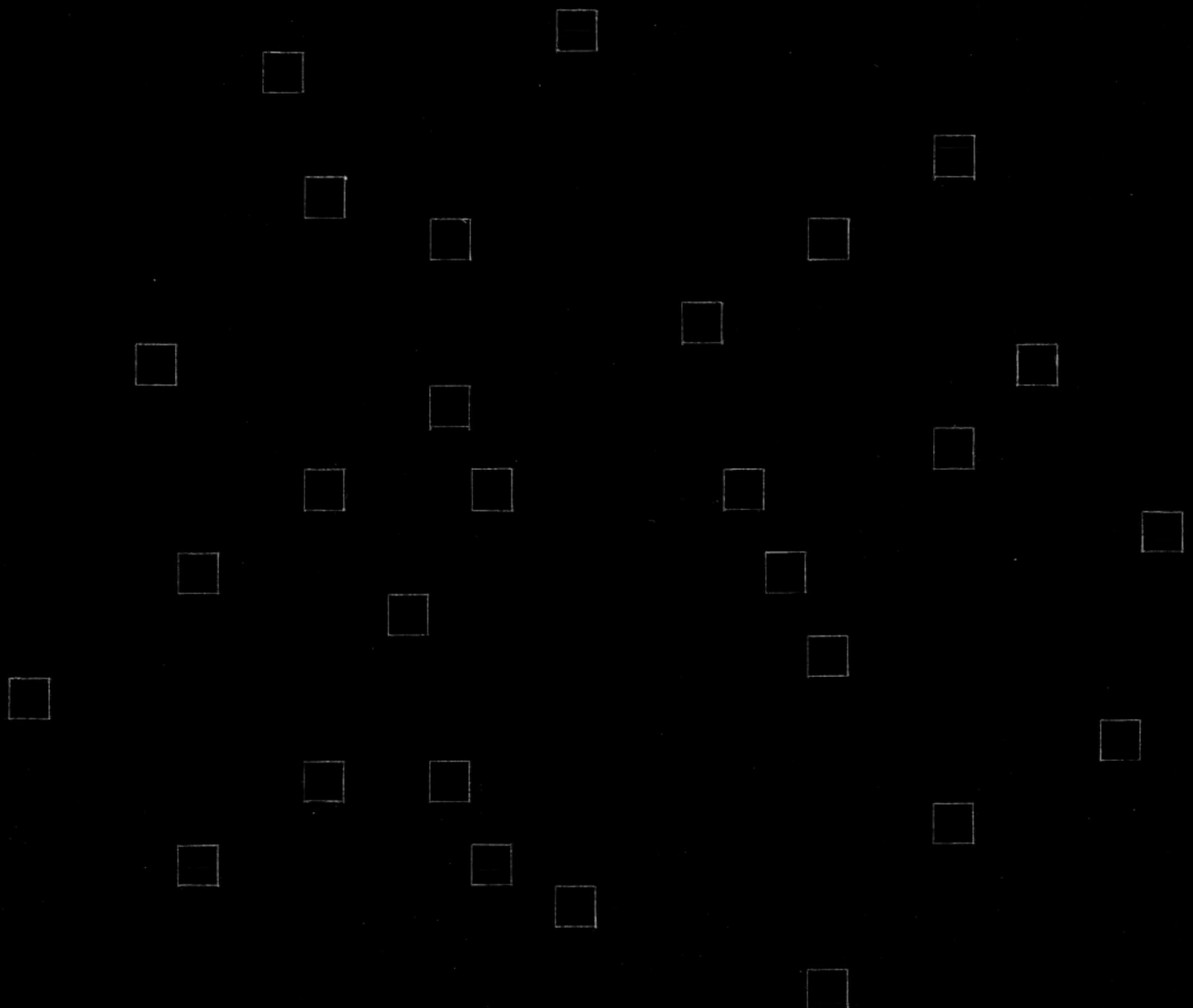
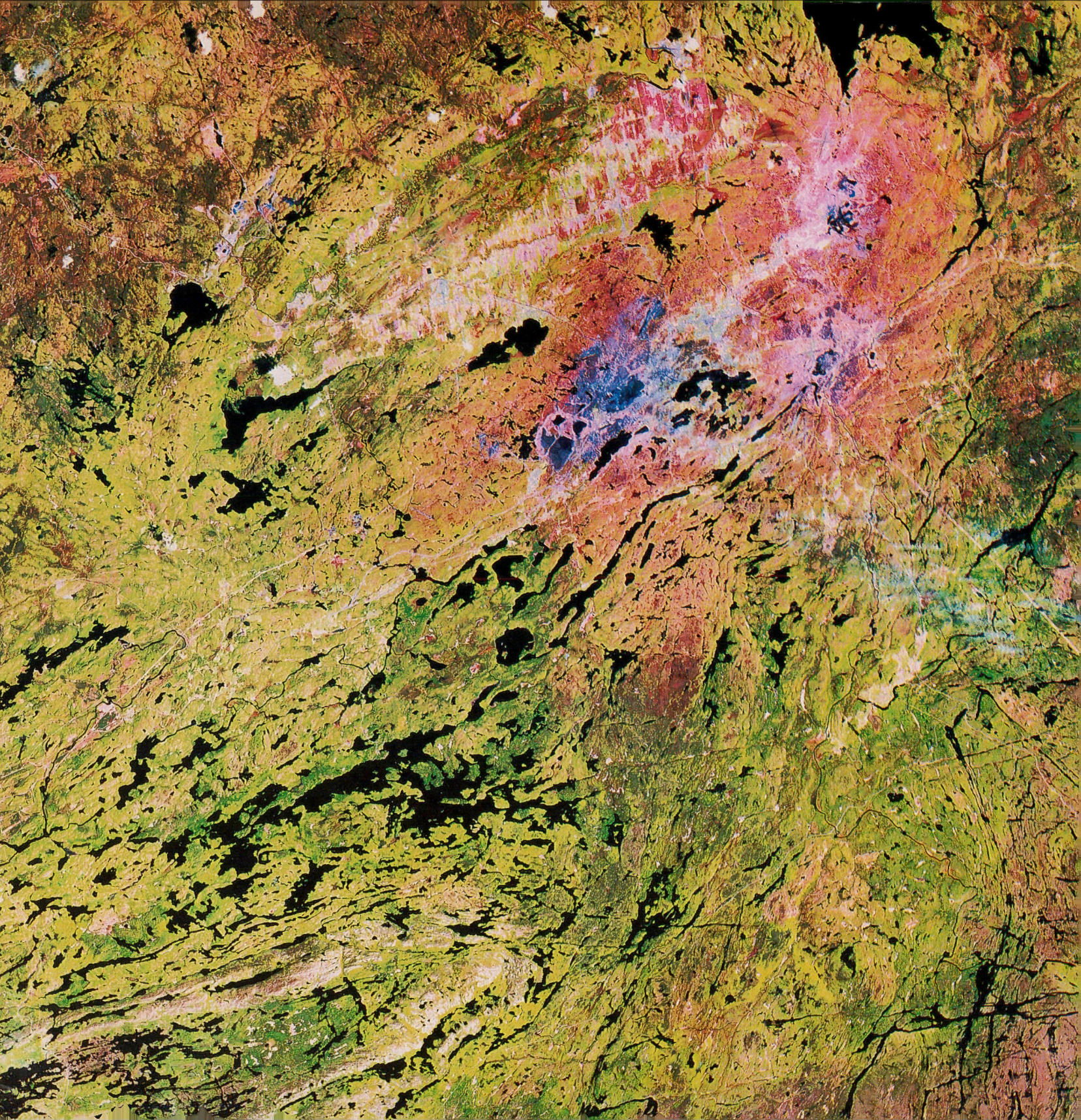
In Geological Exploration, it is hard to get the whole picture...

