# Application of remote sensing and field mapping to a revision of the geology of the Volta Basin

**Colm Jordan*[1], John Carney[1], Chris Thomas[2] and Paul McDonnell[1]**

[1]British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, NG12 5GG, UK. [2]British Geological Survey, West Mains Road, Edinburgh, EH9 3LA, UK.
*E-mail: cjj@bgs.ac.uk

The British Geological Survey (BGS) is currently working with Fugro Airborne Surveys Pty Ltd on an EU-funded revision of the geology of the Volta and Keta Basins as part of the Mining Sector Support Program (Proj. 8ACP GH 027/13) for the Geological Survey Department (GSD) of Ghana. This geological revision is based on interpretations of airborne and satellite images in conjunction with two field campaigns. The methodology for the project will be summarised here, while the stratigraphical, mineral prospectivity, and database results are presented in later BGS abstracts in this volume, and referred to in the Excursion Guide which is included as an appendix.

A basic flowchart for the BGS project methodology is shown in Fig. 1. The first stage (outlined in blue) involved compiling and assessing any available appropriate information before defining a geological model that is fed into the stage 2. The second stage acquired and processed new satellite imagery before interpreting them in light of the geological model, then testing the interpretations with 'traditional' fieldwork and using a Geographic Information System (GIS) to produce preliminary geological maps at 1:100,000 scale. The final stage (outlined in red) was to integrate the newly-acquired Fugro geophysical datasets, undertake additional fieldwork, update the geological model and use a GIS to produce linework, including mineral potential zones, for publication at 1:250,000 scale.

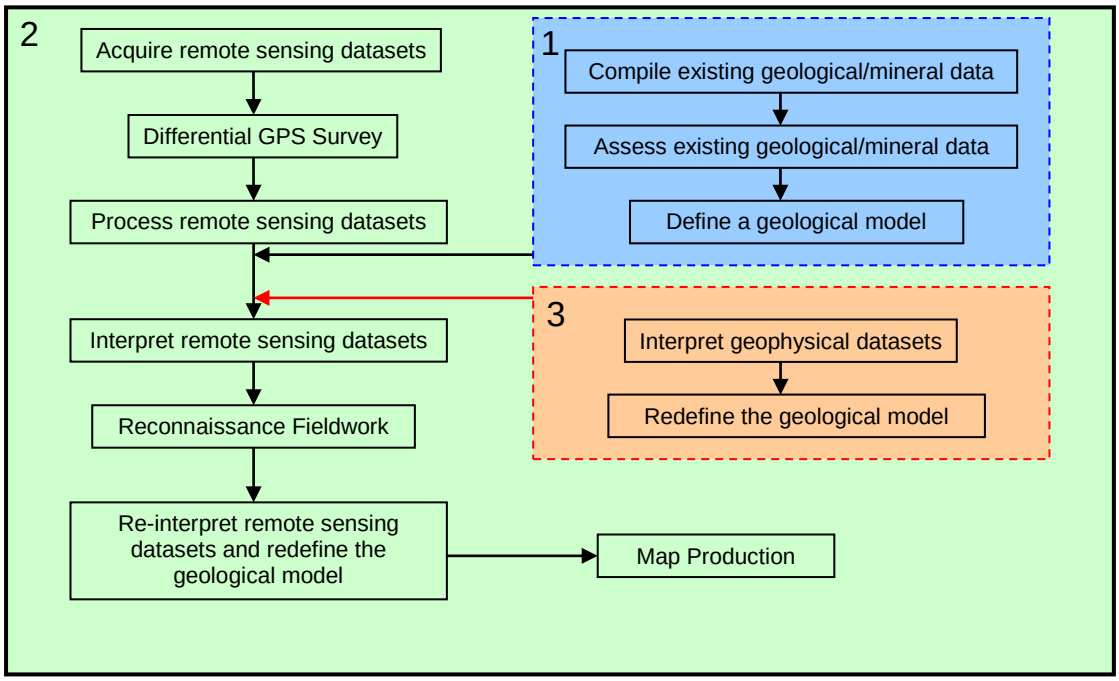


**Figure 1**. *Flowchart for BGS project methodology, refer to text for explanation.*

**Jordan C J**, Carney J, Thomas C and McDonnell P (2008) Application of remote sensing and field mapping to a revision of the geology of the Volta Basin. In: Kalsbeek (ed) *The Voltaian Basin, Ghana Workshop and Excursion, March 10-17, 2008, Abstract Volume.* pp 87-90. ISBN 978-87-7871-233-2. http://nora.nerc.ac.uk/4931/

The datasets acquired in the project by BGS include differential GPS, Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM), a Digital Terrain Model (DTM) and Radarsat imagery. Airborne geophysics data was flown by Fugro. They are discussed in more detail in the BGS database abstract in this volume. Each of these data sources provided different but complementary information to the interpretation, fieldwork and geological/mineral potential modelling.

