

Best Practices for Risks Reduction Rapid Response Mapping

New Remote Sensing Technologies for groundwater emergency situations The WATEX System

Beijing, China, 24th November 2011

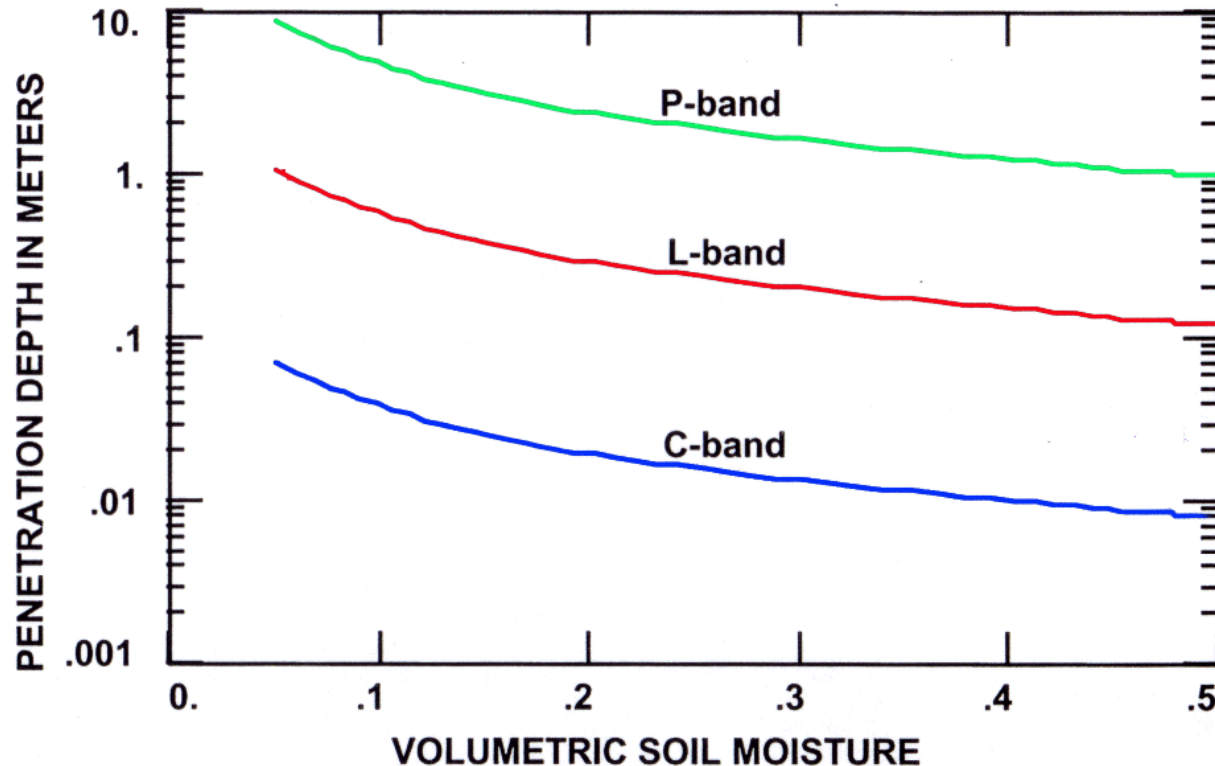
Dr. Alain Gachet

Radar Technologies International

www.radar-technologies.com



SAR is a penetrating tool



$$\delta_p = \lambda_0 \sqrt{\frac{\epsilon''}{2\epsilon'}} \sqrt{1 - \frac{\epsilon''^2}{4\epsilon'^2}}$$

Penetration depths calculated as a function of volumetric moisture for C-, L-, and P-band assuming a sandy loam soil consist 51.5% sand, 35% silt and 13.5% clay (Ulaby et al., 1986).

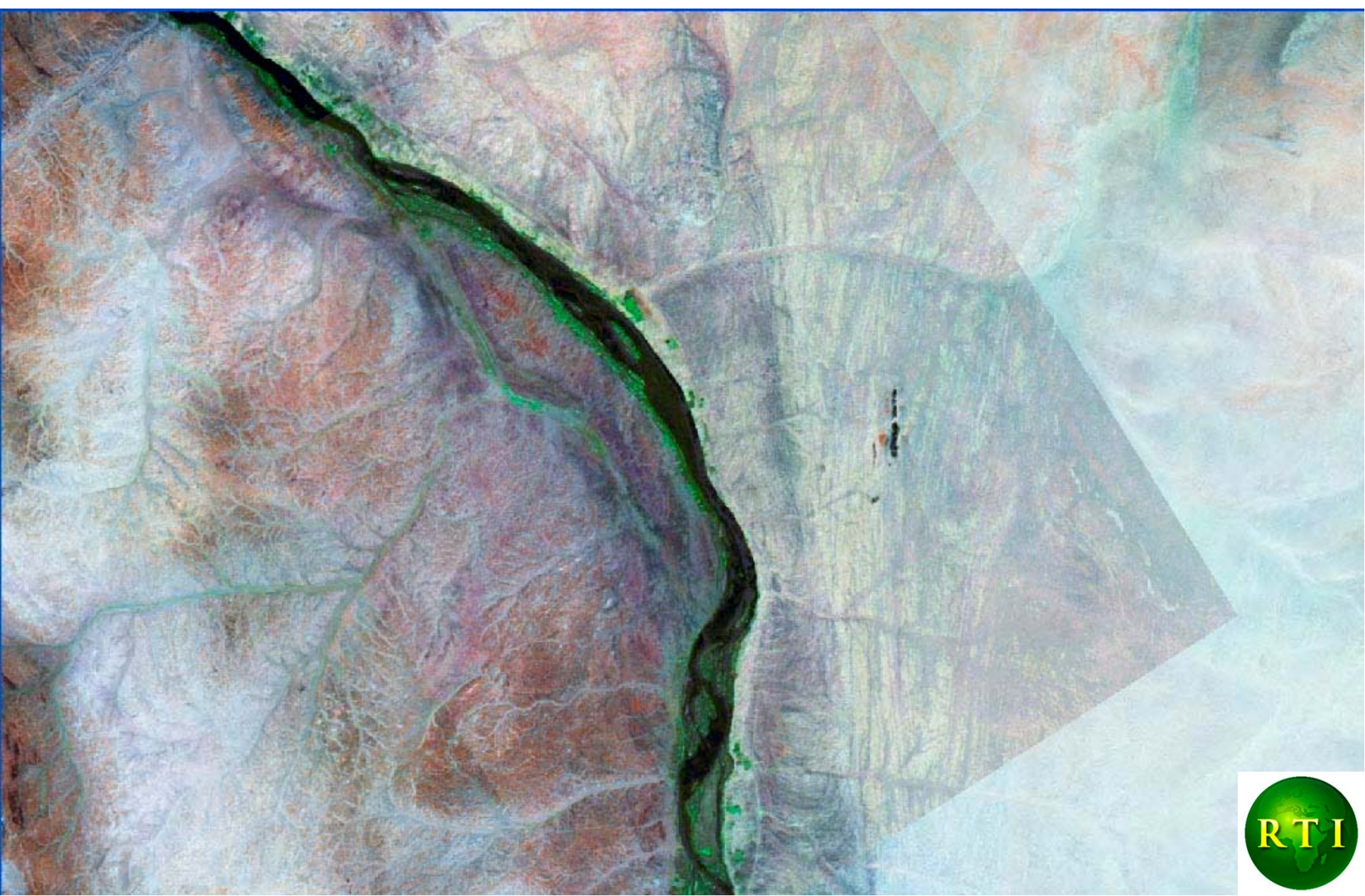
Exploration in Sudan, in the ancient kingdom of Meroe, near the 5th cataract of the Nile



