Commercial Space Technologies

April 1st 2016

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www.cstprospecting.com

COMMERCIAL SPACE TECHNOLOGIES LTD.

Est. 1983

SERVICES

Management & Trading

- Facilitate trade of components from Western companies to Russia
- Management of satellite development projects between Russia and the West (e.g. Kanopus)

Consultancy

- CST began as a general space consultancy
- All fields of technical consultancy (except communications)
- International expertise
- Extensive report library
- Broad client base:
  - Insurance
  - Space agencies
  - Government departments
  - Private industry

Launcher Brokerage

- Representative Moscow office
- Native Russian team
- Specialising in Russian and Ukrainian launch vehicle procurement
- Services include:
  - Launcher selection and price negotiations
  - Contract support (drafting and implementation of MOU, LSA, ICD)
  - Customs and logistics support
  - Fit check support
  - Pre and post launch campaign support

LAUNCHING HISTORY

YEAR	DATE	LAUNCHER (MODE)	SATELLITE(S)
1995	August 31	Tsyklon (1 piggy-back)	Fasat Alpha
1998	July 10	Zenit (2 piggy-back)	Fasat Bravo + TM Sat
1999	April 21	Dnepr (1 dedicated)	Uo Sat 12 (first commercial use of SS-18)
2000	June 28	Cosmos (2 piggy-back)	Tsinghua 1 +Snap (first SSO flight of Cosmos)
2000	September 26	Dnepr (1 piggy-back)	Tiung Sat
2002	November 28	Cosmos (main in cluster)	Alsat-first Disaster Monitoring Constellation (DMC)
2003	September 27	Cosmos (3 in cluster)	NigeriaSat-1, BilSat-1 and UK-DMC (all DMC)
2004	June 29	Dnepr (main in cluster)	Demeter (CNES, first SSO flight of Dnepr)
2005	October 27	Cosmos (3 in cluster)	TopSat, ChinaSat (DMC), SSETI Express+cubesats
2008	August 29	Dnepr (5 in cluster)	RapidEye constellation
2009	July 29	Dnepr (2 in cluster)	UK-DMC2 + DEIMOS-1 (both DMC)
2009	September 17	Soyuz/Fregat (1 piggy-back)	SumbandilaSat (South Africa, first piggy-back from this launcher combination)
2010	June 15	Dnepr (1 of a pair)	Picard (CNES, paired with Prisma)
2011	August 17	Dnepr (2 in cluster)	NigeriaSat-2 and NigeriaSat-X
2012	July 22	Soyuz/Fregat (1 piggy back)	ADS-1B
2014	June 19	Dnepr (1 in cluster)	KazEOSat-2
2014	July 8	Soyuz/ Fregat (2 piggy back)	TechDemoSat-1 (TDS-1), UKube-1

Commercial Space Technologies Prospecting

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CSTP

From CST to CSTP

- Prior CST connections with British oil prospecting specialists and Russian manufacturers of remote sensing satellites and instruments
- CST started the search for geological exploration job in 2004
- 2006 contract between the Sudanese company GNPOC and the Russian Joint Stock Company 'Research and Production Corporation, Space Monitoring Systems, Information & Control and Electromechanical Complexes' named after A.G. Iosifian (VNIIEM)
- In geological studies, VNIIEM collaborated with leading Russian geological and geophysical organisations and specialists

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Experience of our Experts

The mapping of many regions for various geological and landscape conditions:

- Plato Putorana, Eastern and Western Sayan Mountains, Khamar-Daban Mountains, Sredne-Vitimsky mountain area (all – Siberia), Caucasus Mountains, Kazakhstan, Turkmenistan, Algeria, Mauritania, Mali, South Sudan done since mid 1980s.

Due to confidentiality agreements signed, many results and even regions of surveys cannot be named.

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Techniques

For the interpretation of space images, a proprietary technique for revealing a system-hierarchical structure of regions is used. The analysis is carried out at several structural levels.

Interpretation of Images is carried out in accordance to existing structural, lithological, facial, geochemical and geomorphologic criteria:

- **Structural and Geomorphologic Analysis**
- **Analysis of Spectral Brightness**
- **Tectonodynamical Analysis**

Human expertise are combined with the computed processing

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Techniques

OUTPUT:

An **exploration model** of the region of interest implemented in the form of:

- A **map of faults** ranked by size and kinematics and dividing the region into a system of ranked blocks nested within each other
- In case of existence of geophysical, geochemical, petrographic, etc. data – a **forecast map** considering the region block structure
- A **scheme of the modern tectonics** showing areas of local rises and submersions

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Techniques

UNIQUE SELLING POINTS

- Extrapolation of scarce information on a reasonable geomorphology base; allowing for continuous mapping (filling in existing potentially irregular regional data)
- Providing a large field of view from which to refine down a search (thus increasing the quality of information to maximise prospecting results)
- Building a comprehensive foundation of information to complement and cohere with existing data
- **Cost savings** by reducing the need for extensive and more expensive on-ground geological data collection

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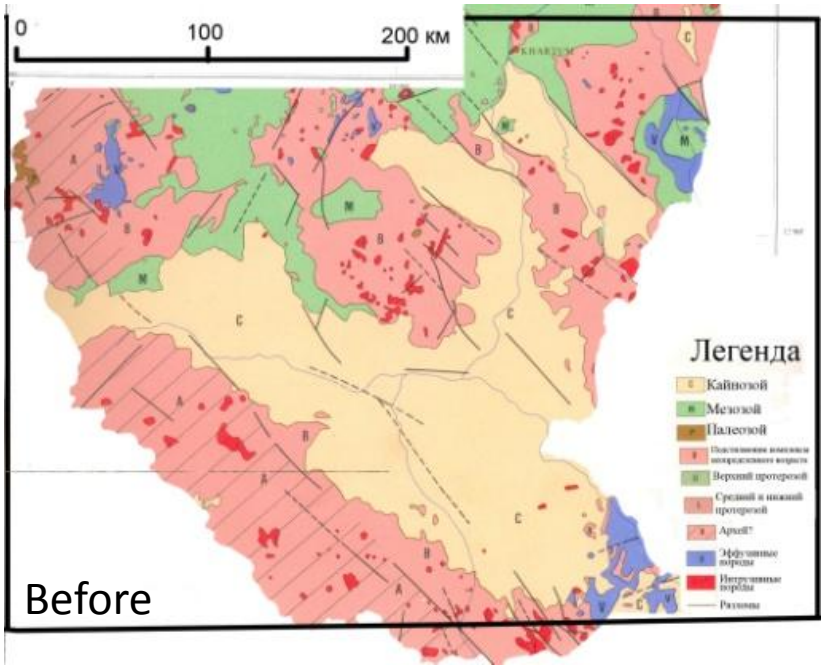
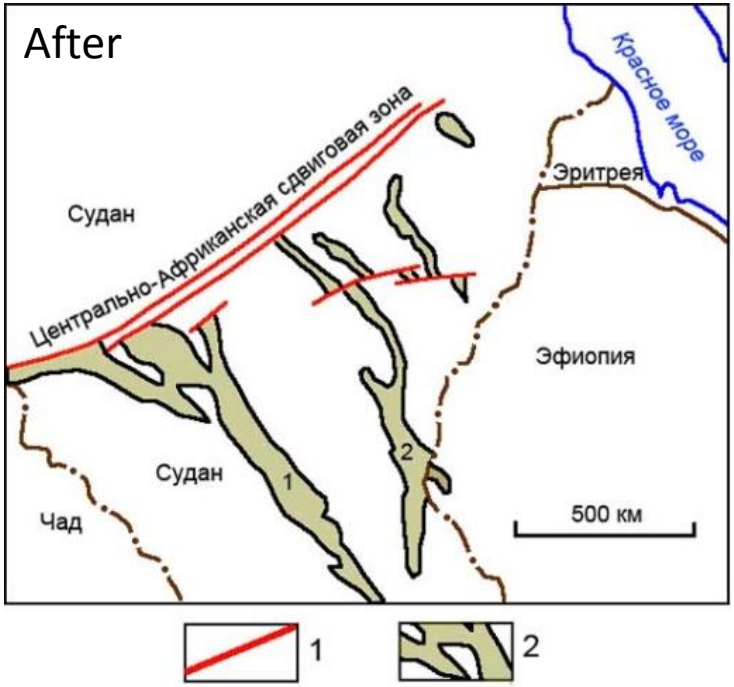
Methodology example

