THREE (3)-DIMENSIONAL MODELING OF LATERITIC PALEO-SURFACES (REGOLITH MAPPING) USING AIR BORNE ELECTROMAGNETISM SURVEYS, IN MALI WEST AFRICA

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1.0 INTRODUCTION:

Combined analysis of airborne electromagnetic (AEM) data, digital elevation model (DEM) and other geophysical and geological data sets are becoming increasingly important in providing scientific information about the earth's subsurface through the construction of 3D models (Wilford, 2009). This research examined the use of integrating a sequence of Conductivity Depth Images (CDI's) generated from a GeoTEM airborne electromagnetic dataset to create a 3D model of the subsurface, of its apparent conductivity. This model was interrogated using a developed methodology to determine the thickness of the "glacis". The identification of exploration targets such as paleo-channels that has been hypothesised to be present in the subsurface was also examined.

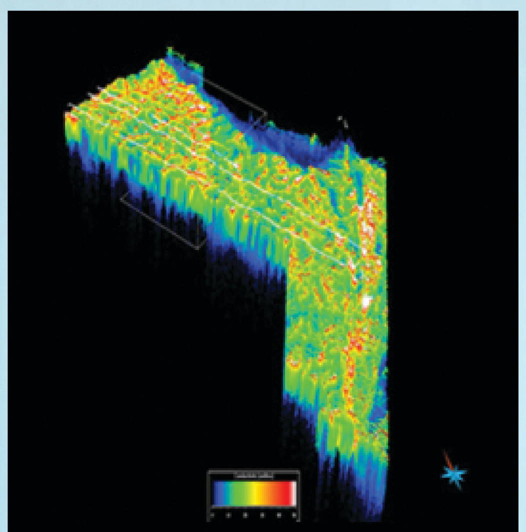

Figure 11: 3 D Model of the subsurface's apparent conductivity with voxet cube capturing part of the dataset

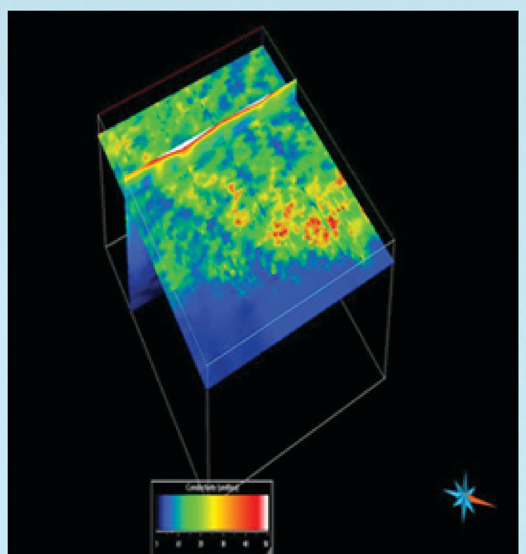

Figure 12: Interpolates apparent conductivity values within voxet cube of the sub surface

2.0 OBJECTIVES:

- Generation of 3D model of subsurface using apparent conductivity values.
- Estimating the thickness of the overlying paleo-land surfaces ("glacis").
- Investigating the existence of possible paleo surfaces within the subsurface.

3.0 METHODS:

- Conductivity depth transformations were carried out on a GeoTEM dataset.

  Digital elevation model (DEM) data were integrated into a 3D space.
- 3D model, was interrogated to estimate the thickness of the regolith, by identifying the depth at which there is a transition from a dendritic pattern (noise and regolith) to shear zone in bedrock pattern.
- ISO surfaces of the same apparent conductivity were used to image for potential paleo channels.
- ISO surfaces with depressions along their surface that can represent pockets of higher conductive material (potential paleo-channel material depositions).
- Identification of these depressions within the ISO surface associated with high elevation values, represent the possible existence of a paleo-channel within the subsurface.

4.0 RESULTS & DISCUSSION:

4.1 3D MODEL OF SUBSURFACE

- A voxet cube within the project area was created capturing the apparent conductivity values of the subsurface.
- Interpolation using nearest neighborhood executed.

