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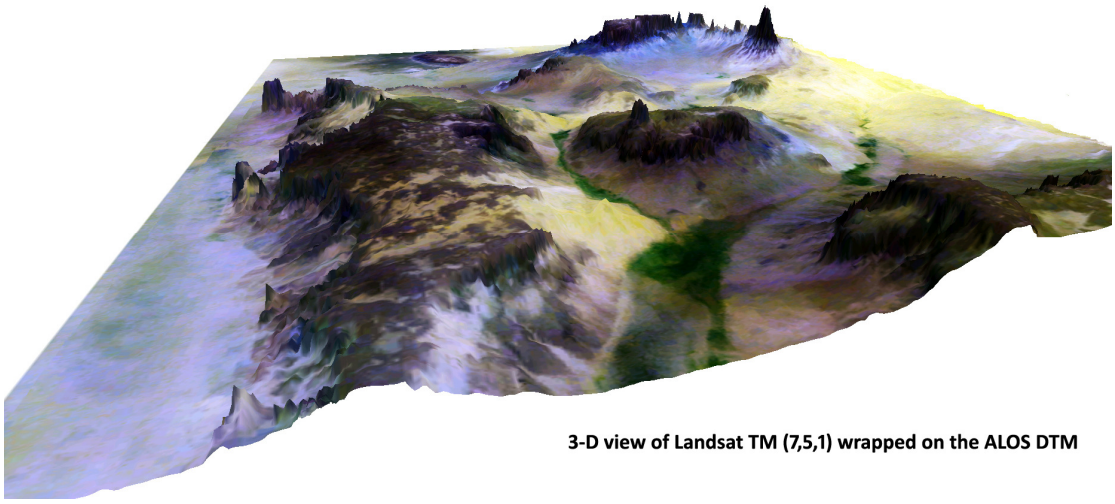
Database creation & analysis for Tin Hina concession, Mali



3-D view of Landsat TM (7,5,1) wrapped on the ALOS DTM

Submitted to

Great Quest Metals Ltd.

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GT-Imaging
64 Brodezki, Tel Aviv, Israel 69052
Telefax: 972-3-6413539 ; Mobile: 972-52-8743040; e-mail: iprs@netvision.net.il

Concession areas

"Red" area (total 1,655 km²) in Tin Hina, Mali with two "Green" sub-areas (total 764km²) see figure 1

Aims of project:

a. High resolution color orthophoto of the "Red" area
b. High resolution DTM of the "Green" area
c. Analysis of phosphates occurrence using satellite images

Data Sources:

a. ALOS PRISM images (2.5 m resolution)
b. DTM – created from the 2.5m ALOS PRISM stereo pairs images which results in DTM accuracy of approximately 10m horizontal and 6m-8m vertical
c. Landsat TM7 images

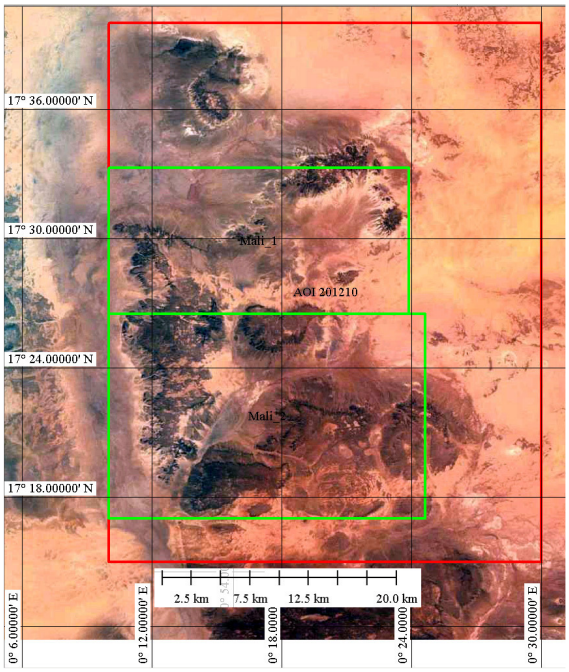

Fig 1: Location map of the study area.

Methods

High resolution orthophoto creation

The orthophoto was performed using images collected by the ALOS (Daichi) satellite in late 2010 (exact scene acquisition dates are depicted in figure 2). The 2.5m panchromatic PRISM images and 10m multispectral AVNIR images were sourced in their raw CEOS and TIF

formats at Level 1B1 with corresponding RPC sensor files. The images were pansharpened, natural color processed and mosaiced using ERDAS Imagine imagery processing software.

