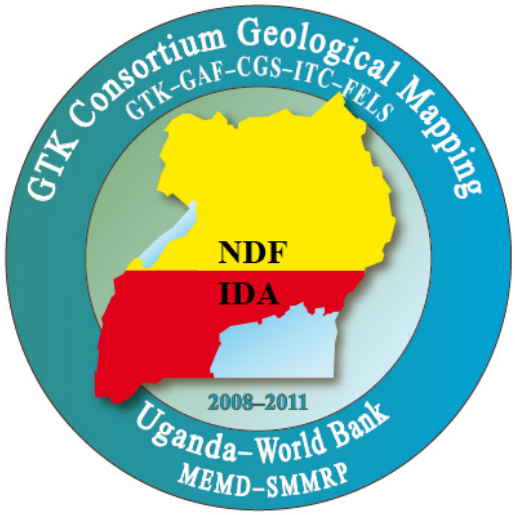
SUSTAINABLE MANAGEMENT OF MINERAL RESOURCES PROJECT

GEOLOGICAL MAPPING, GEOCHEMICAL SURVEYS AND MINERAL RESOURCES ASSESSMENT IN SELECTED AREAS OF UGANDA

Geosites South of 1° North



GTK CONSORTIUM

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1. INTRODUCTION

Geosites are important and/or unique geological or geographical features of great geo-significance such as natural/geological, palaeontological and archeological sites. They should be regarded as sites deserving to be preserved or protected for the community and future generations. A good knowledge of geological heritage – and a healthy respect for it – is an important factor in the holistic approach for sustainable development. Such sites may become tourist destinations, or may be of educational importance. A limited number of them shall be incorporated in the new geological maps of the country. This study concentrates on Ugandan sites which are lying south of 1° north.

The scope of this survey does NOT aim at compiling, evaluating and ranking all geosites in the country. It rather has to be regarded as a first attempt to gather information about possible Ugandan geosites and to visit a limited number of them, hence evaluating the chosen sites with respect to their potential and justification to be shown on the new geological maps of Uganda.

More work is expected to build on this descriptive list. It is hoped, that in future these geosites will be listed in a National Register and preserved. This will contribute to earth science conservation which is concerned with safe guarding these sites.

This report summarizes desk study results and field observations made, in May and June 2010.

2. TEAM MEMBERS, WORK SCHEDULE AND METHOD

The team comprised of V. Kato (Department of Geological Survey and Mines, DGSM), A. Muwanga, and A. Schumann (Makerere University, Mak).

From 11.05.2010 to 31.05.2010 the team spent time carrying out a desk study, which also included visiting relevant stake holders. On 1st of June stake holders from Uganda Museum, Uganda Wildlife Authority (UWA), Mak, DGSM, and GTK attended a meeting in Entebbe (DGSM/GTK offices) discussing sites, which might be included in the new geological maps of Uganda.

V. Kato and A. Schumann prepared for the field work on 4th of June, and visited the sites between 5th and 12th of June 2010. GTK provided the team with a 4x4 field vehicle. A driver from DGSM accompanied the team. The team was supplied with sample bags, a sample box, a hammer, a First Aid kit, a digital camera to photo-document the sites and a GPS (co-ordinates were recorded in WGS 84 UTM/UPS).

Collected information was recorded in a newly designed observation sheet (Appendix 1) and later on, the information was fed into an Excel spreadsheet.

3. WORKING AREA AND SITES

The working area was in southern Uganda, south of 1° north (IDA area). V. Kato and A. Schumann visited 22 sites. This also included all sites which were regarded as priority sites, as discussed during the meeting held in Entebbe on 1st of June 2010.

4. BACKGROUND

In 1995, the International Union of Geological Sciences (IUGS) and the United Nations Educational, Scientific and Cultural Organisation (UNESCO) set up a global scheme to promote geoconservation, with a focus on identifying globally significant sites. The aim of the geosites project was to produce an evolving, comprehensive inventory of the more valuable geosites including their potential value in education and research (Wimbledon 1996).

Attempts of compiling a preliminary inventory of possible geosites within Uganda had been made in the late 90ies (Schlueter 1997, Muwanga & Kamuhangire 1999) and beginning of 2000 (Schumann & Echegu 2000, Schlueter 2001, Schlueter et al. 2001; Schumann et al. 2001; Schumann & Muwanga 2003), and more recently by Bakka Male (2009), Muwanga (2010) and Staudt (2010).

So far, about 20−30 possible geosites had been suggested. However, many of the sites still lack a proper description of the location (e.g. missing GPS co-ordinates) or a detailed description of the site itself, and some of the known sites have to be re-visited in order to evaluate their condition.

5. VISITED GEOSITES SOUTH OF 1° NORTH

During field work 22 locations have been visited. These included geo-relevant sites such as natural/geological, palaeontological, and archaeologial sites. However, many of the visited places have also a cultural or traditional background, hence might also be regarded as cultural or traditional sites, although legends of the sites are often contradictory, and differ from information received at the site from information obtained during the desk study.

5.1. Natural/geological sites

These sites bear an interesting geological record, a special geological feature, or are sites of natural beauty, which are regarded as sites which should be preserved or protected for future generations.

5.1.1. Sezibwa (Ssezibwa)

General description: Scenic waterfall (Plate 1, Figs. 1, 2) and cave/rock shelter (Plate 1, Fig. 3) along the Kampala−Jinja highway.
Type of geosite: Natural/geological but also traditional/cultural.
District: Mukono.
Access: Kampala−Jinja road, between Mukono and Lugazi, branch off at Kayanja trading centre, 5.5km to the site, follow the signpost to Sezibwa Falls Resort (Resort under construction).
GPS coordinates: 36N 484764/39372, altitude 1129m.
Size of site: Approx. 300x300m, guided walks can be done in the wider area.
Owner of site: Land is owned by the Kabaka's Kingdom. The site is now within the premises of Sezibwa Falls Resort (under construction).
Present use: Touristic, cultural/traditional (entrance fees).
State of preservation: Well preserved, partly fenced.
Protection status: None, it needs to be designated as a nationally protected natural monument.

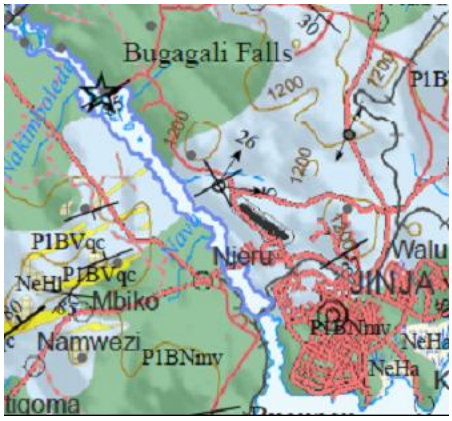
Geological map sheet/stratigraphy/lithology
Sheet: Kampala, NA-36-14 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: -
Group: Buganda.
Formation: Victoria.
Lithology: Orthoquartzite (P_1BVqc), see extract of map.

Geological description: The falls cut through folded, and jointed quartzites (Plate 1, Fig. 2). The rocks were formed more than a billion years ago. However, the falls are much younger, and developed probably during the late Cenozoic, when the Lake Victoria basin, and Lake Victoria itself were formed. At the same time new rivers developed and existing rivers changed their flow directions. The re-shaping of the drainage system of the whole area and topography has to be seen in context with the development of the East African Rift System and adjacent tectonic forces creating it.

Traditional/cultural background: Sezibwa is traditionally derived from the vernacular Luganda word "sizibibwa kkubo" meaning "no obstacle can stop me from moving on". Legend says that this river was born by a woman. It's alleged that the 2 rivers named Sezibwa and its brother Bwanda were born by a woman called Nakkungu Tebatuusa on her way to Kavuma/Bukunja when she experienced labour pains. Nakkungu Tebatuusa whose husband was called Nsubuga Sebwato gave birth to twins in form of water, whereby Sezibwa flowed west, passing many obstacles (meandering) and deriving its name, while Bwanda flowed towards Nyenga to the east to the mother's homeland. Native Baganda believe that this site has spiritual significance and visit the place for cleansing, offerings, sacrifices, miracles and blessings to "Nalongo Kkubo" (Ghost). "Mbuga ya musoke", a cowry shrine (in a small cave) believed to be a home of a python called Nalongo is littered with e.g. eggshells, calabashes, backcloths, spears and a coffee berry basket (Plate 1, Fig. 3). All these signify the cultural, traditional and spiritual beliefs on the site. Other activities at the site may include bird and primate watching as well as forest walks. It is said that Kabaka Mwanga planted a big wild olive tree (freedom tree) in 1889. This tree is still standing in the area.

5.1.2. Bugagali (Bujagali)

General description: Scenic waterfall (Plate 2, Figs. 1, 2) near Jinja at River Nile.
Type of geosite: Natural/geological but also traditional/cultural.
District: Jinja.
Access: Kampala−Jinja road, branch off at Jinja to Budondo, after about 6.2 km follow the signpost to the falls (about 1.3 km).
GPS coordinates: 36N 517508/53320, altitude 1111m.
Size of site: Approx. 1x1 km.
Owner of site: Jinja District, under private management. The area is under the management of Speke Resort Equator Rafts owned by Mr. Sudhir Rupaleria, who leased the area.
Present use: Touristic, cultural/traditional (entrance fees).
State of preservation: Well preserved, partly fenced.
Protection status: None, it needs to be designated as a national protected natural monument.
Threat: Further downstream a new dam is being constructed, and dammed water might cover the area and the falls.



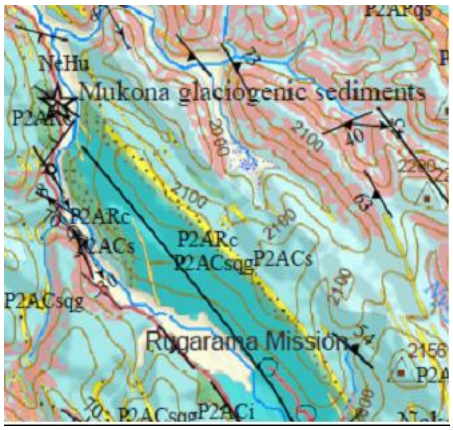
Geological map sheet/stratigraphy/lithology
Sheet: Kampala, NA-36-14 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: -
Group: Buganda.
Formation: Nile.
Lithology: Bujagali basalt (P_1BNmv), see extract of map.

Geological description: At the falls, River Nile cuts through metabasalts (Plate 2, Fig. 3), which were formed more than a billion years ago, when the area was volcanically active. During that time, lava flows were covering a wide area, in the today's central Uganda. However, the falls are much younger, and developed probably during the late Cenozoic when the Lake Victoria basin, and Lake Victoria itself were formed (similar to the development of Sezibwa falls). At the same time new rivers developed and existing rivers changed their flow directions. The re-shaping of the drainage system of the whole area and the topography has to be seen in context with the development of the East African Rift System and adjacent tectonic forces creating it.

