Large Scale Airborne TEM Mapping

Location: Namibia | CASE STUDY

Solution by TEMPEST®

Overview

The Geological Survey of Namibia (GSN) commissioned a large scale airborne geophysical mapping project in the Northeastern part of Namibia. The TEMPEST® fixed wing Time Domain Electromagnetic (TEM) system was used. Approximately 25,000-line km of data was acquired using a 2km by 20km grid. This resulted in a large area being covered at a relatively low resolution. The down line data, however, can still be used to produce high resolution Conductivity Depth Images (CDI's) on a line-by-line basis. The aims of the survey were two two-fold: firstly, to test whether TEM surveys could penetrate the relatively conductive Kalahari cover in the area; and secondly to map the thickness and extent of these areas as well as identify basement domains where little or no cover is present.

Figure 1. TEMPEST® System installed on a Cessna 208 Grand Caravan.

TEM Ternary image

To give an overview of the area, in plan and depth view, a TEM RGB Ternary image was created. This image assigns the late time channels to red, middle time channels to green and early time channels to blue. Conversely, deep conductors with no early time signal appear red. Strong surficial conductors with signal throughout the time range appear white and resistors (no signal) appear black or dark. The northwestern and central parts of the image above show conductive cover in light blue, with deeper conductors (red and white) below the cover. The northern extreme shows thicker conductive cover in white, while the northeastern parts show a basement domain with structural detail trending east-west. The southern parts of the image also show a basement domain, but exhibit a strong surface conductor, and linear structural detail can also be seen in the image.

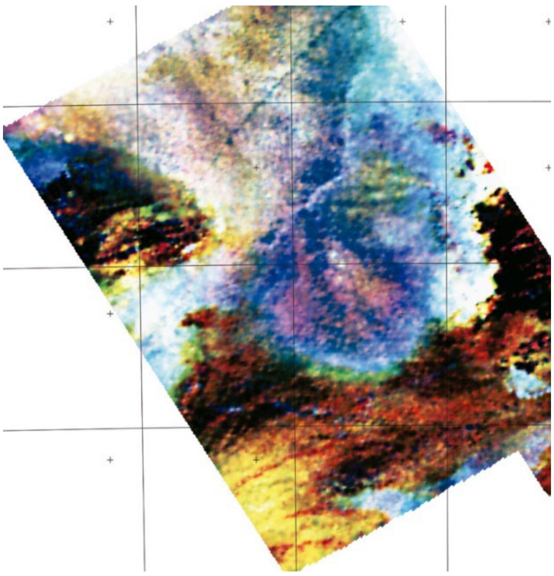

Figure 2. TEM RGB Ternary Image. Red=Late time; Green=middle time; Blue=early time

Conductivity Volume

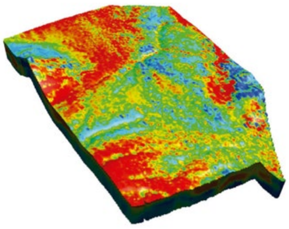

Figure 3. 40m Depth slice Caravan

To convert the TEM data into the physical property, the software program EMFlow was used to create Conductivity Depth Images (CDI's). The CDI's are then gridded in 3D to produce a conductivity volume, which can be visually manipulated to show previously hidden features. The images in Figure 3 show three depth slices through the conductivity volume: 40m, 140m and 240m. The 40m depth slice reveals the conductive Kalahari cover expected in the area, as well as additional surficial detail such as drainage and topographic effects. The 140m depth slice strips off the conductive cover and reveals the conductive edges of the basal unit of a previously unknown sedimentary basin in the north-east and central parts of the survey area; isolated conductors and structural lineaments are also visible. The 240m depth slice shows the bottom of the sedimentary basin in the central region of the survey area, as well as possible basal structures.