A tried and tested mapping system is to use landscape and topographic features to interpret the geology, as explained in detail on pages 3 and 18 of the Field Excursion Guide that is appended to this volume. This system made extensive use of the shaded relief DTM as demonstrated Fig. 2 where the DTM of the Kwahu Plateau is compared to an annotated diagram of the same type of geological features. Note that the DTM has been rotated so that the reader is looking towards the south.

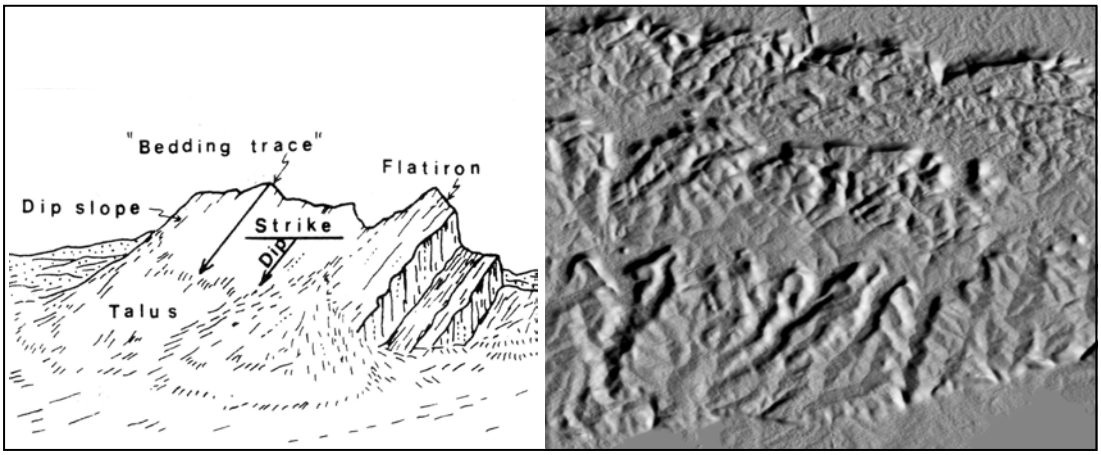


**Figure 2**. *Geological features can be interpreted from a DTM. DTM width is approx 20 km*

Using digital datasets for feature mapping also enabled the evolving geological map to be draped onto perspective views of the DTM (Fig. 3). In this case the elevation was exaggerated to enhance the geological features, looking towards the northwest along the Kwahu Plateau. The Mpraeso, Abetifi, Obocha and Anyaboni sandstone Formations of the Kwahu Group are clearly divisible on the DTM.

**Jordan C J**, Carney J, Thomas C and McDonnell P (2008) Application of remote sensing and field mapping to a revision of the geology of the Volta Basin. In: Kalsbeek (ed) *The Voltaian Basin, Ghana Workshop and Excursion, March 10-17, 2008, Abstract Volume.* pp 87-90. ISBN 978-87-7871-233-2. http://nora.nerc.ac.uk/4931/