Traditional/cultural background: It is a major attraction site in Uganda and holds cultural significance to the nearby living Basoga people. The traditional Bujagali healer holds demonic spirits around Bujagali Falls. He offers psychological/spiritual treatment and cleansing. The falls are believed to be the site of a spirit, called the "Spirit of Budhagali" who protects the community by performing rituals at the falls. The spirit is embodied in a man, "Jajja (old man) Budhagali", who lives next to the falls (Plate 2, Fig. 4); he is the thirty-ninth person to be the spirit medium. Lots of people report to have seen him walking over the water. Indeed he seemed to be able to pass the falls where others did not dare to go. Other activities in the area include rafting, bird and primate watching, forest walks, and swimming.

5.1.3. Mukona

General description: Road cut exposing glacial sediments (Plate 3, Fig. 2).
Type of geosite: Natural/geological.
District: Kabale.
Access: By road, about 13km NW of Kabale, along Kabale−Kisoro Road.
GPS coordinates: 35M 825891/9870434, altitude 1825m.
Size of site: Approx. 400m long, and up to 12m high road cut.
Owner of site: Uganda National Road Authority.
Present use: None.
State of preservation: Not preserved.
Protection status: None, it needs to be designated as a protected natural monument as well as for educational purposes.
Threat: Further road works may destroy some of the exposed geological features.



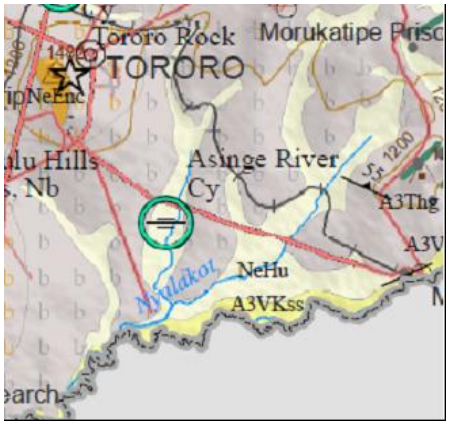
Geological map sheet/stratigraphy/lithology
Sheet: Kabale, SA-36-5 (scale 1:250 000).
Stratigraphy: Mesoproterozoic.
Supergroup: Akanyaru-Ankole.
Group: Ankole.
Formation: Cyohoha and Rugezi.
Lithology: Shale, mudstone, phyllite (P_2ACs), and conglomerate (P_2ARc), see extract of map.

Geological description: The road cut exposes a lower, folded sequence of greywacke, conglomerate and phyllitic rocks, which were once deposited in a marine environment. This sequence is discordantly overlain by almost horizontally bedded fine to medium grained sandstones (Plate 3, Figs. 2, 3). The generally fine grained sandstones carry coarse to very coarse drop stones, indicating a glacial, possibly lacustrine environment during their deposition (Plate 3, Fig. 5). The dropstones, and partly also the finer sands, were once the load of a glacier which floated on the lake water. When the ice was melting (due to change of climate, and rise of temperature) the load was set free, and sank through the water column to the bottom of the lake. The heavier dropstones sank in the unconsolidated sediments. Due to their weight, they deformed the unconsolidated sediments forming a concave depression (Plate 3, Figs.1, 6, 7). However, prior to this event, before the deposition of the glacial sediments, the glaciers erosively cleaned a once exposed land surface (palaeosurface), as indicated by striations seen on the polished surface of the underlying folded sediments (Plate 3, Fig. 4). The discordance between the underlying folded und overlying horizontally bedded sediments proves a hiatus in the sedimentation and tectonic history since the glacial sediments are not folded (and younger). Fig. 1 (with explanations) illustrates the sequence of geological events.

Traditional/cultural background: None.

5.1.4. Tororo Rock

General description: Scenic tor (Plate 4, Fig. 1) and cave/rock shelter (Plate 4, Fig. 2).
Type of geosite: Natural/geological, palaeontological and also cultural/traditional.
District: Tororo.
Access: Kampala−Tororo road, at Tororo Town.
GPS coordinates: 36N 631729/75737, altitude 1484m (top of the hillock).
Size of site: Approx. 290m high tor, rising well above Tororo town.
Owner of site: Tororo Municipal Council.
Present use: Touristic, economic (communication companies, see below), also traditional/cultural.
State of preservation: Preserved.
Protection status: Tororo hillock is protected by Tororo Municipality from future development or alteration, who regard it as the symbol for the town. Its official designation is a "geological monument".
Threat: Although Tororo hillock has a protection status, several communication masts and generators have been installed on its top (Plate 4, Fig. 1). Additionally a cable car is used to transport maintenance materials for the communication instalments. There is a threat that the man made alteration of the monument will continue.



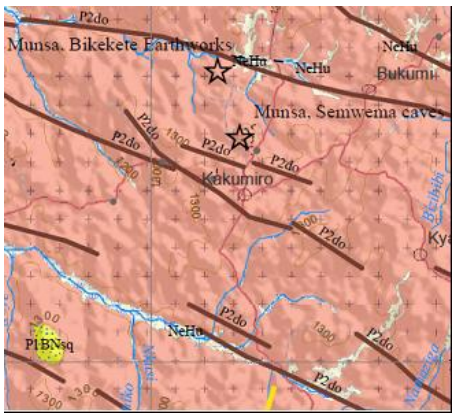
Geological map sheet/stratigraphy/lithology
Sheet: Jinja, NA-36-15 (scale, 1:250.000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Elgon.
Group: -
Formation: -
Lithology: Nephelinite, carbonatite (NeEnc), see extract of map.

Geological description: The carbonatites around Tororo are described by Williams (1952) as a series of separately intruded ring structures, such as the Sukulu ring structure (Plate 4, Fig. 3), and collars. Tororo Rock is one of them, possibly exhibiting a vent or plug of an eroded volcano. According to Tiberindwa (2000), these rocks are mainly soevitic in composition. They are usually fine- to medium grained and may show vertical to sub-vertical magmatic flow structures, indicated by well oriented black pyroxene, and iron ore minerals. Cahen et al. (1984) gave a summary on age determination of eastern Ugandan carbonatites, with an isotopic K-Ar age of 32±1.3 Ma for the Tororo Rock. Carbonatites are not common rocks. On a global scale these rocks have to be regarded as rare. Since Tertiary times, Tororo Rock was and is exposed to semi-tropical and tropical climatic conditions, associated with high rainfalls causing weathering and erosion of the rocks. High rainfall leads to dissolution of the carbonates, preferably along joints, creating common erosive features (as seen elsewhere in limestones) such as karst caves and channels of furrows on massive bare carbonate surfaces (Plate 4, Figs. 4, 5). In some cases, the erosive cavities may be refilled by soil material (e.g. due to extremely heavy rain which washes soil and debris into it). At Tororo Rock a number of them have been refilled and may even contain fossils (Plate 4, Fig. 6). It should be mentioned, that the fillings may be secondarily impregnated by calcium rich solution, which are cementing the filling material (Plate 4, Fig. 4), as already described by Ries et al. (2001).

Traditional/cultural background: It is a major tourist attraction site with ancestral caves, steep vertical rock walls, and hill climbing opportunities.

5.1.5. Munsa, Semwema (Ssemwema)

General description: Cave/rock shelter and scenic landscape (Plate 5, Fig. 1).
Type of geosite: Natural/geological but also and cultural/traditional.
District: Mubende
Access: Kampala−Fort Portal road, branch off at Mubende, take Mubende−Kakumiro road, about 2 km N of Kakumiro trading centre (it needs a guide to find the place).
GPS coordinates: 36N 313261/88414, altitude 1293m.
Size of site: The cave is about 15x15x5m large.
Owner of site: Private, owned by Mr. Anthony Rwahwire.
Present use: Touristic, but also traditional/cultural.
State of preservation: Ok.
Protection status: None.



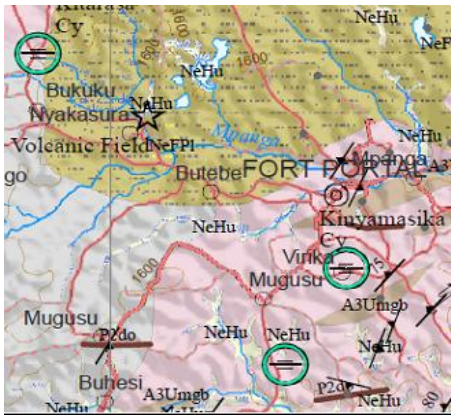
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: Mubende-Singo Suite.
Group: -
Formation: -
Lithology: Megacrystic granite (P_1MSmg), see extract of map.

Geological description: It is an impressive cave, which was formed by a rock avalanche and slumping of a huge rather flat granitic block, which is now forming the roof shelter (Plate 5, Fig. 2.). The size of the block is approx. 25x25x5m. During the time the huge block slid down, it pushed other blocks, hence creating a labyrinth of smaller interconnecting caves, chambers, tunnels or shafts. There are three main structures or chambers inside the shelter, each on top of the other, with stone stairs leading into each of the main chambers. The size of the main cave is approx. 15x15x5m.

Traditional/cultural background: The caves provided refuge, defence and monuments. The area commands cultural significance and people visit it for sacrifice, offerings, blessings, cleansing and worshiping (Plate 5, Fig. 3). It is believed that spirits from Hoima (‘Musajja Mukulu, Muzizi’) all converge here and their powers are tapped by a lady who treats people here. The caves are traditionally held sacred and used to provide hide outs during ancient invasions. They were also used as over night shelters for cattle. Earlier they were used by ancient ‘Bachwezi (Bacwezi)’ kings as shrines − where offerings were made to protect people from demonic spirits. It is believed that ‘Kateboha Munsa’ used to hold his meetings with elders and advisors in these caves. ‘Kateboha’ is a ‘Runyoro’ word literally meaning “one who locks himself in”. The site has no enclosure but it is frequented by believers in spirits.

5.1.6. Nyakasura ('Amabeere ga Nyinamwiru')

General description: Cave/rock shelter, waterfall (Plate 6, Figs. 1, 2, 3), scenic environment with craters and crater lakes within the Fort Portal volcanic field (Plate 6, Figs. 4, 5).
Type of geosite: Natural/geological and cultural/traditional, but also archaeological.
District: Kabarole.
Access: Kampala−Fort Portal road, branch off at Fort Portal, take Fort Portal–Bundibudgyo road, branch off after 5 km, and follow signpost to the caves (another approx. 2.5 km).
GPS coordinates: 36N 191103/74930, altitude 1558m.
Size of site: Immediate site around the caves: 100x100m, wider area several square kilometres.
Owner of site: The caves are found on private property. The land belongs to Mr. Rwebembera.
Present use: Touristic, but also traditional/cultural (entrance fees).
State of preservation: Good.
Protection status: None. However, the landowner is taking good care of the site, and has fenced part of it in order to protect and preserve the site.



