

Progress Report (Mali), November 2011

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November Field Work in Mali's Block #25

Introduction

The main objective of the field work was to define the geological boundaries between the major rock formations of the southern part of the Taodenni basin. The boundaries of the dolerite intrusion have been the priority because of the current geophysical work on the Bourakebougou gas trap. Field observations were also made on the boundaries of other formations in order to develop the stratigraphic cross section framework for the regional deep seismic planning.

The main results of the field work are briefly summarized in this report. Samples collected in the outcrops of the major rock formations will be the subject of laboratory work over next two months. The final interpretation of the collected observations and data will be presented in the next reports.

Boundaries of the dolerite intrusion ('The Crawling Baby')

The entire Crawling Baby area of Figure 1 is covered by a thick layer of rusty-red laterite (cf. November Report PP Slide 2). Although the dolerite is exposed in many outcrops (cf. PP Slide 3) the direct contact between the dolerite and the host rock is usually covered in the area by talus (cf. PP Slide 4). No natural exposures of the contact have been found. The contact is exposed only in the quarries where the dolerite is excavated for road construction (PP Slides 5 and 6).

The direct contacts of the dolerite intrusive body and sedimentary host rock have been studied and sampled in two quarries (PP Slides 5-9). The upper boundary of the dolerite intrusion is shown on Slide 5. The parent bed rock which is not affected by laterization is limited to the thin layer immediately above the dolerite. This contact rock shown in the insets on Slide 5 is a thermally altered shale resembling "clinker". Samples of this shale will be the subject of lab work. The laterite which develops by intensive and long-lasting tropical weathering of the underlying parent rock is about 5 m thick. The lower boundary of the dolerite intrusion is shown on Slides 7-9. The parent bedrock is a laminated siltstone plus fine grained sandstone. On the contact between the fresh-black dolerite and the bedrock there is a layer of very badly weathered buff coloured dolerite (Slides 7-9).

The dolerite is usually 'fine-crystalline', and it shows very well developed columnar jointing. The vertical orientation of the jointing suggests a 'sills' rather than a 'dykes' geometry of intrusion. As a rule, the sills are very extensive laterally covering areas of many square kilometres. Samples have been taken from fine and medium crystalline dolerites for lab work that will discover the age of the intrusion and the temperature of its emplacement.

Southern Margin of the Basin

The southern margin of the Upper Proterozoic Sedimentary Basin is visible north of Tabou (PP Slide 10) where the Lower Proterozoic Granite ($\gamma 1$) is underlying the Lower Koulouba Sandstone (So1) with an angular unconformity (Outcrop # 70). The direct contact is not well exposed but the morphological difference between these rocks is clearly visible (PP Slide 11). It is very rare to ever see the outcropped margin of a basin like is seen in Mali.

This unconformable contact between the granite and the lowermost sandstone of the basin, which is so well exposed in the Sibi-Tabou area (PP Slide 12), is of prime significance for the regional geology of the area. For example, at the southern edge of Block #25, this contact could be at a depth of 1200m; at Bourakebougou this same contact could be below 2200m; and at Didieni, it is of course much deeper than 2500 meters because the F1 and F2 wells never encountered the basement. Everywhere on the regional cross-section this represents the base of the first clastic sequence of the basin fill. This boundary should be clearly visible on the seismic reflections due to the high impedance contrast between the granite and the sandstone.

Nkomi Black Shale (So1-2)

The discovery of a good exposure of a black shale horizon near Nkomi (PP Slide 14) has a two-fold significance: (1) for the regional stratigraphy, and (2) for the petroleum system of the basin.

The Nkomi Black Shale divides two major sandstone formations of the basin. The Souroukoto Sandstone (S1) is divided from the Kati Sandstone (S2). Both the lower and the upper boundary between the Nkomi Shale (S1-S2) and the sandstones should be very clear on the seismic reflection and the Nkomi Shale should be interpreted as the major flooding surface in the basin.

The significance of the Nkomi Black Shale is most crucial for the petroleum system of the basin. This 18 meter thick interval of shale is laterally continuous, and therefore it represents the major flooding event in the basin. On average the Nkomi shale outcrop is observed to be 22m thick, and at most 30m thick. It might be assumed that the thickness of this shale increases towards the middle part of the basin, so that in the subsurface of Block #25, its thickness could be much greater than in the Nkomi area.

The lab results of the Total Organic Carbon (TOC) and thermal maturity will give us a better understanding of the significance of the Nkomi Black Shale as the source rock.

