomaly
(density: 2.33 g/cm^3)

(Unit : mgals)

Figure 132 Gravity interpretation map in El Akhouat-Argoub Adama prospect

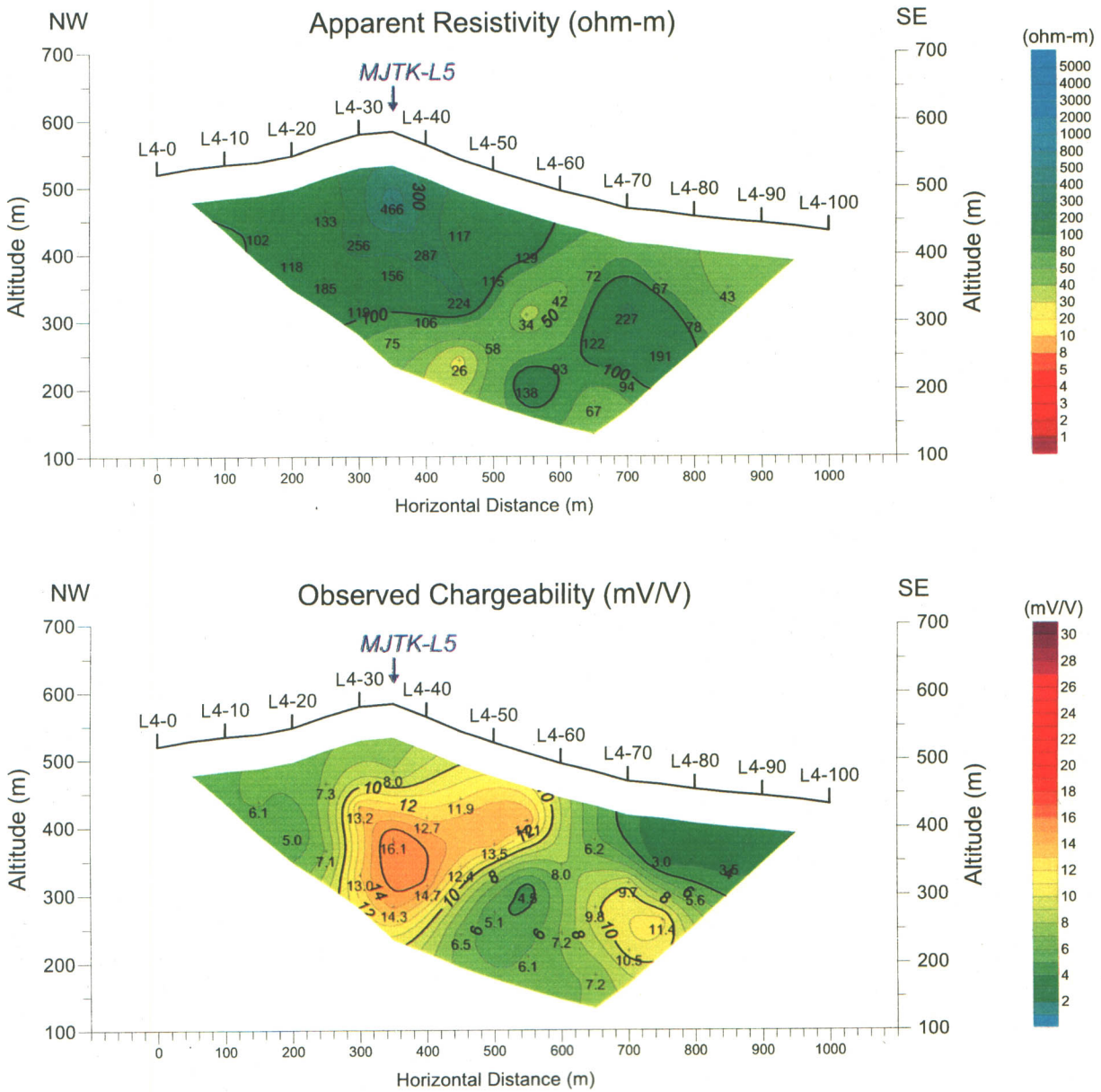


Figure 133 Observed IP pseudo-section (Line L4)

northwestern deep part and the southeastern deep part.

The anomalies of observed chargeability exceeding 10 mV/V lie in the area from the station L4-30 at the hilltop to the L4-60 in the southeastern slope and in the deep zone between the station L4-70 and 80 in the southeastern part.

