Geology of the Bisil Region, Kenya

GEOLOGIC HISTORY

PLEISTOCENE:
Singaraini Basalts (2.31 - 2.33 Ma): these olivine basalts feature bouldery outcrops and occasionally, small visible feldspar phenocrysts. See Baker and Mitchell (1976) for a discussion regarding previous correlations and dating of this formation.

MIOCENE
Kapiti Phonolite (12.9-13.4 Ma): large (<76 mm) white feldspar and nepheline phenocrysts make this phonolite quite distinctive. The formation is about 100m thick near the edge of the rift valley, with individual flows being around 30m thick each. The upper surfaces of the flows are sometimes vesicular and glassy. These phonolites were erupted onto the eroded, irregular, surface of the underlaying metamorphic rocks.

BASEMENT SYSTEM:
Precambrian metamorphic rocks exposed in this region are part of the Mozambique Belt. These rocks experienced significant thermal events during the Neo-Proterozoic and biotite K-Ar dates suggest cooling and uplift during the Cambrian. The Mozambique Belt represents the closure of the Mozambique ocean during the Pan-African Orogeny, and the metamorphic rocks are thought to be the altered sediments associated with that ancient ocean (Nyamai et al., 2003).

Deposition may have commenced around 1.4 Ga, with major metamorphic events at 800 Ma and 600 Ma (Warden & Horkel, 1984). Bauernhofer et al. (2008) provide an evolutionary model for the Taita Hills, starting with rifting of Rodinia, island arc formation, followed by accretion and continental collision. Note that the Mozambique Belt is composed of migmatites and high-grade metasediments in Kenya, but similarly aged material in Ethiopia and Somalia are of lower metamorphic grade (Baker, Mohr & Williams, 1972).

The high-grade paragneisses in SE Kenya are part of the Turoka series, which was divided into the Upper, Middle and Lower Groups by Matheson (1966), but the terms Kurase and Kasigau are more frequently used. These rest on a lower succession of psammitic gneisses, likely representing deep water deposition. The Turoka Series rocks are predominantly metamorphosed shallow marine sediments. While these rocks are all migmatized to some degree, the sedimentary origins for the bulk of these rocks is still easily recognized (Matheson, 1966).

The Kurase Group and Sobo Formations are represented by dolomitic marbles, quartzites and metapelites that grade into banded bioite gneisses. These have been interpreted as representing a former shallow shelf environment with associated carbonate swells (Warden & Horkel, 1984).

The Kasigau group, is composed of thick quartzo-feldspathic gneisses that grade upwards into banded biotite gneiss. These have been interpreted as arkose, greywackes, and basic lavas deposited within a subsiding basin (Warden & Horkel, 1984).

The previous basement the original sediments were deposited on is not well understood due to the subsequent deformation. However, it has been suggested that the extensive migmatite complexes, mantled gneiss dome cores, and granulites may be the remains of a granitoid gneissic basement that predated the Turoka sediments (Warden & Horkel, 1984).

Ultramafic complexes occur at the contact between the Kurase and Karigau facies, which has been interpreted as a reworked ophiolite suture. These are best developed to the east of the mapped area as part of the Voi Suture Zone (Warden & Horkel, 1984, Nyamai et al. 2003).

Kurase Group
--> Upper Group: dominated by limestones
--> Middle Group: dominated by quartzites
Kasigau Group
--> Lower Group: banded gneisses with abundant garnet but lacking kyanite and sillimanite.

The Kurase to Kasigau groups show a facies change towards the east from shallow water to deeper water. The uppermost shelf deposits are found east of Nairobi, and the present scapolite-bearing gneisses indicate there had been evaporites in that region (Nyamai et al. 2003).

These sediments have been subjected to several deformational stages (descriptions below from Warden & Horkel, 1984, ages from Mosley 1993) with all but the most recent sediments reaching upper amphibolite/granulite grade (Nyamai et al. 2003):

F1 (830-800 Ma): formed recumbent, isoclinal folds in the shelf sediments and more open folds in the ancient rift sediments, both with NNW axial trends. The change in style reflects different rock competencies between these sediments.