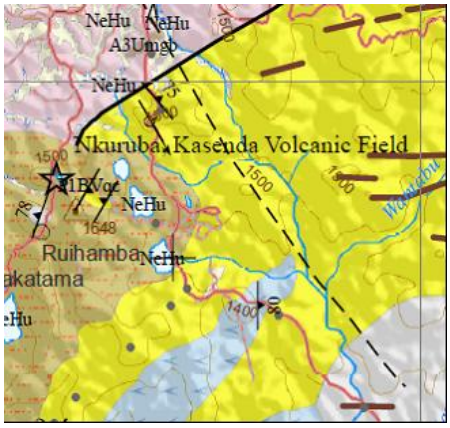
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Fort Portal.
Lithology: Lapilli tuff (NeFPt), see extract of map.

Geological description: These are caves with unique structures – stalactites and stalagmites unknown elsewhere in Uganda (Plate 6, Figs. 2, 3). They are spectacular because they occur in carbonatitic lavas and tuffs, and not in the usual limestone or marble environments. There are three major caves with the biggest about 10−20m long, 7m high and 4−6m deep.

Traditional/cultural and archaeological background: The caves are known locally as "Amabeere ga Nyinamwiru" translating as "the breasts of the mother of Mwiru". From legends, "Ndahura the King of the Bachwezi" who occupied this area lived in these caves and was fed as a child from the "breasts" (stalactites) that dripped a milky liquid. This is a cultural site recognised locally but not nationally gazetted. It is reported that in these shelters, human bones and other materials (cowry shells, pots) used by earlier "Bachwezi" kings were found. In the same area a fissure filling structure is found, 5m wide, 8m deep and 62m long, indicating a fissure eruption during the time of formation. Its trend is E/NE−W/SW. Due to its shape it is locally named "obwato" (small boat). These "obwato" were used by "Bachwezi" kings as ponds to store water for their cows but also as shelters. One of the "obwato" is called "omuggo gwanyinmawiru" (stick of "Nyinamwiru").

5.1.7.1. Nkuruba

General description: Scenic craters and crater lakes within the Ndale (Kasenda) volcanic field (Plate 7, Fig. 1).
Type of geosite: Natural/geological.
District: Kabarole.
Access: Kampala−Fort Portal road, branch off at Fort Portal, take Fort Portal–Kamwenge road, branch off again towards Kakanihanda (about 18km from Fort Portal).
GPS coordinates: 36N 199617/57273, altitude 1522m.
Size of site: Immediate site 100x100m, wider area several square kilometres.
Owner of site: Private, Mr. Bosco Sanyas, community camp site.
Present use: Touristic (entrance fees).
State of preservation: Good.
Protection status: None.



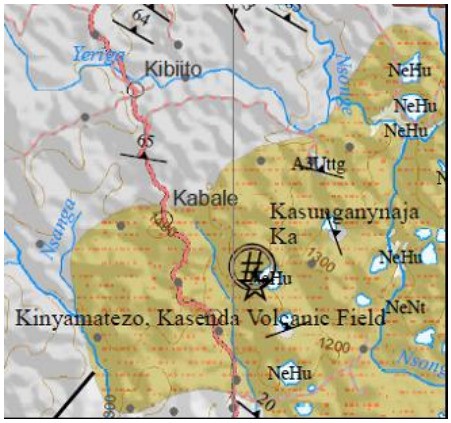
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Ndale.
Lithology: Lapilli tuff (NeNt), see extract of map.

Geological description: The volcanic field consists of 70 craters − Nkuruba crater (lake) is one of them. They are explosion craters, and during the time of eruption, mainly pyroclastic material was ejected, with only subordinate alkaline lavas.

Traditional/cultural background: None.

5.1.7.2. Kinyamatezo

General description: Scenic craters and crater lakes within the Ndale (Kasenda) volcanic field (Plate 7, Fig. 2).
Type of geosite: Natural/geological
District: Kabarole.
Access: Fort Portal−Kasese road up to Kasunganyanja, branch of to the east for about 2.5 km.
GPS coordinates: 36N 190666/48039, altitude 1321m.
Size of site: Immediate site 500x500m, wider area several square kilometres.
Owner of site: Private, several owners.
Present use: Touristic and domestic.
State of preservation: Ok.
Protection status: None.



Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Upper Albertine.
Group: Albertine.
Formation: Ndale.
Lithology: Lapilli tuff (NeNt), see extract of map.

Geological description: This explosion crater (with a lake) is among the many around Kasunganyanja. It is part of the Ndale (Kasenda) volcanic field. It is here that mankind appreciate how nature through volcanism sculpted landscape. Of interest to this site is a huge crater which was left behind after the explosion and absence of volumes of material (at the immediate site) which resulted from this explosion. Only a thin pyroclastic layer is partly covering the basement rocks. It is of geological interest, that the crater walls expose a contact between meta-sediments and granitic rocks. Kaolin (probably the weathering product of a pegmatitic dike in the basement rocks) is mined here for house painting and the water of the lake is used for domestic purposes.

Traditional/cultural background: Not known.

5.1.8. Lake Katwe

General description: Scenic craters and crater lakes as well as springs within the Katwe-Kikorongo volcanic field (Queen Elizabeth National park).
Type of geosite: Natural/geological.
District: Kasese.
Access: Kasese−Mbarara road, after about 33km from the Kasese direction, branch off to Mweya Lodge (sign post), continue to Katwe Town**.**
GPS coordinates: 35M 820481/9985924, altitude 908m.
Size of site: Immidiate site covers about 4 km^2.
Owner of site: Immediate site is owned by the Local Government and controlled/managed by Katwe/Kabatooro Town Council.
Present use: Touristic, economic.
State of preservation: Poor.
Protection status: Poorly protected.
Threat: Local mining and domestic activities might destroy valuable geological spots at the immediate site.

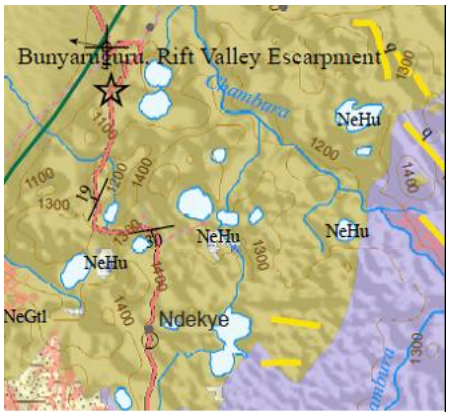
Geological map sheet/stratigraphy/lithology
Sheet: Mbarara, SA-36-1 (scale 1:250 000).
Stratigraphy: Phanerozoic.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Bunyaruguru.
Lithology: Tuff and lava (NeGtl), and high-K volcanics (NeGpv), see extract of map.

Geological description: There are two craters (or three?) which coalesced to form one with a diameter of about 1300m covering an area of about 2.5 km^2 (Plate 8, Fig. 1). The inner walls of the crater expose well bedded pyroclastic layers, and surge deposits, in cases exhibiting cross bedded layers (Plate 8, Fig. 2). Up to 15m high calcium carbonate moulds and travertine cones (Plate 8, Fig. 3) indicate past, extensive hot spring activity. The cones are occasionally mined for lime production (Plate 8, Figs. 4, 5). Further indications of hot spring activities include travertine channels in the tuffs (Plate 8, Fig. 6) gaseous emissions and thermophyllic grass, the latter being an endemic plant species. In the central part of the crater, saline lake water is used for salt production (Lake Katwe salt gardens, Plate 8, Figs. 7, 8). The Lake Katwe salt gardens, so far, form the largest saline mineral reserve in Uganda. The saline lake level is below the neighbouring fresh water level of Lake Edward.

Traditional/cultural background: Salt mining at Katwe is one of the indigenous African's oldest industries still surviving. More than 3000 people still work in the Katwe 'mines', owing salt pans to take care of (Plate 8, Fig. 8). Since the 16th century, salt has been one of the most important goods that attracted attention of many people and traders. The explorer Sir Henry Morton Stanley was the first white man who mentioned the site in his report. He visited Lake Katwe with his expedition team in 1875.

5.1.9. Apida/Kichwamba, Bunyaruguru Rift Valley Escarpment

General description: Craters and crater lakes within the Bunyaruguru volcanic field, with scenic views overlooking the Albertine Rift (Plate 9, Fig. 1), Queen Elizabeth National Park, the Lake Katwe-Kikorongo volcanic field, the Rwenzori Mountains, the western rift escarpment (already in the DRC), lake George and lake Edward.
Type of geosite: Immediate site, natural/geological but also palaeontological.
District: Bushenyi.
Access: Kasese−Mbarara road, about 51km from Kasese at the escarpment (eastern rift shoulder).
GPS coordinates: 36M 176516/9975078, altitude 1188m.
Size of site: A 300m long road cut exposes the immediate site, with the wider area covering several square kilometres.
Owner of site: Immediate site is owned by UNRA (Uganda National Road Authority).
Present use: At the immediate site tuffs are locally mined as building materials, and for pozzolanic cement manufacturing at Hima cement factory.
State of preservation: Poor.
Protection status: None.
Threat: Local mining activities might destroy the most valuable, fossil bearing layers.



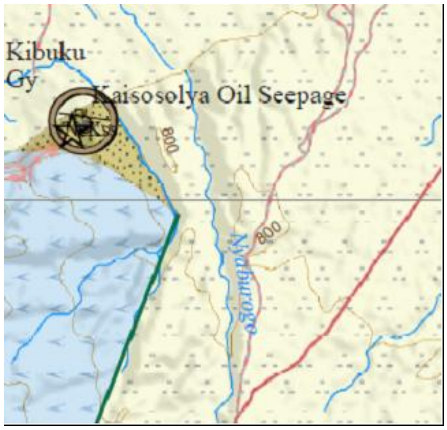
Geological map sheet/stratigraphy/lithology
Sheet: Mbarara, SA-36-1 (scale 1:250 000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Bunyaruguru.
Lithology: Tuff and agglomerate (NeGtl), and high-K volcanics (NeGpv), see extract of map.

Geological description: The up to 5m high and several hundred meters long road cut exposes well stratified beds of pyroclastics (Plate 9, Fig. 2, 4). The pyroclastics and tuffs are interlayered with surge and mudflow deposits (Plate 9, Fig. 3), which bear a rich flora, manifested as leaf impressions, fossil wood (Plate 9, Figs. 5, 6), but also fossil gastropod shells.

Traditional/cultural background: None at the immediate spot.

5.1.10. Kibuku/Kaiso (Kaisonsolya)

General description: Natural oil seepage at the foothills of the Rwenzori Mountains in the Albertine Rift.
Type of geosite: Natural/geological.
District: Ntoroko.
Access: The place is accessed by driving along Fort Portal–Bundibugyo road up to Sempaya (about 50km). At Sempaya, branch off to the north through a gravel/muddy road to Kibuku (about 15km from the main road). The seepage is along Kaisonsolya stream which is a seasonal stream. It needs a guide to find the place.
GPS coordinates: 36N 192689/101882, altitude 671m.
Size of site: Immediate is site exposed by a 5m high wall in a small river gorge.
Owner of site: Private, by Mr. Rwamwalu.
Present use: None.
State of preservation: Ok.
Protection status: None.



