THE USE OF SPACE SATELLITE IMAGES IN THE EXPLORATION FOR OIL & GAS, GROUNDWATER & MINERALS

CSTP

Moscow-London-South Africa

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CSTP is offering services to assist in the exploration for oil, gas, groundwater and mineral resources based on a technique involving the interpretation of space images.

CSTP have assembled a team which comprises experts drawn from several organisations in Britain and Russia who have established collaborators from the remote sensing and oil & gas business and academic fields. The team have considerable, appropriate and unique experience which can be brought to bear on particular needs. The experts from which the team is composed are all at a senior level and have proven reputations in their fields. The British partner in this endeavour, Commercial Space Technologies Ltd. (CST), has been managing advanced technical projects in the Former Soviet Union/Russia for over 25 years.

The experts have a proven track record of successful exploration and the identifying of drilling targets through the interpretation of complimentary suites of satellite data and its full integration with the existing well, seismic, gravity and magnetic data as available.

Technique

Interpretation of space images is the only method allowing one to have a view of geological objects as they are revealed on the surface as well as a view of their signatures in a landscape within natural boundaries and showing original relationships. In other words, the analysis of images at different levels of generalisation gives extra information on the geological structure. This is why it is expedient to use this method despite the fact that it is indirect. Fig. 1 illustrates the global level of generalisation (approximately 1000x1000 km).

Any ore or oil and gas deposit is a geochemical anomaly which is always accompanied by tectonic, petrographic, geophysical and landscape anomalies. They display themselves in a landscape in different ways and respectively are reflected in aero- and space images in connection with their hierarchy rank, nature, climate, latest tectonic movements, intensity of anthropogenic transformation of landscape and other factors.

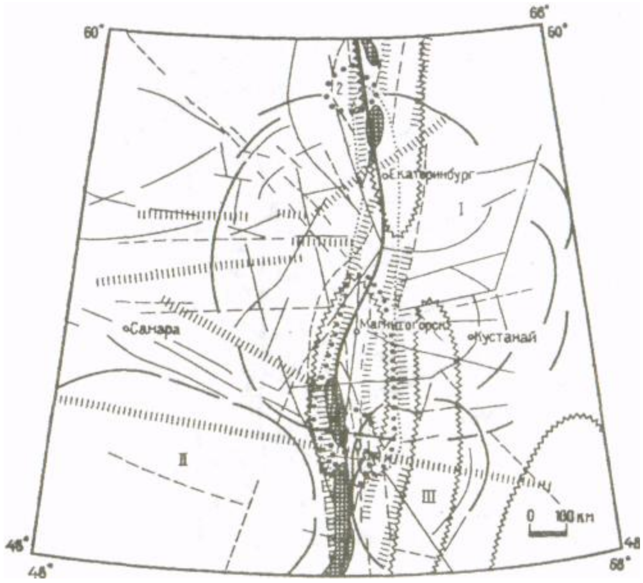


Fig. 1. Forecast-exploration model of the central part of the copper pyrites province of Ural. The global level of generalisation.

About 80 years ago, aircraft images brought a revolution to the geological understanding of the Earth's surface. In exposed areas (especially where climates were arid) aircraft (or aero-) images allow the direct examination of lithological and stratigraphic complexes and small-to-medium scale geological structures, (Fig. 2).

Fig. 2. Medium altitude aero image, the southern part of Ural Mountain area, Russia. The folds composed by limestones (bright strips) and aleurolites (dark strips) are clearly seen.

The main object of the interpretation, resolutions of images used, types of shooting and methodological techniques are chosen in correspondence with the particular forecast, prospecting or exploration task or group of tasks and particular territorial geological situation and climate. Search prerequisites (criteria) and search features of the objects to be found are used to the maximum extent possible.

Since the late 1970's all Soviet and Russian geological explorations have the stage of space imagery use as an obligatory part of a survey. Space imagery is used for the construction of forecast-exploration models with the help of images of various spectrum bands and resolutions. Different levels of image generalisation – global, regional, ore deposit field, etc. allow the identification of faults, lineaments, ring structures and other elements. Judging by the intensity and configuration of them the forecast is made, (Fig. 3).