Landsat (7,4,2) nous reveals a suture zone near Méroé



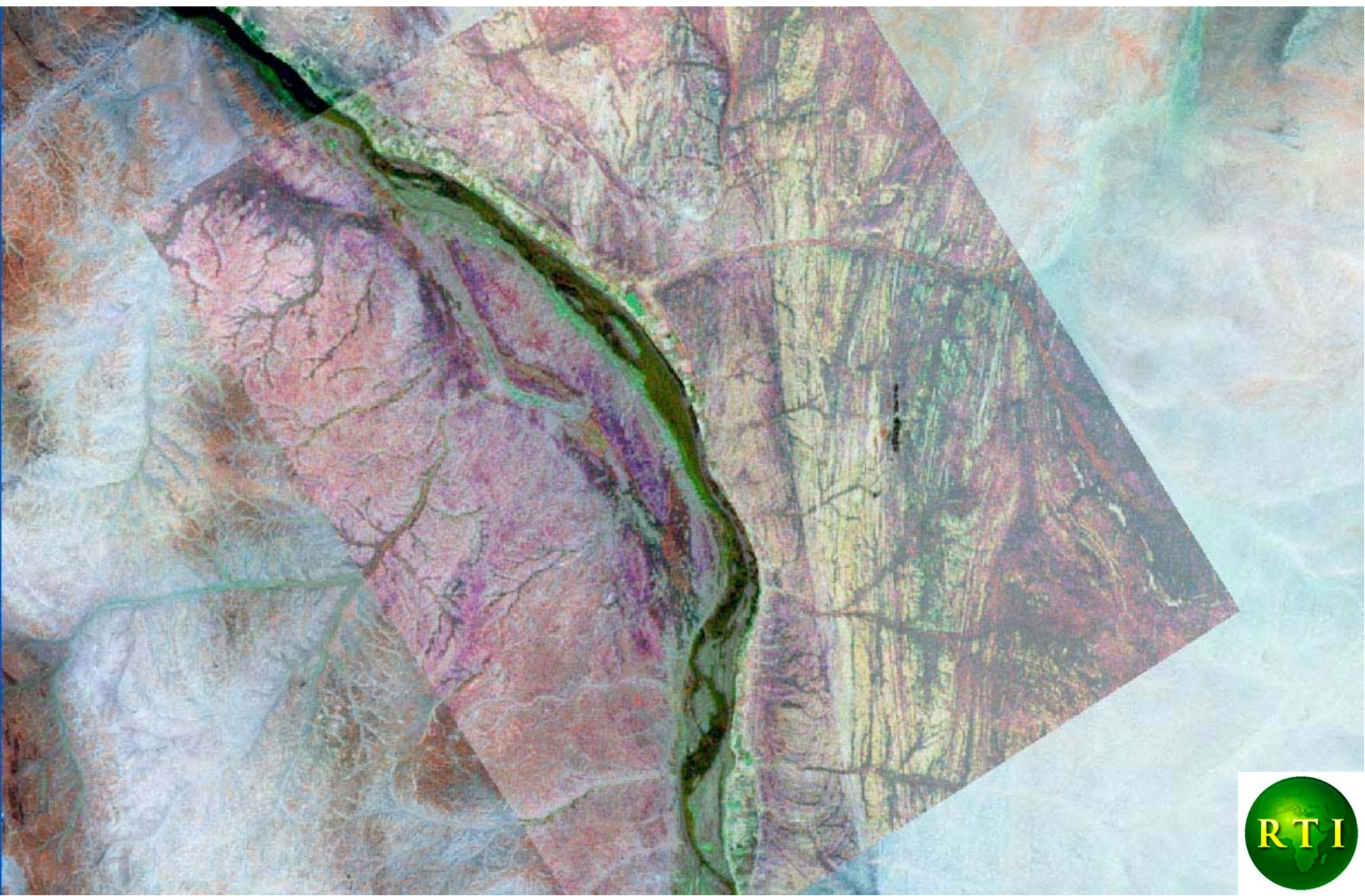
Radar multi frequency application



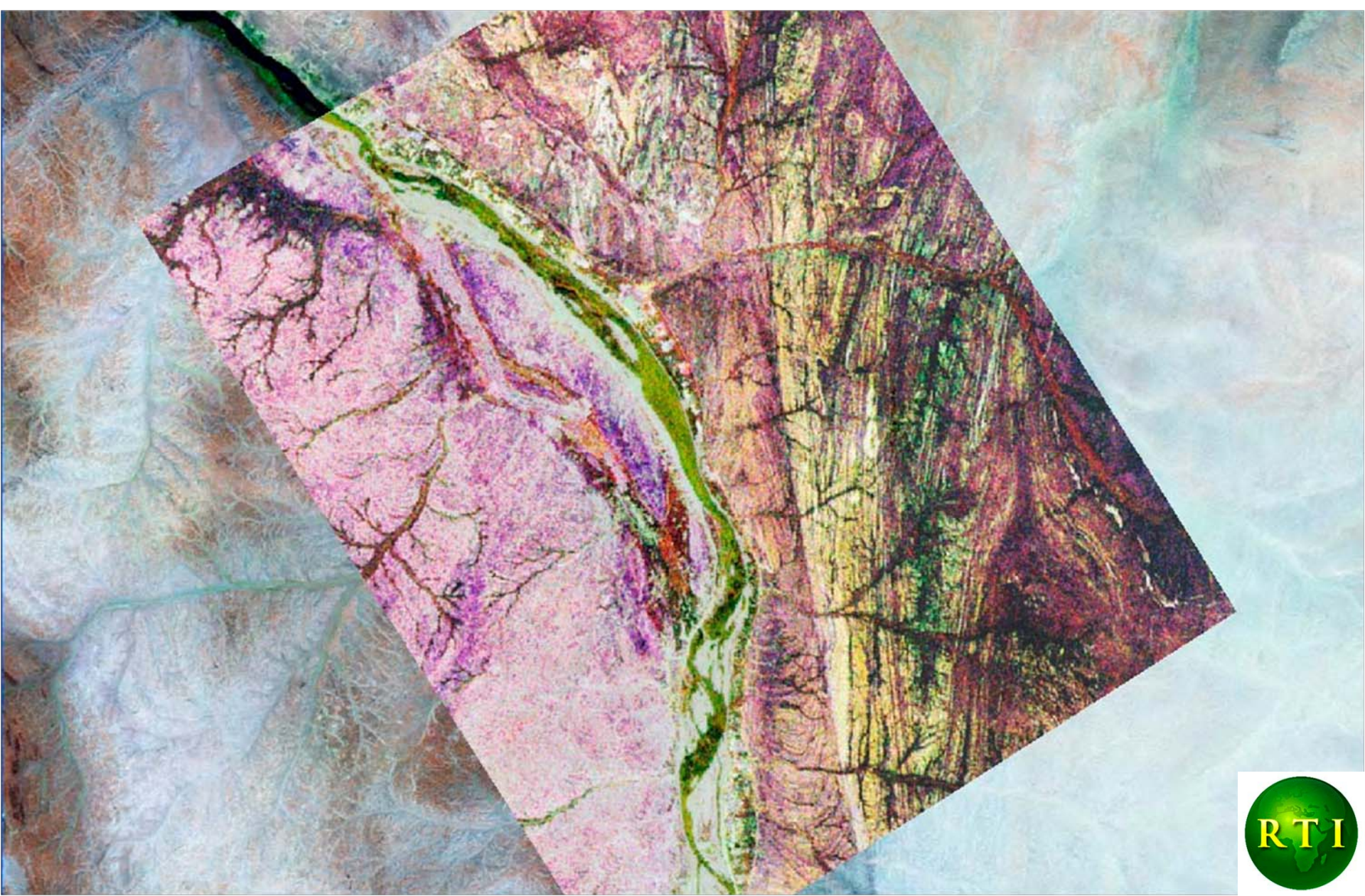
Penetration under the sand cover