· L6 Cross Section (Figure 134)

This section crosscuts the southwestern end of the prospect from the northwest to the southeast. A high anomaly of apparent resistivity exceeding 500 Ωm in the surface zone in the central hill part stretches in two directions towards the northwestern deep parts and the southeastern deep part. Surrounding this high anomaly low apparent resistivity below 20 Ωm distributes broadly. The low anomalies of apparent resistivity less than 10 Ωm lie in the northwestern end, the central deep part and the southeastern end of the section.

The anomaly of observed chargeability beyond 10 mV/V extends from the station L6-60 in the central shallow part southeastwards the deep part around the L6-80.

· L9 Cross Section (Figure 135)

This section runs from the northwest to the southeast in the northern plain area of the prospect. Apparent resistivity in the section is low below 20 Ωm as a whole except for the high anomaly of apparent resistivity above 50 Ωm in the shallow zone between the station L9-30 and 40 in the northwestern part of the section. A low anomaly of apparent resistivity less than 10 Ωm extends in the southeastern side of the station L9-60.

Observed chargeability in this section tends to increase towards the deep part. The anomaly of observed chargeability beyond 10 mV/V lies in the deep zone around the station L9-30 in the northwestern part.

② Section of modeled resistivity and chargeability

Characteristics of resistivity and chargeability, as the result of modeling, are described below for each of the cross sections.

· L4 Cross Section (Figure 136)

This section crosscuts the hill in southern part of the prospect from the northwest to the southeast. High resistivity exceeding 100 Ωm distribute broadly in the shallow part between the station L4-20 and 60 from the hilltop to the southeastern slope and in the deep part from the station L4-60 to 90 in the southeastern foothill. In the deep part of the hilltop area low resistivity below 20 Ωm distributes and rise up towards the shallow part around the station L0-75 in the southeastern slope, dividing the area distributed high resistivity.

The chargeability anomaly exceeding 10 mV/V extends from the station L4-40 to the 70 in the southeastern slope. Resistivity in the center of the anomaly indicates higher