F2 (630-580 Ma): amphibolite & granulite facies metamorphism plus migmatization. Highly mobile slip and flow folds with NNE trending axes were also formed during this deformational event.

F3 (560-520 Ma): this concluding deformational phase finished the suturing in SE-Kenya. High temperature, low pressure metamorphism was followed by retrograde metamorphism and cataclastic fracturing. This period also controlled the emplacement of pegmatites and the overall jointing pattern seen in the metamorphic rocks today. The regional metamorphism was also associated with hydrothermal activity, metal mineralization, and widespread resetting of radiometric ages to around 550Ma (Nyamai et al. 2003).

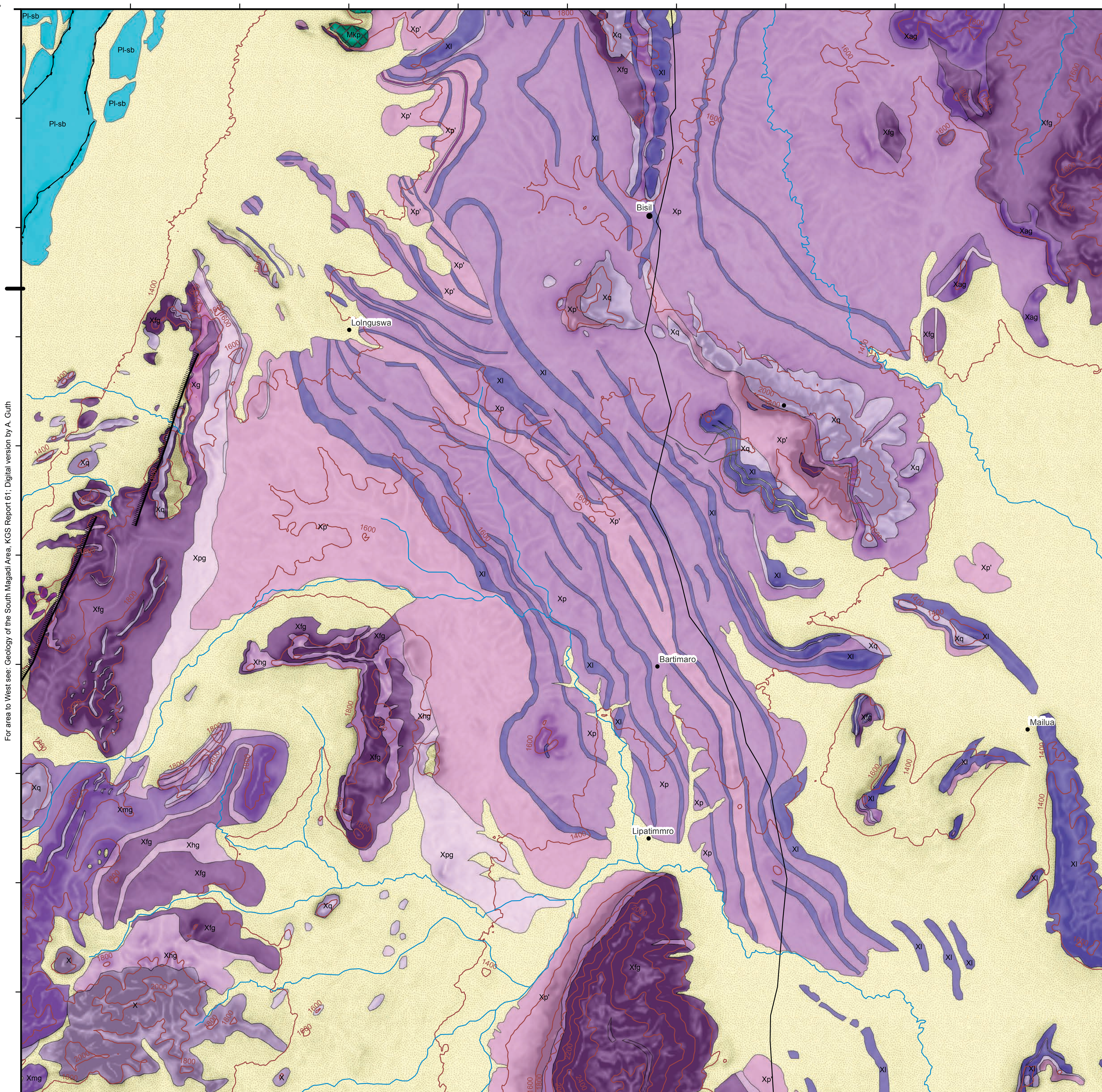
The east and west edges of the metamorphic exposure in southeast Kenya, represented by the Kajiado and Taita-Taveta regions, have narrow marble units that are considered to be tectonically related, possibly through nappe folds (Nyamai et al. 2003).

