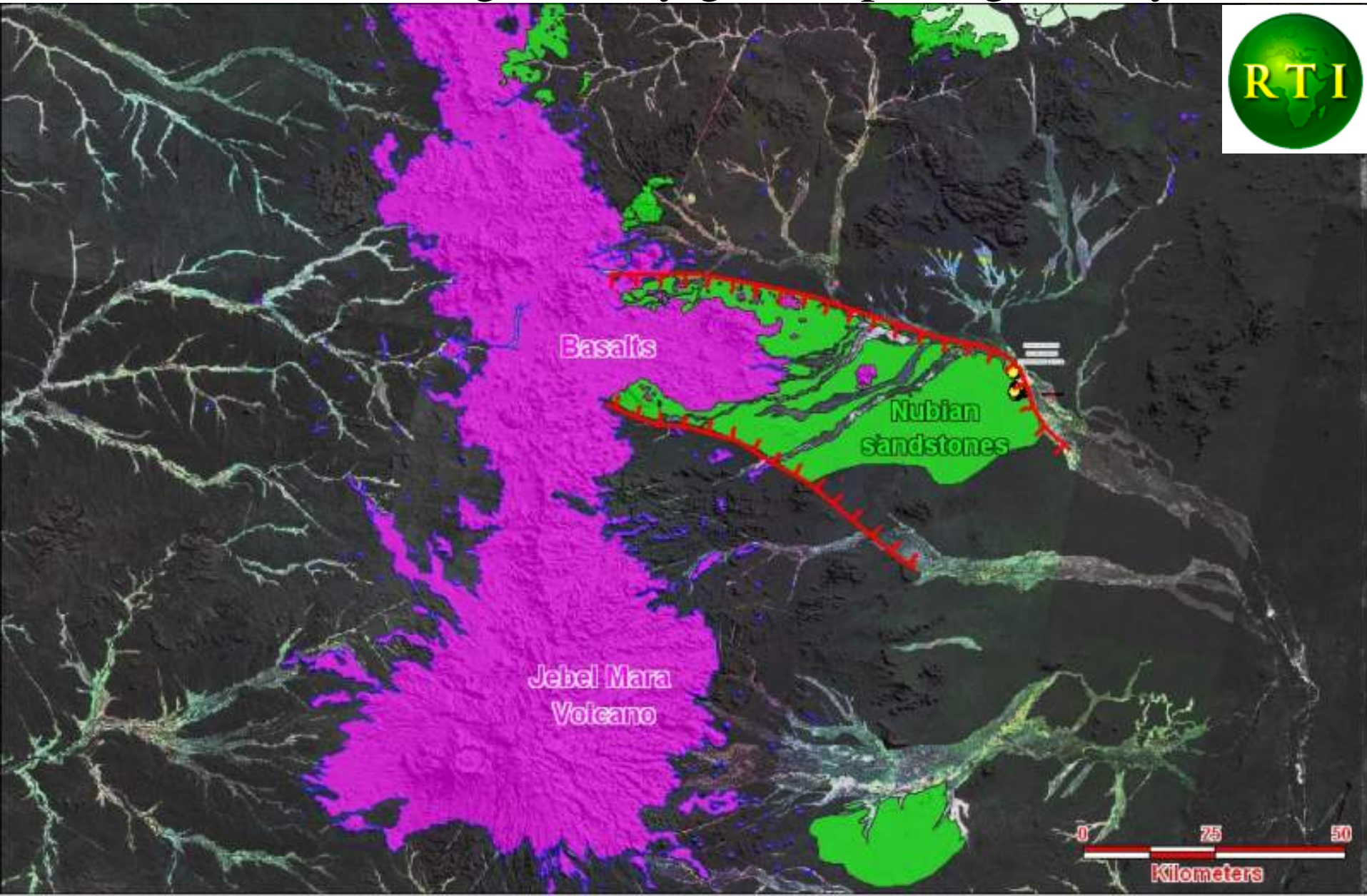


WATEX© can also detect  
Deep aquifers  
Using seismic data

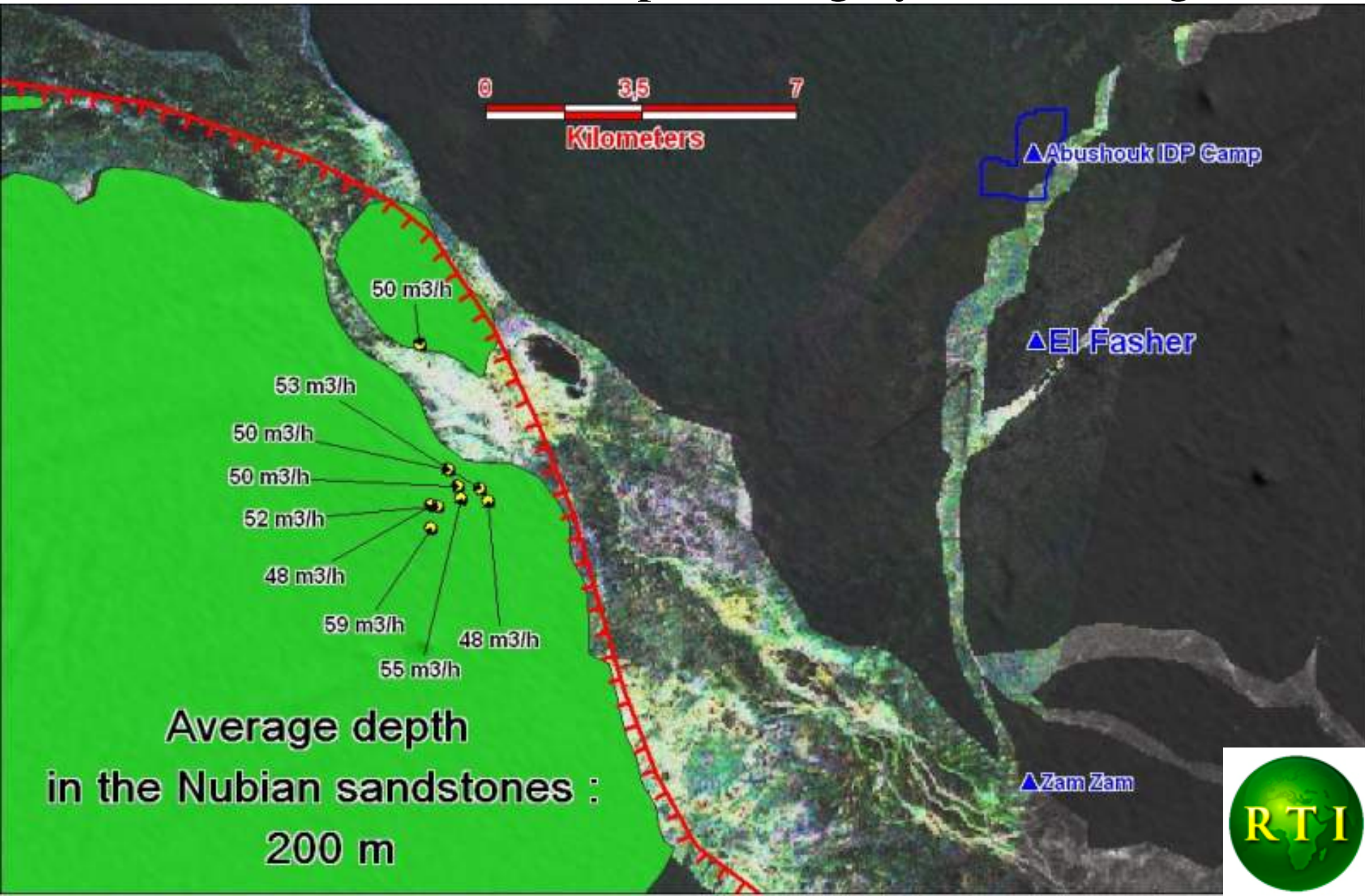


## 9- WATEX© can detect sustainable aquifers within Nubian sandstones in a graben by geomorphologic analysis





9- WATEX© indications confirmed by the El Fasher wells in Darfur drilled @ 200 m deep with high yields in the graben.