Updated view on geological structure of regions





It was:

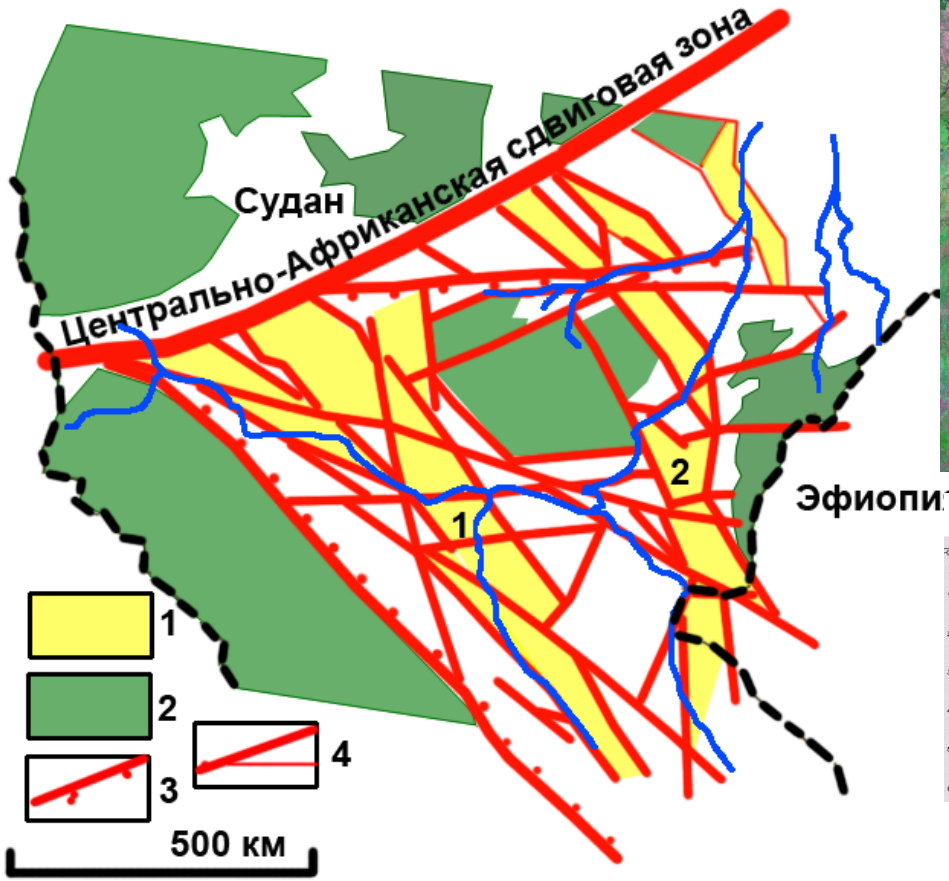
Left: Geological map of Sudan

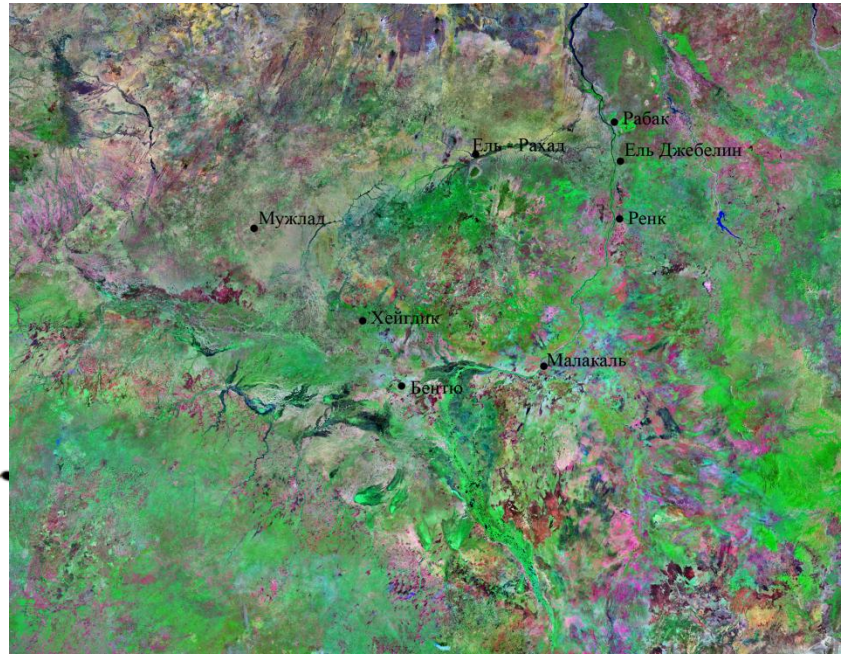
Right: Cretaceous-Palaeogene sedimentary basins in Sudan (1- Muglad, 2 – Melut) (by Dolginov, Farakh, 2008). Graben as a geological structure incorporating the basins is not shown

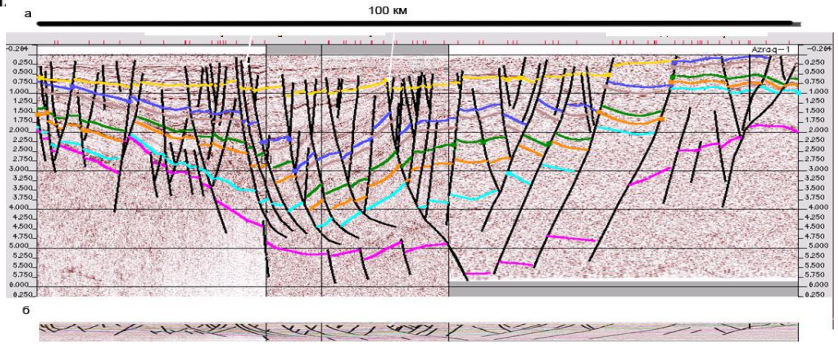
Methodology example

Updated view on geological structure of regions

- <u>Now it is:</u>



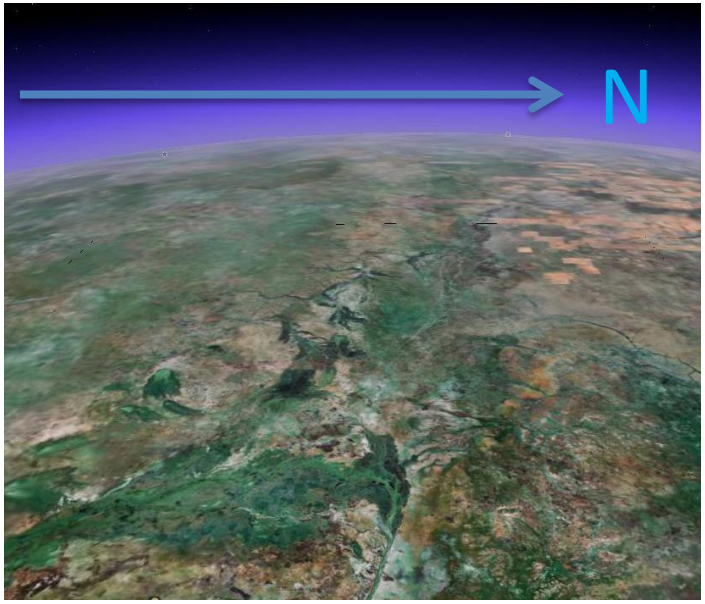


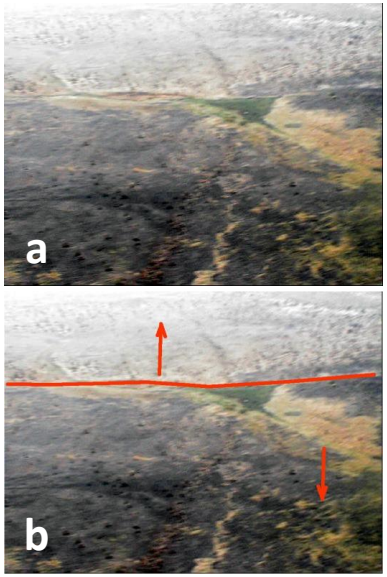


Methodology example

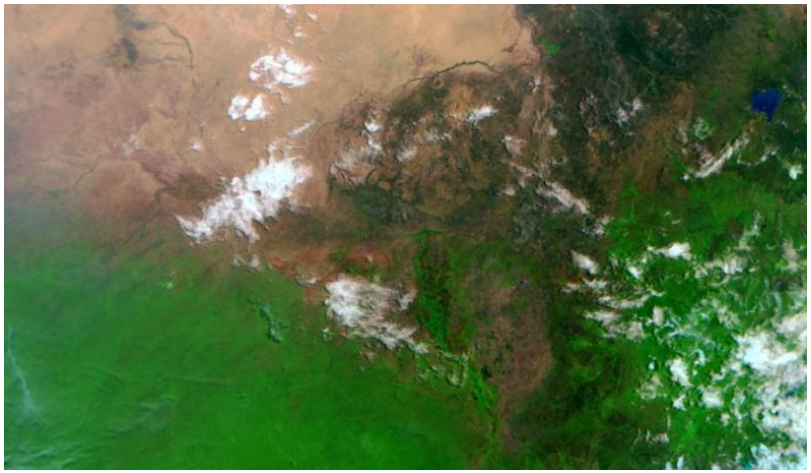
Updated view on geological structure of regions