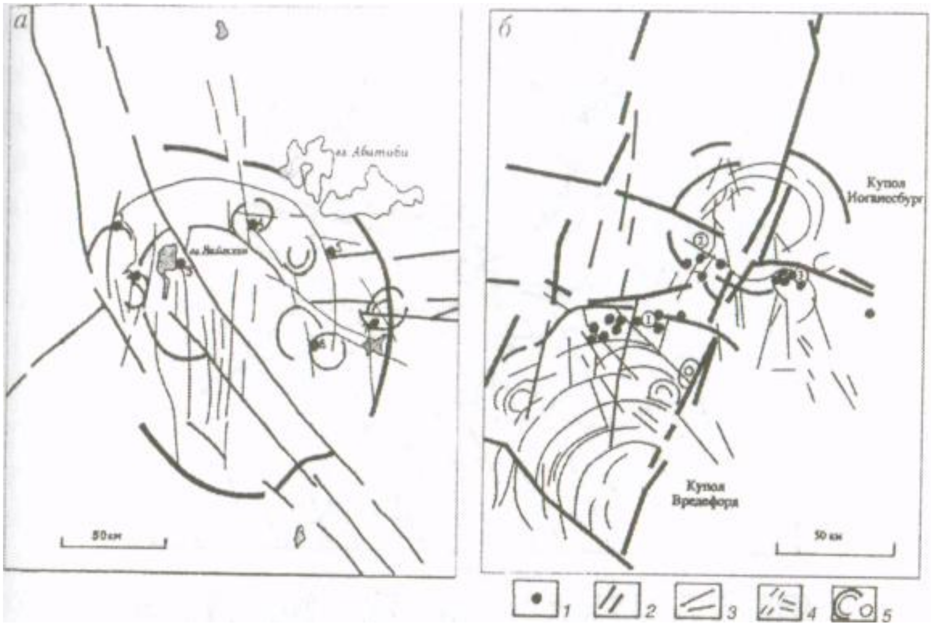
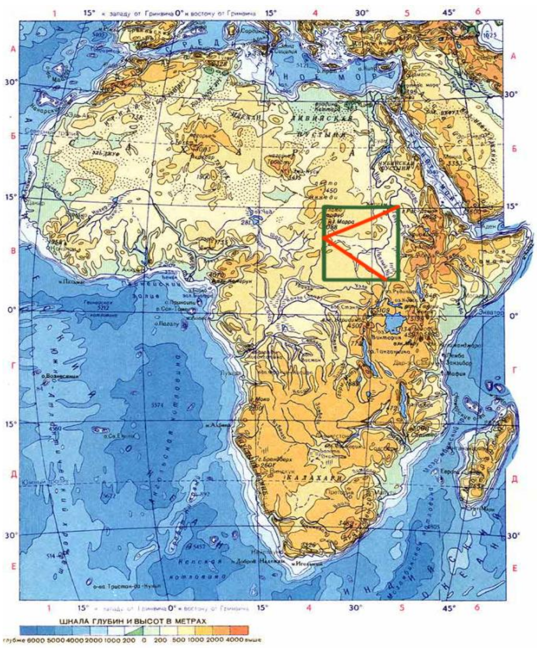


Fig. 3. Space structural models of а) — gold ore subprovince Abitibi (Canada), б) — gold ore basin Witwatersrand (South Africa)

The method has proved to be efficient for:

- mapping of fault and block structure of the Earth’s surface
- identifying of the most promising areas for further more detailed exploration in combination with traditional geological and geophysical data
- quick educated assessment of plots having licenses for a customer wishing to buy them

CSTP has used this method in Southern Sudan in the central part of Africa (green square on the map, Fig. 4 and 5). On space images the area looks like a single sublatitude submerging wedge which becomes narrower to the West. Space images assisted geologists to identify a huge graben there. The cut here contains rocks dated from Lower Cretaceous to Quaternary and oil bearing from Neocomian to Miocene. The cut is broken down by multiple faults which collectively form a complex graben. Sandstones are collectors and clays are traps. Most of these traps are tectonically shielded. The customer’s licensed block of 120x120 km size is approximately in the centre of the square shown on the map.



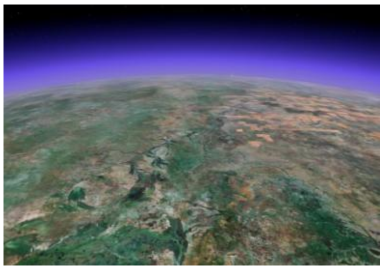


Fig. 4. Area in Southern Sudan in the central part of Africa (green square on the map) in which work was done.