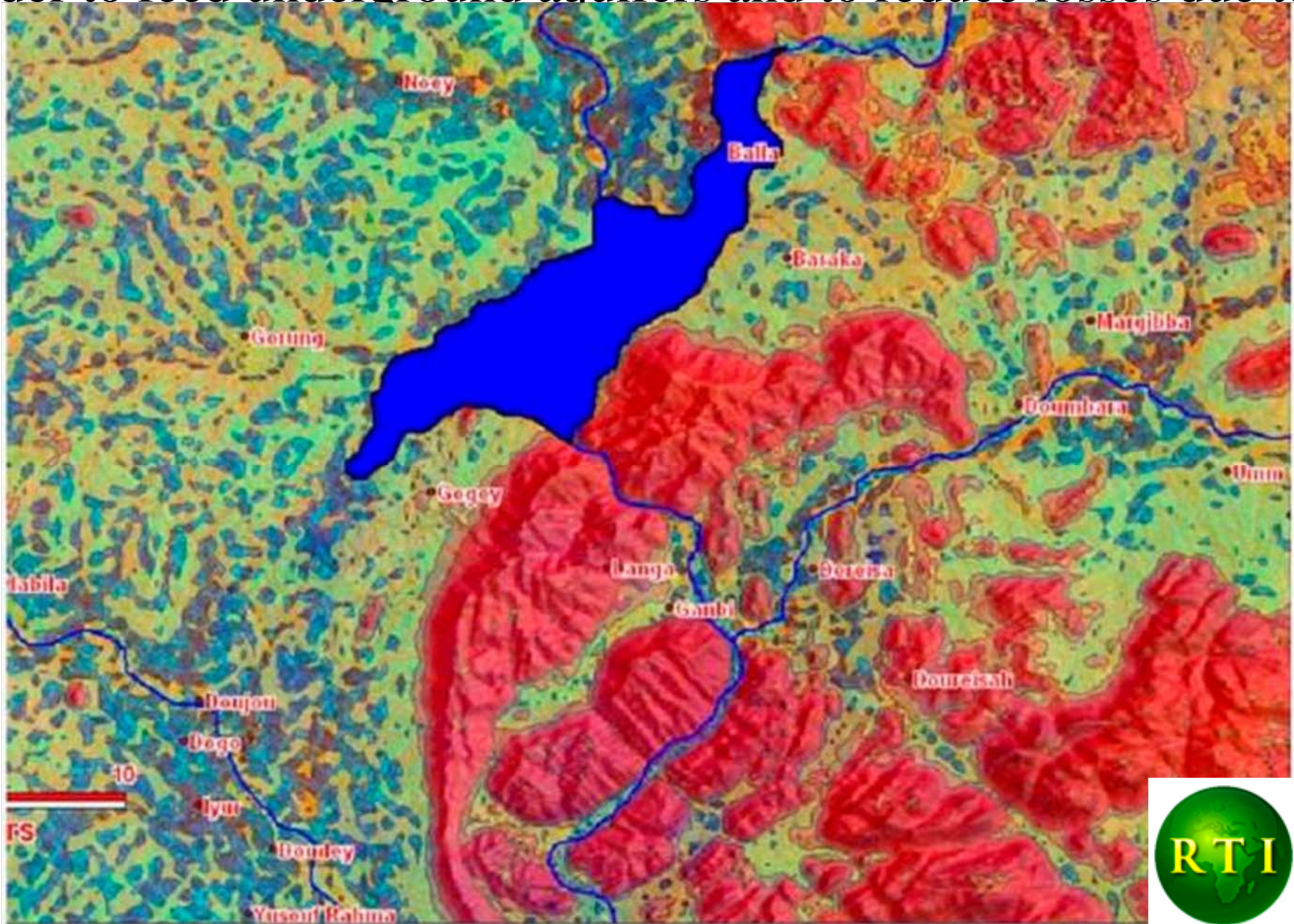
# WATEX© can detect the best microdam sites :

- to replenish buried aquifers
- to increase water circulation within faults
- to reduce soil erosion
- to reduce downstream floods





These micro-dams allow the infiltration of surface water, in order to feed underground aquifers and to reduce losses due to