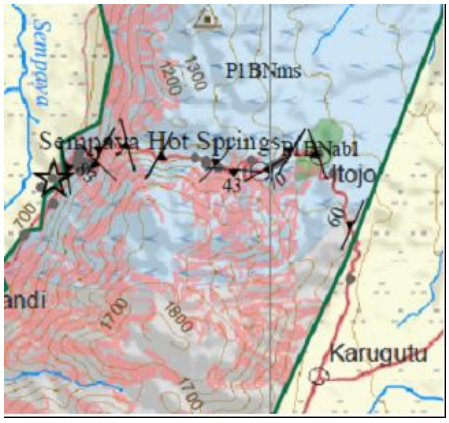
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale, 1:250.000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Kaiso.
Lithology: Gritty sandstone (NKss), see extract of map.

Geological description: The oil seepage is of paraffinic type and seeps out from the base of rift sediments (fine to medium grained sandstones and conglomerates) along a small gorge where river Kaisonsolya flows (Plate 10, Figs. 1, 2). The sediments are discordantly overlying well foliated weathered basement gneisses, which are seen just a few meters away (10m). The geological setting implies that oil (mixed with water) is seeping out at the contact between rift sediments and the basement rocks, and or along a fault, which is exposed in the lower part of the sedimentary profile (Plate 10, Figs. 3, 4).

Traditional/cultural background: None.

5.1.11. Sempaya

General description: Hot springs in a scenic environment near the foothills of the Rwenzori Mountains in the Albertine Rift surrounded by a natural tropical forest, within Semliki National Park.
Type of geosite: Natural/geological, but also traditional/cultural.
District: Bundibugyo.
Access: The place is accessed by driving along Fort Portal –Bundibugyo road up to Sempaya (about 50km).
GPS coordinates: 36N 184518/92444, altitude 667m.
Size of site: Wider area with three hot springs covers several square kilometres.
Owner of site: UWA.
Present use: Touristic, but also cultural/traditional (entrance fees).
State of preservation: Ok.
Protection status: Ok, since it is within a National Park.



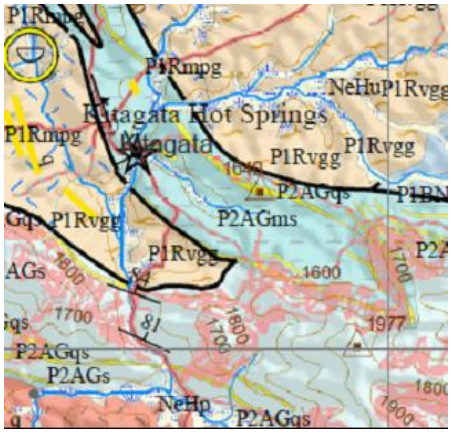
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: -
Group: -
Formation: -
Lithology: Rift alluvium (NeHr), see extract of map.

Geological description: The springs occur in Rift Valley sediments, and are associated with rift faults, and are indicative of heat sources in the earth's crust (e.g. hot magma chambers). Rain- and ground water flows along joints and faults, is heated in the underground, and migrates along faults or fault zones to the surface. The springs occur at three sites all characterised by heated bare thermal ground, thermophyllic grass, algae mats, gaseous emissions, and travertine (calcium carbonate) deposits. Typically calcareous deposits precipitate from CO_2 rich hot waters, which are cooling at marginal and shallow subsurface zones. As the hot waters cool, calcium carbonate becomes more soluble (retrograde or reverse solubility) and in the process supersaturated. When the solubility of calcium carbonate is exceeded, precipitation of travertine begins. Three springs occur at the site, and are named "Female" ("Nyansimbi", Plate 11, Fig. 1), "Male" ("Bintente", Plate 11, Fig. 5) and "Kagoro" (Plate 11, Figs. 6, 7). At the "female" spring, water is spouting out of travertine cones and terraces (Plate 11, Figs. 1, 3). Water boils up to 95°C at one of the hottest spots. The "male" spring is made up of a thermal pool which is enclosed by a thin crust of precipitated calcium carbonate. It is dangerous to go near this pool because a thin crust can give way and someone may easily break through it and fall in the pool of hot water. The pool is about 5m deep. The origin of this pool is unknown but could possibly be related to a hydrothermal eruption which created a crater shaped hole in the ground (Plate 11, Fig. 5). The elevation of the water surface in the pool is above the surrounding, and water pours over its edges.

Traditional/cultural background: The "female" spring is of cultural significance to the "Bamaga" clan. They named it "Nyansimbi" associating it with wealth and a wife to the hot spring. The women are supposed to carry out worships and sacrifice at the place. Cultural ceremonies for women are performed here for instance barren women come to request for fertility and pregnant women come to ask for safe delivery. Female animals are slaughtered and coins are dropped into the hot springs for sacrifice. "Bitente" (male hot spring) was named because of grass surrounding it ("ntente"), the swampy environment and difficulties to access it (Plate 11, Fig. 4). Only men were allowed at the place, carrying out sacrifices to pacify their ancestors. The men would later join the women at the female spring for more celebrations.

5.1.12. Kitagata

General description: Hot springs.
Type of geosite: Natural/geological and traditionally/cultural, but also medicinal.
District: Bushenyi.
Access: South of Ishaka, about 18.5 km along Ishaka−Ntungamo road.
GPS coordinates: 36M 183959/9924743, altitude 1480m.
Size of site: The wider area has two major hot springs, and covers several square kilometres.
Owner of site: Kitagata sub-county.
Present use: Touristic, but also cultural /traditional and medicinal.
State of preservation: Ok.
Protection status: Protected by Kitagata sub-county.



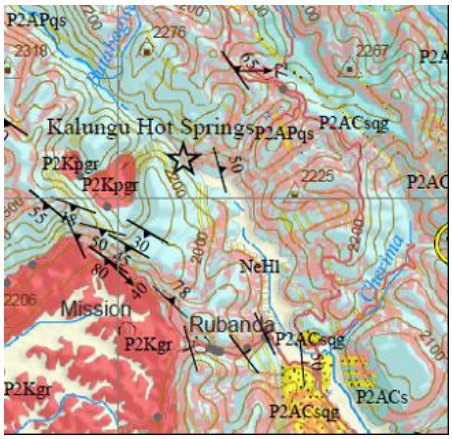
Geological map sheet/stratigraphy/lithology
Sheet: Mbarara, SA-36-1 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: Rukungiri.
Group: -
Formation: Rukungiri Suite.
Lithology: Variable granitic gneiss (P_1Rvgg), and nearby mica-schists (P_2AGms), see extract of map.

Geological description: Clear hot water flows out of joints and shear zones. The rock at the immediate site is an intensively jointed granite gneiss (Plate 12, Fig. 1). The area is used by people to bathe for curative purposes. The water temperature reaches up to 69°C.

Traditional/cultural background: The "Mugabe" springs are on the easterly side and used to be reserved for the "king" to bathe in, while the communal springs are on the westerly side of the road.

5.1.13. Kalungu (Karungu)

General description: Hot springs.
Type of geosite: Natural/geological but also medicinal (Plate 13, Figs. 1, 2).
District: Kabale.
Access: About 21 km along Kabale–Kisoro road, branch off to the north for about 6 km.
GPS coordinates: 35M 819739/9881206, altitude 1802m.
Size of site: 30x30m
Owner of site: Private, by Mr. Zonobia Ndibanohe.
Present use: Touristic, but also medicinal.
State of preservation: Ok.
Protection status: None.



Geological map sheet/stratigraphy/lithology
Sheet: Kabale, SA-36-5 (scale 1:250 000).
Stratigraphy: Mesoproterozoic.
Supergroup: Akanyaru-Ankole.
Group: Ankole.
Formation: Cyohoha.
Lithology: Shale, mudstone, phyllite (P_2ACs), see extract of map.

Geological description: The springs occur along a river valley possibly along a fault system. Hot water is issuing from joints (Plate 13, Fig. 2) of a ferruginised and silicified phyllite. The water reaches temperatures up to 65°C. The nearest volcanic centre is at Katunga, where lava flows are exposed (some 30km away).

Traditional/cultural background: Not known.

5.1.14. Kibenge

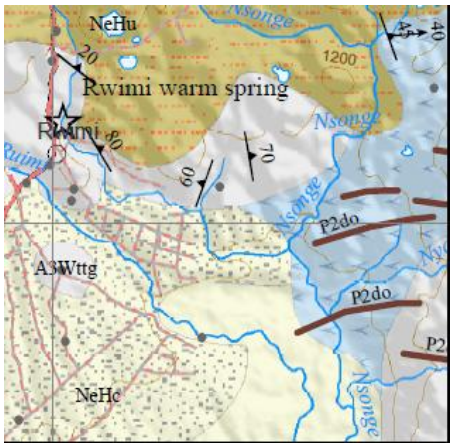
General description: Warm springs.
Type of geosite: Natural/geological but also medicinal.
District: Kasese.
Access: Kasese−Kilembe road, near Hotel Margherita.
GPS coordinates: 36M 172067/207986, altitude 1802m.
Size of site: 10x5m
Owner of site: Private, by Mr. Mufte Basaaza.
Present use: Touristic, and medicinal.
State of preservation: Ok.
Protection status: None.

Geological description: The warm springs (up to 45°C) are characterized by feeble gaseous emissions in a pool of about 5x10m (Plate 14, Fig. 1). They are located in a valley and water issues from lateritic, alluvial and pediment gravels overlying fractured gneisses, amphibolites and schists.

Traditional/cultural background: Not known.

5.1.15. Rwimi

General description: Warm springs.
Type of geosite: Natural/geological.
District: Kabarole.
Access: Fort Portal–Kasese road, branch of at Rwimi for about 500m to the east. It needs a guide to find the place.
GPS coordinates: 36N 190297/42796, altitude 1109m.
Size of site: Immediate site 20x20m.
Owner of site: Private.
Present use: None.
State of preservation: Ok, currently found in a banana plantation.
Protection status: None.



Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale, 1:250.000).
Stratigraphy: NeoArchean.
Supergroup: -
Group: -
Formation: -
Lithology: TTG gneiss (A_3Wttg), see extract of map.

Geological description: Effervescence of dissolved carbon dioxide is characteristic of Rwimi warm springs (Plate 15, Fig. 1). Clear and cloudy water is issuing under a pool of cold water that is approx. 2.5m in diameter. The water temperature is 25.5°C. A travertine deposit rises up to 1.5m (Plate 15, Fig. 2), and is surrounded by swamps and soils. The Rwimi thermal area is possibly related to mountain front faults, or rugged front fractures. A magma chamber might be a reasonable source of the huge quantities of carbon dioxide and nitrogen degassing at the site. The gaseous emission might be related to the nearby Ndale volcanic field (Armannsson et al. 2005).