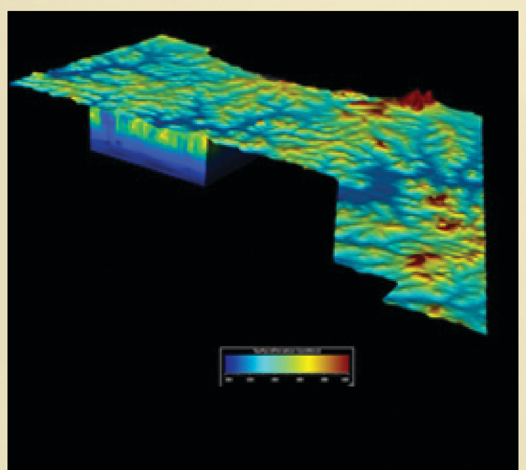

Figure 10: 3 D Digital Elevation Model of the project area showing subsurface apparent conductivity within Voxet cube

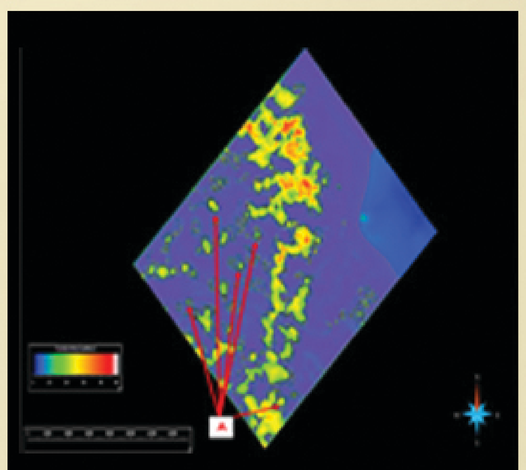

Figure 18: Shows strong correlation between the depressions along ISO surface 19mS/m and the high conductivity values (red and yellow)

4.1 ESTIMATING THE THICKNESS OF THE OVERLYING PALEO-LAND SURFACES ("GLACIS"):

- An estimate of the thickness was determined by observing the changes in the conductivity patterns between, Figure 14 (a) through Figure 14 (g).
- The upper boundary of the 3D voxet cube is positioned at 300m above sea level whilst the lower boundary of the voxet cube is position at 700m below sea level. The model starts at a datum, 50m below surface elevation.
- Figure 14 (f) represents the transition point between the overlying regolith or "glacis" unto the underlying bedrock lithology. The basement of the regolith is located approximately 125m below the 50m datum line.
- Thickness is estimated at 175m, this is comparable to thickness of regolith found in nearby manganese mineralization in nearby Burkina Faso.

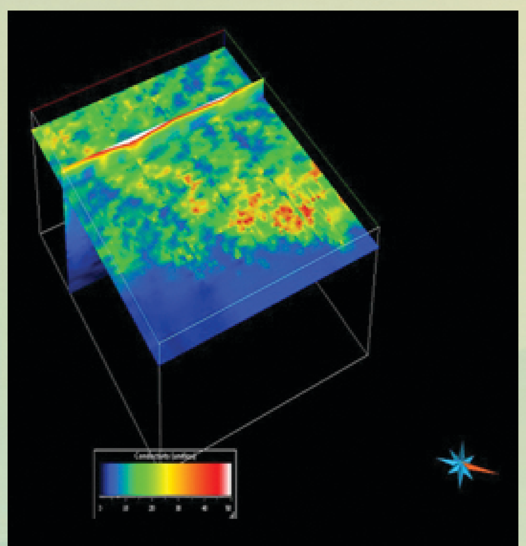

Figure 14 f: Conductivity pattern at 125m within the model (175 m above see level)