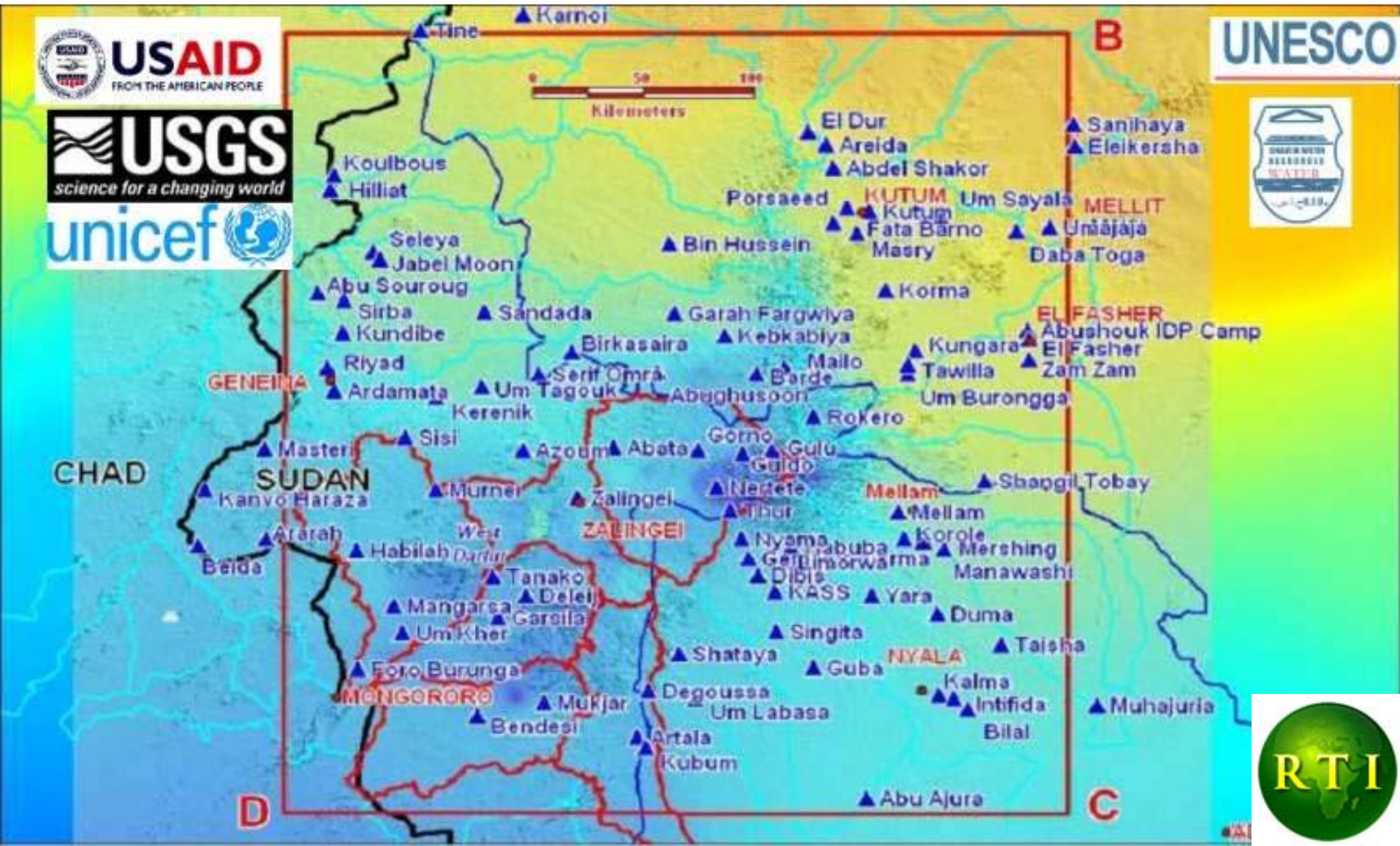


Within the context of sustainable development, WATEX© recommends the creation of micro-dams over key locations, at small scale by the local population, or through the building of





WATEX© in Darfur-Sudan helped UNESCO to drill 1 500 successful wells since 2006, and found enough water for several million persons. Enough water for reconstruction.





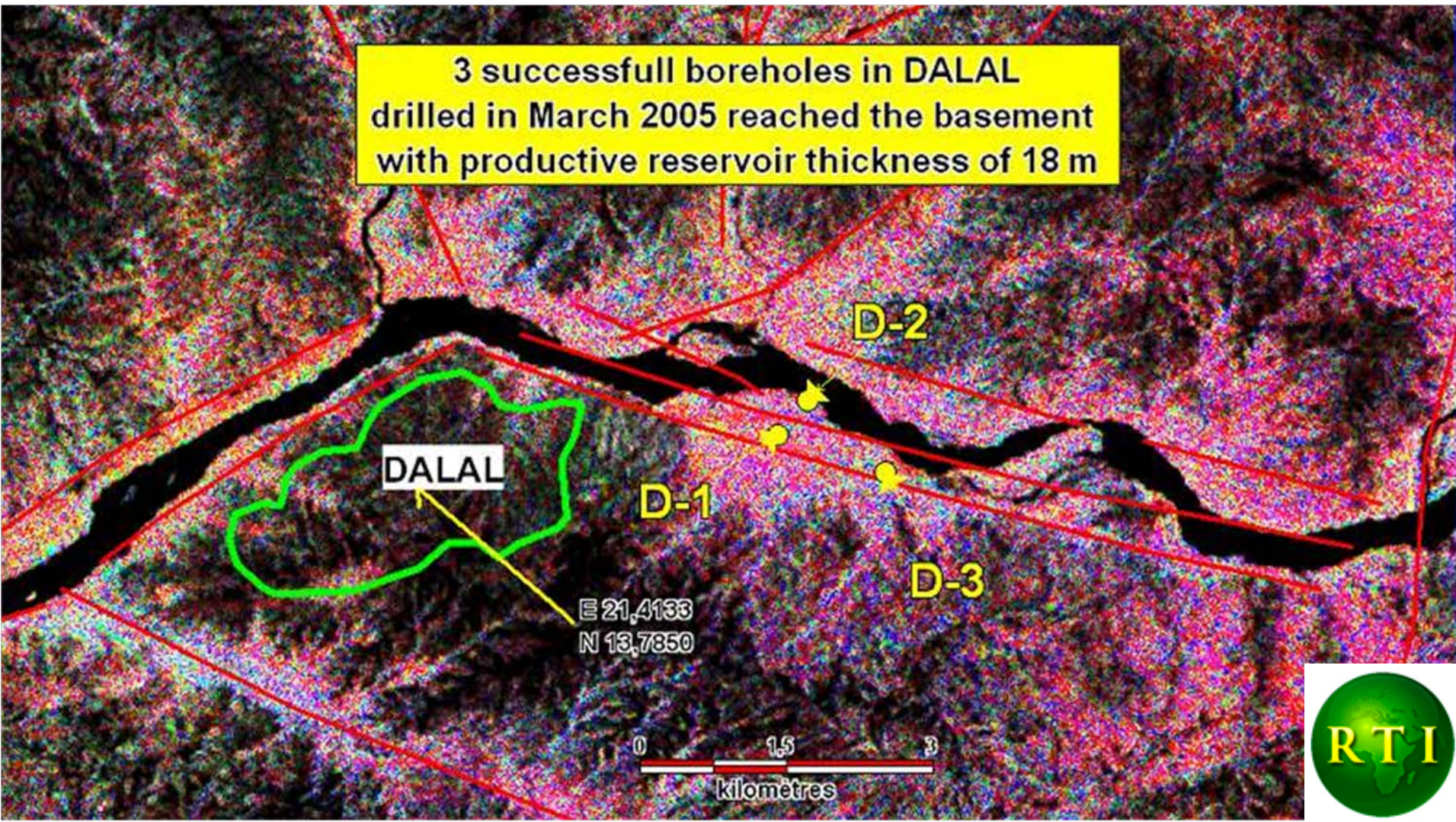
WATEX© application in Chad-  
Sudan to identify the best  
location for refugee and IDP  
camps

EXPRESS SERVICE.





WATEX© system in Chad discovered the Dalal Camp in december 2004 which was successfully drilled in march 2005. This alluvial aquifer is sustainable with vertical recharge





The Dalal-Gaga campsite currently houses 20 000 Sudanese refugees, under the protection of UNHCR.