Basement Domains

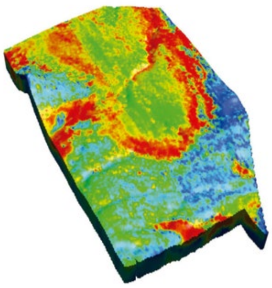

Figure 3. 140m Depth slice Caravan

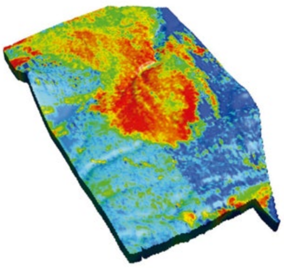

Figure 3. 240 Depth slice Caravan

Two basement domains were identified by the TEM survey: a smaller domain in the northwest of the survey area, and a larger one in the south, trending north-east south-west. The basement domains, both exhibiting isolated conductors and strong structural features, will be of interest to mineral exploration companies. Figure 5 (next page) shows a chair clipped (200m) conductivity volume that highlights various significant features. The far left of the image shows conductive Kalahari cover at the surface with isolated conductors beyond 200m depth. The center of the image shows the central parts of a sedimentary basin, where there is no conductive cover, while the right shows the same basin underneath conductive cover. The profile of L720, shown in Figure 4 below, displays some of these isolated conductors, conductive cover, and parts of the sedimentary basin.

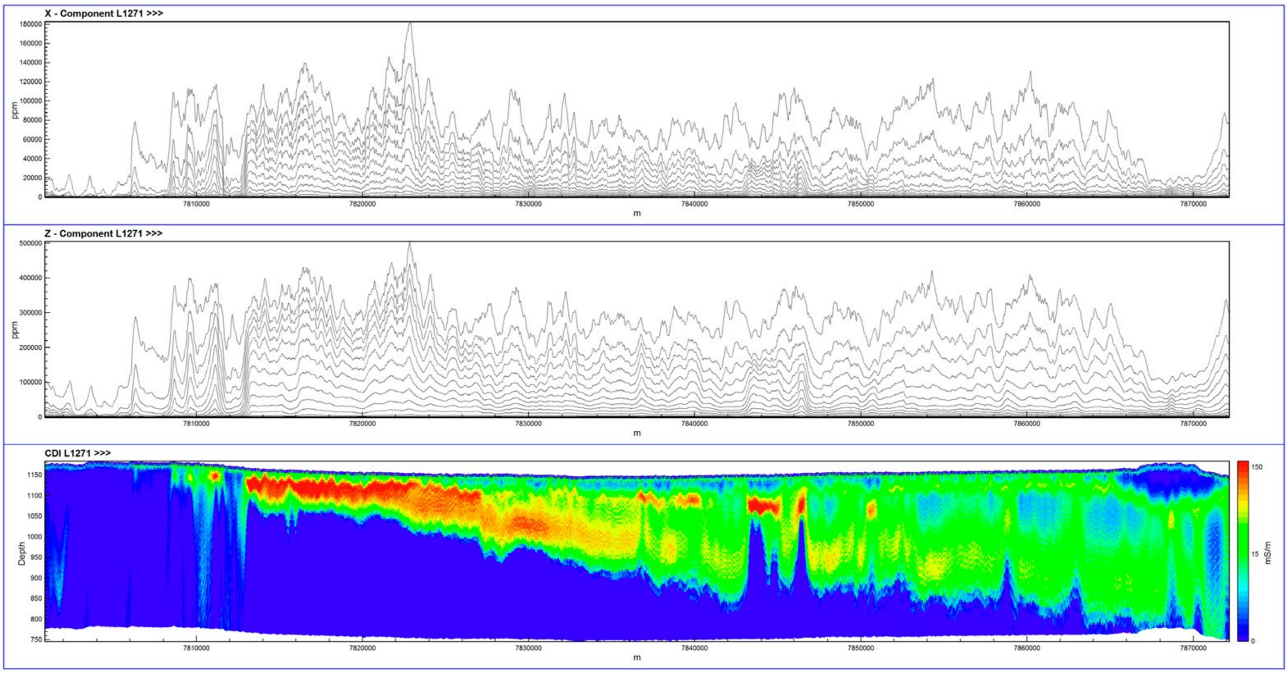

Figure 4. Data and CDI profile of L720

Sedimentary Basin

A pervasive conductive basal unit is evident throughout the central and north-east part of the survey area. This seems to be a large previously unknown sedimentary basin. The conductivity volume in Figure 5 clearly shows the southern margin of clearly shows the southern margin of the basin, as well as the resistive southern basement domain. Conductive Kalahari cover can be seen in the extreme north with the basal conductor being imaged.