SUB-MIOCENE BEVELS AND UPLIFTS
These pre-rift rocks have been affected by erosion, peneplaination, and several periods of uplift, such that several widespread bevels have been recognized in the region. Saggerson and Baker (1965) mapped three such bevels and attributed them to the Cretaceous, sub-Miocene and end-Tertiary.

For area to North see: Geology of the Kajiado Area, KGS Report 70; Digital version by A. Guth

For area to West see: Geology of the South Magadi Area, KGS Report 61; Digital version by A. Guth

For area to East see: Geology of the Sultan Hamud Area, KGS Report 29



0 5 10 20 30 Kilometers

N S E W

Legend

- Pl-sb Singaraini Basalt
- Mkp Kapiti Phonolite

Metamorphic

- X Metamorphic, Undiff.
- G Intrusives

Kurase Group

- Xl Crystalline Limestone
- Xp Undiff. Pelitic host
- Xq Quartzite
- Xp' Undiff. Semi-pelitic host

Karigau Group

- Xfg Feldspathic Gneiss
- Xmg Muscovite-Biotite Gneiss
- Xpg Hornblende Pyroxene Gneiss
- Xag Augen Gneiss
- Xbg Biotite/Banded Gneiss
- Xhg Hornblende Gneiss
- Xkg Kyanite Gneiss
- Xg Granulites

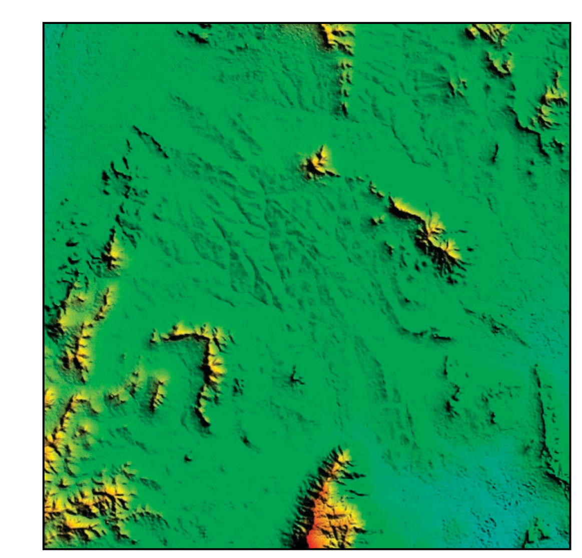
- faults-large
- faults-small
- City
- Town
- Village
- 200m-contour
- rivers
- Road-major
- Road-minor
- Road-track
- rail

STRUCTURE
The metamorphosed sediments that comprise the basement series exposed in this area were affected by orogenic folding that produced a general NNW-SSE foliation.

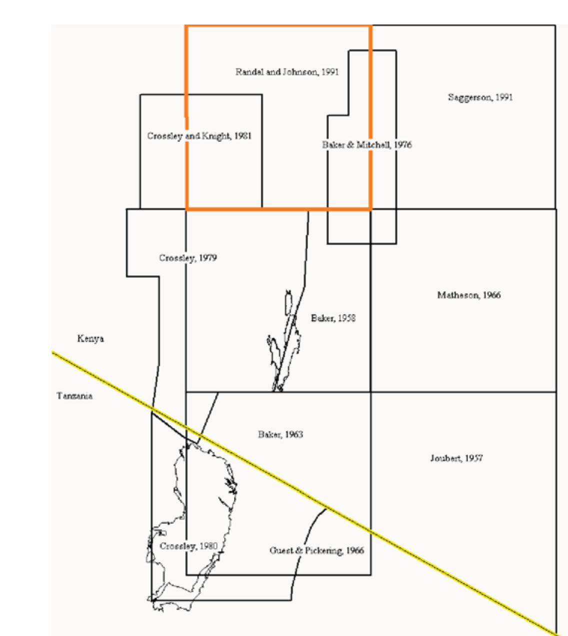
ECONOMIC DEPOSITS
Metamorphosed limestones are mined to produce slaked lime for agricultural and other uses. Diatomite deposits are found on the rift floor at the sites of ancient lakes.