Progressively reveals buried structures



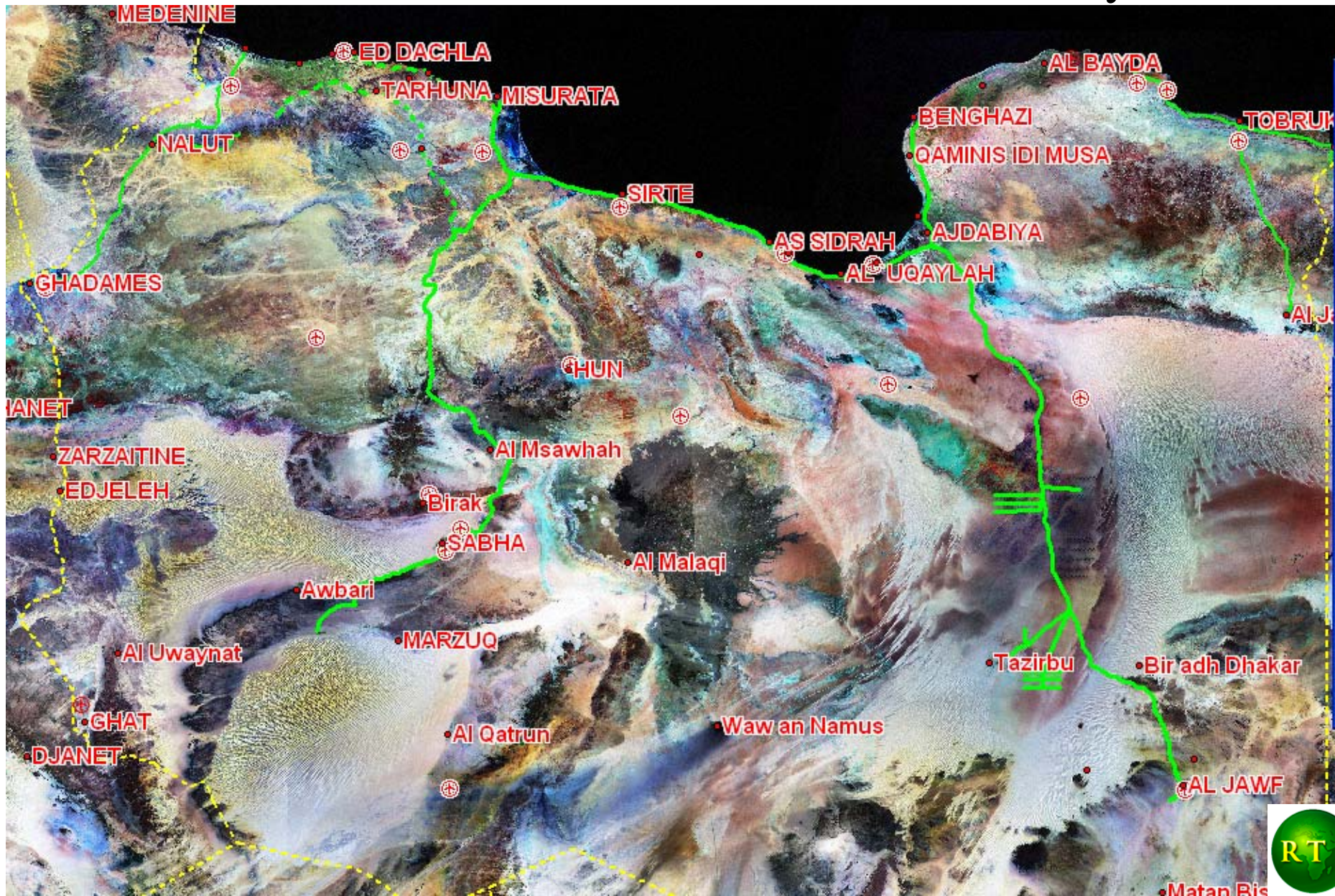
Details which confirm existence of a shear zone with potential base metals mineralization



