Geotherm Project with Kenya: Airborne Thermal Survey „Silali Geothermal Prospect“

Background

The Programme „Geotherm II – promoting geothermal development through capacity building and political advice“ is executed by the BGR and KfW on behalf of the BMZ.

Therefore, an Airborne Thermal Survey at the „Silali Geothermal Prospect“ between middle of January and beginning of February 2012 in cooperation with Kenyan and German partners has been conducted.

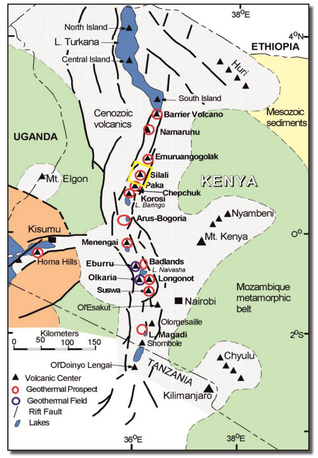
The project aims to support the „Geothermal Development Company (GDC)“ as partner of the BGR by the exploration of geothermal energy resources.

The thermal images provide a faster and more precise exploration of the survey area by locating thermal anomalies.

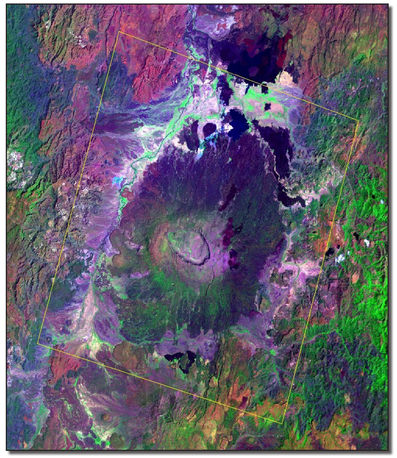
Additionally, an airborne laser scanning flight was conducted to demonstrate how advanced remote sensing techniques can contribute to make planning of future geothermal infrastructure more effective.

One core component of this work is the training of the local experts.

Survey Area



Sketch of the Kenya rift showing the location of Silali geothermal prospect (yellow rectangle).



Landsat 5 satellite image of Silali volcano (RGB composite B7/R, B4/G, B1/B); yellow frame shows the extent of the survey area.

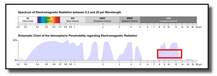
Infrared Thermography

Infrared thermography is a method that detects and records energy emitted from an object at the earth surface. Chiefly utilized wavelength ranges are from 3 to 5 µm for “high temperature targets” (MWIR) and 7.5 to 14 µm for “moderate temperature targets” (portion of LWIR).

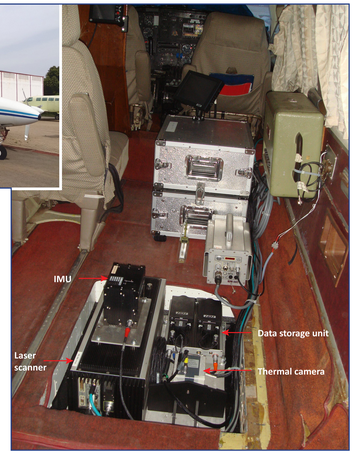
Infrared thermography makes it possible to visualize temperature distributions over wide areas, even if the areas are of large extent and hard to access by ground-based survey methods.

The thermal camera IGI DigiTHERM captures the energy emitted from the earth’s surface in the wavelength range between 7.5 and 14 µm and displays it as an image, which allows high-resolution area-wide surface temperature detection and evaluation.

Piper Navajo used for thermal survey and airborne laser scanning mission.



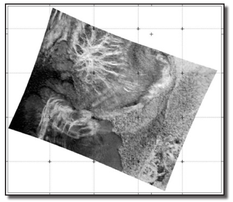
Spectrum of Electromagnetic Radiation; red rectangle shows the temperature detection range of IGI DigiTHERM thermal camera.



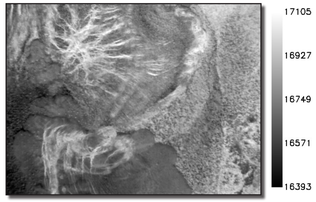
Mounted equipment (thermal camera IGI DigiTHERM, Riegl scanner LMSQ 560, Flight Navigation System, IMU Aero Control).

Pre-Processing

Original single thermal image in IRB-Format (for IRBIS only).



Single thermal image after ortho-rectification in 16Bit Tiff format.



