Finding water in one of the world's largest refugee camps

Lake Turkana is the world's largest permanent desert lake and the largest alkaline lake. In this part of Africa, precipitation is scarce and arrives as big torrential events. Thus, the population of Turkana County is entirely dependent on groundwater.

Turkana County, formerly known as Rift Valley Province and located in the northwestern corner of Kenya, is home to what is called the Cradle of Humankind, where some of the oldest human fossils and tools, dating back 3 million years, have been discovered.

Turkana County is Kenya's largest territorial administration measured by land area. Bordering South Sudan and Ethiopia, this county, already Kenya's poorest, has long suffered from humanitarian challenges due to conflicts in neighbouring countries. In 1992, the UN Refugee Agency (UNHCR) built a refugee camp in the town of Kakuma, in the northern part of the county. Since then, the arrival of refugees to the camp has steadily increased, and, according to the latest reports, 275,000 people now live in Kakuma Refugee Camp, making it one of the world's five largest refugee camps.

The geology of the area complicates the water supply: first, it requires very deep wells, in the order of hundreds of metres; and second, the volcanic origin of the rocks where groundwater is located makes the water saline and unsuitable for human consumption.

While the tTEM system is towed by an ATV, it performs electrical resistivity mappings of the subsurface, which can be correlated to the type of geology underneath. For example, bedrock is very resistive, sand less resistive and clay very lowly resistive. ↑

Photo: Aarhus University HydroGeophysics Group

Still, many of the shallower and available water wells in the county, especially in Kakuma, are characterised by old volcanic rocks. This is a great challenge for water distribution in a place where water has become more a question of quantity than quality.

Many people consume highly saline water, which can shorten life expectancy. The water can also contain fluoride, which can lead to skeletal fluorosis (malformation of the bone structure). Luckily, there are other, non-volcanic and shallower structures that recharge during the wet season.

Water dowsing with science

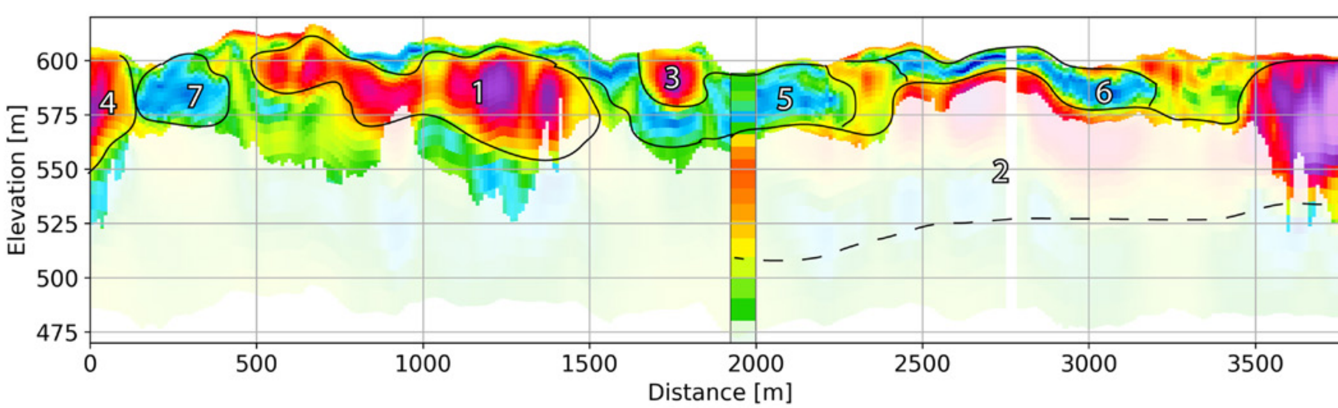
Geophysics can be used non-invasively from the surface to map physical characteristics of the subsurface before making boreholes. In this field of science, the HydroGeophysics Group (HGG) from Aarhus University has been developing electromagnetic groundwater mapping methods for almost 30 years. This has led to several spin-off companies, including TEMcompany, which is backed by the Grundfos Foundation.

Two of the company's instruments, the tTEM and the sTEM, both intended for groundwater mapping, have been purchased by the NGO Water Mission.

These groundwater mapping campaigns aim to target water-bearing structures. During the past three years, HGG has been collaborating with foundations and charity organisations, and helped bring water to nearly 40,000 people in Africa. By financing a groundwater mapping campaign and training local scientists in Turkana, the Grundfos Foundation has made sure that these efforts continue in the right direction and can be scaled up via various strategic partnerships.

On a good day of mapping with two crews of one to two members each, up to 60 km of the subsurface can be revealed by tTEM, achieving an unprecedented level of geological detail and maximising the chances of finding safe and abundant water supplies for the community. By including geophysics at an early stage, drilling can be performed on an educated basis, and sustainable predictions and solutions can be implemented. ●

→ The maps show the location of the Turkana region within the African continent.



The image shows a section covering a 3.7 km stretch of the Tarach river, which crosses Kakuma town. This stretch was covered by the tTEM shown in the photo on the previous page in less than 15 minutes, revealing the resistivity distribution from the surface down to depths of 150 m. The deeper sounding in the middle was obtained with the sTEM. ↑

The profile shows a complicated subsurface, where features 1, 3 and 4 could be good targets for groundwater for human consumption; features 5, 6 and 7 show sediments not suited to groundwater storage; and feature 2 could indicate a big water reservoir appropriate for livestock and irrigation.

Photo: Aarhus University HydroGeophysics Group