WATER RESOURCES
Water is scarce as there are no perennial rivers. Water can be obtained from the river bed of the Kajiado River, but much of the population in this area depends on boreholes. The most accessed horizons are the biotite gneisses, or the contact between the metamorphic rocks and the volcanics. There are also some springs located on the Ol Doinyo Narok Plateau.

GEOTHERMAL PHENOMENA
There is no known geothermal phenomena in this map area.



Colored DEM with hillshade for the mapped region.
Elevation range from 1153 - 2521m (cyan - red).



Reference map showing the source maps and their geographic coverage

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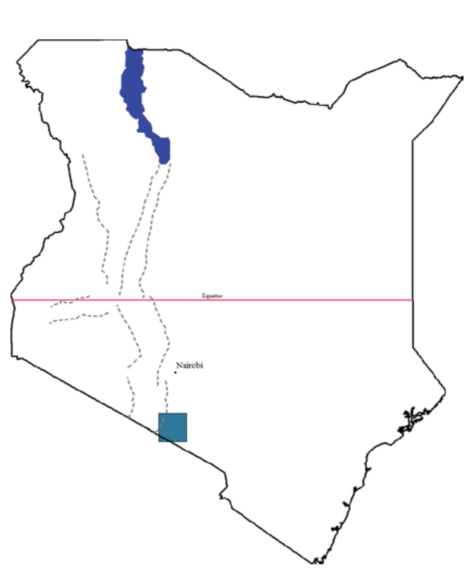
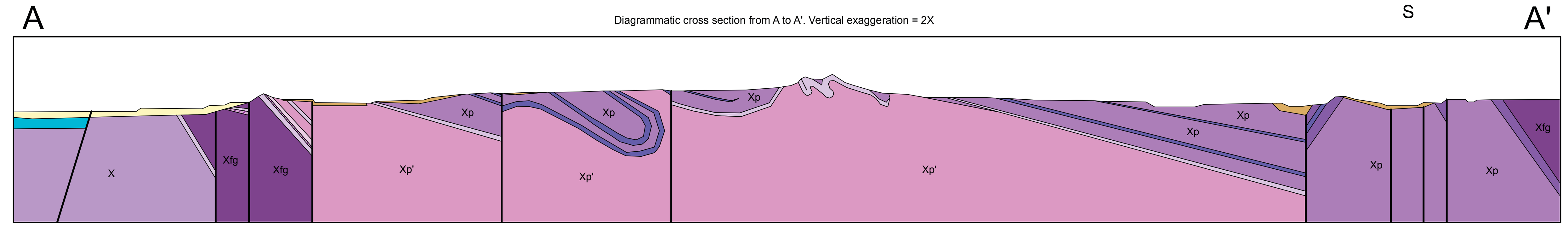
Cross Section Legend

- Lacustrine Sediments
- Metamorphic soils
- Singaraini Basalt
- Undiff. Pelitic
- Crystalline Limestone
- Quartzites
- Undiff. Semi-Pelitic
- Quartzo-Feldspathic Gneiss
- Augen Gneiss
- Hornblende Schist
- Hornblende Pyroxene Gneiss
- Metamorphic, Undiff.



Above: Location of presented geologic map (grey-square) iin relation to the major rift bounding faults and Lake Turkana.

Diagrammatic cross section from A to A'. Vertical exaggeration = 2X



Geological Map of the Southern Kenya Rift

contour interval 200m

Location: Bisil, Kenya 36.5 E - 37.0 E, 2.0 S - 2.5 S	A. Guth, J. Wood (2013)
Coordinate System: Geographic WGS84	Michigan Technological University

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