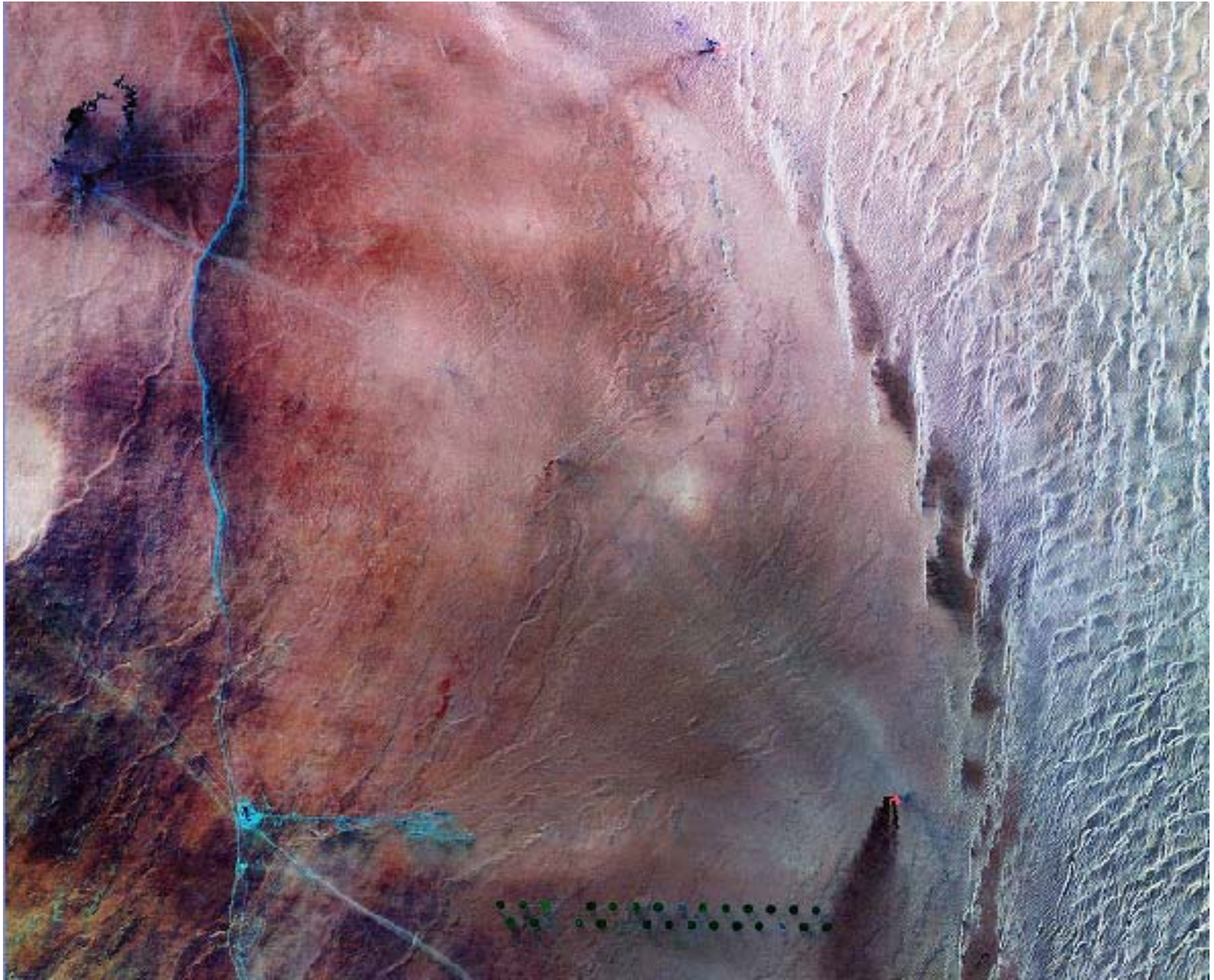
This is the way we rediscovered the old gold mines of the
Black Pharaohs of Meroe Kingdom.