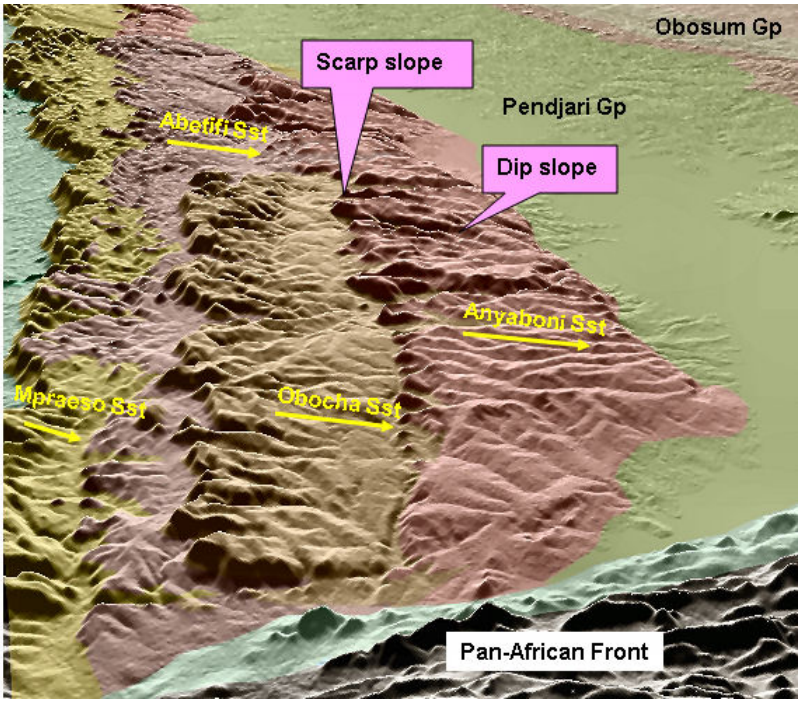


**Figure 3**. *Perspective view of the geology draped onto the DTM, looking towards the northwest along the Kwahu Plateau.*

Quaternary features, primarily the extents of alluvium, were also interpreted from the imagery (and subsequently checked in the field), and the Landsat data proved invaluable for this. The importance of the fieldwork cannot be overstated as it provided corroboration of the bedrock and Quaternary features interpreted from the imagery as well as the opportunity to collect information relating to lithology, stratigraphy and structural measurements as well as rock samples for thin sectioning and multi-element analysis. Additional measurements were taken using a GR-110 scintillometer total count device and a magnetometer in the first field season, along with a GRM-260 that enabled individual potassium, uranium, and thorium readings to be recorded in the second field season.

A combination of the image interpretation briefly described above, along with two field campaigns (each one month long and consisting of two field teams) enabled the BGS to revise the geology and the lithostratigraphy of the Voltaian. The revision was used as input to computer modelling in an effort to predict potential zones of economic minerals (McDonnell et al. this volume).

Ninety six 1:100 000 scale maps were produced and presented to the GSD following the first fieldwork component which took place in October 2006. Half of the maps are geological and the other half are topographical. Those preliminary 1:100 000 geological maps have been superseded by updated linework that was derived from the second field season in November 2007. An A3 compilation map of the new geological linework, with a simplified legend showing the bedrock geology has been included within these proceedings. This linework has been presented to the GSD for incorporation into the new 1:1 000 000 scale geological map of Ghana, and to GEUS for use in Task G of the MSSP/TA-GSD project that is providing a stratigraphical overview of the Voltaian. The BGS linework (summarised on the A3 map in this volume) will be published at 1:250,000

**Jordan C J**, Carney J, Thomas C and McDonnell P (2008) Application of remote sensing and field mapping to a revision of the geology of the Volta Basin. In: Kalsbeek (ed) *The Voltaian Basin, Ghana Workshop and Excursion, March 10-17, 2008, Abstract Volume.* pp 87-90. ISBN 978-87-7871-233-2. http://nora.nerc.ac.uk/4931/

scale by April 2009 once it has been integrated by Fugro with the latest geophysical interpretations.

Finally, an additional component of the project involved on-the-job training for GSD counterparts in mapping techniques during fieldwork in Ghana, as well as through formal remote sensing and geophysics training at BGS in Nottingham and Edinburgh. We were accompanied in the field by A. Appiah-Akuramaa and J. Quaye, and three formal courses were held in the UK that also included W. Akah, T. Akamaluk, S. Kwabla, and A. Suale.

A map and stratigraphy for the Keta Basin has also been produced as part of this project, but not described here because the workshop from which this volume derives focussed on the Voltaian geology and stratigraphy.

## Reference

McDonnell, P., Jordan, C., Carney, J. & Thomas, C. 2008: Mineral Prospectivity Modelling in Ghana's Volta Basin: Utilizing ArcSDM to model Geological and Geophysical data. . In: Kalsbeek (ed) *The Voltaian Basin, Ghana Workshop and Excursion, March 10-17, 2008, Abstract Volume*. pp 95-98. ISBN 978-87-7871-233-2. http://nora.nerc.ac.uk/4940/