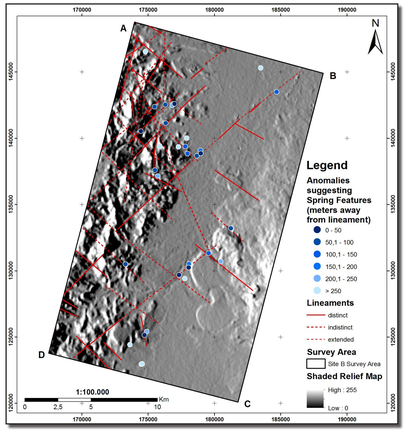
„Original“ single thermal image after transformation in 16Bit Tiff format.

Original single thermal images contain temperature information for every pixel of the image.

Transformation of image in 16Bit Tiff format and the following ortho-rectification of the image are important steps to receive coordinates for every pixel of the image.

Temperature range function converts 16Bit digital number values of pixels to temperature values again.

Analysis of Thermal Anomaly - Spring Feature



Lineaments (red) and all 32 thermal anomalies suggesting springs (blue) identified over ASTER-GDEM-based shaded relief map.

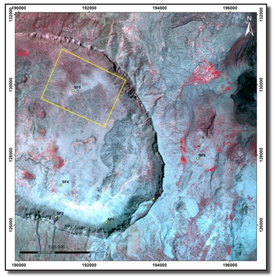
Spring with 36°C.

The analysis shows that possible spring features often correlate with lineaments and intersection of lineaments.

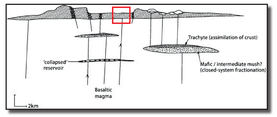
This result is significant for geochemical sampling of the spring features.

Air photo of spring feature.

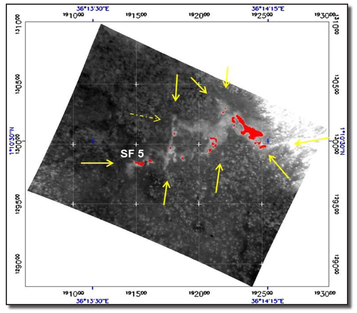
Analysis of Thermal Anomaly - Fumarole Field No. 5



Subset of SPOT-image; yellow frame shows outline of thermal image covering fumarole field No. 5.



Main storage reservoirs taken to be sill-like (section taken from Macdonald, 2012).



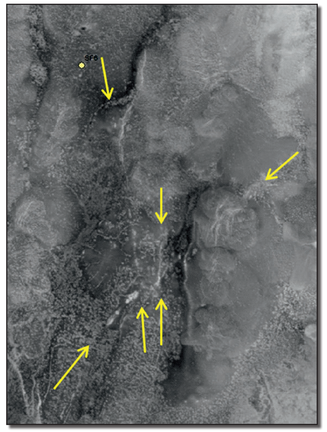
Single thermal image showing fumarole field No. 5; yellow arrows indicate lineaments visible on thermal image; highlighted in red are temperatures above ~15°C, surrounding temperatures are between 11-12°C.

New findings

Fumarole Field No. 5 was so far known as single point in the field.

Thermal image reveals that this fumarole field actually forms a whole system with a thermally active area of 1.0 km by 0.5 km.

Analysis of Thermal Anomaly - Fumarole Field No. 6



Subset of thermal mosaic on eastern flank of Silali volcano (yellow arrows indicating thermal lineaments).

New findings

The known single anomaly (SF6) is part of an area-wide thermally active fracture system. The thermal lineaments have lengths of 0.5 km to 2.5 km.

This important result contributes to focusing further exploration activities.

Temperature measurement during field work; fumarole has temperature of 82°C.

Completed Tasks during Mission

Record of thermal images for an area of 2,000 km² (40 km by 50 km) with 3 m GSD (pixel) and 1,920 m by 1,440 m FOV (Field of View) per image covered by 6,236 single thermal images.

Survey-synchronous field campaign to check character of fumaroles and hot spots to support interpretation of thermal data.

Training of Kenyan partners in Kenya and Germany in basics of airborne thermal survey including planning issues, quality assessment, aviation matters, data processing, data interpretation, etc.

Overview map of all thermal anomalies.

Field verification of thermal anomalies identified on thermal mosaic.

Detailed analysis of thermal anomalies in two defined priority areas.

Accompanying review of geological knowledge through interpretation of satellite images (Landsat TM, Spot 5, ASTER).

Airborne laser scanning flight (ALS, LiDAR) for Silali and area south of Silali.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

GEOTHERM
GDC
BGR
SolTec

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