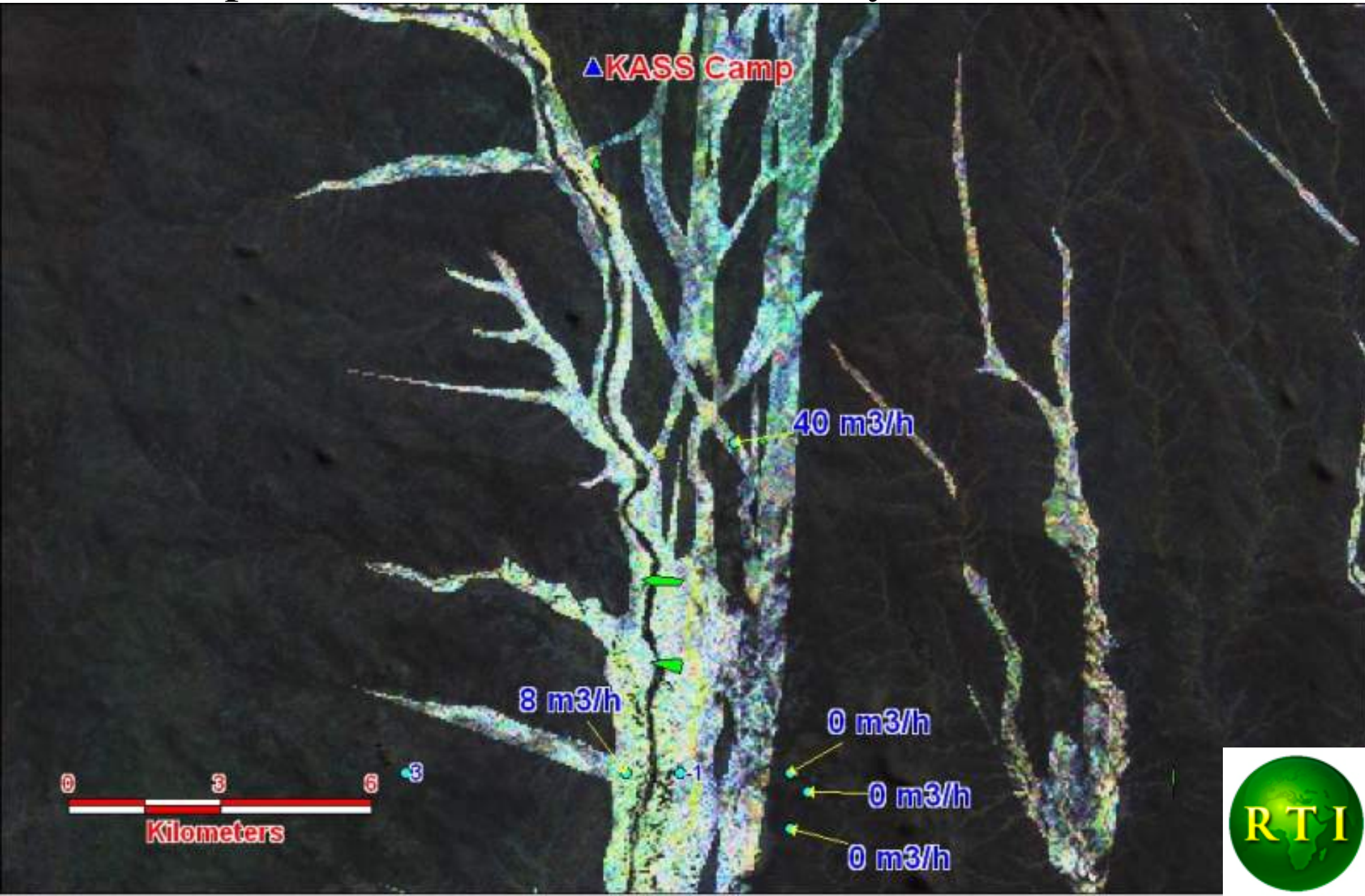




WATEX© can detects groundwater  
circulation through conductive fractures  
down to 100 meters



## 8- WATEX© in Darfur near Kass Camp shows wet fractures deeper than 80 meters successfully drilled in 2006



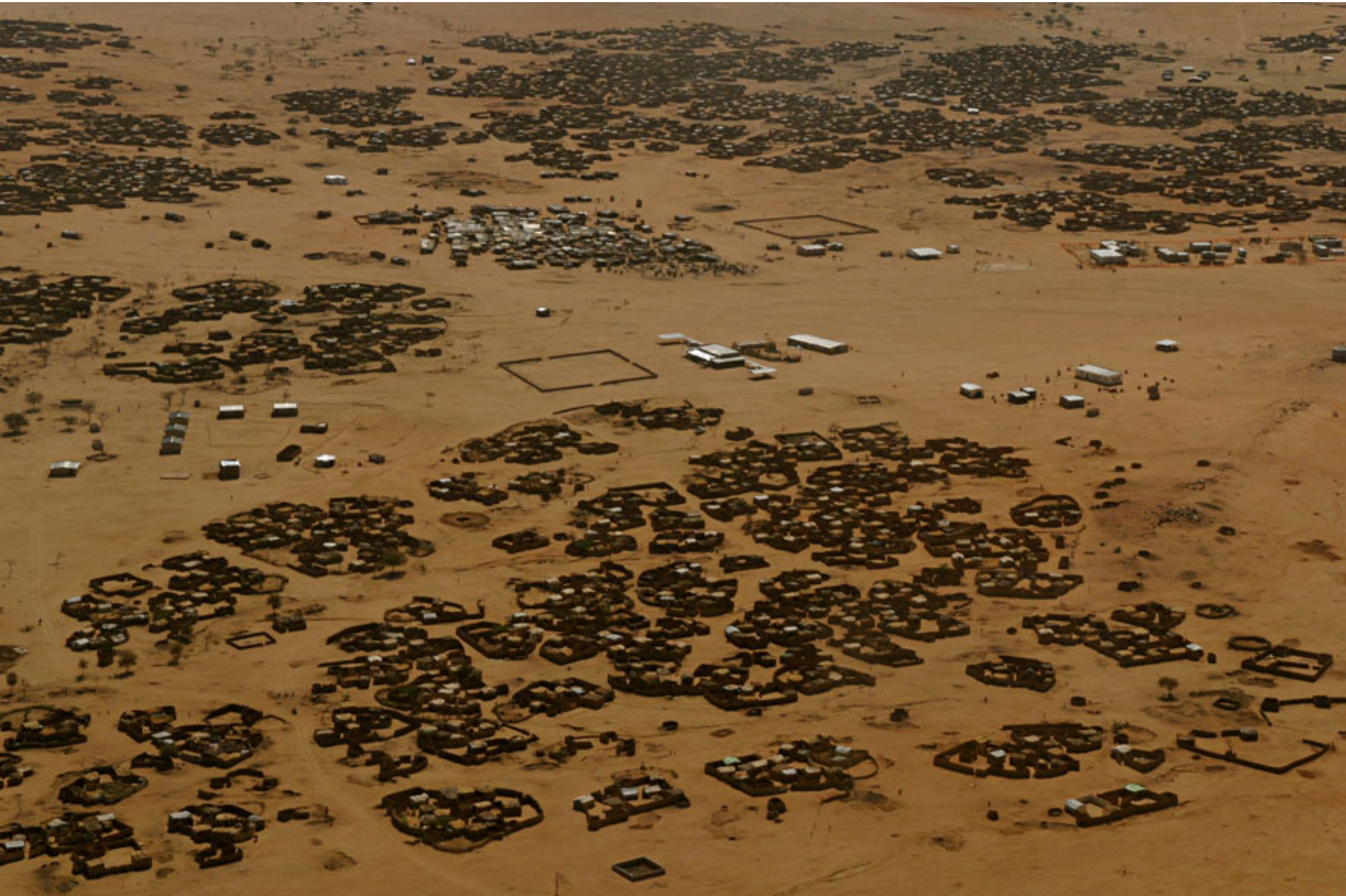
WATEX© application in Chad  
to identify conductive fractures  
and drill wells for the refugees  
of Iridimi Camp

EXPRESS SERVICE.