Leaks detection on the Great Mad Man river in Libya in 2002



Optic image of the Great River in the Syrt desert



Water Leaks from the buried pipe were detected only by radar



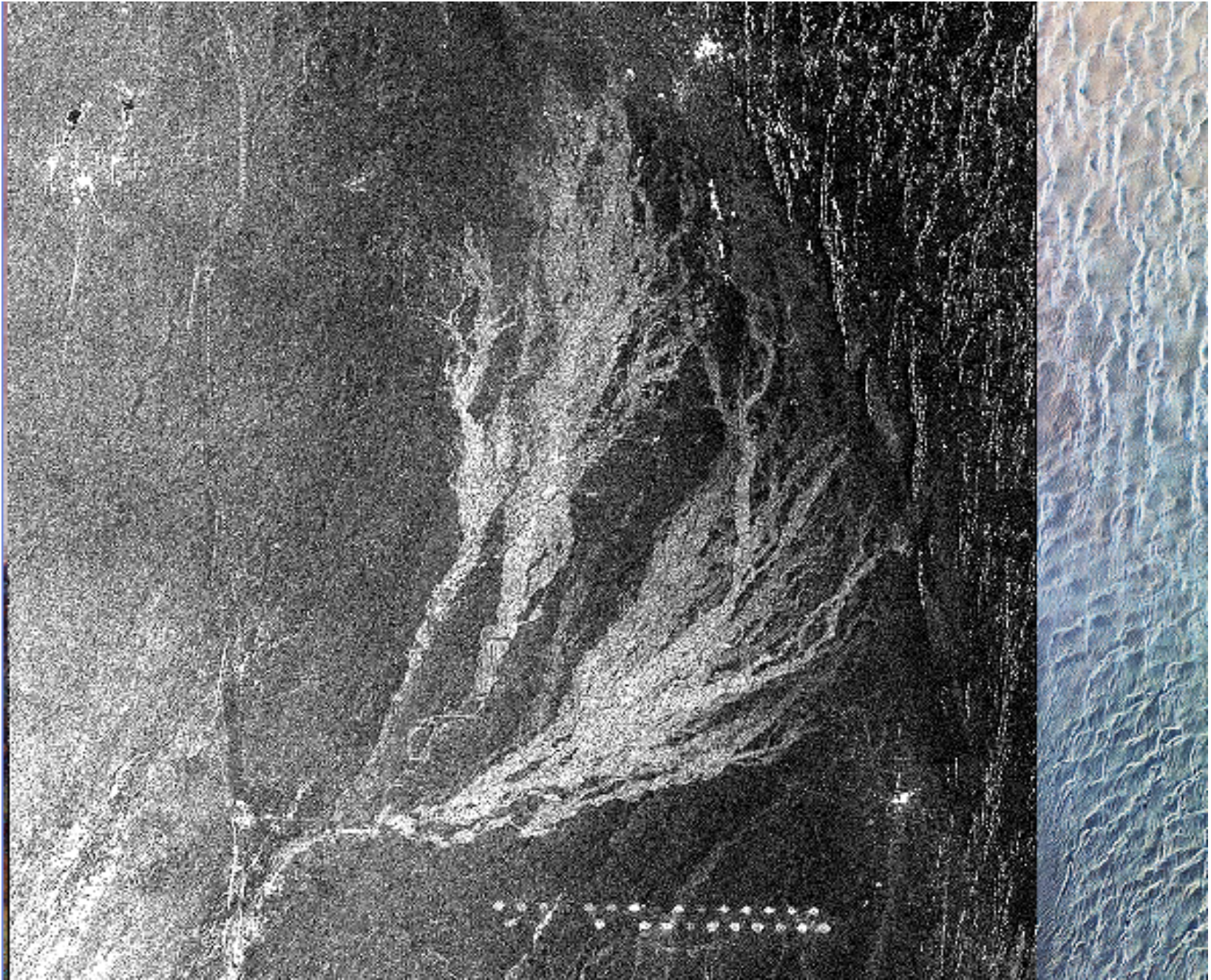
By RTI in 2002



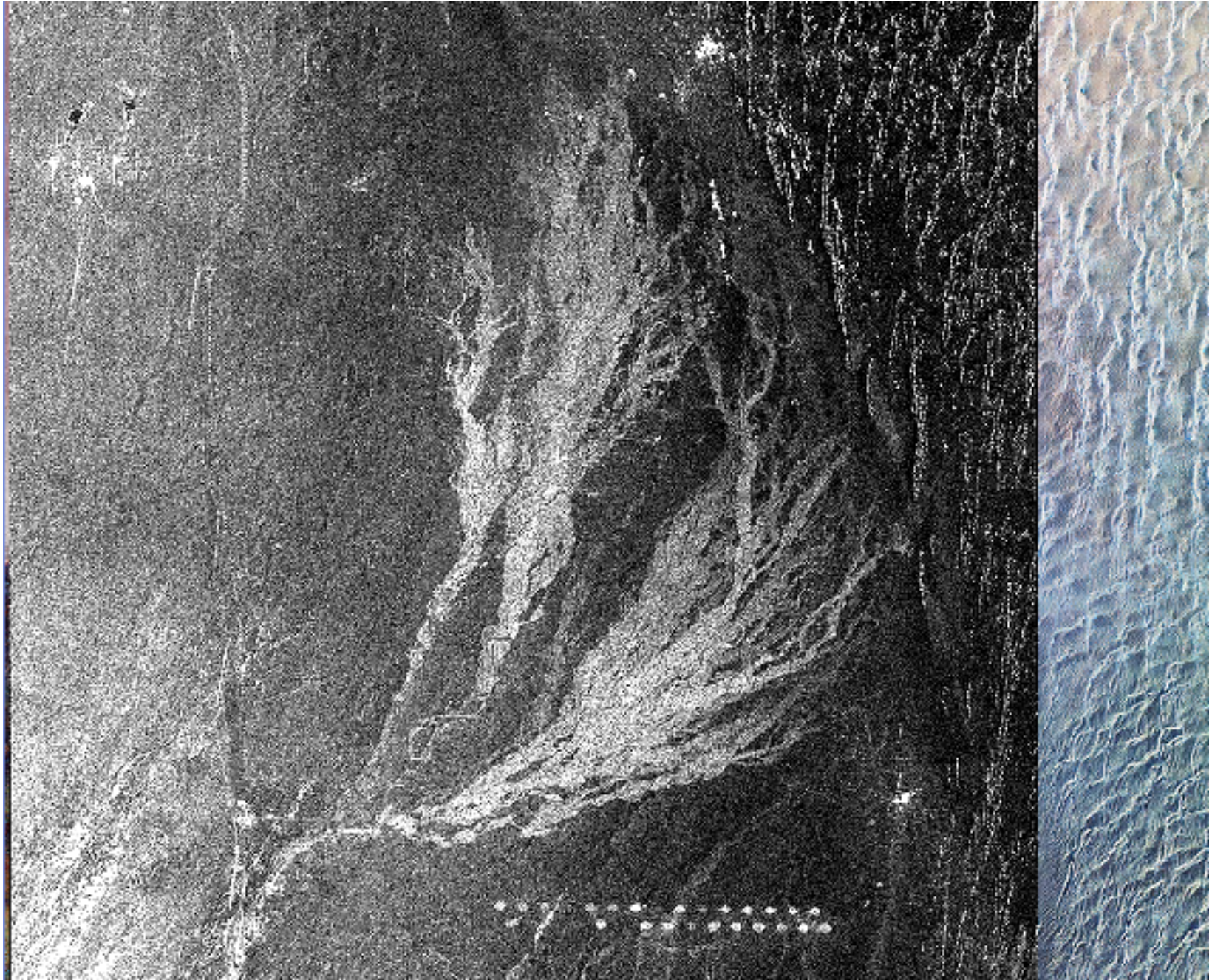
Leak covering 2 700 km²



Corresponding to a water loss of several billion of m³



This experience launched the WATEX™ System



What is the WATEX© System?

- WATEX is a hydrological tool designed to detect buried aquifers and soils in desert areas, invisible at ground level.
- WATEX is a GEOSCANNER operated by satellite which can cover entire countries in few weeks, anytime, anywhere.
- WATEX is an instrument used for quick mapping for emergency situations in crisis areas