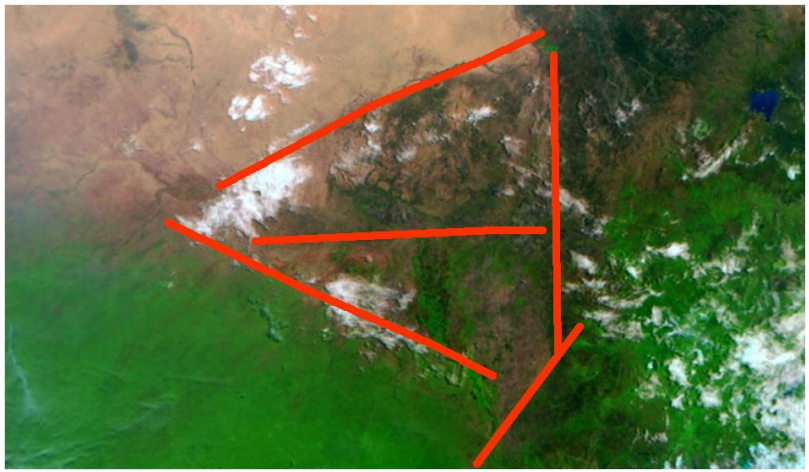
How it was done





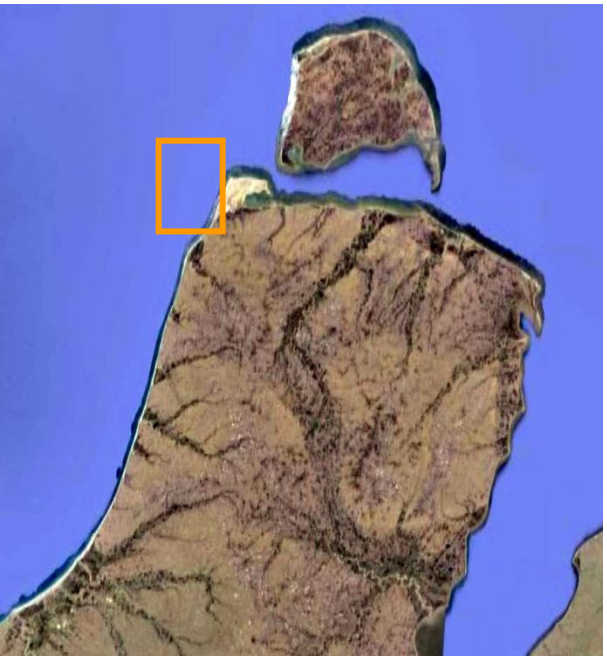
Top Left: image by Google Earth
Bottom right and left: image by Meteor-M, MSU-MR, 24.05.2010. The wedge interpreted as a giant graben is clearly seen by anomalies of waterways' network and vegetation.
Top right: (a,b) the southern border of the graben is only seen in aerovisual images (author C, Milyaev). The relief drop is ca. 20 cm. (b) The arrows show the rising and the submersing blocks.





Methodology example

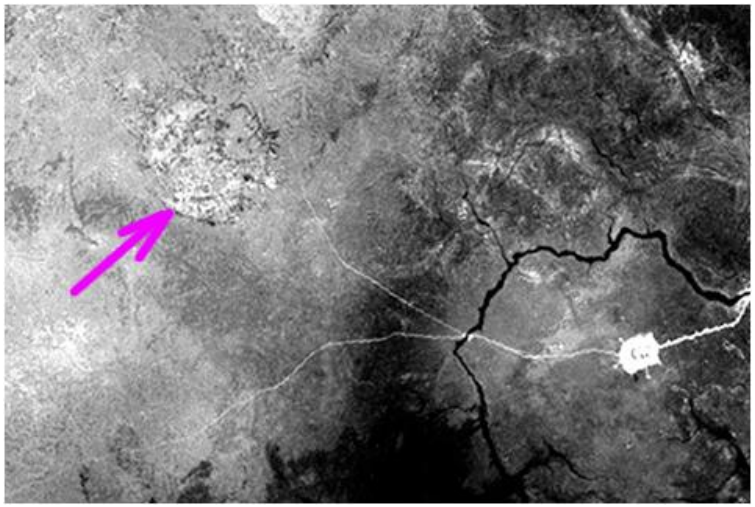
Changes in pattern of the lineament networks at various hierarchy levels

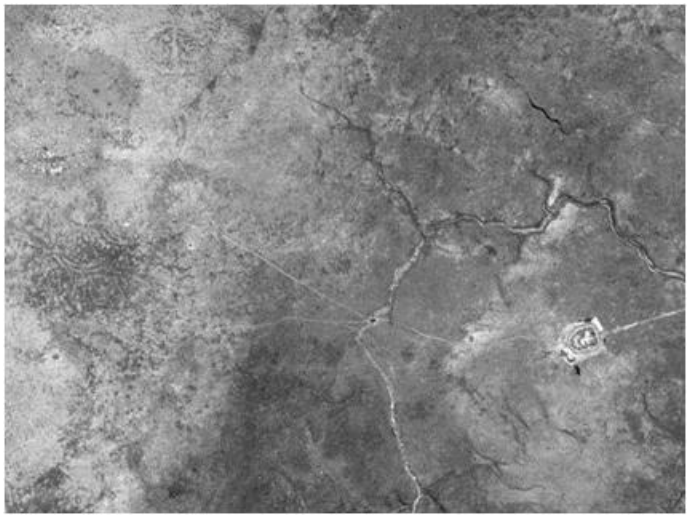


Yamal Peninsula, Russia. Examples of lineaments sectioning the submersing plate that are seen with various resolutions. Image by Landsat-7

Methodology example

Some objects are only seen in specific spectral zones

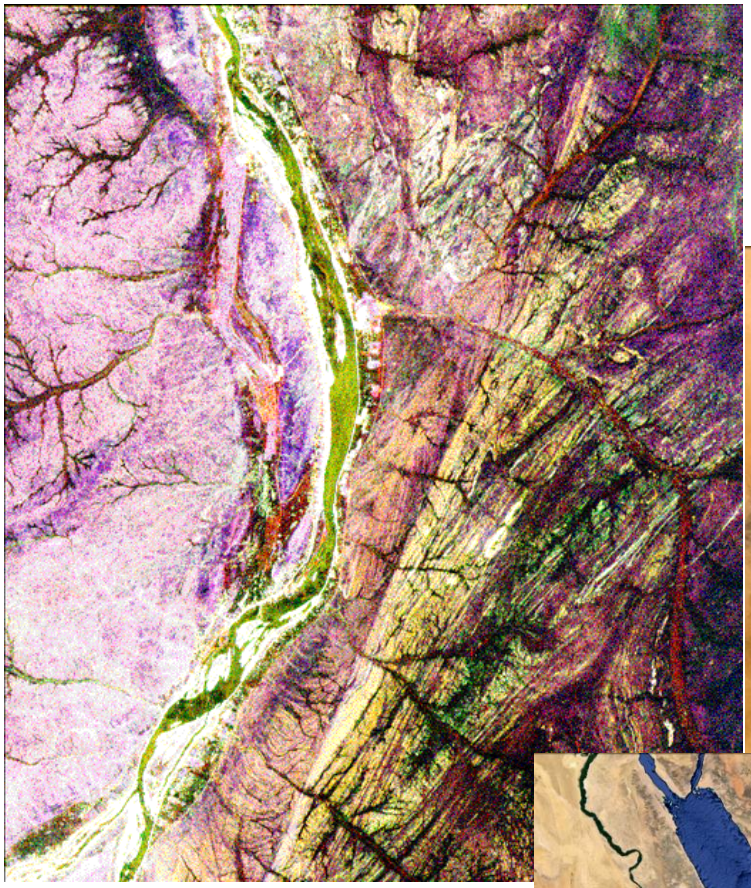




A ring structure in the Southern Sudan: top left – near infrared zone; top right – visible diapason. Below – helicopter survey