Traditional/cultural background: Not known.

5.1.16. Kyambura

General description: Impressive gorge and scenic environment within Queen Elizabeth National Park.
Type of geosite: Natural/geological.
District: Bushenyi.
Access: Kasese – Mbarara road, branch off to the east after about 44 km, follow signpost to the gorge (another 2.5 km to the site).
GPS coordinates: 36M 177311/9979140, altitude 1024m.
Size of site: Several kilometres long and up to 100m deep gorge.
Owner of site: UWA.
Present use: Touristic.
State of preservation: Ok.
Protection status: Ok, since it is in a national park.

Geological map sheet/stratigraphy/lithology
Sheet: Mbarara, SA-36-1 (scale, 1:250.000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: Albertine.
Group: Upper Albertine.
Formation: Bunyaruguru.
Lithology: Tuff and lava (NeGtl), see extract of map.

Geological description: The Kyambura (Chambura) river cuts through an impressive sequence of well bedded mainly pyroclastic deposits. The gorge is up to 100m deep, and extends from the escarpment (in the SE) almost up to Kazinga channel (in the NW), (Plate 16, Fig. 1).

Traditional/cultural background: Not known.

5.2. Palaeontological sites

Palaeontological records reflect ancient life on earth and are preserved as e.g. fossils within the rock column.

5.2.1. Kazinga Channel

General description: Fossil sites at the shores of Kazinga channel.
Type of geosite: Palaeontological but also archaeological.
District: Kasese.
Access: Kasese–Mbarara road, at Katunguru (at Kazinga channel), about 40km from Kasese.
GPS coordinates: 36M 171255/9986148, altitude 945m.
Size of site: Several hundred meters long and up to several metres high cliffs (Plate 17, Figs. 1, 2).
Owner of site: Katunguru town council at the immediate site, other areas lay within Queen Elizabeth National Park.
Present use: Touristic.
State of preservation: Poor at the immediate site.

Protection status: Not protected at the immediate site.
Geological map sheet/stratigraphy/lithology
Sheet: Mbarara, SA-36-1 (scale, 1:250.000).
Stratigraphy: Phanerozoic, Neogene.
Supergroup: -
Group: -
Formation: -
Lithology: Rift alluvium (NeHr), see extract of map.

Geological description: The channel connects Lakes George and Edward in the Western Rift Valley. The sedimentary column as exposed at the cliff comprises of well stratified, horizontally layered fine to medium grained lacustrine sandstones, clay-, and mudstones (Rift Valley sediments). In the lower sequence gastropod shells, and fossil root fillings can be observed (Plate 17, Figs. 3−5). In the upper clay rich horizons vertebrate bones and artifacts (pottery) are found (Plate 17, Figs. 6, 7).

Traditional/cultural background: Not known.

5.3. Archaeological sites

Archaeological sites bear a record of the history of mankind on earth.

5.3.1. Munsa, Bikekete

General description: Earthworks, cave/rock shelter, and scenic landscape.
Type of geosite: Archaeological, but also natural/geological and cultural/traditional.
District: Mubende
Access: Kampala−Fort Portal road, branch off at Mubende, take Mubende−Kakumiro road, about 3km off Kakumiro trading centre, close to the Ssemwema site. It needs a guide to find the place.
GPS coordinates: 36N 312455/90894, altitude 1266m.
Size of site: Trenches several kilometres long.
Owner of site: Private.
Present use: Touristic, but also traditional/cultural.
State of preservation: Poor.
Protection status: None.

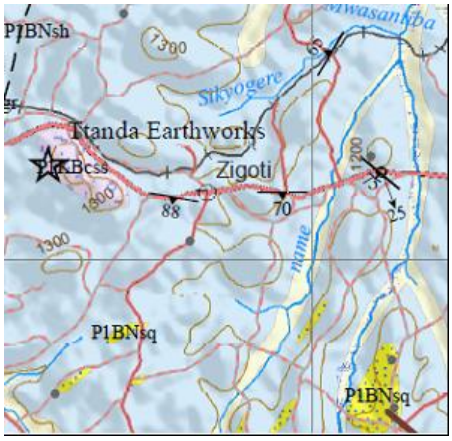
Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: Mubende-Singo Suite.
Group: -
Formation: -
Lithology: Megacrystic granite (P_1MSmg), see extract of map.

Geological description: These rock shelters and earthworks are just about some few kilometers from the Ssemwema cave (see above). The cave at Bikekete is also made up of huge granite boulders which form shelters, caves, chambers and tunnels.

Archaeological, traditional/cultural background: Silted-up earthworks (‚ndani') and occupation of Bikekete dates back to the 14th Century. It is reported by tradition and archeologists that the ruler of Munsa ('Kateboha') lived within Bikekete Hill. There are spacious rock shelters to seat several people at a go. Earthworks were constructed purposely for protection/fortification from any possible invasion. The earthworks measure more than 3m deep and up to 7m wide forming a V-shape trench ('ndani'). These were stronghold forts for 'Bachwezi' rulers. It is reported that the orientation of these trenches implied they expected the enemy forces from the south. Archeological studies in 1995 (pers. communication from a local guide) discovered clay furnaces used for smelting iron ore. The glass beads implied trade with coastal Swahili. Royal burials were also discovered in this place. People up to now still worship 'Chwezi' spirits. The rock shelters of Bikekete in the Munsa earthworks were sure abodes of spirits. They hold cultural significance (legends, myth and spiritual). Inside the shelters are cowry shells, spears, knives, coffee beans all signifying worshiping of 'Chwezi' spirits. Like rock shelters at Ssemwema, these also form caves, chambers and tunnels (Plate 18, Fig.1). The tunnels are interconnected vertically and horizontally.

5.3.2. Ttanda

General description: Earthworks, and cave/rock shelter.
Type of geosite: Archaeological, and cultural/traditional.
District: Mityana.
Access: Kampala–Mityana road, branch off at Ttanda and follow signposts (Plate 19, Fig. 1) to the site (about 2km from the main road).
GPS coordinates: 36N 402818/42626, altitude 1317m.
Size of site: Immediate site about 1.5 x 1.5 km, wider area several square kilometres.
Owner of site: Private, by Besweli Mulondo.
Present use: Touristic, but also traditional/cultural (entrance fees).
State of preservation: Ok.
Protection status: Ok, partly fenced.



Geological map sheet/stratigraphy/lithology
Sheet: Kampala, NA-36-14 (scale 1:250 000).
Stratigraphy: Palaeoproterozoic.
Supergroup: -
Group: Buganda.
Formation: Nile.
Lithology: Slate, shale, phyllite (P_1BNsh), and conglomerate, sandstone, siltstone (P_1KBcss, Bukoba Group).

Geological description: The earthworks are dug in partly hardened lateritic soils (Plate 19, Fig. 2). There are no rock outcrops at the immediate site.

Archaeological, traditional/cultural background: Ttanda pits (‘Enyanga za Walumbe’) are ancient archeological sites. The area is characterized by aligned deep sinister pits of about 1m in diameter, and up to 14m deep (Plate 19, Figs. 2, 3). It has been reported, that about 400 pits had been dug in the wider area.

The site is of cultural/traditional importance, and materials seen include bark cloth, cowry shells, spears, knives, pots and several shrines. Local people visit this area for sacrifice, cleansing, miracles, getting riches and for blessings. These pits are believed to have been dug by ‘Kaikuzi’ (literally digger of holes) during a momentous fight with his brother ‘Musajja Mukulu Walumbe’ (demonic spirit) according to ‘Kiganda’ legend.

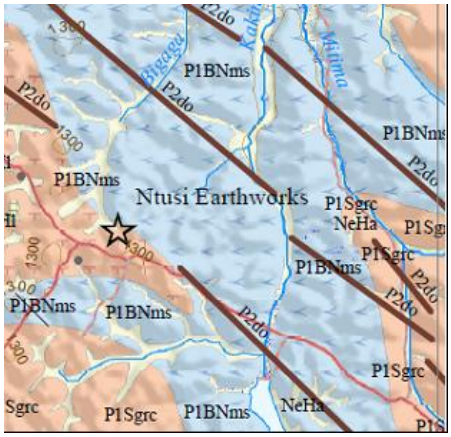
‘Kaikuzi’ and ‘Walumbe’ are sons of ‘Gulu’ (creator). They are brothers to ‘Nambi’. ‘Nambi’ was married to ‘Kintu’ and she forgot millet at her father’s place (heaven). On return (to earth), she came back with ‘Walumbe’, whom they had avoided to go with to earth. ‘Walumbe’ wanted to eat/kill ‘Nambi’s’ children so ‘Kaikuzi’ had to set up a spirited fight through these interconnecting pits. ‘Kaikuzi’ failed to trap ‘Walumbe’ and a ‘Kiganda’ legend is that ‘Walumbe’ is still disturbing this earth with death and ill fortunes. Legend is that these pits are still used by ‘Walumbe’ and is still active reining terror to human beings, descendants of ‘Nambi’ and ‘Kintu’. It is believed that this is the source of Baganda since they are descendants of ‘Nambi’.

Visually, the vertical interconnecting pits could be ancient mined out pits according to their geometric pattern and currently observed artisan mining methods all over the world, yet the target mineral of the possible mining activities is not known.

Natural caves (as also seen at the site) have been fashioned shelters long before the advent of dry walls. The site holds cultural (spirits, myths, legends) and is of economic (touristic) significance. It is protected and preserved but more is needed to meet international significance. The site is owned by Mr. Besweli Mulondo. The natural cave(s) are made up of lateritic materials with visible quartz and quartzite pebbles (Plate 19, Fig. 4).

5.3.3. Ntusi

General description: Earthworks.
Type of geosite: Archaeological and cultural/traditional.
District: Ssembabule.
Access: 61 km north of Lyantonde (Lyantonde−Mubende road), within Ntusi trading centre.
GPS coordinates: 36N 300813/5972, altitude 1256m.
Size of site: Approx. 100m in diameter.
Owner of site: Not known.
Present use: Touristic, but also traditional/cultural.
State of preservation: Poor.
Protection status: None.



Geological map sheet/stratigraphy/lithology
Sheet: Fort Portal, NA-36-13 (scale, 1:250.000).
Stratigraphy: Palaeoproterozoic.
Supergroup: Sembabule.
Group: -
Formation: Sembabule Suite.
Lithology: Rwamasha granite (P_1Sgrh), see extract of map.