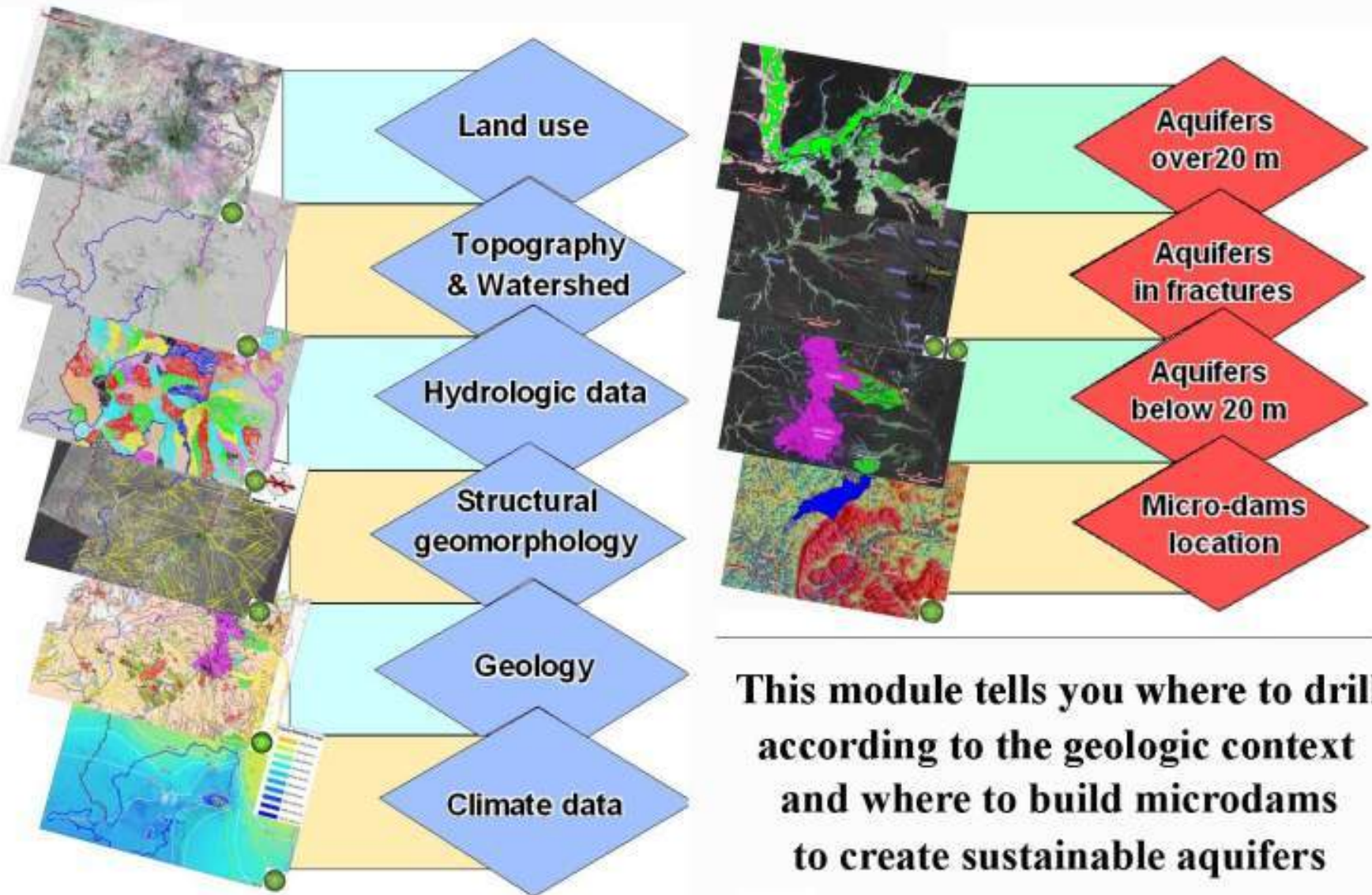


The WATEX SYSTEM integrates two modules

**Traditional Water Resources
Management system**

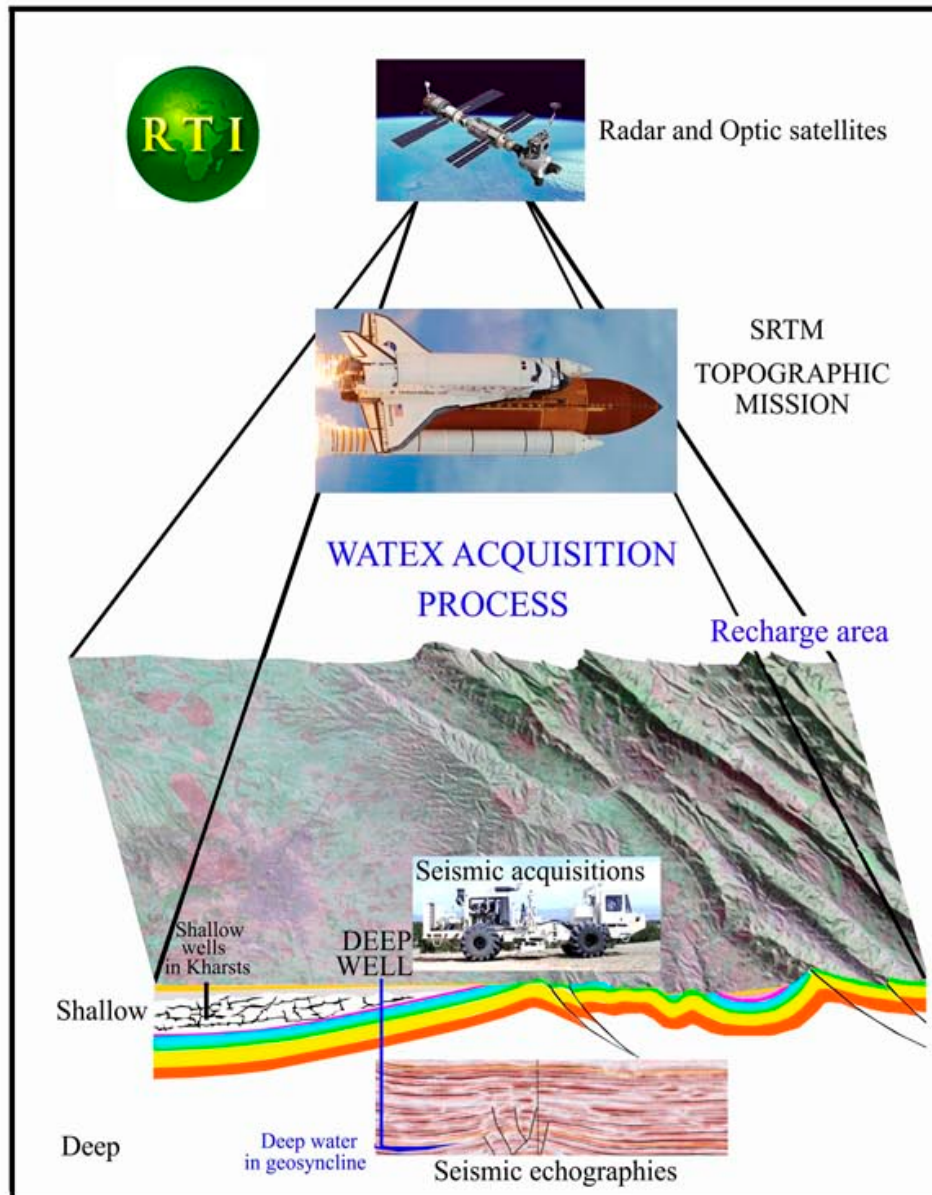
+

The WATEX Imagery system



**This module tells you where to drill
according to the geologic context
and where to build microdams
to create sustainable aquifers**

WATEX is needed to detect buried aquifers not visible from the surface



Phase II : the WATEX process

**Needed to discover deeper
and sustainable aquifers**

New generation of Optic sensors

Radar multi frequency/Polarity

Radar Interferometric data

Ground Penetrating Radar

Magnetic and gravimetric data

Seismic echographies (Oil Exploration)

Deep wells data (Oil exploration)

Hydrological modeling in 3D

DETECTION AND MAPPING OF :