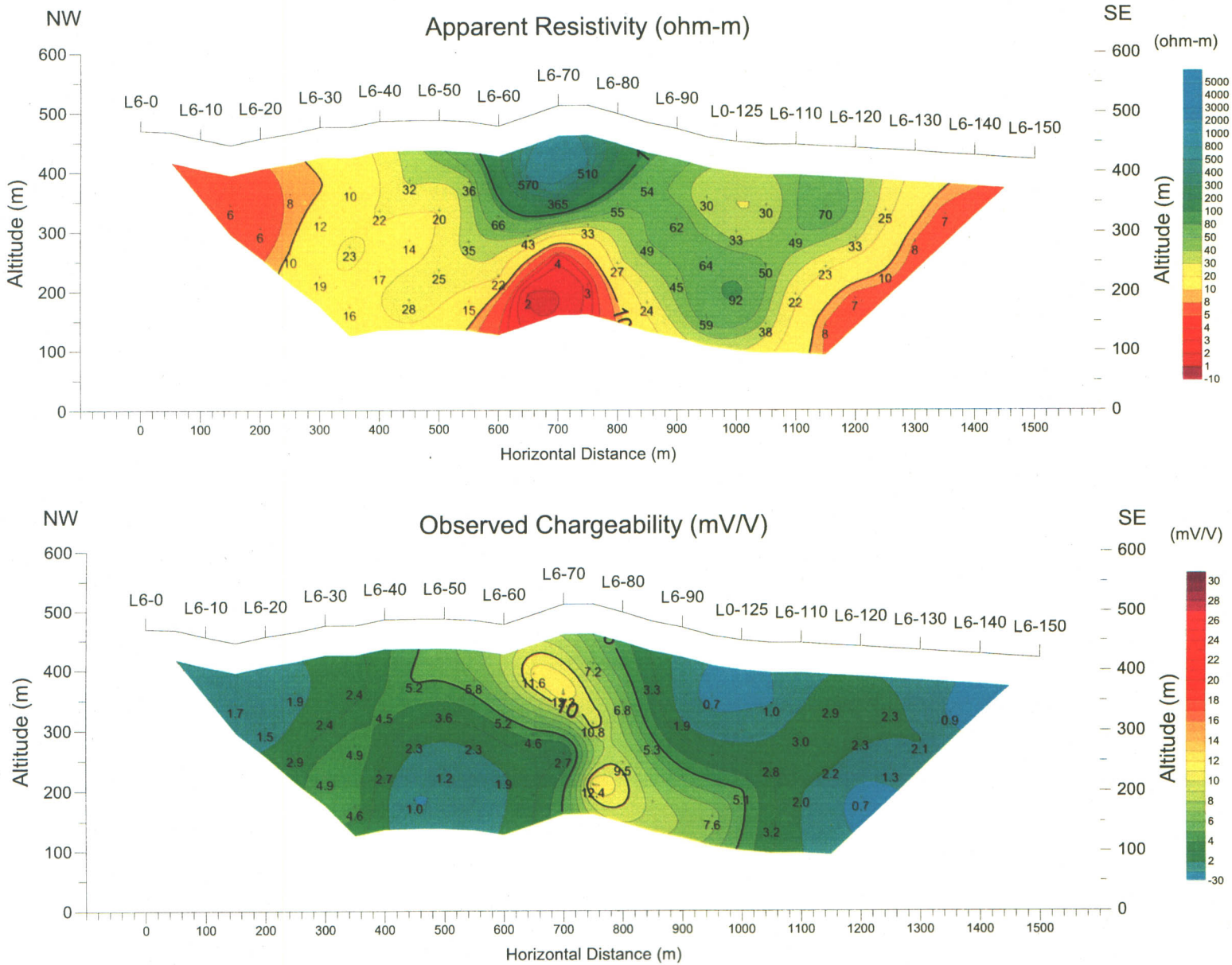


Figure 134 Observed IP pseudo-section (Line L6)

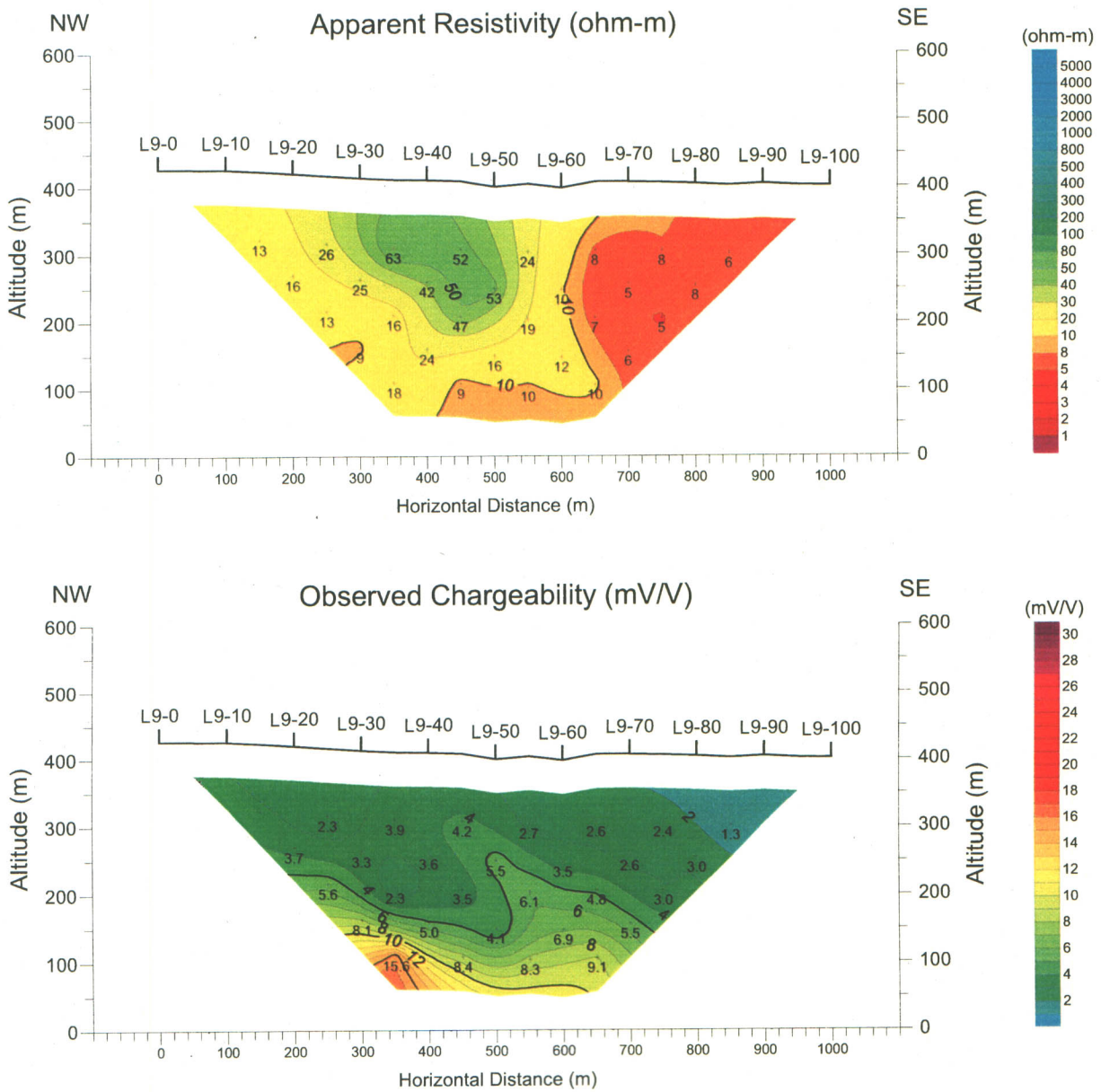


Figure 135 Observed IP pseudo-section (Line L9)