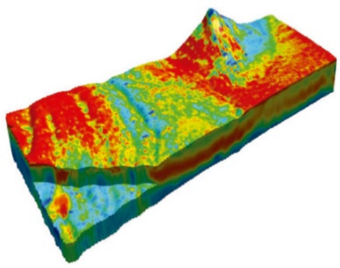

Figure 5. 200m chair clipped conductivity volume, looking west.

Mapping regional conductors

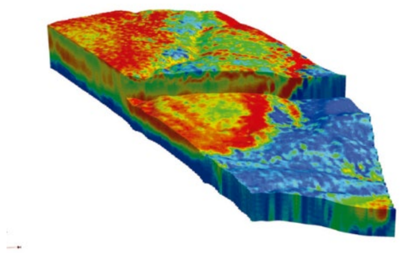

Figure 5. 200m chair clipped conductivity volume, looking north.

The CDI in Figure 6 shows a flight line that images the basal conductor of the sedimentary basin in the central area. The length of the displayed section is 90km and it extends to a depth of 400m. On the far left of the profile, a basement domain with isolated conductors is evident. This signature transition into the sub- cropping basal conductor, which reaches depths of 350m as we move to the right. The far right of L1270 shows conductive Kalahari cover at 50-100m depth with the basal conductor below this at 350m.

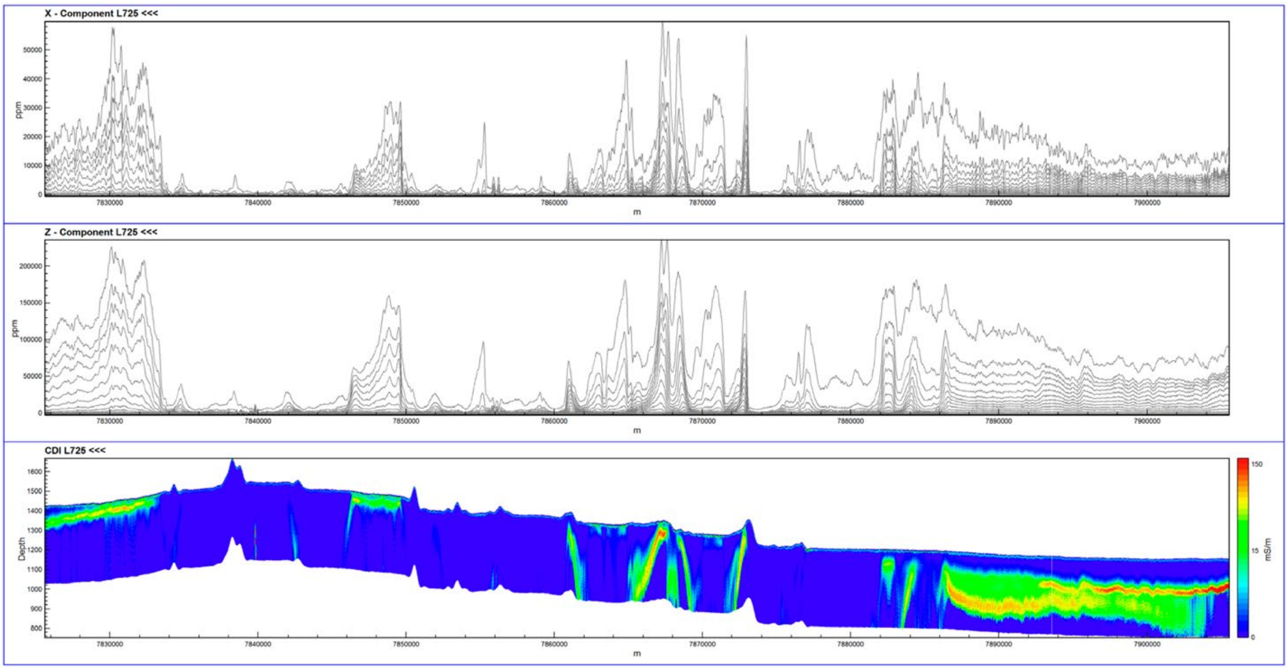

Figure 4. CDI profile of L1270 showing the dipping basal conductor of a previously unknown sedimentary basin