Attachments:

- 1. November Report – Outcrops (Power Point File),**
- 2. Complete sample list (Excel File).**

Pending laboratory work

Under supervision of the authors of the report the following specialists and labs will be working on the samples which have been sent from Bamako:

1. Total organic carbon (TOC):

Professor Izabela Bojakowska

mgr inż. Dariusz Lech

The Polish Geological Institute National Research Institute

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and

Mr. Kirk Osadetz

Geological Survey of Canada

Calgary

2. Thermal maturity:

Dr Grzegorz Nowak

The Polish Geological Institute, Lower Silesian Branch in Wrocław

19 Jaworowa Avenue, 53-122 Wrocław

3. Inorganic Geochemistry:

Dr. Kimberley Johnston

Department of Earth Sciences, Mount Royal University

4825 Mount Royal Gate SW, Calgary, Alberta T3E 6K6

4. Paleontology:

Dr. Jolanta Muszer

Institute of Geological Science, Wrocław University

9 M. Borna Square, 50-204 Wrocław, Poland

5. Thin sections:

Mr Paweł Matz

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9 M. Borna Square, 50-204 Wrocław, Poland

6. Preparation for reflected light:

Andrzej Szumny, Anszlif Company

62 Zakamycze Street, 30-240 Kraków, Poland.

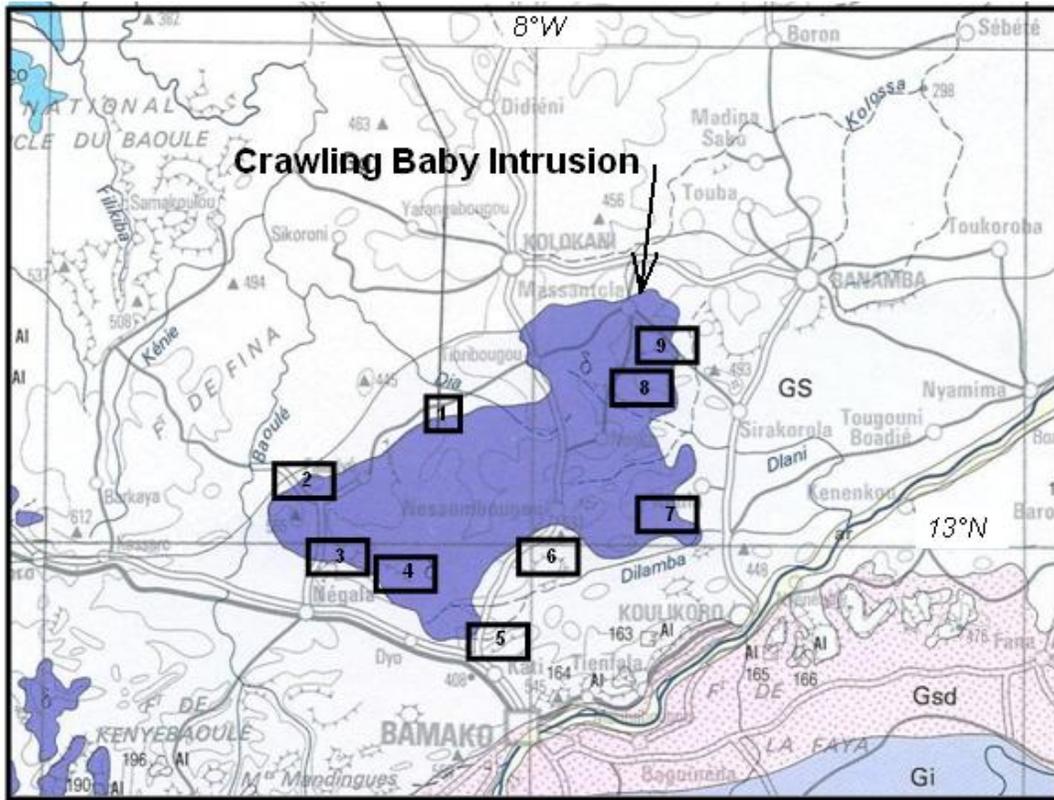


Figure 1. Areas of planned geological field work in the outcrops of the Crawling Baby Intrusion. Actual field work in these areas recovered outcrop samples as follows:

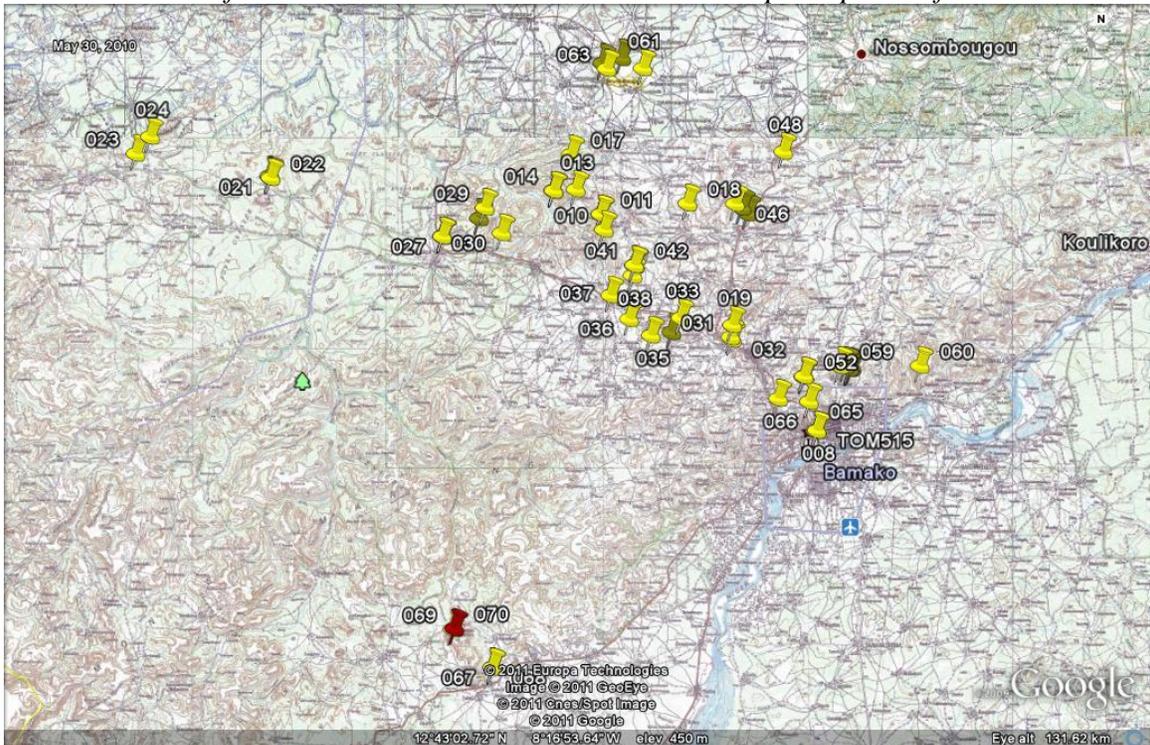


TABLE 1: Outcrop Samples

#	Sample description
12	Sandstone coarse grained
13	Dolerite
16	Chert
17	Iron shale, dark grey
17	Shale laminated, grey
18	Dolerite medium crystalline
18	Dolerite medium to coarse crystalline
19	Sandstone fine laminated
19	Dolerite medium crystalline
19	Sandstone medium grained, light grey
19	Very fine grained sandstone with trace fossils
21	Fine grained sandstone
28	Mudstone grey indistinct lamination
28	Mudstone beige, laminated
30	Mudstone grey massive
30	Mudstone dark grey massive
30	Mudstone almost black massive
31	Very fine sand, beige, laminated
31	Fine sandstone light
40	Dolerite altered on the contact with mudstone
40	Dark shale with iron below the contact with dolerite
44	Sandstone fine grained with indistinct lamination
44	Sandstone massive medium grained
45	Sandstone medium grained white
46	Contact rock - 'cooked' mudstone
46	Dolerite fine crystalline
46	Dolerite with white crystals on the joint surface
46	Dolerite with sulfide mineralization
46	Dolerite with ankerite vein C5~ 24 m (core)
46	Dolerite coarse crystalline (core)
47	Sandstone medium grained laminated
48	Dolerite, fine crystalline
49	Sandstone medium grained, massive, (similar to 47)
50	Iron ore sandy and massive with hematite
50	Black shale (Nkomi Shale) laminated
50	Black shale (Nkomi Shale) non-laminated
53	Iron Ore
54	Black shale (Nkomi Shale) laminated
57	Black shale (Nkomi Shale) non-laminated
59	Sandstone with caverns, pink
64	Dolerite, fine crystalline
66	Black shale (Nkomi Shale) laminated