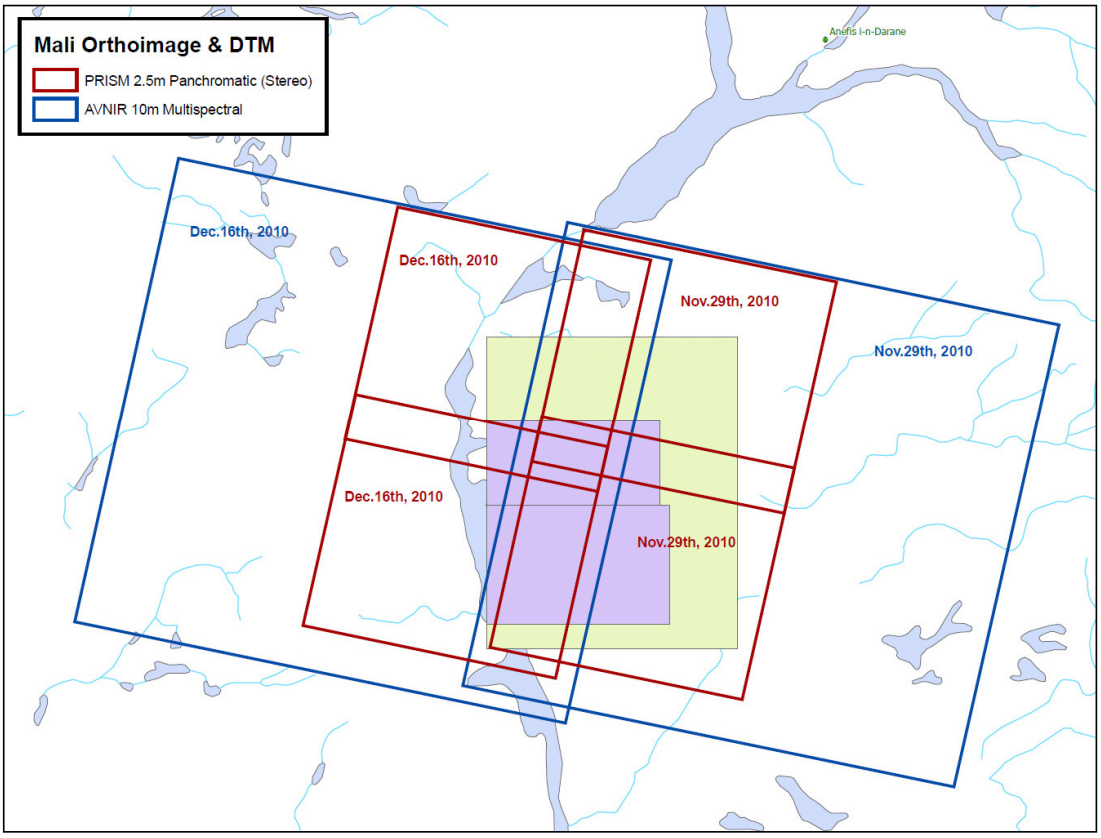

Figure 2: ALOS images that were used for orthophoto and DTM production.

DTM

Photogrammetric DTM extraction was done from the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) that has three independent optical systems for viewing nadir, forward and backward producing a stereoscopic image along the satellite's track. Stereo DSM extraction was performed using PCI Geomatics software. The DTM accuracy is approximately 10m horizontal and 6m-8m vertical.
The final DTM for the "Green" area is shown in figure 3.