Methodology example

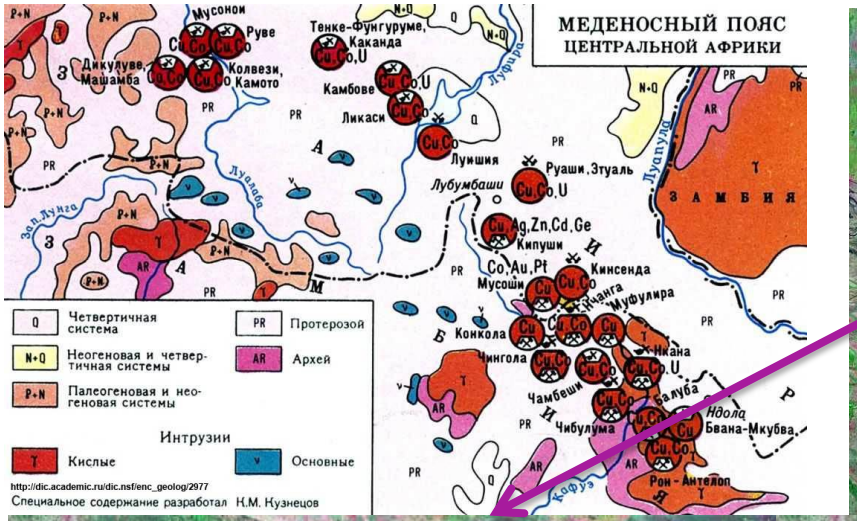
a radar survey

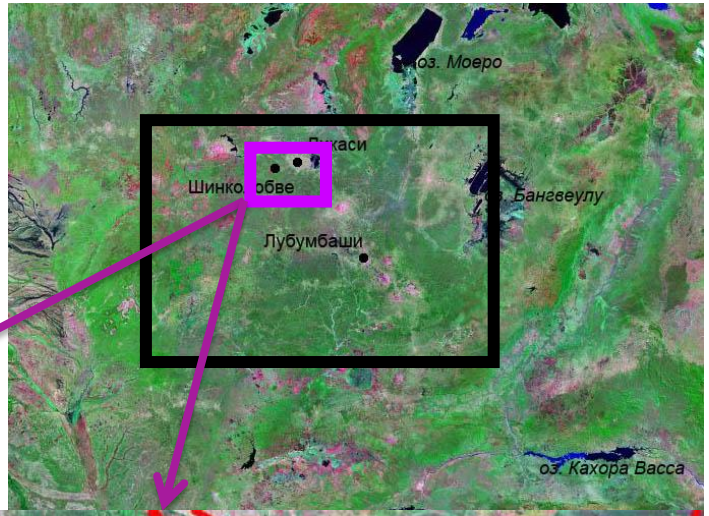


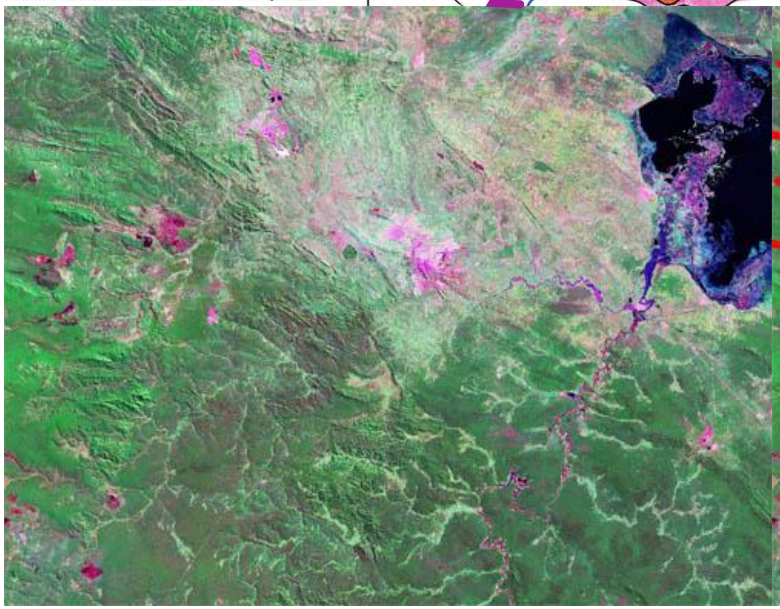
3 cm band – the image is transparent up to the first water-bearing horizon: it is possible to see what is located below soil and sands