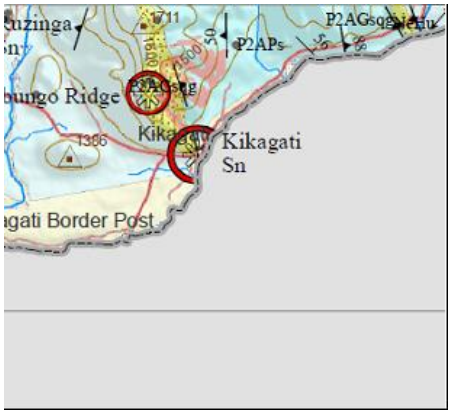
Geological description: There are no rock outcrops at the immediate site. However, the soils used to create the concentrically arranged, and up to 4m high walls (Plate 20, Fig. 1) are rich in small quartz pebbles, indicating a granitic source of the weathered material.

Archaeological, traditional/cultural background: Abandoned Ntusi mounds are the largest ancient settlement in Uganda and it is believed to predate the 'Bachwezi' dynasty as early as the 10th century. The villagers probably lived in small cone huts and grew sorghum and millet and herded cattle. There are two concentric earthworks (male and female), an outer ditch and an inner royal enclosure in which local people believe that the earthworks have supernatural powers. There are massive piles of bones, waste materials and pottery shards. The people made ceramic pots with a distinctive rouletted pattern. Iron smelting, fire clay materials, and pottery are reported in the area. It is an abandoned site with occasional believers visiting it intermittently to get spiritual powers (Plate 20, Fig. 2).

Ntusi evokes images of the ancient 'Bachwezi' dynasty. It is an abandoned treasure of massive earthworks. Excavation revealed huge piles of refuse heaps deposited over a 300 year period. Several scrapped depressions are reported in the middle ('obwogero'). The largest is believed to be 20m deep. This deep 'obwogero' lies 150m from the 'male' mound. These 'obwogero' are probably associated with ancient irrigation ditches. Other sites nearby include Masaka hill and Bigo Byamugenyi earthworks. These areas hold cultural (myth, legend, spirit). It holds significant archaeological importance and should not have been trampled upon by neighboring communities. The spirit medium, 'Nabasa' seeks spiritual powers from here and people flock her shrine for miracles, cleansing, worshiping and offerings.

5.3.4. Nsongezi

General description: Cave/rock shelter.
Type of geosite: Archaeological and cultural/traditional.
District: Isingiro.
Access: Mbarara-Kikagati road, 2km from Nsongezi town towards Kikagati trading center.
GPS coordinates: 36M 249740E/9890260, altitude1236m.
Size of site: 4x15m.
Owner of site: Private, Mr. Kigambe Andrew
Present use: Touristic, but also traditional/cultural.
State of preservation: Poor.
Protection status: None.



Geological description: The rocks are gravels which have been lateritized and hardened. Pebbles and gravels of quartz are visible (Plate 21, Fig. 1).

Archaeological, traditional/cultural background: They are abandoned rock shelters. Once justifiably associated with archaeological treasures, Nsongezi is no more. It needs urgent remedial action. It is reported archeologists carried out some work here and found ancients materials. Legend ties it to 'Bachwezi' kings.

6. CONCLUSIONS

This document has to be regarded as a first attempt to collect viable information about geosites in southern Uganda (south of 1° north). All visited sites bear an interesting geological 'story', worth protecting the sites. Additionally, many sites are also of cultural/traditional importance, reflecting ethnological but also archaeological treasures of humans living, or have been living there.

Some of the geological heritage has been formed billions of years ago, that once lost cannot be replaced. They therefore need to be protected and conserved. UNESCO and IUGS have been recognizing the need to conserving sites and terrains of special earth science interest.

In Uganda, earlier studies have compiled an inventory of possible geosites but with rather limited description. In this report, 22 geosites in southern Uganda, south of 1° north, have been identified and visited to get a description of various attributes, their importance and their status of protection as well as preservation. Out of the 22, 17 have been categorised as natural/geological sites, 1 as a palaeontological site and 4 as archaeological sites. For the natural/geological sites, 4 have some degree of protection while 14 have no protection at all. Thirteen are preserved with 4 not protected. The palaeontologial site is neither protected nor preserved. Only 1 archaeological site can be said to be preserved and protected leaving the other 3 neither protected nor preserved. The degree of preservation depends largely on the robustness of the feature in question, its fragility and land use around it.

Given that almost all these geological monuments and landforms are irreplaceable, action must be taken to protect them from elements of the weather and destructive human activities. They are a fundamental part on the natural heritage and can be a source of revenue with great scientific/educational and cultural value.

7. RECOMMENDATIONS

So far, there is no national controlling body for protecting geosites in Uganda. However, some of them are found in National Parks (protected by UWA), others are recognized sites by Uganda Museum, or are situated on private land and occasionally fenced, hence having some kind of protection status.

It is recommended to forward this document to the relevant stakeholders, in order to improve on its cultural/traditional and archaeological contents (there might be more information available), and to create awareness on Ugandan geosites, but also to discuss further steps of developing a national register and policy of protecting, and conserving these sites for future generations. The document may be forwarded to UWA, Mak, Uganda Museum, Uganda National Council of Science and Technology (UNCST), IUGS and UNESCO.

The field visit has also shown that many of the sites can only be found with the help of a local guide, since signposts were absent, or have been vandalized. There is a need to clearly indicate the way to the sites. A small information board on the site, with text and illustrations about the geotope will help visitors understanding its natural/geological (see e.g. Plate 3, Mukona), but also palaeontological, archaeological and cultural/traditional background.

More scientific research can be done to improve on the knowledge of the sites (e.g. by students carrying out their BSc, MSc or PhD theses on a particular geosite or sites).

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APPENDIX 1

Geosites in Uganda, Field Trip June 2010

Name of site / local name of site

Date, and time visited (if not visited, and info is from literature, or earlier visits, indicate)

Site and location

GPS WGS 84 UTM

Site:

District:

County:

Geological description

Type of geotope:

Type of exposure:

Regional geological setting:

Stratigraphy (to be added after plotting the site on the geological map):

Lithology or petrography:

Fossils, artefacts, minerals, etc.:

Mode of formation:

Size of site

Owner of site, contact of owner

Name of site

Access

Present use

State of preservation

Protection status

Recommendations to protect the site

Brief description

Any other suggestions, remarks, and comments to be added by Vincent and Andreas

Photos
YES NO

Site should be considered to be plotted on the new Geological Map of Uganda
YES NO

PLATE 1: Sezibwa

Fig. 1. Sezibwa waterfall.

Fig. 2. On top of the falls, where river Sezibwa is cutting through quartzites.

Fig. 3. Cave used for traditional/cultural ceremonies by the Baganda tribe.

PLATE 2: Bujagali

Fig. 1. Bujagali waterfalls.

Fig. 2. River Nile and the falls.

Fig. 3. Meta-basalt outcropping at the shore of river Nile.

Fig. 4. "Jajja (old man) Budhagali (Bujagali)".

PLATE 3: Mukona

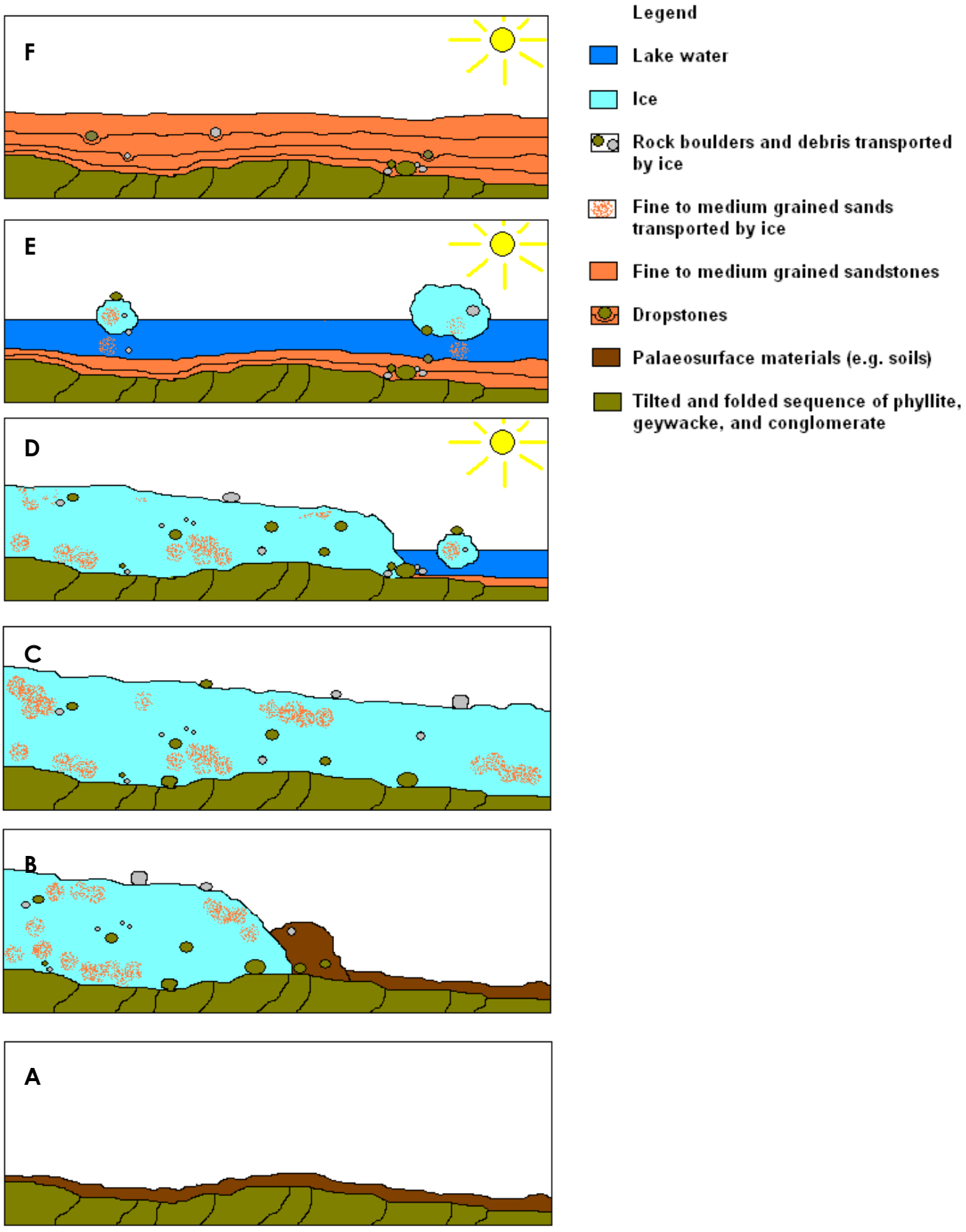


Fig. 1. Schematic illustration of the deposition of the glacial sediments (see text, and explanations to Fig. 1, next page, and photos).

PLATE 3: Mukona

Explanations to Fig. 1.