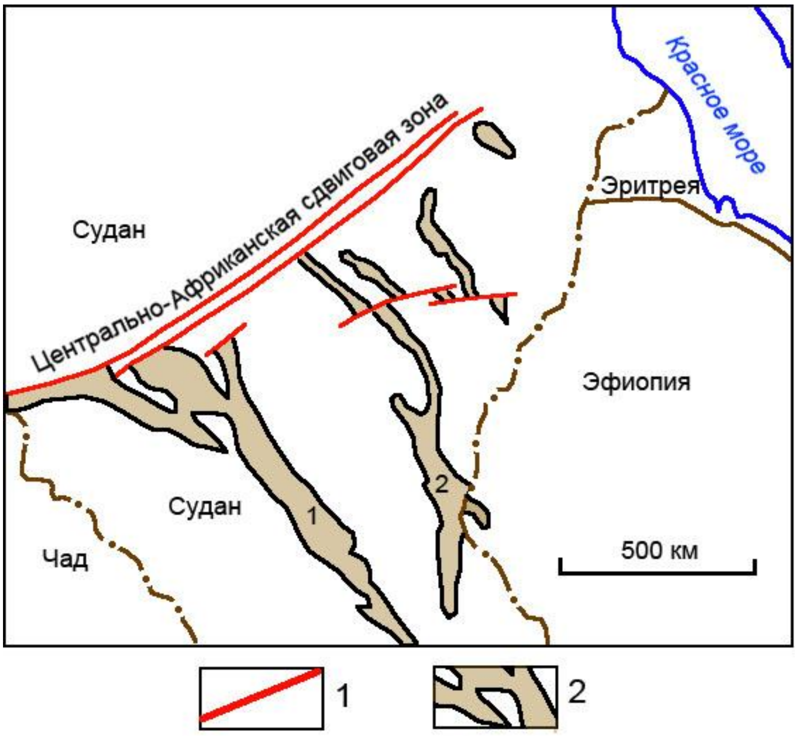


Fig. 5. The basins.

Oil and gas bearing here is connected with the two basins 1 – Melut and 2 – Muglat, which stretch mainly in North-West direction adjoining the Central Africa shear zone in the South.

Space images like that on the left hand side in Fig. 6 were interpreted and a map of the fault and block structure of the area was constructed (right):

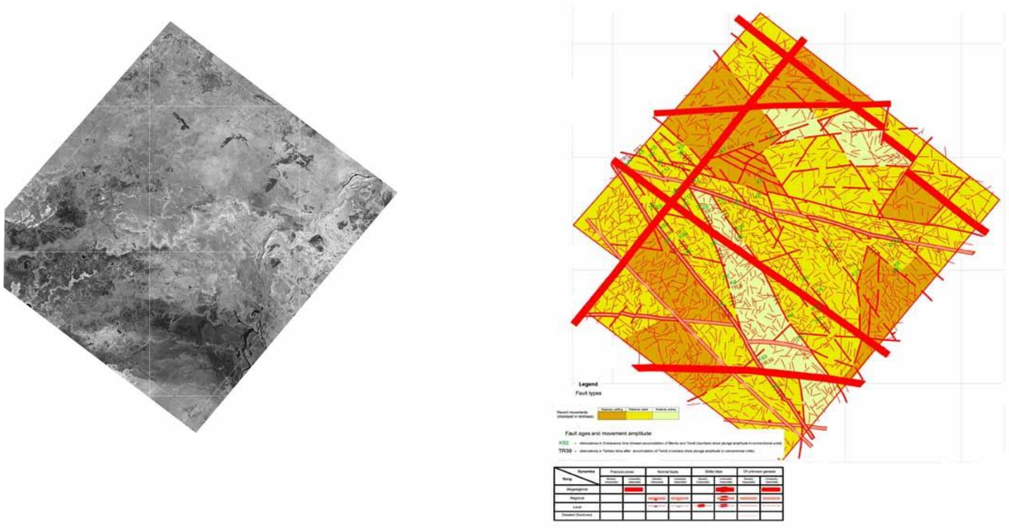


Fig. 6. Space image and the map of the fault and block structure.

The interpretation of the space images together with already existing gravimetric, magnetic, and fragmental seismic data enabled the compilation of a map of the revealed graben (Fig. 7). Certain locations were recommended for detailed seismic. One of such points is characterised by several oil-bearing indications seen on space images and was qualified as the most promising one (encircled). The interpretation of the space images (combined with the analysis of conventional data) resulted in the choice of the locations for detailed seismic exploration limited to the areas of the size of 80 x 80 miles at 4 chosen points, the accuracy of the coordinates of which being within a diameter of 5 miles.