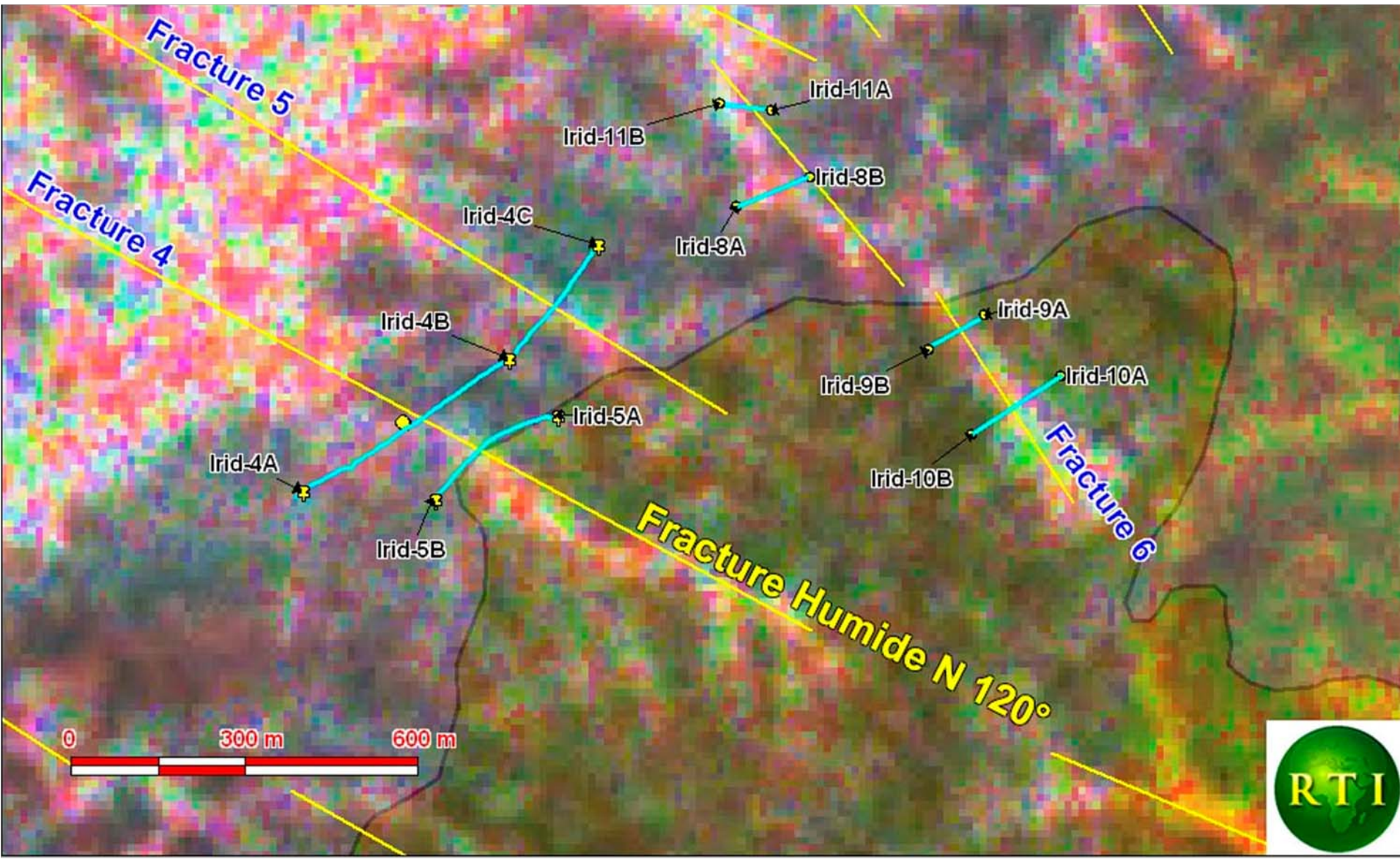


# Iridimi refugee camp hosting 20 000 refugees





WATEX© image showing fractures detected from 800 km high : are they real and detectable by GPR?





We operate a 40 Mhz GPR antenna across the fracture to check its existence and accurate location

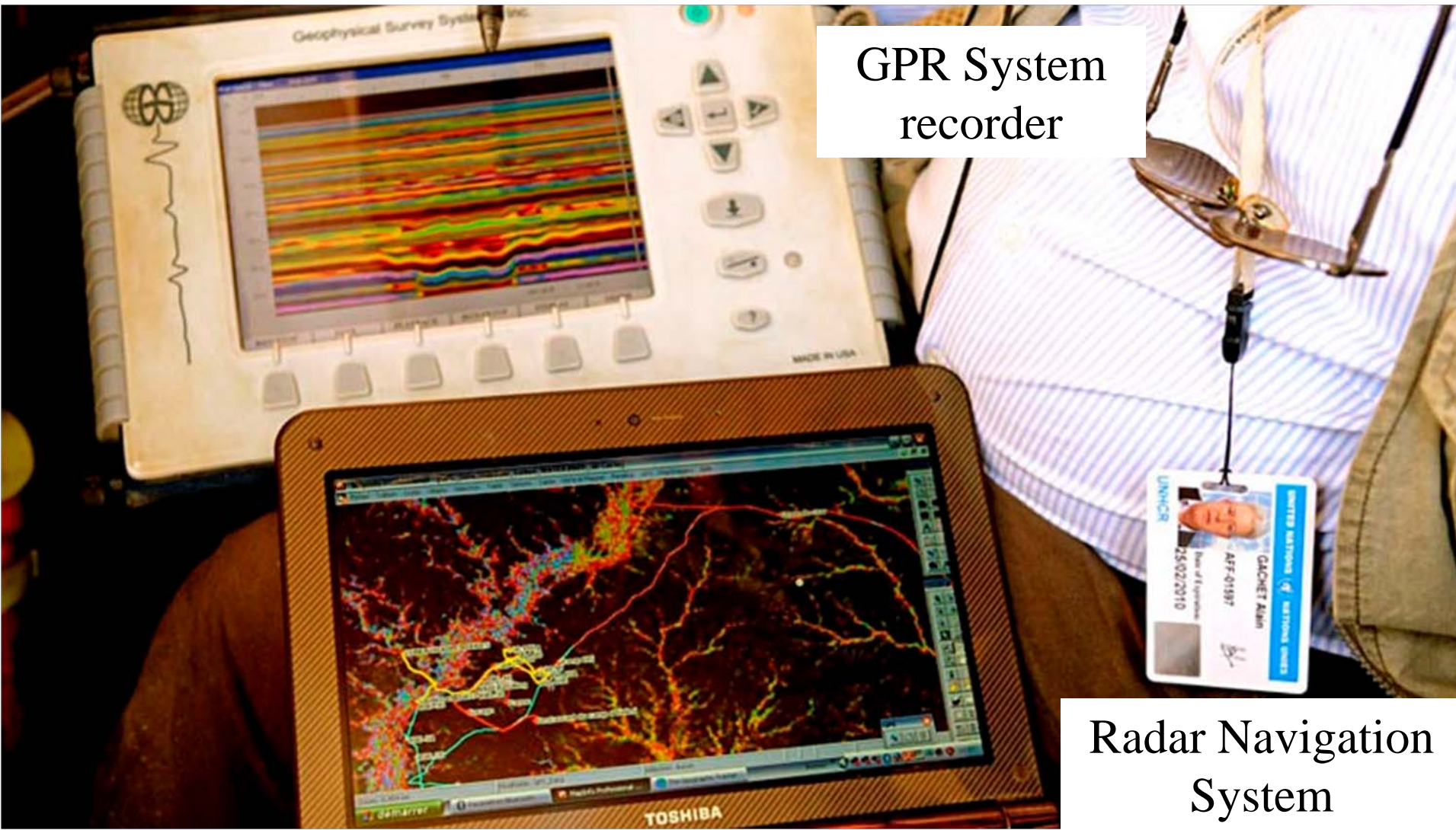




Record completed by a 400 Mhz GPR antenna to check the validity of the WATEX© image with an accuracy : 50 cm



We use simultaneously our radar navigation system while recording the GPR echographies in real time