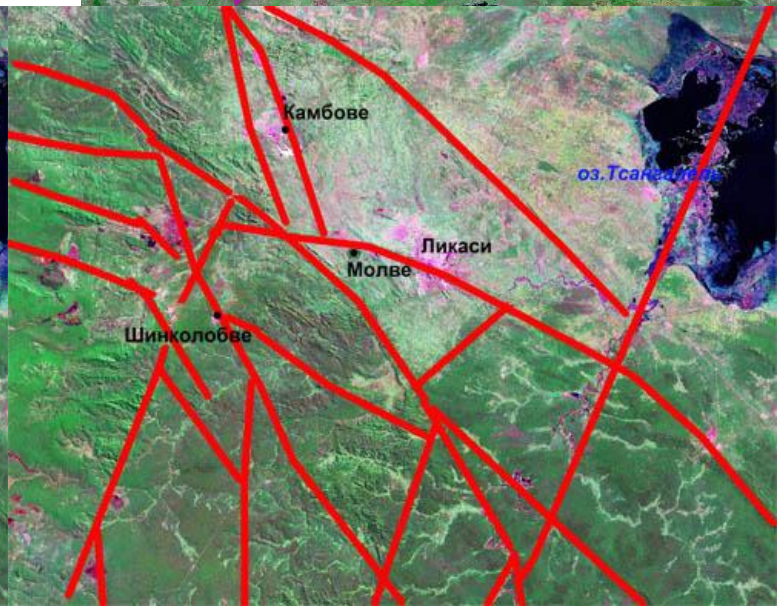
Methodology example

Copper bearing belt in Central Africa



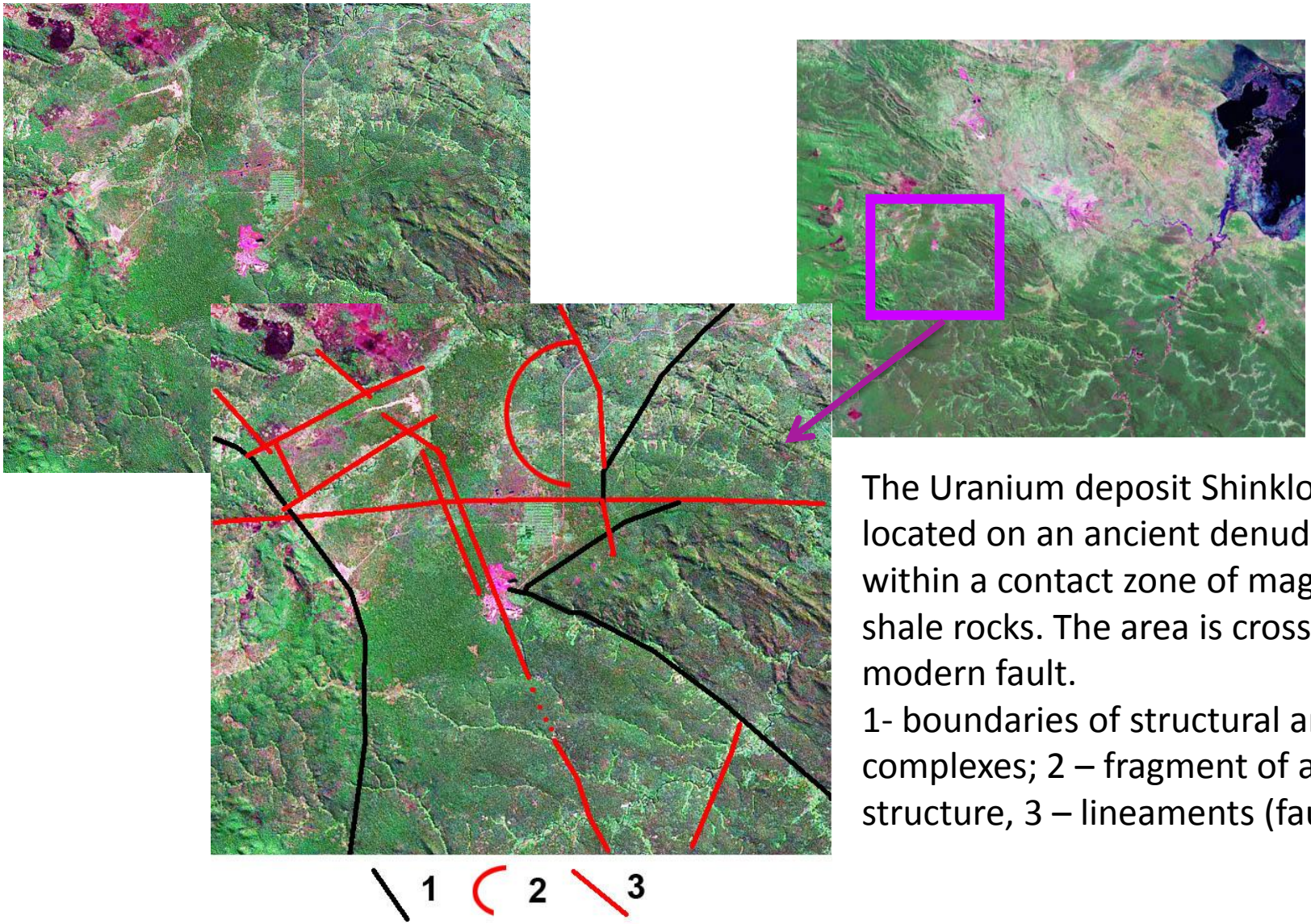






Methodology example

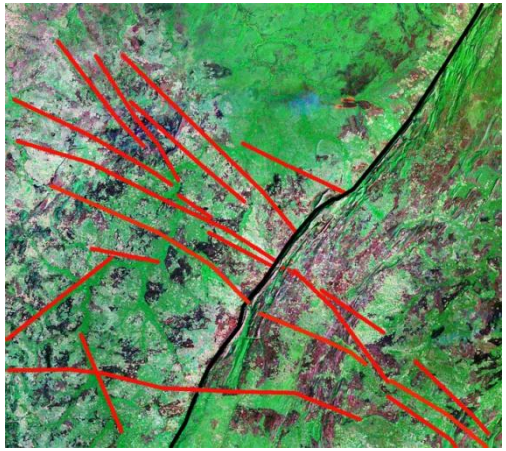
Uranium deposit within the belt

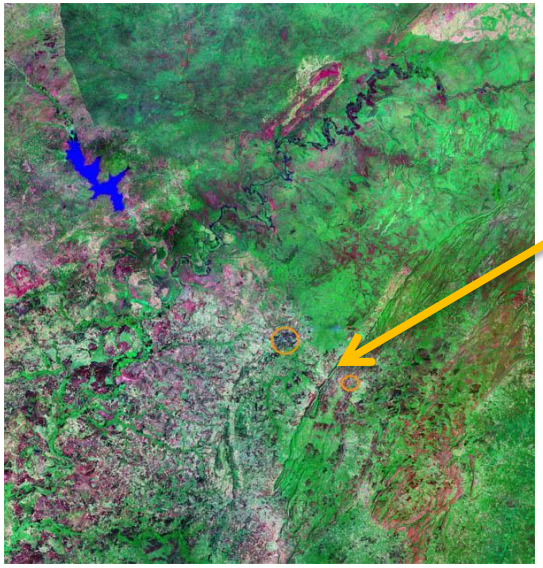


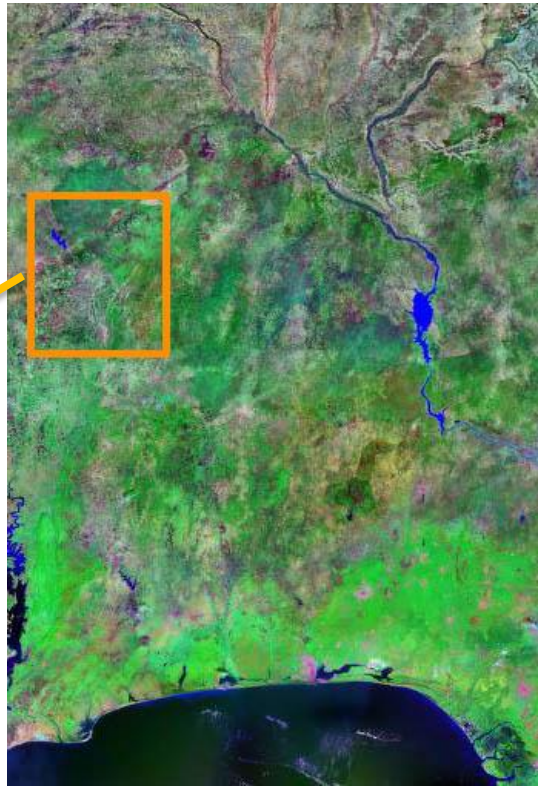
The Uranium deposit Shinklobe is located on an ancient denudation plane within a contact zone of magmatic and shale rocks. The area is crossed by a modern fault.

1- boundaries of structural and facial complexes; 2 – fragment of a ring structure, 3 – lineaments (faults)

Methodology example
Placer gold mine, Benin





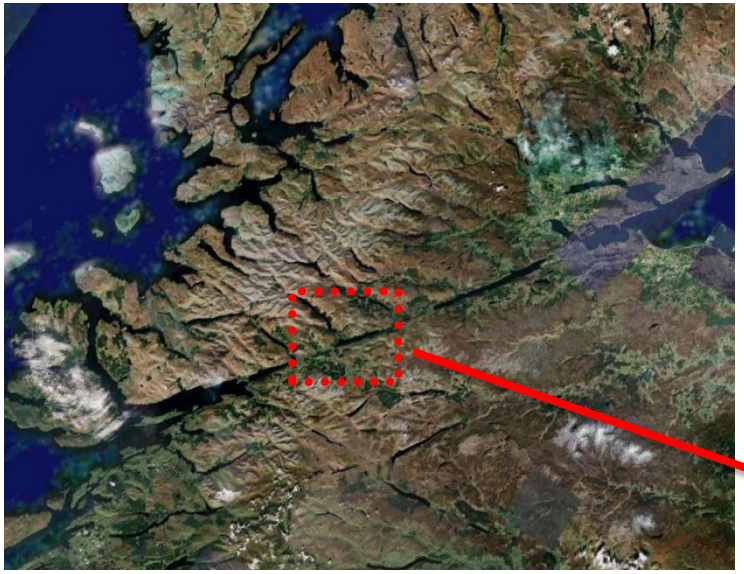


The placer gold deposits are confined to crushed zones with modern tectonic movements.

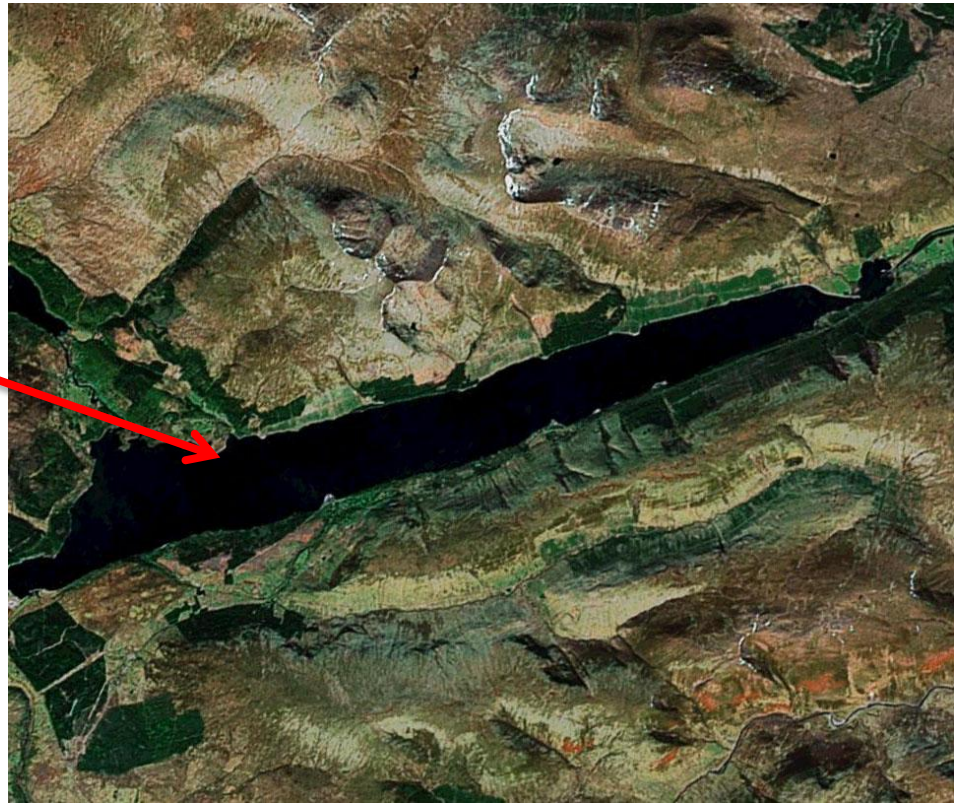
The placers may be detected by a processed caused transfer of the ore mineral away from the primary deposit. The same processes cause a link of the placer to relief elements of various scales. To discover a placer, it is needed to analyse the relief-forming factors, location of the potential primary deposits, routes of migration, and areas of accumulation of clastic elements.