General: The earth has to be regarded as a living organism, changing its shape constantly, involving moving of continents, and even creating new continents. The rock sequence as seen at the site is bearing a complex geological history. The story might start like … Once upon a time, more than a billion years ago continents were not in their present position. During that time an ocean was covering today's Kabale region. It was also a time, when life on earth was just at the beginning with only simple organisms like algae occupying it. That was the time sediments were deposited in the 'Kabale' ocean. After the time of their deposition, the whole environment must have changed, the ocean disappeared, and the sediments must have down-warped into the earth's crust due to tectonic forces. Heat and pressure in the earth's crust consolidated and hardened them. They were transformed into phyillites, greywackes and conglomerates. The tectonic forces also deformed, tilted and folded them (lower rock sequence in the profile, Plate 3, Figs. 2, 3).

Again, it took some time before erosion of overlying rocks, and tectonic forces raised them up to the earth's surface. When they were exposed to the surface, weathering caused the development of soils on top of them (Plate 3, Fig. 1A). Then the climate must have changed drastically, and glaciers occupied the today's Kabale area, and probably wider parts of today's Uganda (Plate 3, Figs. 1B-C), Again the changing climate was responsible for melting of the ice (Plate 3, Figs. 1D-F), and depositing glacial sediments (upper rock sequence in the profile).

Plate 3, Fig. 1, sketch A: Ttilted and folded sequence of meta-sediments (phyllite, greywacke, conglomerate), which is overlain by palaeosurface materials (e.g. soils).

Plate 3, Fig. 1, sketch B: Glaciers are scratching and polishing the meta-sediments (Plate 3, Fig. 4) but also (re-)moving the soil cover.

Plate 3, Fig. 1, sketch C: On their way, glaciers are 'collecting' and transporting loose rock materials (rock boulders, debris) and sand.

Plate 3, Fig. 1, sketch D: A climate change causes melting of the ice. A lake is forming and ice bergs are floating on it.

Plate 3, Fig. 1, sketch E: When the ice is melting, it releases its 'freight' (sand and rock boulders), which then is deposited at the bottom of the lake. The heavier rock boulders (dropstones) sank in the unconsolidated sediments. Due to their weight they deformed the unconsolidated sediments creating a concave depression (Plate 3, Figs. 5, 6, 7).

Plate 3, Fig. 1, sketch F: The rock profile as it is seen today, with dropstones as indicators of a complex geological history at the site (Plate 3, Fig. 2).

PLATE 3: Mukona

Fig. 2. The outcrop exposes a lower tilted sequence of phyllite, greywacke and conglomerate, which is discordantly overlain by horizontally bedded glacial sediments.

Fig. 3. Contact between the two rock sequences.

Fig. 4. Polished rock surface with striations at the contact between the two rock sequences.

Fig. 5. Coarse rock boulders (dropstones) embedded in finer grained sandstones.

Fig. 6. Dropstone.

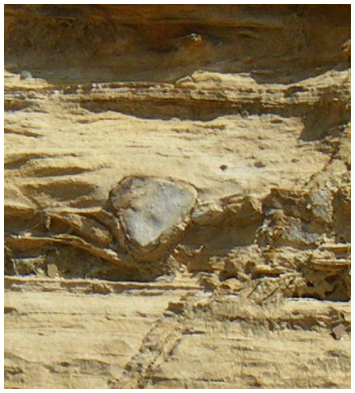


Fig. 7. Dropstone.

PLATE 4: Tororo Rock

Fig. 1. Tororo Rock, with telecommunication masts on top.

Fig. 2. Biggest cave at Tororo Rock.

Fig. 3. Sukulu carbonatitic ring structure as seen from the top of Tororo Rock (view to the south).

PLATE 4: Tororo Rock

Fig. 4. Carbonatite (A) with a secondarily cemented fracture filling (B), containing fossil gastropod shells.

Fig. 5. Typical dissolution features in carbonatititic rocks.

Fig. 6. Enlarged section of Figure 4, showing the fracture filling with a fossil gastropod shell.

PLATE 5: Munsa, Ssemwema

Fig. 1. Massive granite outcrop, with the Ssemwema cave at its foothill.

Fig. 2. 'Entrance' to the cave.

Fig. 3. Inside the cave. The site is used for traditional/cultural ceremonies.

PLATE 6: Nyakasura

Fig. 1. Waterfall at Nyakasura

Fig. 2. Large stalactites, and stalagmites.

Fig. 3. Small, up to 15cm high stalagmites.

PLATE 6: Nyakasura

Fig. 4. Scenery near Nyakasura. In the background are the Rwenzori Mountains, in the foreground is one of the explosion craters (Kalyango) of the Fort Portal volcanic field.

Fig. 5. Scenery near Nyakasura. In the background is Kyeganywa hill, in the foreground is the Kigere crater lake.

PLATE 7: Nkuruba and Kinyamatezo

Fig. 1. Nkuruba crater lake.

Fig. 2. Kinyamatezo crater lake.

PLATE 8: Lake Katwe

Fig. 1. Lake Katwe.

Fig. 2. Partly cross-bedded pyroclastics.

Fig. 3. Large travertine cones.

Fig. 4. Travertine cone mined for lime production.

Fig. 5. Layers of travertine.

PLATE 8: Lake Katwe

Fig. 6. Road cut in the Katwe explosion crater, exposing a travertine channel in tuffs.

Fig. 7. Lake Katwe salt.

Fig. 8. Lake Katwe salt gardens.

PLATE 9: Apida/Kichwamba, Bunyaruguru Rift Valley escarpment

Fig. 1. View from the escarpment to the north-west overlooking the Albertine Graben.

Fig. 2. Road cut exposing well bedded pyroclastics.

Fig. 3. A mudflow layer rich in fossilized wood, over- and underlain by pyroclastic materials.

PLATE 9: Apida/Kichwamba, Bunyaruguru Rift Valley escarpment

Fig. 4. Fine to medium grained tuffs.

Fig. 5. Fossilized wood.

Fig. 6. Leaf impressions (approx. size 7 cm).

PLATE 10: Kibuku/Kaiso (Kaisonsolya)

Fig. 1. Rift Valley sediments.

Fig. 2. River Kaisonsolya.

Fig. 3. The outcrop exposes sedimentary sequences of sandstones and conglomerates. In the lower part of the profile the sedimentary layers are offset by a fault (neo-tectonics), (A). The lower sequence is discordantly overlain by younger rift sediments (B).

Remark: The lower sequence is discordantly overlying basement gneisses which are outcropping about 10m upstream.

Fig. 4. A mixture of oil and water is oozing out at the seepage (spring).

PLATE 11: Sempaya

Fig. 1. One of the "female" hot springs.

Fig. 2. Signpost at the springs.

Fig. 3. Hot spring.

Fig. 4. Trail to the "male" hot spring (in the background are the foothills of the Rwenzori Mountains).

PLATE 11: Sempaya

Fig. 5. The “male” hot spring.

Fig. 6. Small pool, with a hot spring.

Fig. 7. The field team (from right to left: V. Kato, A. Schumann, and the driver from DGSM), at the ‘Kagoro’ hot spring.

PLATE 12: Kitagata

Fig. 1. The “communal” Kitagata hot spring.

PLATE 13: Kalungu

Fig. 1. Kalungu hot springs is a community meeting point, and the thermal water is used for bathing and medicinal purposes.

Fig. 2. Hot water is oozing out along joints.

PLATE 14: Kibenge

Fig. 1. Kibenge warm spring.

PLATE 15: Rwimi

Fig. 1. Gaseous emissions at Rwimi warm spring.

Fig. 2. A plant covered, with a 1.5m high travertine cone is indicative of a former, more intense geothermal activity in the area.

PLATE 16: Kyambura

Fig. 1. Kyambura gorge.

PLATE 17: Kazinga

Fig. 1. Kazinga channel, in the back ground the eastern rift shoulder of the Albertine Graben.

Fig. 2. Rift sediments, outcropping at Kazinga channel.

Fig. 3. Fossil gastropod shells in a mudstone.

Fig. 4. Gastropod shells.

Fig. 5. Possible fossil root fillings in a sandstone.

PLATE 17: Kazinga

Fig. 6. Fossilized bones in the uppermost part of the sedimentary sequence.

Fig. 7. Pieces of pottery in the uppermost horizon of the sedimentary sequence.

PLATE 18: Munsa, Bikekete

Fig. 1. Bikekete rock shelter.

PLATE 19: Ttanda

Fig. 1. Signpost to the site.

Fig. 2. Earthworks/pits following a preferred direction.

Fig. 3. The pits are up to 14m deep, and about 1m wide.

Fig. 4. Nearby rock shelter in a laterized conglomerate. The shelter is used for traditional/cultural ceremonies.

PLATE 20: Ntusi

Fig. 1. Ntusi earthworks.

Fig. 2. Shrine, used for cultural/traditional ceremonies.

PLATE 21: Nsongezi

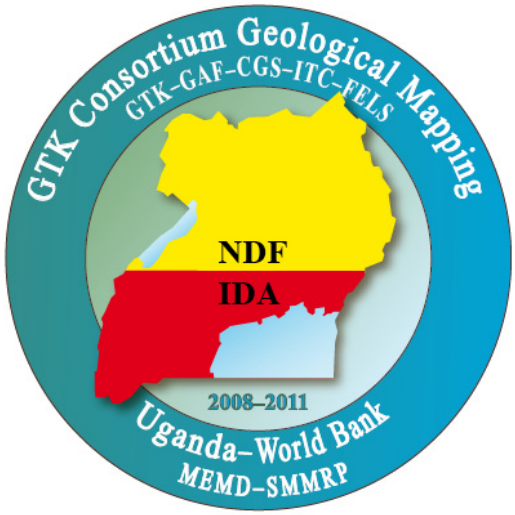
Fig. 1. Abandoned Nsongezi rock shelter.

SUSTAINABLE MANAGEMENT OF MINERAL RESOURCES PROJECT

GEOLOGICAL MAPPING, GEOCHEMICAL SURVEYS AND MINERAL RESOURCES ASSESSMENT IN SELECTED AREAS OF UGANDA

Geosites South of 1° North

ADDENDUM



GTK CONSORTIUM

Andreas Schumann and Vincent Kato

27.5.2011

Contract No.:MEMD/SMMRP/services/2006/000011

CONTENTS (Addendum)

1. Introduction (Addendum)

This addendum to the report 'Ugandan geosites south of 1° north' incorporates additional spots, accompanied by a brief description of the sites or references for further reading. These sites have not been visited during the field trip between 5th and 12th of June 2010, and information presented is extracted from reports made available by the Department of Geological Survey and Mines (DGSM); photos are provided by V. Kato (DGSM).

These sites are not plotted on the new geological maps but may be included in later editions of the maps. Co-ordinates given are either in UTM/UPS WGS 84 or in UTM/UPS Arc 1960 (see respective site descriptions).