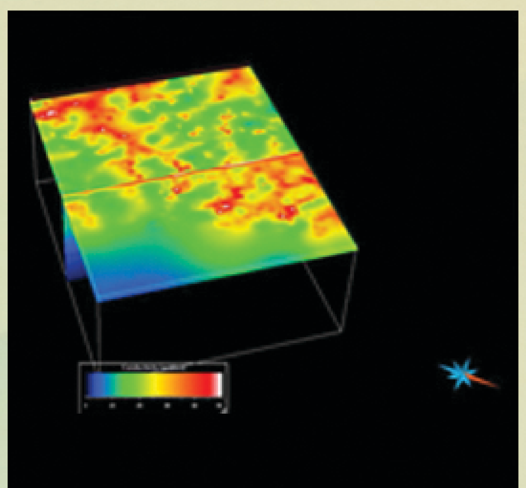

Figure 14 a: Showing the strong drainage effect on the apparent conductivity observed at the surface of the model (300m above sea level)

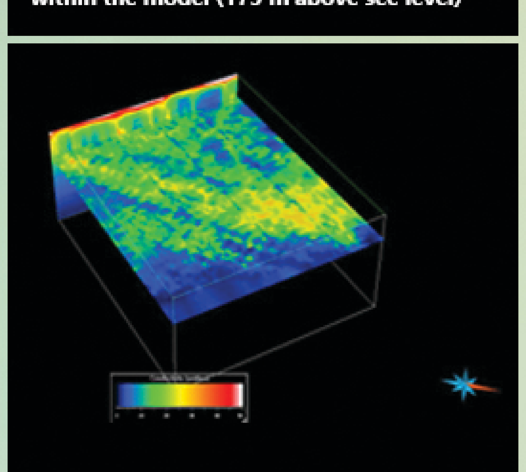

Figure 14 g: Conductivity pattern at 215 m within the model (86 m above see level)

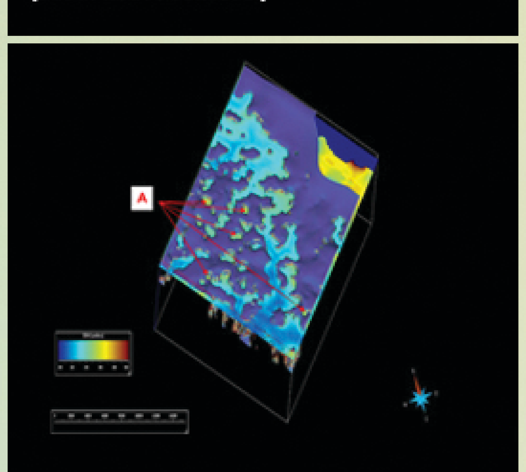

Figure 17: The ISO surface having apparent conductivity of 19mS/m

4.3 INVESTIGATING EXISTENCE OF POSSIBLE SHEAR ZONES WITHIN THE BEDROCK:

Figure 14 (g) indicates the existence of several North-South trending high conductive bodies (red, green and yellow areas), alternating with zones of low conductivities (blue areas).

4.4 INVESTIGATING THE EXISTENCE OF POSSIBLE PALEO SURFACES WITHIN THE SUBSURFACE:

- In this research ISO surfaces were generated at increments of 1 mS/m and compared with the DEM dataset to identify the possible existence of paleo-channels.
- Depressions occurring along its surface, is indicative of the presence of higher conductive areas (paleo channels).
- The identification of pockets of higher conductive materials, associated with high DEM values, is labelled as "A" in Figure 17.
- May be the existence of remnants of paleo-channels sediments trapped within the subsurface.

5.0 CONCLUSION:

- A 3D model using Digital Elevation Model and apparent conductivity values of the subsurface was generated.
- The thickness of the regolith or "glacis" was accurately estimated and was comparable to thickness of the Mn–oxide zones that are confined within the "glacis" of the neighboring Tambo mines of Burkina Faso (Beauvais et al 2008).
- Several exploration targets were identified that includes the sub parallel fault/shear zones and possible remnants of paleo-channels within the subsurface.

6.0 REFERENCES:

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