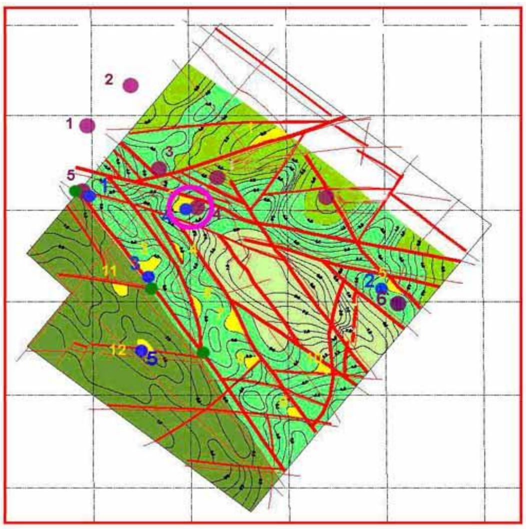


Fig. 7. A map of the revealed graben.

The results of detailed seismic exploration have confirmed the conclusions made from space images (Fig. 8).

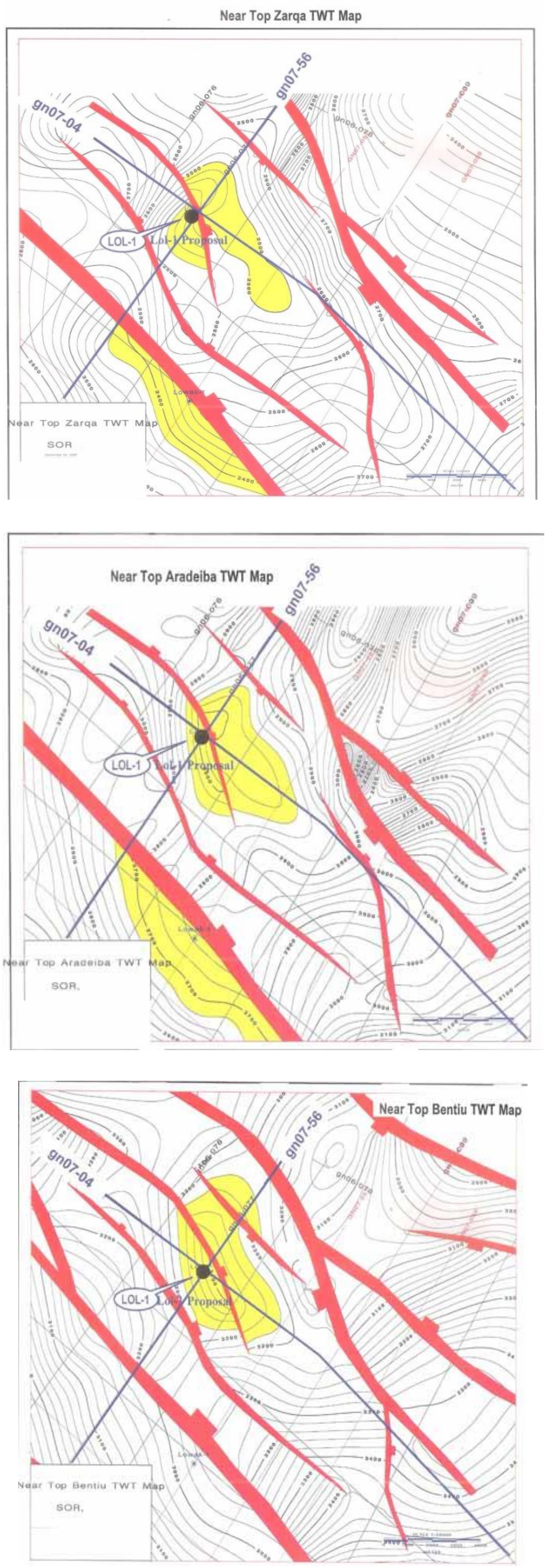


Fig. 8. Detailed seismic exploration confirmed the conclusions made from space images.

Later, drilling at 2 out of the four promising locations which CSTP identified was done by the Sudanese company The Greater Nile Petroleum Operating Company (GNPOC) and confirmed that oil was present in one of them.