Methodology example

Revealing of ‘alive’ faults of any scale

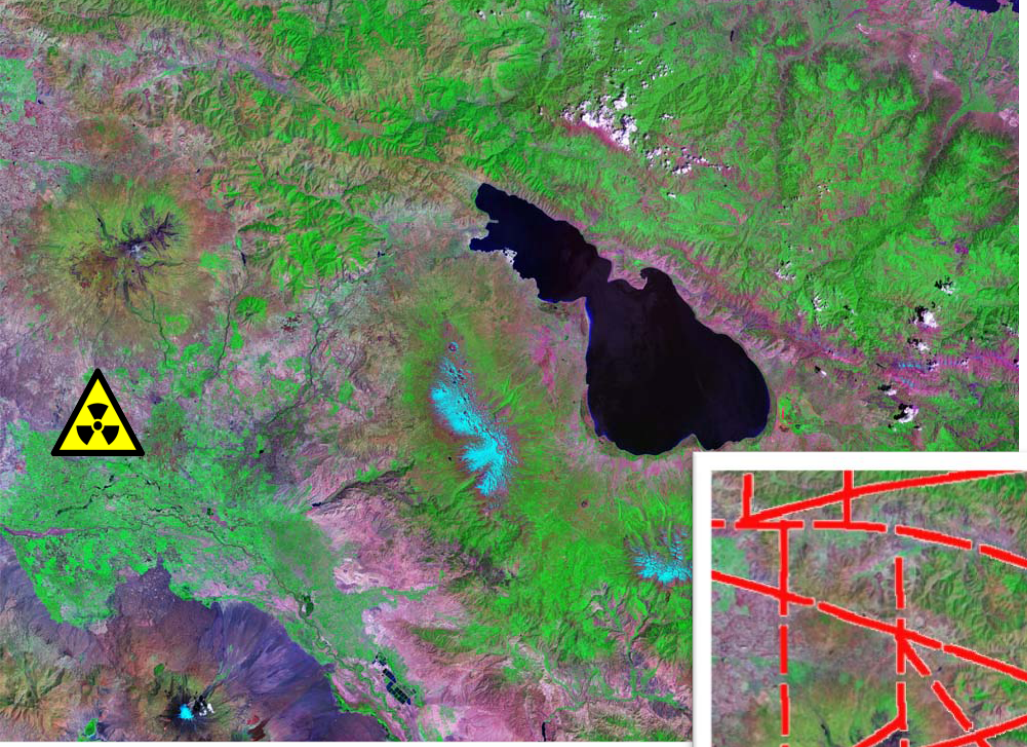


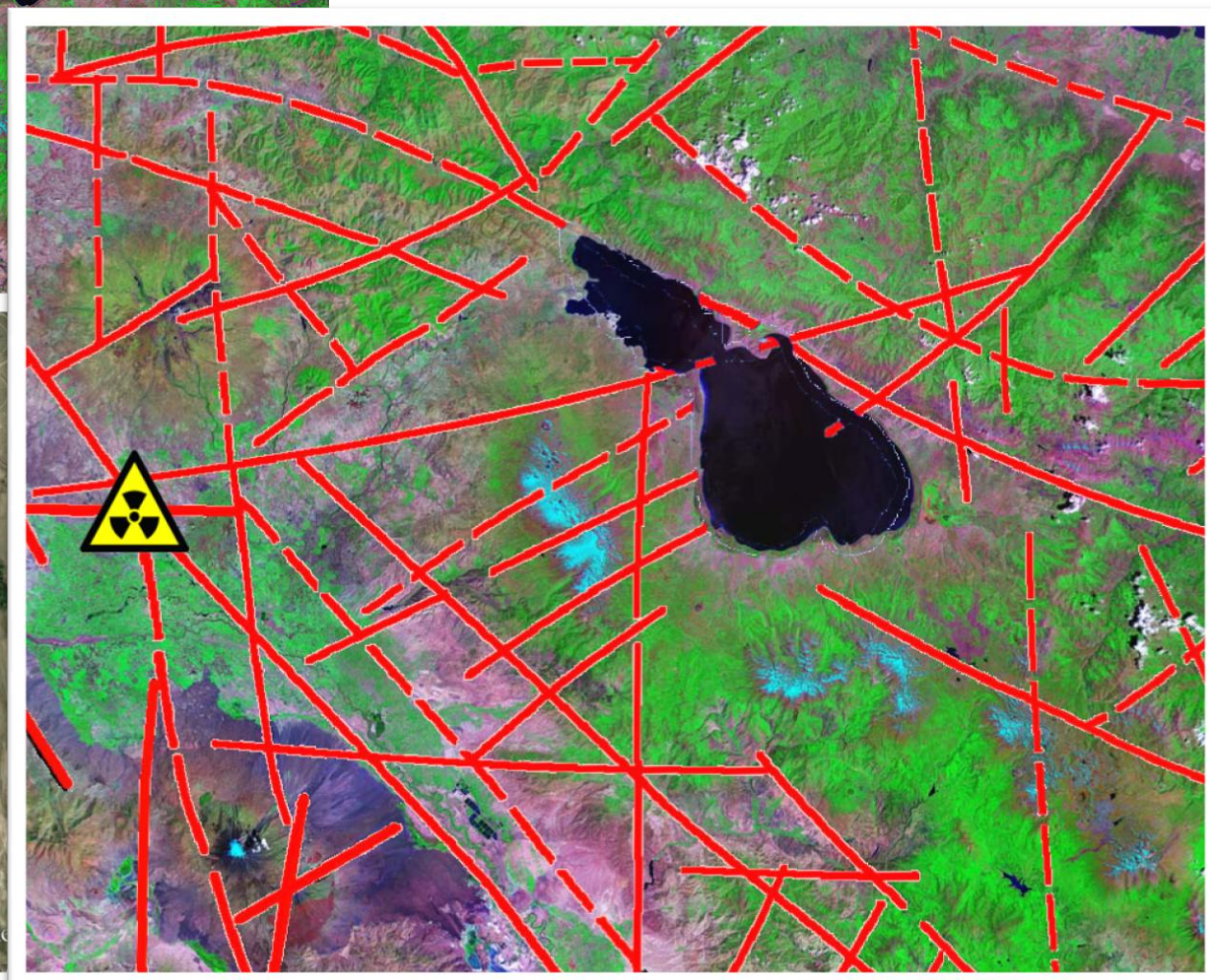
Depth fault in Scotland (Great Glen) and its fragment. Replacements along the fault reach in some areas 100 km. Triassic initiation; earthquakes in 816, 1888, 1890, and 1891



Revealing potentially dangerous faults:

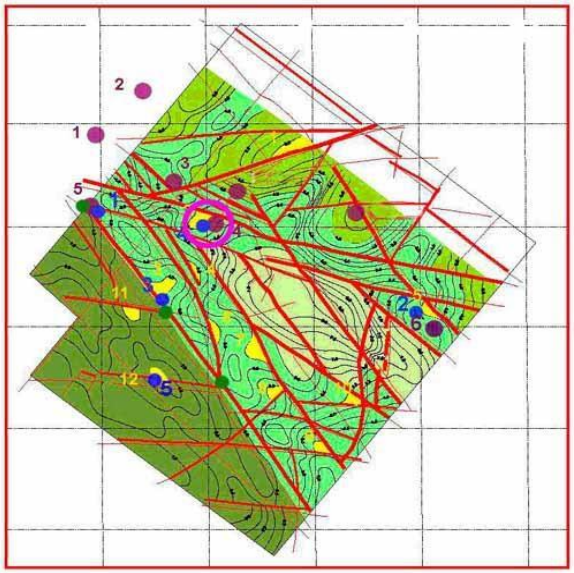
Nuclear power station in Armenia

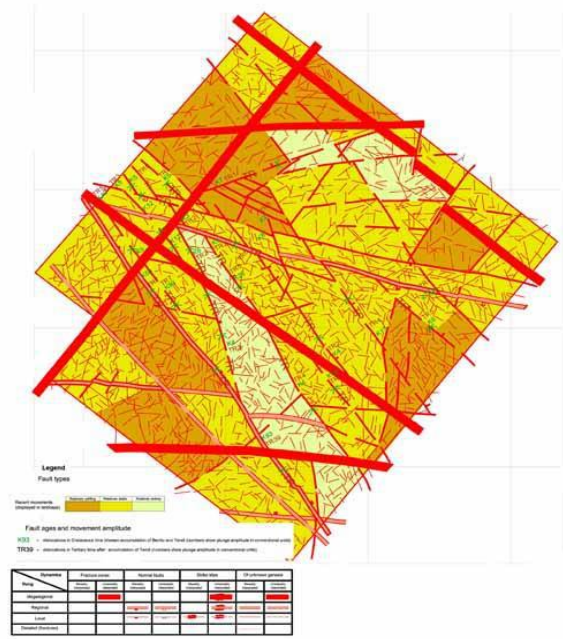


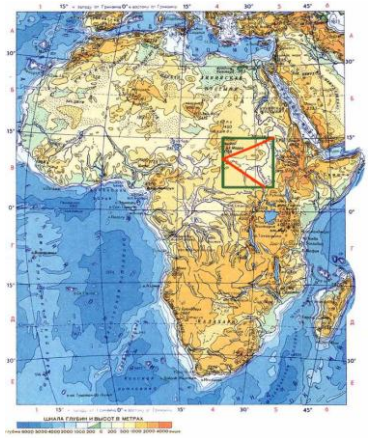


Sudan Case Study

Interpreting the Space Data







1 out of the 4 promising locations identified by CSTP was drilled by the Sudanese company 'The Greater Nile Petroleum Operating Company' (GNPOC), and presence of oil was confirmed

Left – geological map obtained by space image data; lilac circle shows the priority No.1 drilling point;
Right – map of rising and sinking blocks

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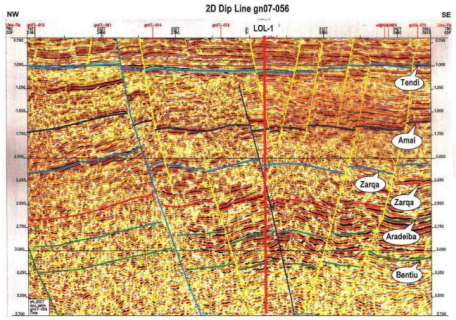
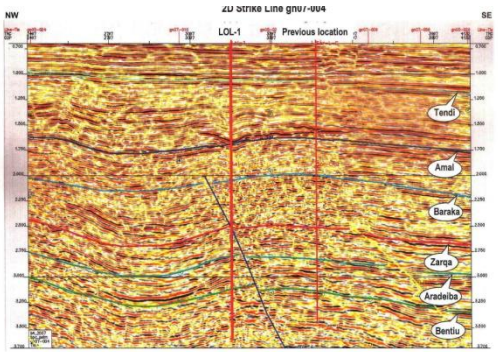
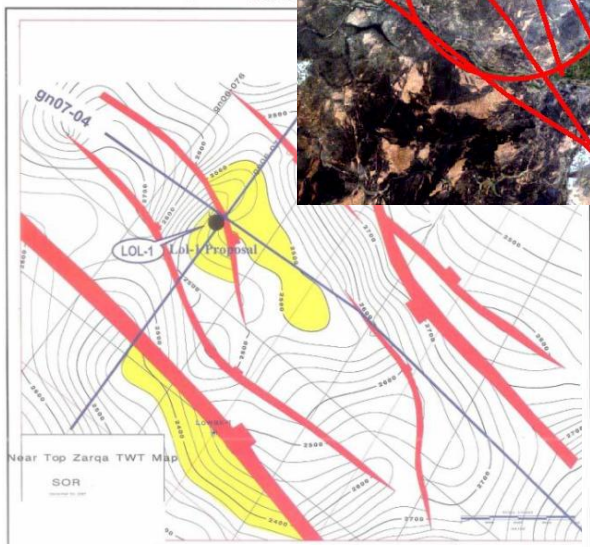
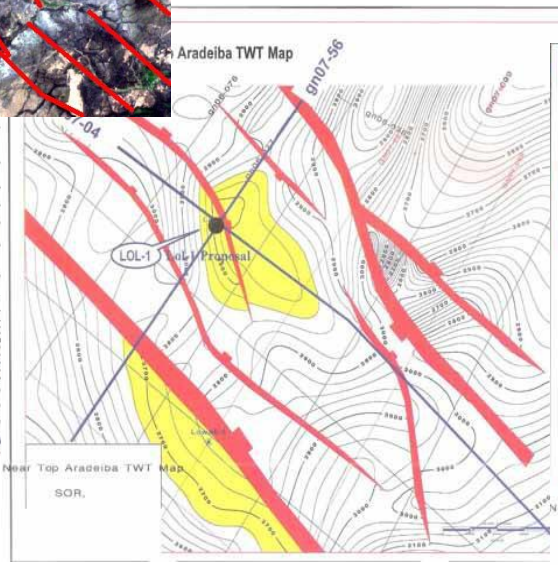
Sudan Case Study