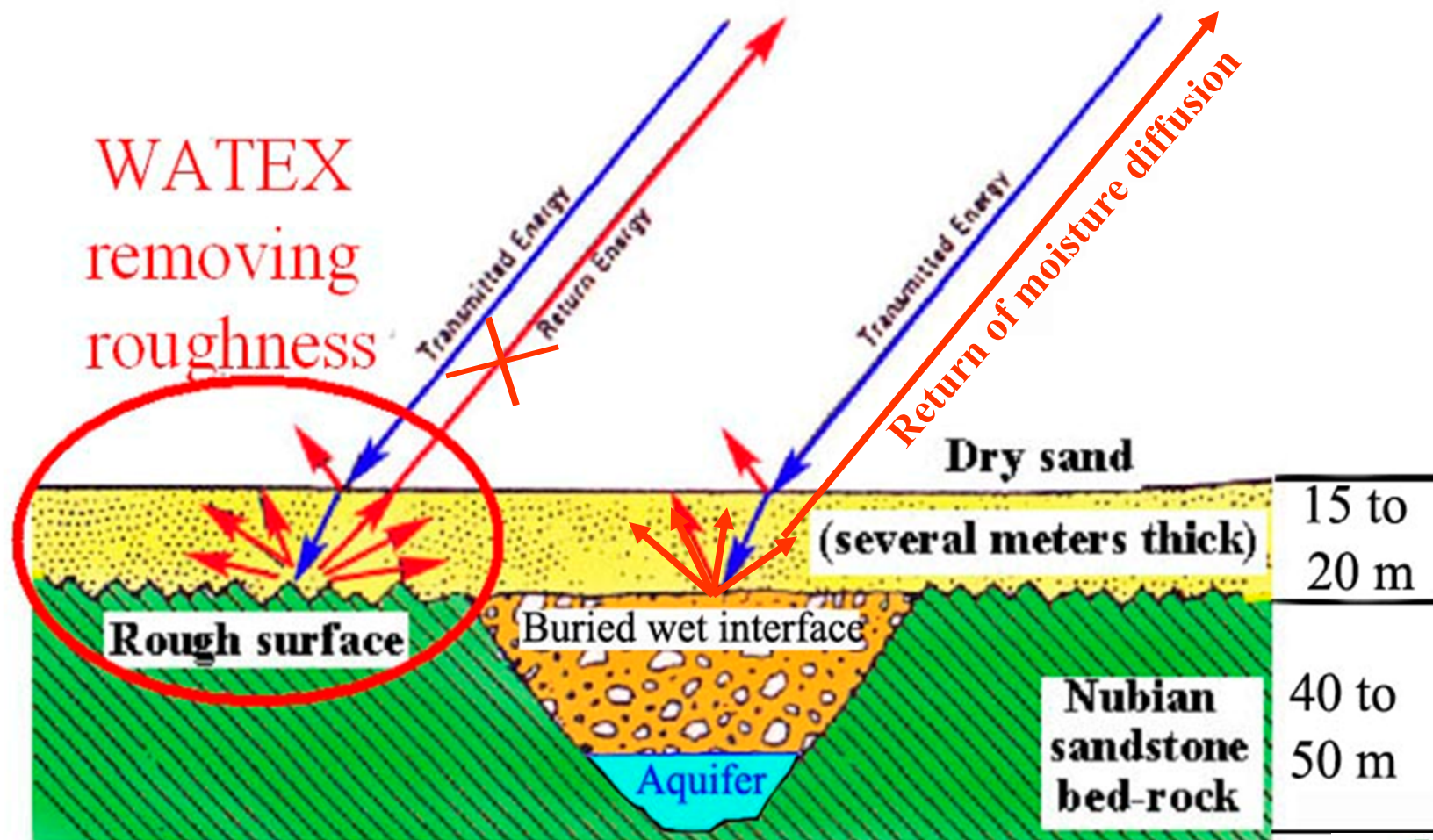
- Deep aquifers down to 3000 m
- Recharge areas
- Conductive fractures
- Soil hydromorphy
- Soils for agriculture
- Microdam sites for aquifer recharge

WATEX© System is
a unique technological
breakthrough

WHY?



WATEX Processing sequence can remove roughness
And enhance soil moisture signal



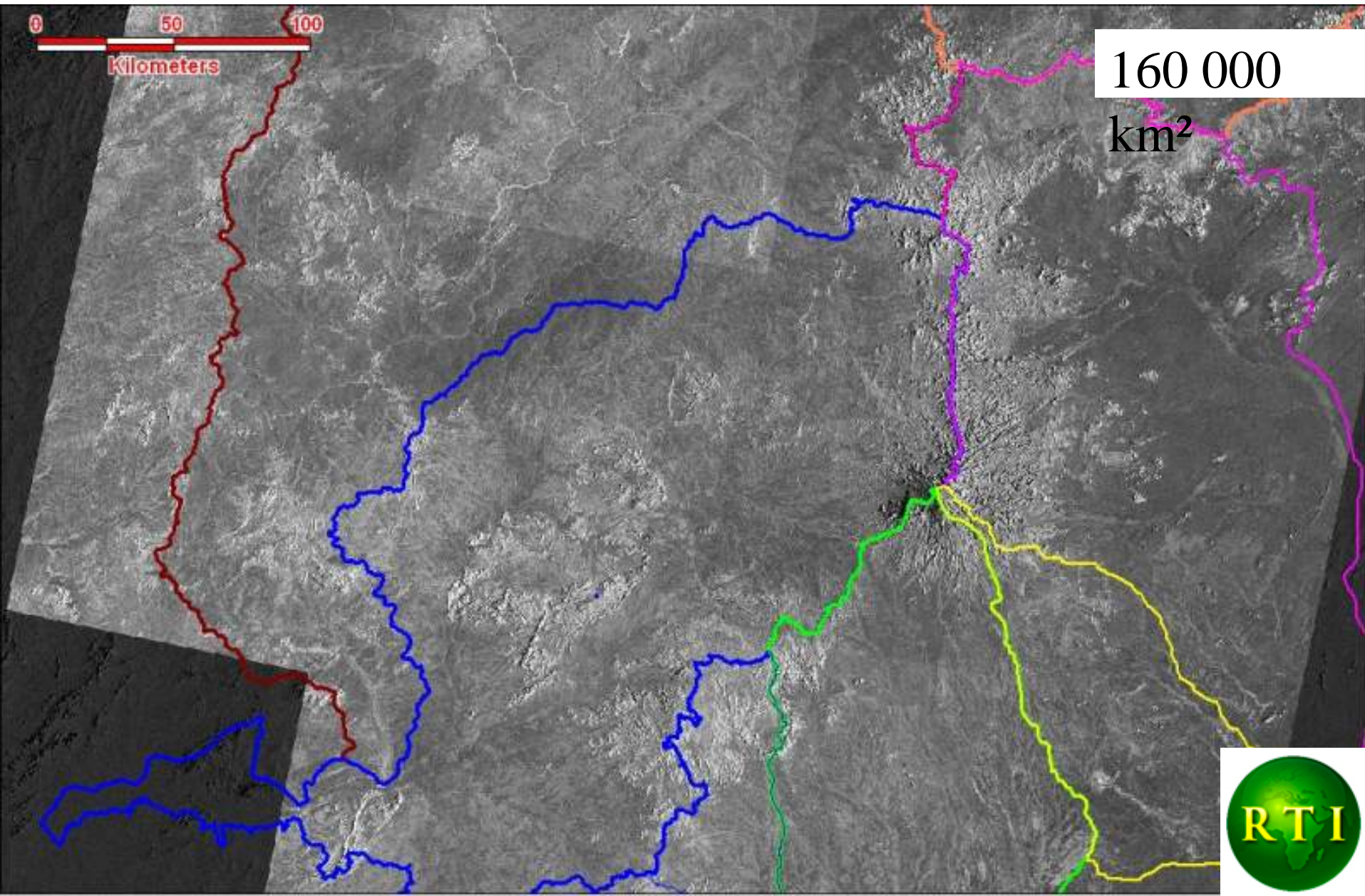
Aquifer buried in a paleo-channel covered by dry sand