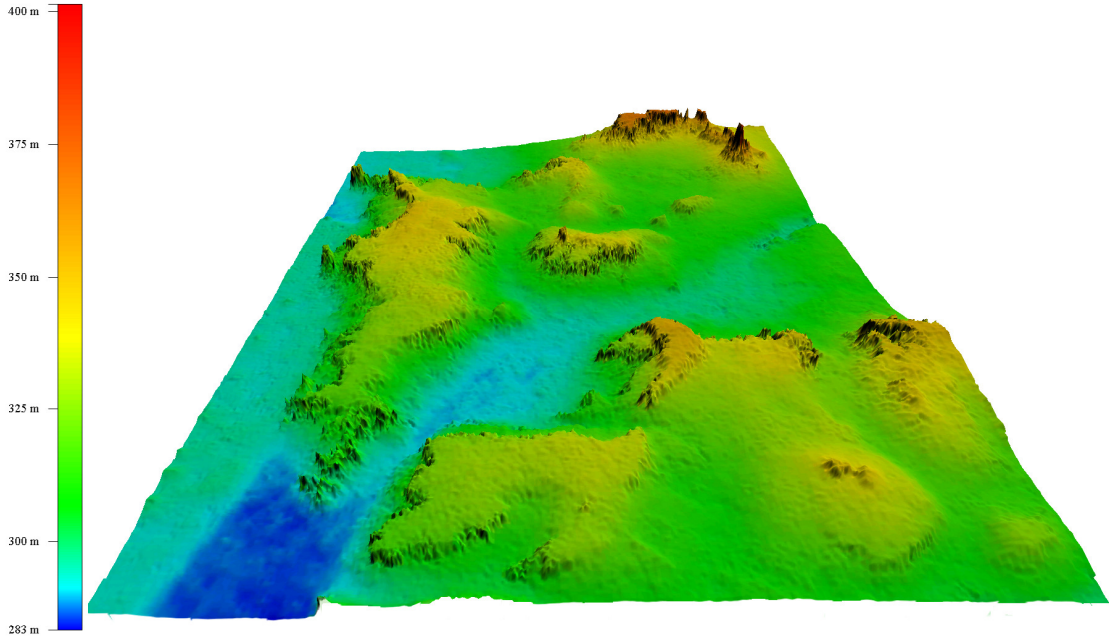

Figure 3: 3D view of the DTM in the "Green" area that was created from ALOS PRISM images. Elevation range from 283 to 401 m.

Analysis of phosphates - sedimentary hydroxyapatite

The analysis was based on the Landsat TM7 satellite images from the August 2001 and was done with PCI Geomatics software. Landsat TM7 has the following spectral bands in μm:

	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7
ETM+	0.45 - 0.52	0.53 - 0.61	0.63 - 0.69	0.78 - 0.90	1.55 - 1.75	10.4 - 12.5	2.09 - 2.35
	Band						
	.52 - .90						

Bands 1-5 and 7 at 30 m resolution, band 6 (Thermal) 60 m resolution and the Panchromatic band 8 is at 15 m resolution. The analysis was based on band combination and band ratio algorithms that are selected based on the spectral signature of phosphates in the VNIR, SWIR and TIR regions of the electromagnetic spectrum. The spectral response of Hydroxyl-apatite that fall in the Landsat TM7 spectral range (0.45-2.35 μm) is shown in figure 4.

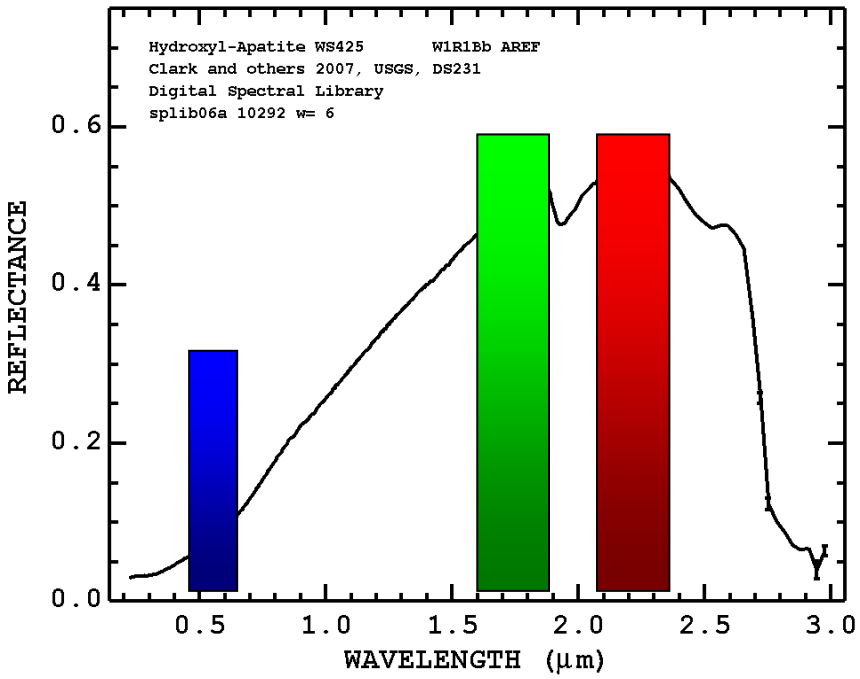

Fig. 4: Spectral signature of Hydroxyl-apatite from The USGS spectral library. In color the location of the three most important spectral bands that were used (7,5,1) for the analysis.

The image analysis followed several steps:

- Histogram analysis and correcting atmospheric effects
- Orthophoto production (DTM + GCP)
- Masking vegetation using spectral band 4
- Principal Component Analysis (PCA) to produce uncorrelated output bands
- Band rationing
- Color composite of band ratios
- Integration of field data maps to extract the spectral signature of the areas were phosphates was found on the surface
- Image classification

Field data of phosphate rich areas was extracted from figure 3.4-6 of Tamguelelt hill in the document "Summary of Exploration in the Tilemsi valley by Bumifom During 1958/59" and from maps sent by Nietie BenGali, GQ geologists in Mali.

The final interpretation and polygon extraction of areas suspected to have phosphates (figure 5) on the surface was done on Geographic Information System (GIS) by integrating the different processed images together with geological map, high resolution orthophoto and DTM.