Canada

without Remote Sensing.



LANDSAT TM image of Sudbury region, Ontario



Remote sensing completes the picture

Satellite remote sensing is a valuable tool for interpretation of geological information required for mineral exploration in Canada.

Satellite images can provide details on regional geology and on local structure, lithology, physiography, overburden and vegetation.

Much of Canada's exploration activity takes place in areas covered with vegetation and transported soil. The Canada Centre for Remote Sensing (CCRS) has therefore developed an approach that combines image analysis methods with conventional photo-interpretation techniques for identification of geological features.

The experience of the geologist is a valuable asset to successful interpretation of remote sensing data. Making effective use of satellite remote sensing in mineral exploration depends on several factors:

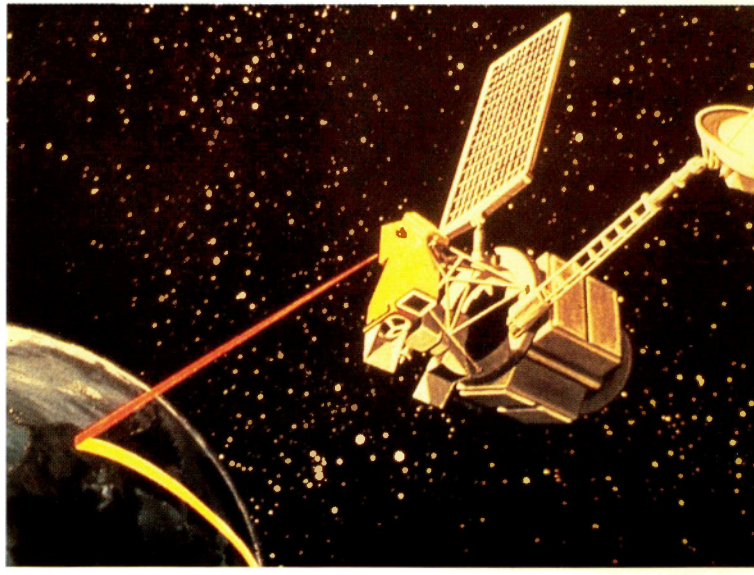
- the photointerpretation experience of the geologist;
- the field experience of the geologist in the area of geological interest;
- the suitability of bedrock structures and lithology for analysis by remote sensing;
- the nature and extent of vegetation cover; and
- the nature and extent of surficial materials.

Detailed geological analysis of satellite images usually requires that data be obtained in digital form for use on a computer-aided image analysis system.

The Geological Analysis Aid Package (GAAP), a methodology model for computer-aided image analysis, has been developed by geologists at CCRS in cooperation with Canadian mining companies.

GAAP is designed to assist geologists who are new to satellite imagery and computers and provides a good introduction to the principles and methods of computer-aided image analysis. As experience is gained with the data and digital analysis techniques, methodologies can be developed that are specifically tailored to local lithology, structure, overburden and vegetation features.

The three basic image products or 'interpretation aids' generated through GAAP are a textural analysis aid, a lineament analysis aid and a colour-enhanced image for visual interpretation. They are derived through the application of image analysis techniques such as contrast stretch, ratios, classifications and edge filtering.



LANDSAT-5

After satellite data are analyzed by computer and image products are generated, the standard geological practice of multiple data set integration, field evaluation and geological interpretation should be followed.

Satellite imagery analysis has made a valuable contribution to reconnaissance or regional scale exploration activities using this approach in Canada and in other countries.

The Canada Centre for Remote Sensing provides satellite data to Canada's mineral exploration industry

CCRS obtains data for geological applications from the Multispectral Scanner and the Thematic Mapper sensors on the LANDSAT series of satellites.

The LANDSAT Multispectral Scanners (MSS) have been acquiring data over Canada since 1972. MSS obtains images that cover an area of 185 km x 185 km and have a spatial resolution of 80 m.

The LANDSAT Thematic Mapper (TM) is a higher resolution sensor from which data over Canada have been acquired regularly since 1984. This sensor also produces an image of a 185 km x 185 km area. However, it has significantly improved spatial resolution (to 30 m), improved spectral bands and better radiometric resolution when compared with the MSS (see accompanying tables). The TM has been used to replace small-scale aerial photography in some cases.