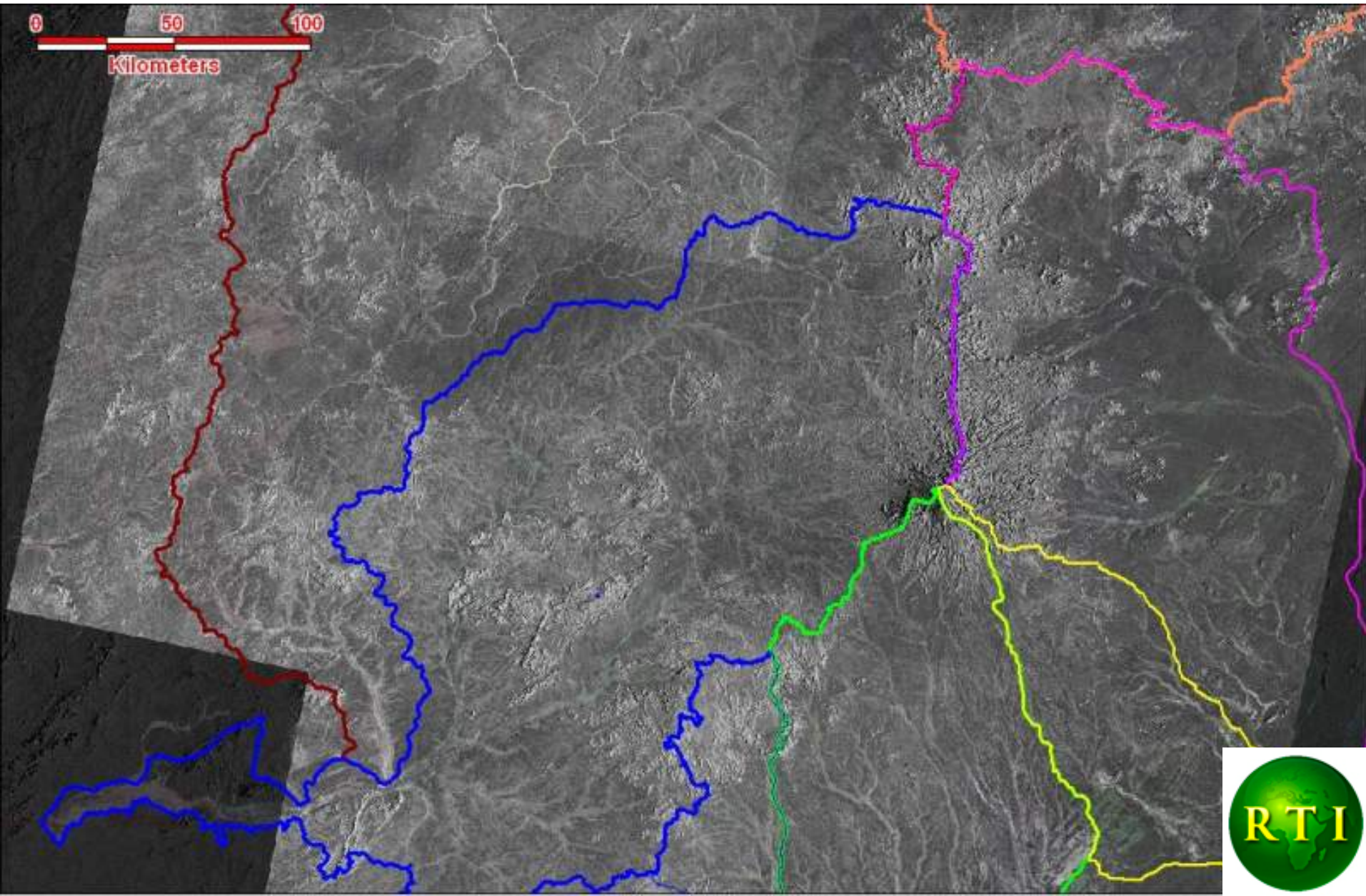
WATEX© is a
GEOSCANNER



1-We start from commercially available radar images where soil moisture is hidden by surface obstacles (roughness effects)



2- WATEX© imagery penetrates through the surface in order to detect buried aquifers down to a depth of 20 meters



3- WATEX© is a 3D Geo-scanner which removes all surface obstacles in order to enhance soil moisture effects



4- WATEX© allows the instant visualisation of the active drainage sytem, above and under ground over broad surfaces.



5- WATEX© thanks to fractures allows mapping of storage, infiltration and flow transfers, far below 20 meters.



6- WATEX© eliminates false signals linked to clay deposits (green)
using slope maps combined with Radar backscattering



WATEX© technology for Groundwater and soils. Success stories since 2004

Sudan, for US States Department (emergency for IDP in Darfur)

Chad, for UNHCR (emergency for Darfur refugees in Chad)

Angola, for US NGO (Post war reconstruction)

Afghanistan for USGS (refugee camps)

Oman for Shell (soil mapping for agriculture)

Gabon for Eni Gabon (Social program)

IRAQ for UNESCO (Post War Reconstruction)



☞ All the aquifers and microdams have been recorded in the
« Darfur Drilling Hand Book » used by NGO since 2004

SUDAN DARFUR

Drilling Hand Book

by Dr. A.Gachet, april 2006



Radar Technologies France



Contract funded by USAID, operated by Radar Technologies France - RTF and implemented by USGS

Ground truth in Darfur-Sudan



Welcome on Planet Mars



Cattle killed by drought near dry wells

Photo : Alain Gachet



Incineration to prevent epidemics

Photos Helene CAUX



250 000 refugees spread on a front of 650 km between Chad and Sudan in July 2004



Major humanitarian crisis

Photos Helene CAUX



WATEX has detected
in 4 months over 200 000 km²
all alluvial aquifers of Darfur

and detected
the best locations
for refugee camps



WATEX in Darfur led the drillers to the right spots on alluvial aquifers, avoiding dry areas or low productivity