2. Background (Addendum)

From 11.05.2010 to 31.05.2010 the team spent time carrying out a desk study, which also included visiting relevant stakeholders. On 1st of June stakeholders from Uganda Museum, Uganda Wildlife Authority (UWA), Makerere University (Mak), DGSM, and GTK attended a meeting in Entebbe (DGSM/GTK offices) discussing sites, which might be included in the new geological maps of Uganda. V. Kato and A. Schumann prepared for the field work on 4th of June, and visited all suggested sites between 5th and 12th of June 2010.

A draft version of the report had been handed in to GTK and DGSM for their consideration (September 2010). On the basis of comments received a final draft was produced in February 2011 with latest amendments done in March 2011.

The final document was edited by GTK in April 2011(revised version, 29.04.2011).

However, mid of May 2011 very late comments have been received by the client (DGSM). On the basis of their comments this addendum has been compiled.

3. Natural/geological sites (Addendum)

The additional sites comprise of warm or hot springs and fossil travertine occurrences in southern Uganda, as well as water falls N/NW of Bujagali falls along river Nile.

3.1. Geothermal sites (Addendum)

A number of warm and hot springs are located in SW-Uganda. Probably all of them derived or developed during the evolution of the rift valley (western branch of the East African Rift System).

A selection of sites was already mentioned in the final geosite report (revised version of 29.04.2011), and gave an overview of the diversity of such springs in terms of water temperatures, gaseous emissions, and geological settings.

Armannsson *et al.* (2005) gave a description of most of the thermal springs in Uganda with respect to their water chemistry, temperatures, and possible potential as an alternative energy resource (other than fossil energy resources), (see Fig. 1). They also gave a brief geological

description of the surrounding rocks. Kato (2006) summarized the findings of Armannsson *et al.* (2005) and added more recent information.

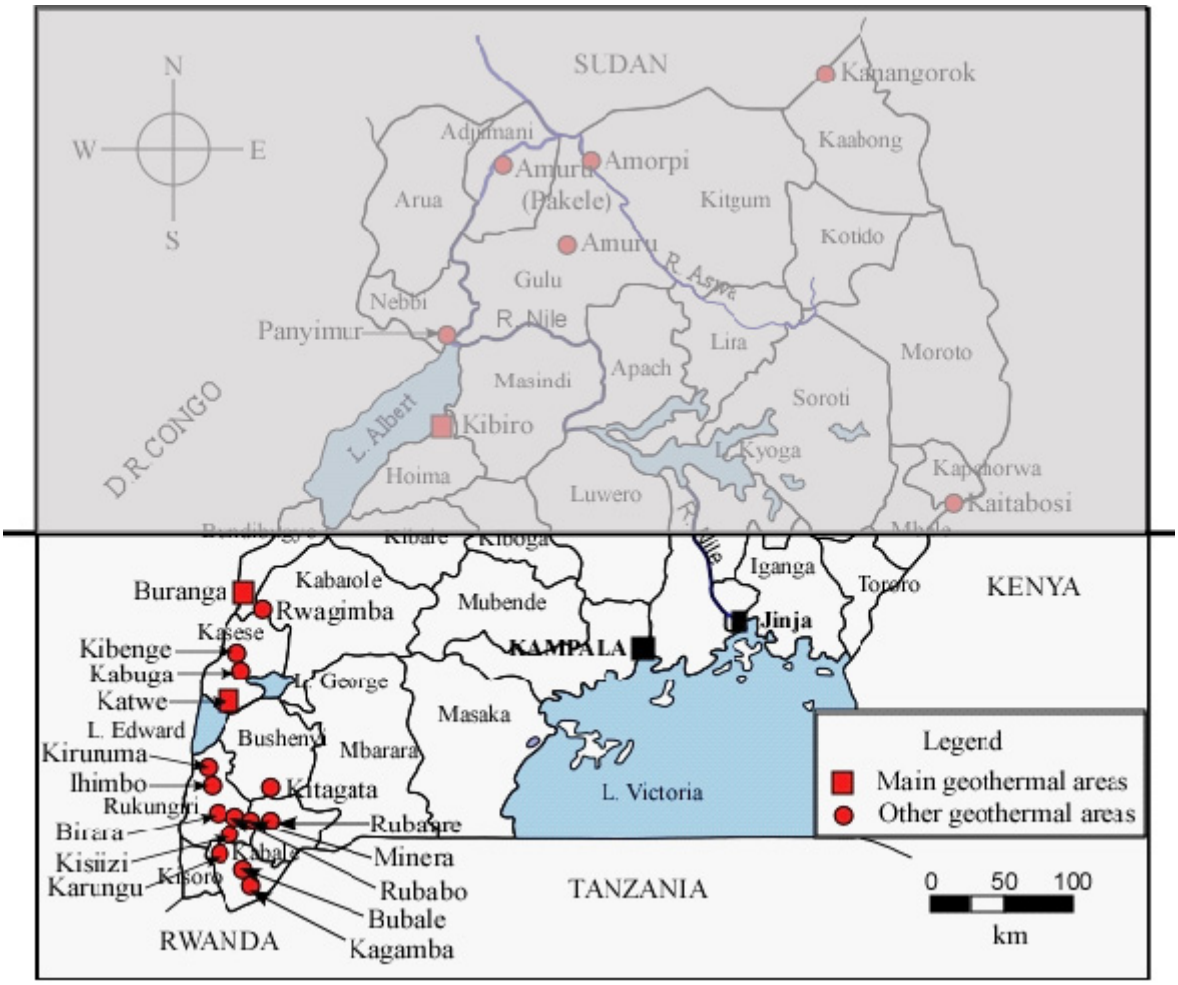


Fig. 1. Geothermal springs in southern Uganda, south of the shaded area (modified after Armannsson *et al.* 2005).

3.1.1. Geothermal springs (Addendum)

3.1.1.1. Rwagimba

General description: Hot spring.
Type of geosite: Natural/geological.
District: Kabarole.
Access: Kampala-Kasese road, located in Kibito subcounty (see also Fig. 1, above).
GPS coordinates: UTM/UPS Arc 1960; 177800E/0053083N, altitude 1555m.
Size of site: About 30m along river Mubuku.
Owner of site: Not known.
Present use: Medicinal, by local community.
State of preservation: None.
Protection status: None.

Geological description: The springs issue clear water. Surface geothermal manifestations in the area includes travertine moulds, intermittent feeble gaseous emissions (H_2S) and hot water with a temperature ranging from 40° (warm) to 69°C degrees (hot spring). The area is underlain by fractured crystalline basement rocks (granite gneisses), along river Rwimi gorge,

flowing into Mobuku river gorge. The river gorges seem to be fault lines, structurally controlling the hot water flow (Kato 2006), (Plate 1, Figs. 1−3).

3.1.2. Sites indicating past geothermal activity (Addendum)

3.1.2.1. Kibuku

General description: Rather limited outcrop of travertine layers.
Type of geosite: Natural/geological.
District: Bundibugyo.
Access: Fort Portal Bundibugyo road, branching off to Kibuku (new road construction is going on, therefore easier access will be possible in future, however, it needs a guide to find the place).
GPS coordinates: UTM/UPS WGS 84; 36N 193043/102193, altitude 728m.
Size of site: Approx. 50x30m.
Owner of site: Not known.
Present use: None.
State of preservation: Not preserved.
Protection status: None.

Geological description: Travertine layers indicate past geothermal activity. The deposits (Plate 2, Figs. 1−2) overlay upraised clastic rift sediments at the margins of the northern slopes of Mt. Rwenzori.

3.1.2.2. Kihyo

General description: Rather big outcrop of travertine.
Type of geosite: Natural/geological.
District: Kasese.
Access: Kampala-Kasese road, branching of at Hima (near Hima Day Adventist Church) to the right, follow the gravel road for about 8 km to river Kihyo.
GPS coordinates: UTM/UPS Arc 1960; 0182049E/0041165N
Size of site: Exact size is not known.
Owner of site: Not known.
Present use: The deposit is earmarked to be mined.
State of preservation: Not preserved.
Protection status: None.

Geological description: Large travertine outcrop indicating extensive past geothermal activity (Plate 2, Figs. 3−4). Other travertine occurrences found in Kasese district are located at **Kikorongo** (Plate 2, Fig. 5, GPS co-ordinates; UTM/UPS Arc 1960; 0033402E/0000903N) and **Bugoye** (Plate 2, Fig. 6; GPS co-ordinates; UTM/UPS Arc 1960; 0172004E/0032747N).

3.1.3. Bujagali falls

The site has been described in the final document (revised version, 29.04.2011). However, it can be mentioned, that further downstream along river Nile two more scenic falls occur; **Kalagala** and **Isimba** falls.

4. Archaeological sites (Addendum)

4.1. Ntusi

The site has been described in the final document (revised version, 29.04.2011). However, it can be mentioned that just 13 km north of Ntusi earthworks a similar archaeological but also cultural traditional site is located. The site is called **Bigo Byamugenyi**, and comprises of a network of ditches extending over several kilometres in length.

4.2. Kimera-Ngogwe

General description: Ancient mining site.
Type of geosite: Archaeological but also cultural/traditional.
District: Buikwe.
Access: Kampla-Jinja road, branching off at Lugazi to the right, Kimera-Ngogwe site is about 7 km south of Ngogwe-Si road.
GPS coordinates: UTM/UPS Arc 1960, 0498934E/0022176N.
Size of site: Immediate site 30x30m.
Owner of site: Ssemakula Tonda.
Present use: None.
State of preservation: None.
Protection status: None.

Geological description: The surrounding rocks are Proterozoic quartzites, but the area is mostly covered with lateritic soils. The iron ore is reported to appear in haematite and magnetite boulders, implying a secondary origin of the ore. However, the site need to be re-visited and explored with modern methods (Plate 3, Figs. 1−3).

References

Armannsson, H., Bahati, G., Kato, V. and Data, G. (2005). Preliminary investigations of geothermal areas in Uganda, other than Katwe-Kikorongo, Burunga and Kibiro. Unpubl. report, Department of Geological Survey and Mines, Uganda, Entebbe, 18 pp.

Kato, V. (2006). Progress report on geothermal reconnaissance survey of Uganda. Unpubl. report KVK/47, Department of Geological Survey and Mines, Uganda, Entebbe, 13 pp.

PLATE 1: Rwagimba

Fig. 1. Water sampling at the spring.

Fig. 2. Kids enjoying the warm water.

Fig. 3. Hot spring water flows over travertine rocks.

PLATE 2: Kibuku

Fig. 1. Travertine at Kibuku.

Fig. 2. Blocks of well stratified travertine.

Kihyo

Fig. 3. Rather huge travertine deposit at Kihyo.

Fig. 4. Massive travertine outcrop.

Kikorongo, Bugoye

Fig. 5. Well layered travertine as seen at Kikorongo.

Fig. 6. Travertine terraces at Bugoye.

PLATE 3: Kimera-Ngogwe

Fig. 1. Nowadays iron works at Kimera-Ngogwe.

Fig. 2. Entrance of the tunnel leading to the iron rich rocks.

Fig. 3. Close view of the entrance.