The broad view and low cost of the Multispectral Scanner data are ideally suited to wide-area mapping. For areas in the order of 30 000 km^2, visual analysis of LANDSAT MSS colour composites is an effective approach. For areas in the order of 10 000 km^2, LANDSAT MSS imagery, analyzed digitally, can be a helpful and cost-effective tool for geological analysis. Thematic Mapper data are more expensive, but may result in a wider range of applications and greater overall accuracy. LANDSAT TM data at 30 m resolution, analyzed digitally, are appropriate for areas in the order of 2000 km^2.

For very narrow areas of investigation (25 km^2), the higher resolution of airborne remote sensing would more likely yield satisfactory results.

Data in many forms for many uses

LANDSAT MSS and TM data can be obtained in either photographic form (as prints or transparencies) or digital form on computer-compatible tapes.

Photographic prints at the larger scales (1:250 000 for MSS, 1:250 000, 1:125 000 and 1:50 000 for TM) provide an overview of an area, which can be examined by several persons at once.

Transparencies provide improved photographic qualities and thus more detailed information. However, they are available only in the smaller scales (1:1 000 000 and 1:500 000 for MSS, and 1:500 000 and 1:250 000 for TM) and generally require projection or magnification equipment to improve the scale for interpretation. Interpretation at scales as large as 1:50 000 is generally satisfactory with MSS transparencies. Scales of 1:15 000 are practical with the TM.

Receiving Station, Prince Albert, Saskatchewan

Digital data require the use of a computerized image analysis system. The user then has much greater flexibility in data analysis, including image enhancements, multidate image registration and image classification.

Get the whole picture on how CCRS has made advances in remote-sensing technology

Together with others in the field, CCRS is constantly striving to refine the quality and usefulness of satellite images and enhance image interpretation techniques.

Several conferences and symposia each year cover current geological remote sensing research. The RESORS data base at CCRS also contains extensive references on the subject.

For additional information on this and other remote-sensing capabilities, please contact:

User Assistance and Marketing
Canada Centre for Remote Sensing
Energy, Mines and Resources Canada
Ottawa, Ontario
K1A 0Y7
Telephone: (613) 993-9900

Orders for image data should be directed to:

The Order Desk
Prince Albert Satellite Station
Canada Centre for Remote Sensing
Energy, Mines and Resources Canada
P.O. Box 1150
Prince Albert, Saskatchewan
S6V 5S7
Telephone: (306) 764-3602

TABLE 1
LANDSAT Sensors

Specifications		
Multispectral Scanner		
Swath Width		185 km
Spatial Resolution		80 m
		(micrometres)
Spectral Bands	1	0.50—0.60 (green)
	2	0.60—0.70 (red)
	3	0.70—0.80 (near-infrared)
	4	0.80—1.10 (near-infrared)
Radiometric Resolution		64 grey levels
Thematic Mapper		
Swath Width		185 km
Spatial Resolution		30 m
		(micrometres)
Spectral Bands	1	0.45—0.52 (blue)
	2	0.52—0.60 (green)
	3	0.63—0.69 (red)
	4	0.76—0.90 (near-infrared)
	5	1.55—1.75 (shortwave infrared)
	6	10.50—11.50 (thermal infrared resolution—120 m)
	7	2.08—2.35 (shortwave infrared)
Radiometric Resolution		256 grey levels

TABLE 2
LANDSAT Satellite Data Products

	MSS	TM
Transparencies	1:1 000 000 1:500 000	1:500 000 1:250 000
Prints	1:1 000 000 1:500 000 1:250 000	1:500 000 1:250 000 1:125 000 1:50 000
Computer Tape	System Corrected 4 bands Geocoded 4 NTS 1:50 000 map sheets 4 bands	System Corrected 1—7 bands Geocoded 4 NTS 1:50 000 map sheets 4 bands

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A resource centre for Canada's resource industries

Energy, Mines and Resources Canada

Hon. Gerald S. Merrithew, Minister of State (Forestry and Mines)

Énergie, Mines et Ressources Canada

L'Hon. Gerald S. Merrithew, Ministre d'État (Forêts et Mines)

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