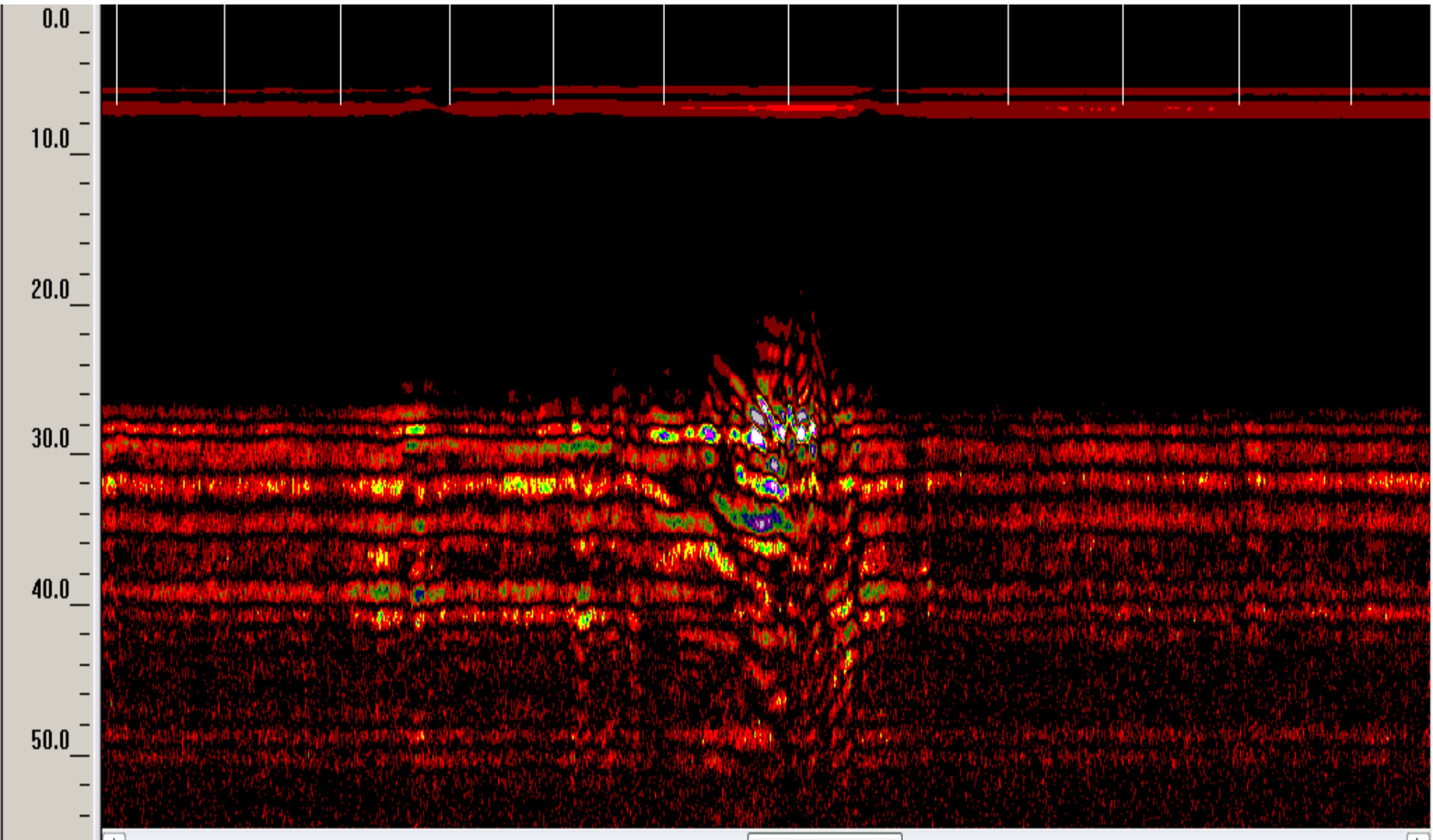


GPR System  
recorder

Radar Navigation  
System



GPR echography confirmed exactly with 50 cm accuracy, the location indicated on the WATEX© image : this fracture is 8 meters broad.



# With this technology, we can drill through conductive fractures with reduced risks.



Drilling down to 60 m.

Red mylonites from surface to 25 m deep, which confirm the fractured zone.

-Grey granites from 26 m to 50 m,

-Oxydized granites from 51 m to 60 m.

-Water struck from 20 to 25 m

-Static level at 14 m





Successfull well for the children of Darfur drilled in this area  
on the NW part of Iridimi camp .





**This job could be achieved in difficult context, thanks to  
MINURCAT Peace Keepers**





Wednesday, May 2, 2007 : 9:40 a.m.

## Remote Sensing Technique in Ground Water Exploration in Sudan

Alain Gachet, Ph.D<sup>1</sup>, Saud Amer, Ph.D<sup>2</sup> and Verne Schneider, Ph.D<sup>2</sup>, (1)Radar Technology France, (2)U.S. Geological Survey

Identification of aquifer potential in Central Darfur over an area of 135000 km<sup>2</sup> has been achieved by Radar Technologies France, USGS and UNESCO in 6 months.

The study was funded by USAID OFDA. The area is the home of most of the IDP's camps, hosting 2.5 million people, where security is a major concern.

Such identification was made possible using the WATEX process based on new radar remote sensing technologies developed and patented by RTF.

This process combined with optical remote sensing, geology, geomorphologic features and climatic data, revealed significant buried aquifers not visible from the surface.

The study has revealed vast stretches of land in central Darfur hosting enough ground water reserves to sustain 33 million people year round with 15 litres of water per day (according to Sphere Humanitarian Charter Standards).

These aquifers are renewable and easily accessible within a depth ranging from subsurface to 50 meters in unconsolidated sediments easy to drill.

Ground Penetrating Radar (GPR) operated by RTF over some aquifers, confirming their depth and structure up to 40m deep. Drilling results collected in Sudan have confirmed the validity of the results with a success rate of 95% on 740 wells and boreholes.

Potential water drilling sites map and drilling manual have been produced and given to NGOs, UNESCO and UNICEF.

**Saud Amer, Ph.D., U.S. Geological Survey** BS: special major/Agronomy, California State Univ., Chico MS: soil and water, Univ. of Arizona, Tucson Ph.D. soil, watershed management and remote sensing, Univ. of Arizona, Tucson. More than twenty years in remote sensing applications for environmental studies. Extensive international experience in many parts of Africa, Central America, Central and South Asia and the Middle East. A member on several science and technical advisory committees for national and international environmental issues. Received several awards for top performance in data processing systems and remote sensing applications.



# WATEX cited by USAID in front of the American Congress in 2007



## INVESTMENTS IN DRINKING WATER SUPPLY PROJECTS AND RELATED WATER RESOURCES ACTIVITIES REPORT TO CONGRESS FISCAL YEAR 2006





## **USAID/OFDA, US Geological Survey, UN and NGO Progress Addressing Groundwater-derived Sustainable Water Supplies for Potable Water and Sanitation Needs in Three Darfur States, Sudan.**

Significant progress has been made in addressing basic potable water and sanitation needs in the three Darfur states since USAID's Office of Foreign Disaster Assistance (OFDA) first sent out Disaster Assistance and Response Teams in 2004. OFDA, NGOs, UN agencies and implementing partners have made considerable advances providing water/sanitation to the internally displaced persons and affected populations in the region. However, gaps remain while the need for potable water for affected populations increases. Reliable hydrogeological studies, data and information are limited and groundwater sources have been developed without understanding characteristics of the underground aquifers. This has had significant impact on the ability to plan, organize, and implement a sustainable and effective potable water strategy for the region in response to the current humanitarian crisis and future development activities.