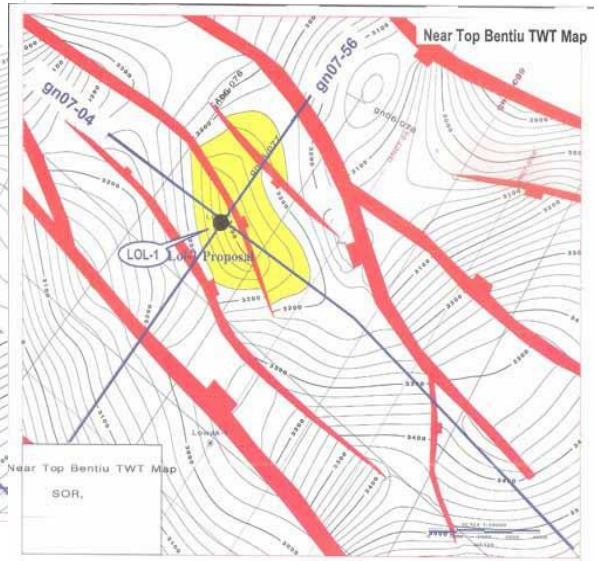
Results and Checks of the Forecast











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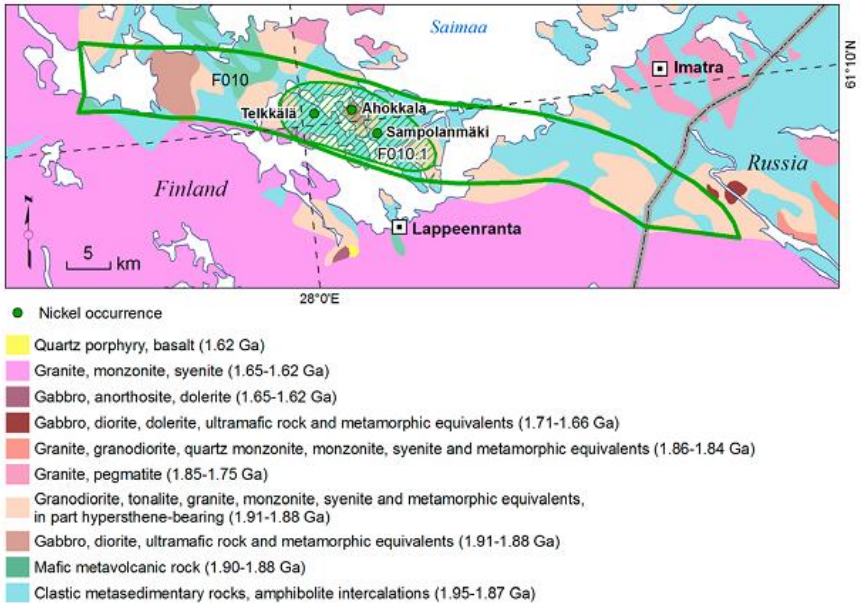
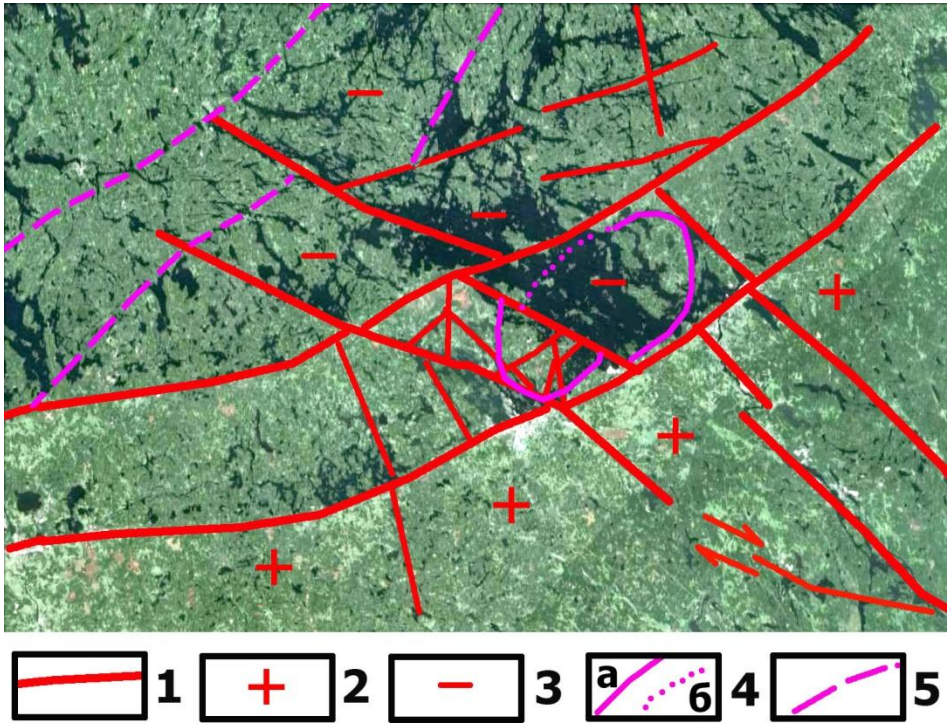
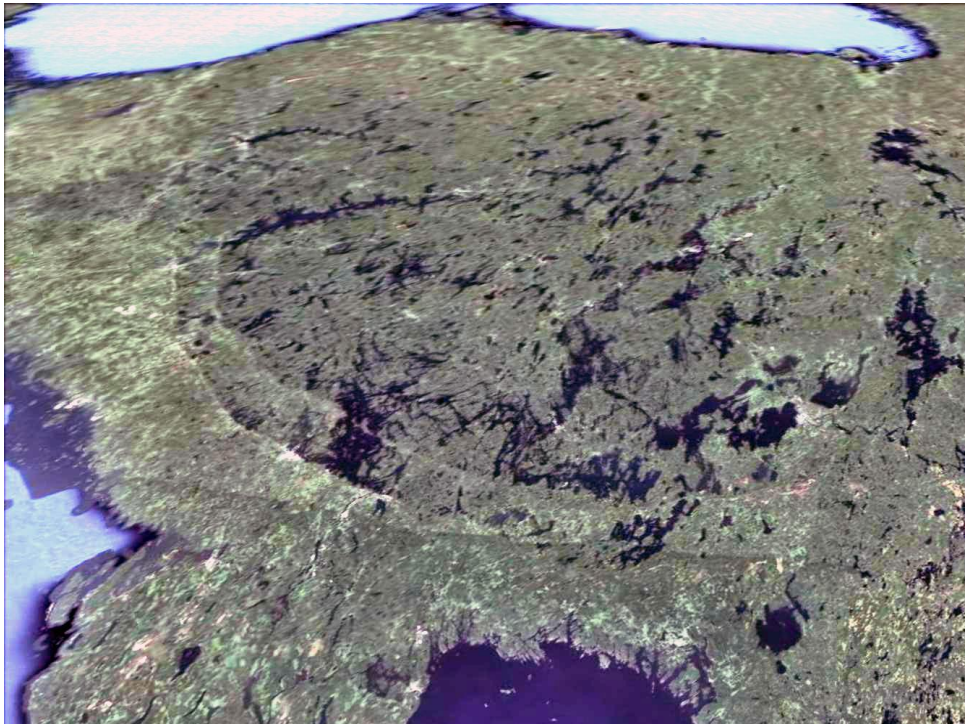
An initial look at Finland

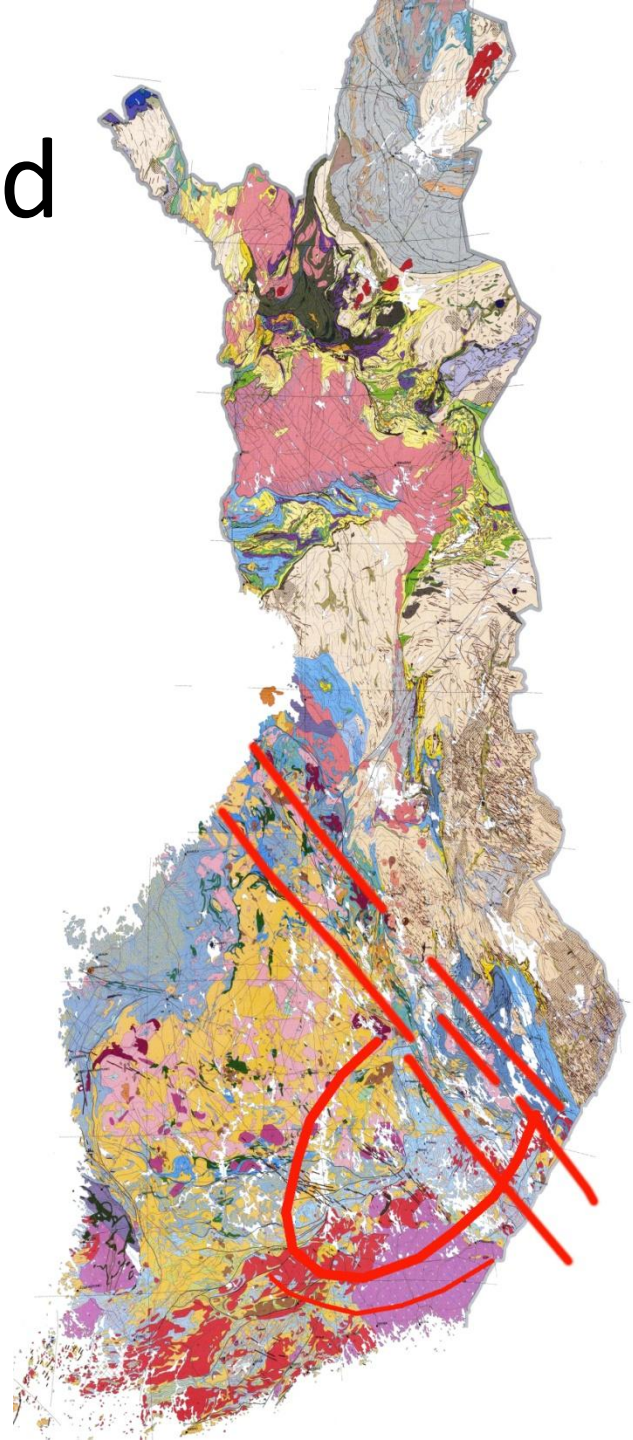




Left: the initial map
Top right: an image
Below: the interpretation: 1 – the supposed faults (lineaments), 2 – supposedly rising blocks; 3 – supposedly sinking blocks; the arrows show shift replacements; photo pattern anomalies: 4 a - reliably seen, 4b – supposed, under water; 5 – unreliably interpreted

An initial look at Finland





The “wheel of fate” is not yet interpreted...

Thank you

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