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# Hyperspectral data for Arctic geology and mineral resources

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Development of the mineral and energy resources in Canada's north requires detecting and mapping surface lithology and geochemistry to provide the key indicators used by exploration companies for evaluation and exploitation of natural resources.

The remote nature and environmental challenges posed by the arctic environment reduces the capacity to economically explore and locate mineral resources by using traditional techniques. Hyperspectral remote sensing is providing a new tool to the mineral exploration community to explore larger areas and focus on key lithological detections to reduce exploration costs and increase development.

A large proportion of Canada's land mass north of the treeline remains unexplored and poorly understood from a remote sensing perspective. Hyperspectral remote sensing investigations have been carried out in temperate and tropical regions, but few have occurred in the arctic environment. The Canada Centre for Remote Sensing (CCRS) pursues arctic geology hyperspectral study support in collaboration with the Canadian mineral exploration community.

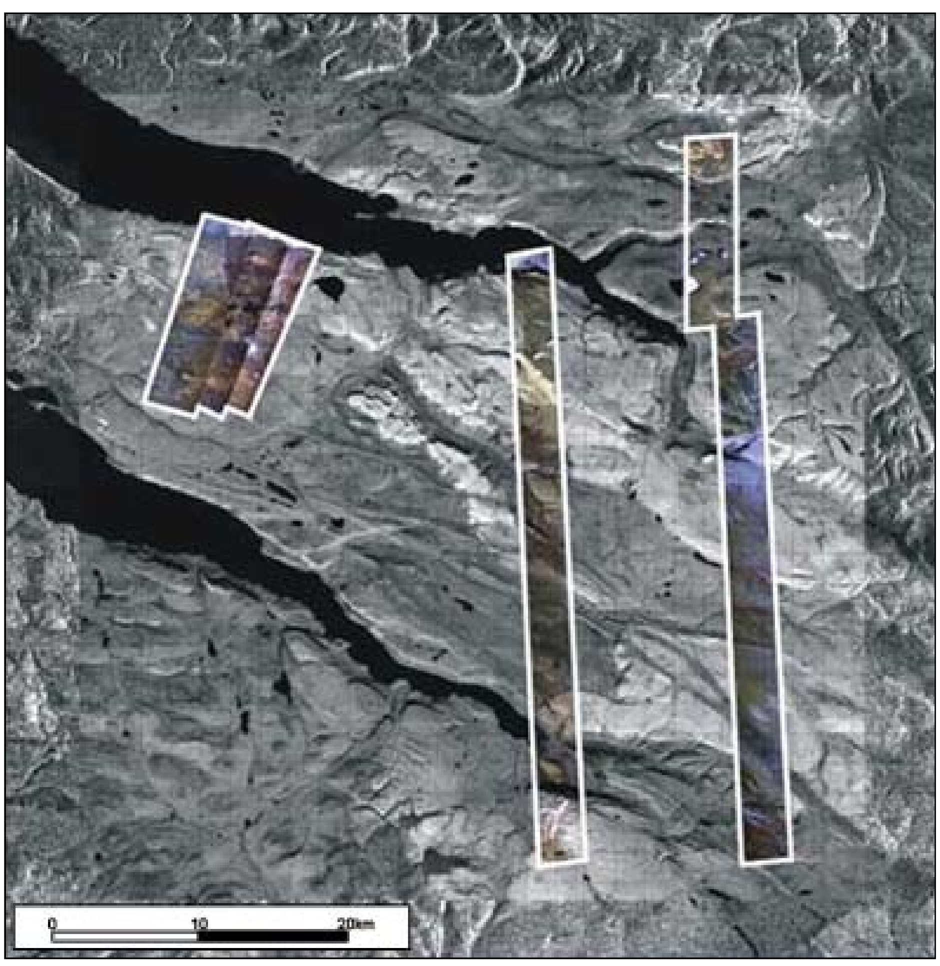


**Figure 1. CCRS Arctic Hyperspectral Geology Project, Borden Rift Basin, Baffin Island.**

## Foundation

Imaging spectrometry science at the CCRS pursues research to develop information products from hyperspectral remote sensing data. Within this framework, exploration and mineral mapping applications are prime candidates to exploit imaging spectrometry data. These efforts will help the geoscience community evaluate hyperspectral data and will allow industry to develop confidence and expertise in using these data sets.

## Advances

A key contribution of hyperspectral remote sensing to exploration geology is the mapping of indicator minerals. Better techniques are needed to increase the accuracy of the information from hyperspectral imagery, including more accurate derivation of at-surface spectral reflectance, extraction of key spectral signatures and surface material delineation and unmixing. It is important to bring these techniques and the development of data products to an operational level for use in the exploration industry and for mapping programs.

For this reason, CCRS engages in projects on Arctic hyperspectral geology. An example field site is the Cape Smith Belt in northern Quebec. It hosts economic occurrences of nickel, copper and platinum group elements and represents a Low Arctic environment with the challenge of abundant tundra vegetation. The Borden Basin on Baffin Island, Nunavut, was chosen for study because it is a High Arctic environment that has relatively little vegetation, its geology is fairly well understood, and it has an economic zinc and lead deposit (see Figure 1).

Collecting field work data for the development of a representative spectral database of arctic materials is an important contribution to the successful application of this technology. In these projects, the spectral reflectance characteristics of various lithologies, vegetation types and alteration zones that are near mineral occurrences are measured by using a GER3700TM portable field spectrometer, covering a wavelength range of 400 to 2400 nanometres (nm) (see Figure 2).

**Figure 2. Field spectrometer in operation over a bedrock target in the High Arctic *(Photo: Paul Budkewitsch)***

Overflights that use sensors such as the Probe-1, an airborne visible near-infrared and short-wave infrared hyperspectral sensor, provide the imagery for localized case studies. Additional ground-based spectral measurements and validation of the airborne and satellite hyperspectral data round out project planning. Preliminary results indicate successful results can be obtained from hyperspectral data gathered from high latitudes for mapping and mineral exploration.

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