In 2005-2006, OFDA provided funding for a Darfur Groundwater Exploration Project to address the water supply sustainability issue. OFDA, US Geological Survey (USGS), a remote sensing/ hydrogeology firm, and UNESCO worked together to better understand aquifer potential in Darfur. The WATEX process,<sup>9</sup> based on new radar remote sensing technologies combined with optical remote sensing, geology, geomorphologic features and climatic data, revealed significant aquifers not visible from the surface which could provide sustainable water supplies for humanitarian assistance. Ground Penetrating Radar was used over various aquifers in Sudan to verify the results of the study. Potential water drilling site maps and a drilling manual have been produced and NGOs, UNESCO and UNICEF have been trained on the use of these products. UNICEF has been already begun using these maps to provide water to IDPs in Darfur.

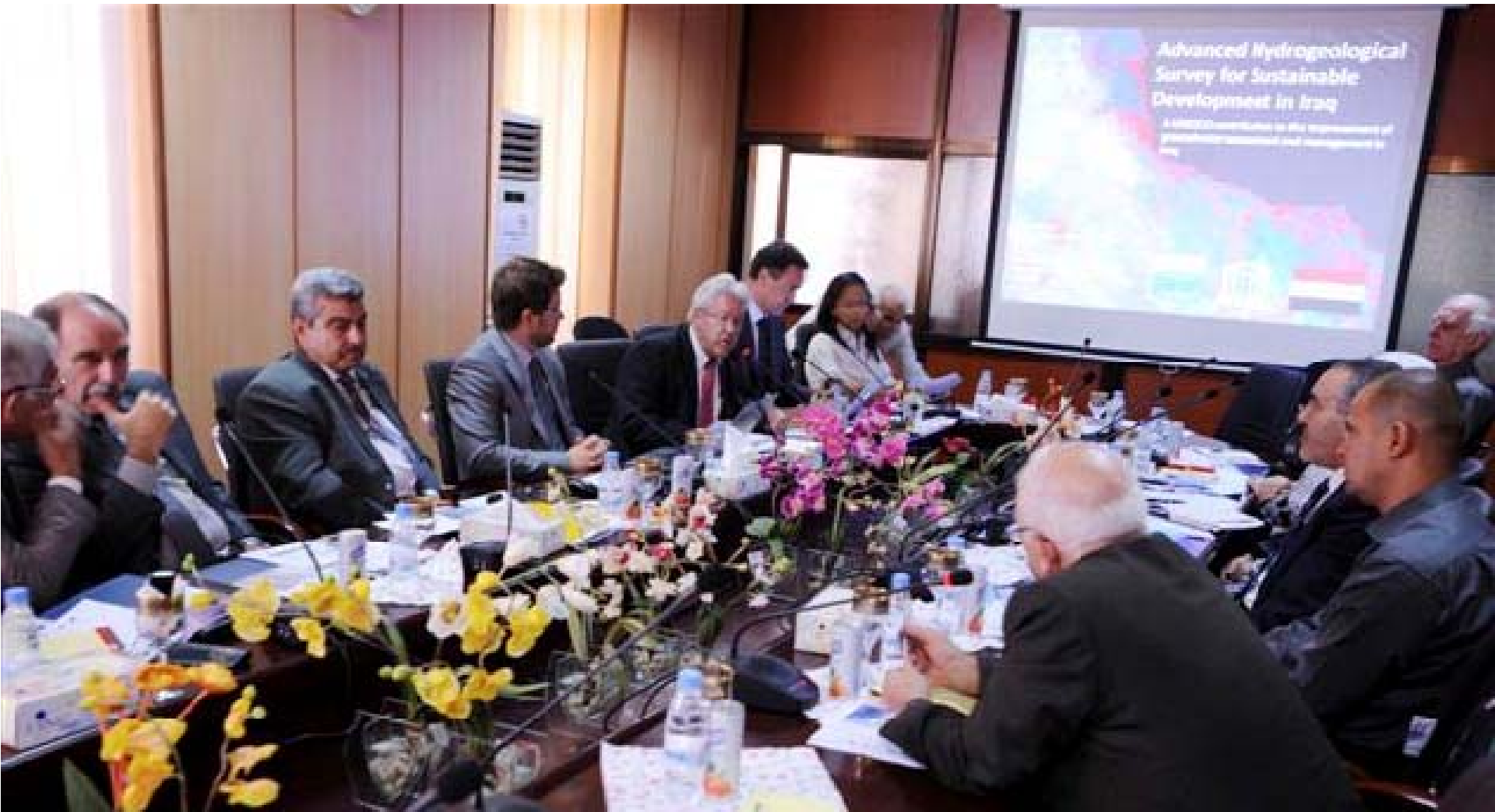
<sup>9</sup> A specific groundwater exploration process used for identifying potential groundwater resources

# WATEX© training in Khartum for 40 NGOs with UNESCO, UNICEF, USGS by RTI





# WATEX<sup>®</sup> presented and adopted by PM Cabinet and EU in Baghdad last July 2011 For Post-Conflict reconstruction



# Project declared strategic and urgent





# WATEX recently used for emergency situations for the Horn of Africa crisis

November 2011 expedition in Dolo  
Ado Camps in Ethiopia



# Djibouti, Ethiopia, Eritrea, Kenya, Somalia and Yemen

As of January 2010



FIGURE  
Road Network and  
Coordinate Support System  
Division of Operational Services