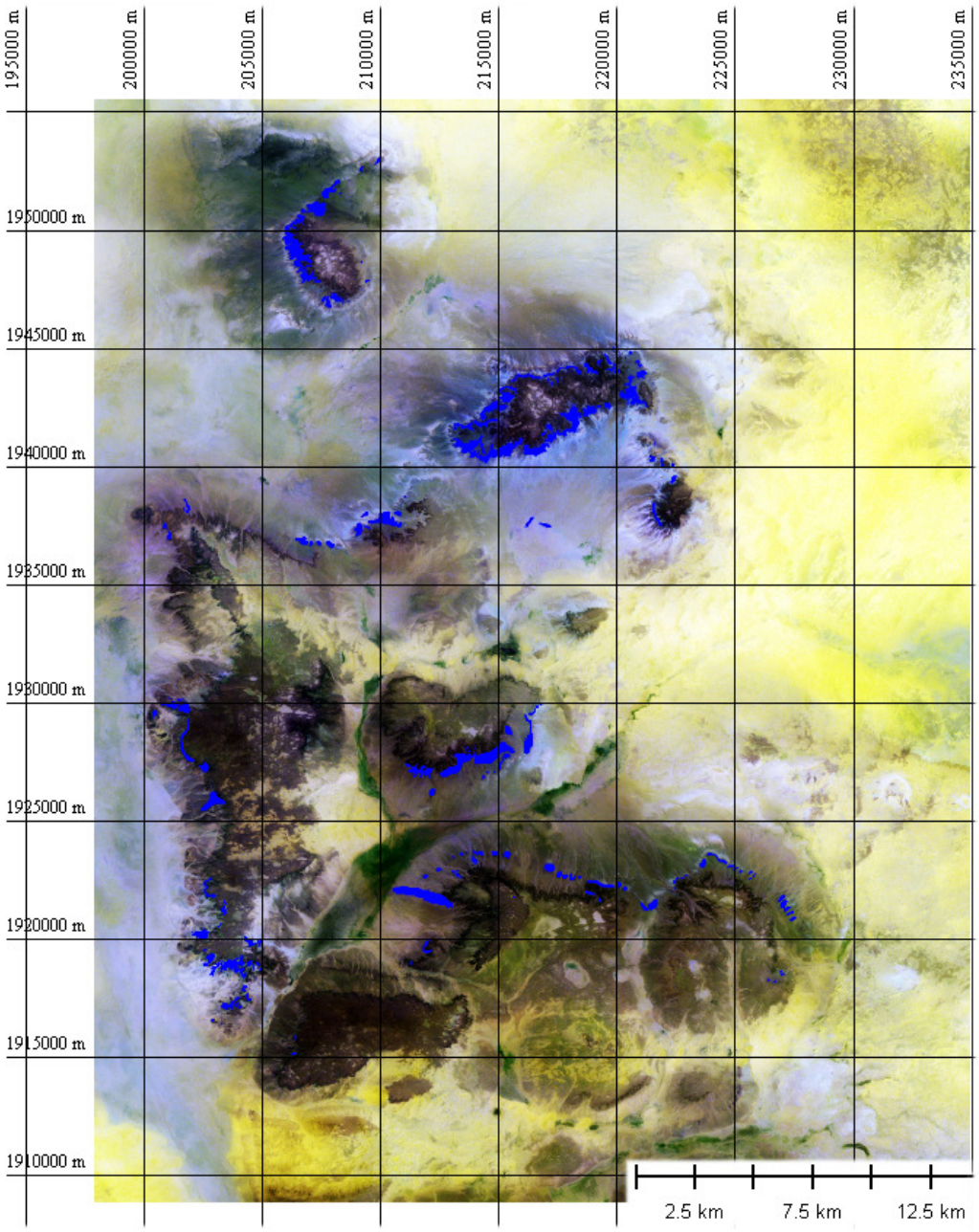

Fig. 5: Interpretation map showing locations suspected as phosphate on the surface (blue). The background image is Landsat TM7 band combination 7,5,1.

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DVDs content

All the data was projected to UTM coordinates Zone 31 datum WGS84.
List of files:

- ALOS 2.5 m orthophoto _ color (Red area)_format GeoTiff
- ALOS 2.5 m orthophoto_B/W (Red area)_ Format GeoTiff
- ALOS DTM_ (Green area)_ Format GeoTiff (32bit)
- Landsat image (30 m resolution) Spectral Bands (3,2,1)_Format GeoTiff
- Landsat image (30 m resolution) Spectral Bands (4,2,1)_Format GeoTiff
- Landsat image (30 m resolution) Spectral Bands (7,5,1)_Format GeoTiff
- Topography contour interval 1 m (Green area)_Format SHP
- Topography contour interval 5 m (Green area)_Format SHP

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