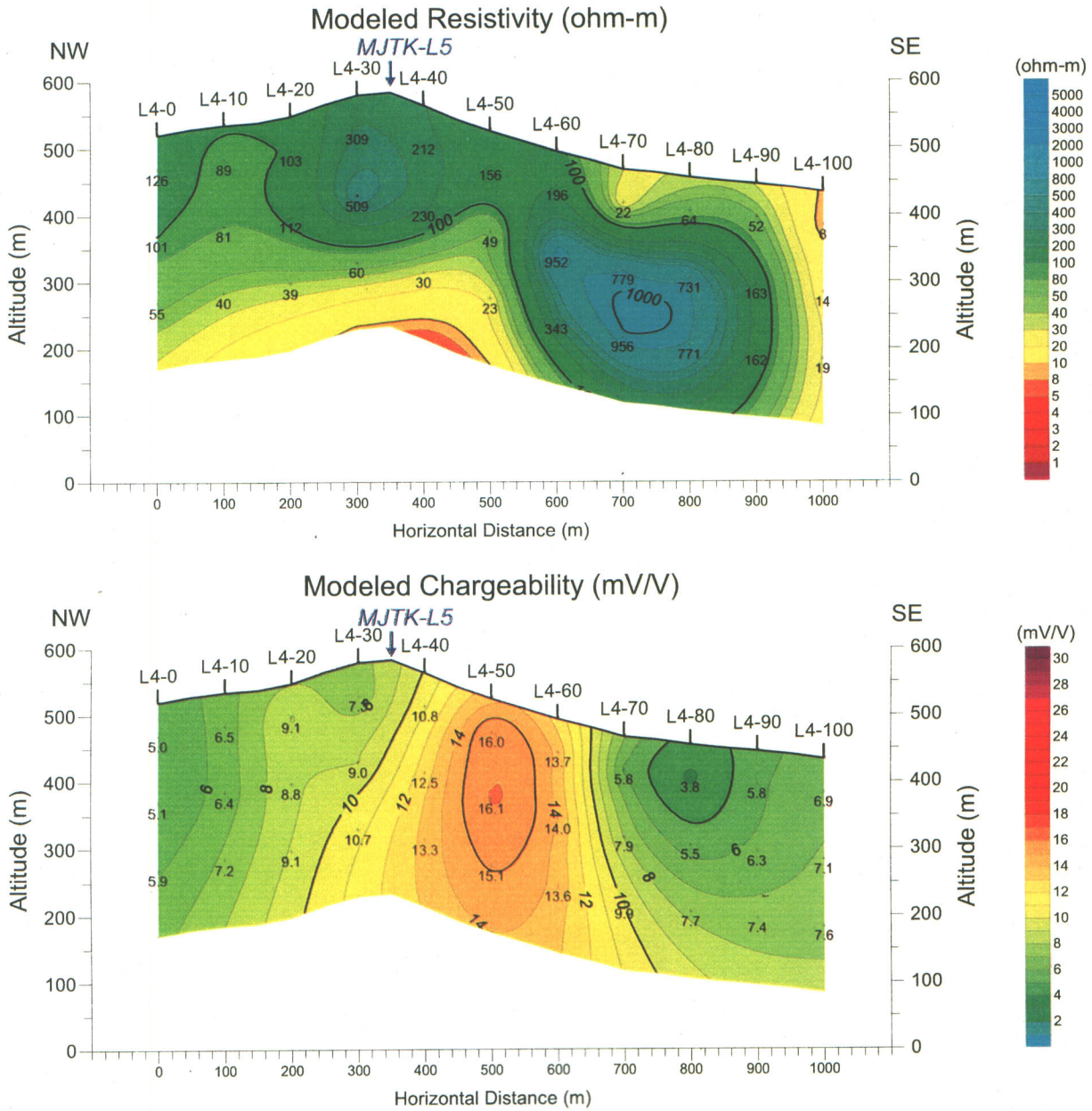


Figure 136 Modeled IP section (Line L4)