Source:  
UNHCR, Global insight digital mapping  
© 2008 Europa Technologies Ltd

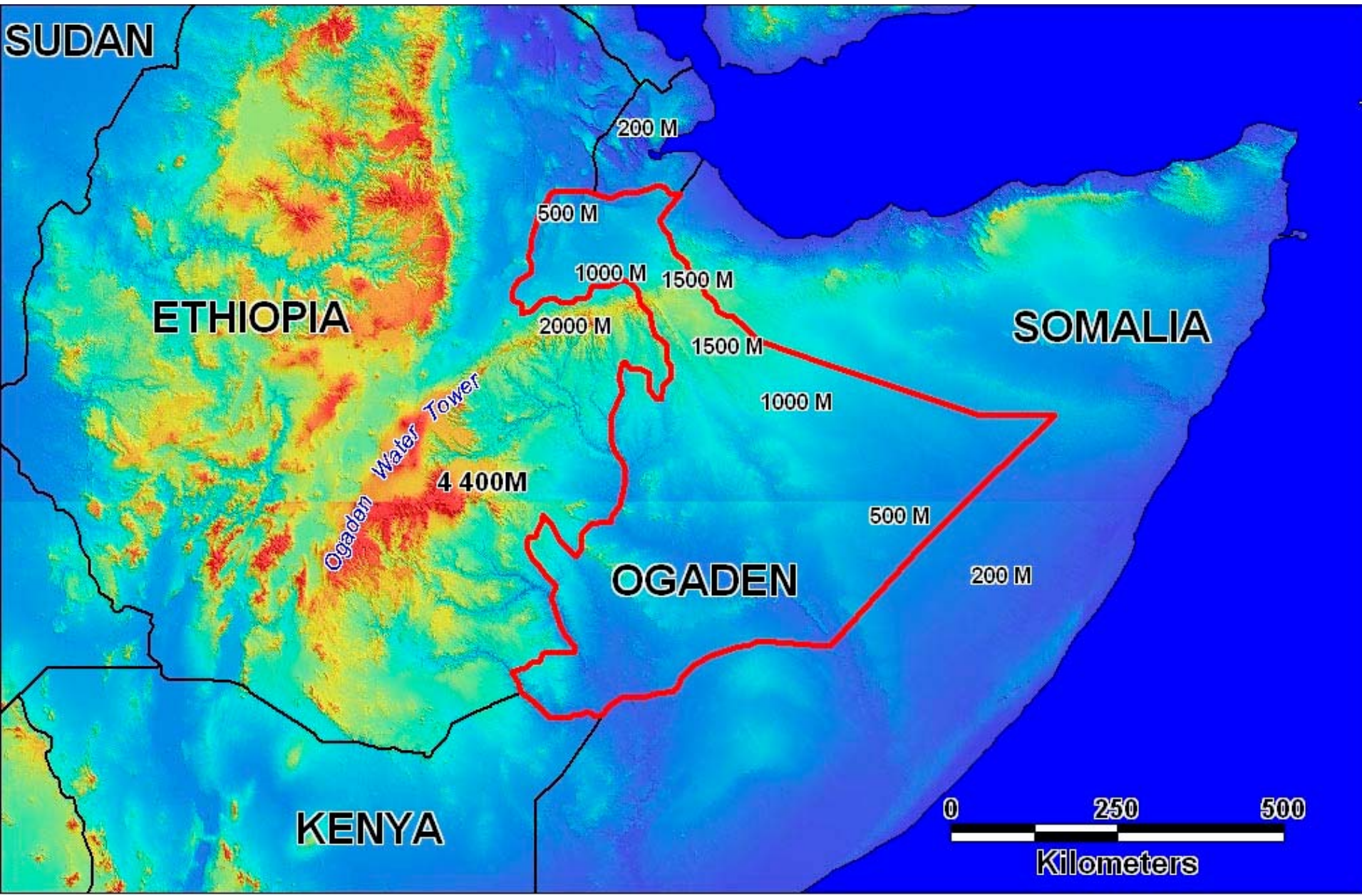
The boundaries and names shown  
and the designations used on this  
map do not imply official endorsement  
or acceptance by the United Nations



- Capital
- UNHCR Regional Office
- UNHCR Country Office / National Office / Liaison Office
- UNHCR Sub-Office
- UNHCR Field Office
- UNHCR Field Unit
- UNHCR regional service centre (Regional technical support hub)
- UNHCR Planned Office
- Refugee camp
- Refugee centre
- Refugee accommodation
- Town of interest
- Main town / village
- Secondary town / village
- International boundary
- Main road



Dolo Camps are located in Ogaden, the lowest province of Ethiopia, with average altitude of 700 m (SRTM color coded)



# Transit center of Dolo Ado for the Somali refugees

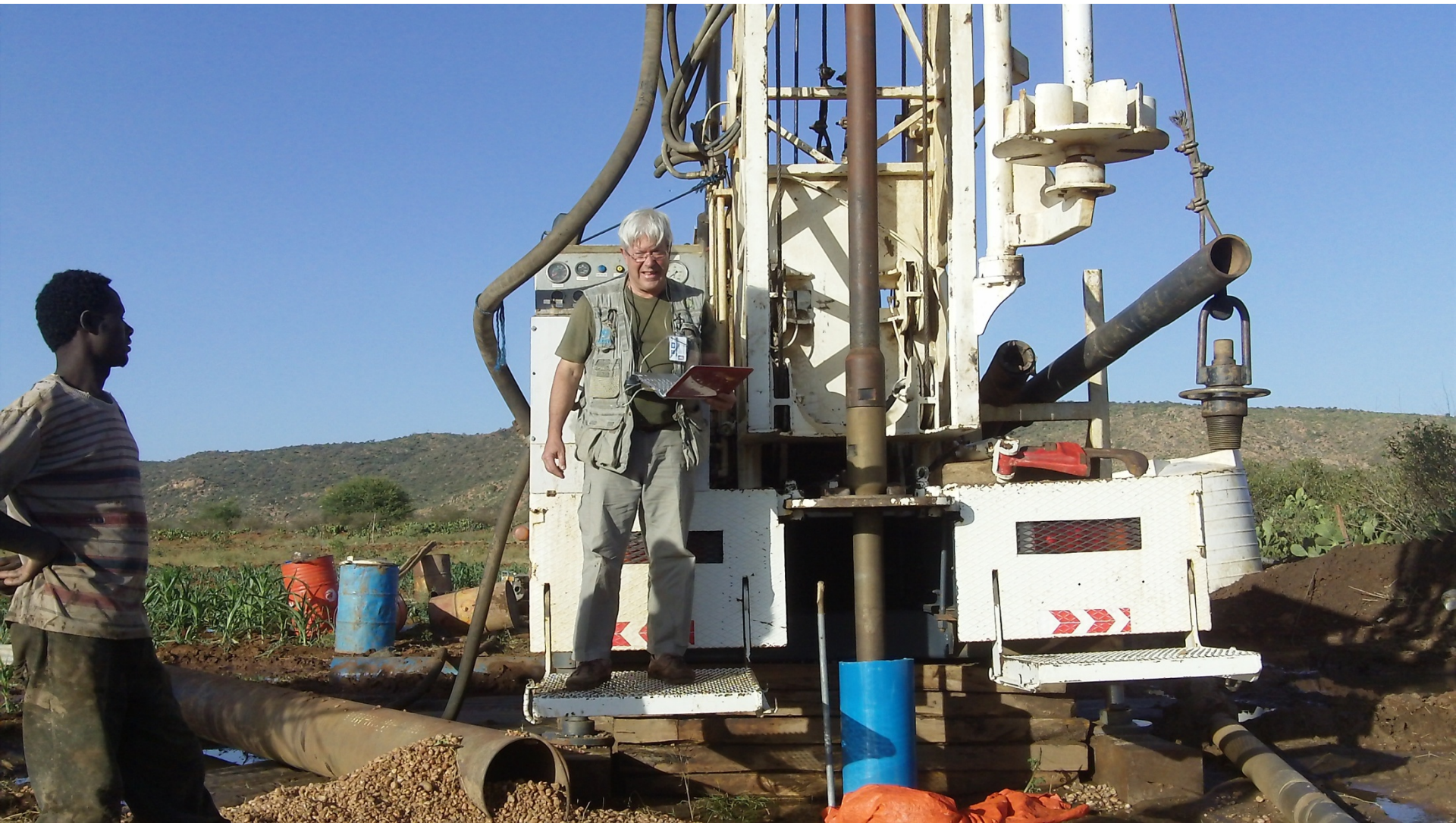
## 9 November 2011





# Drilling in Jijiga, Fafen Valley of Somali-Ethiopia

## 12 November 2011



After 8 years of successful applications  
the WATEX system appears to be the most  
efficient tool for quick emergency mapping

WATEX can map very large surfaces  
in a very short time.

In case of emergency, we know exactly where  
to go over vast stretches of dry land.



# **WATEX© mapping has shown**

- Main aquifers not visible from surface
- Micro-dams sites to replenish aquifers
- Drilling sites with great accuracy

**Drilling success rate has increased  
from 33% to 95% over 1 500 wells.**

**Drilling costs reduced of 60%**



**These new technologies are  
absolutely needed for quick  
mapping response in  
emergency situations**





# Thanks for your attention and Good Bye



Since 2004, The WATEX© process is supported  
by a team of international experts

**Bill Woods, Cartographer of the White House**, First supporter of RTI

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