
Mineral prospection
&
raw materials
(435 G)

- What kind of work does the geological engineer do before and during the mining operation?

A)- Mineral Explorations;

B)- Preparing geologic and mining maps

C)- Calculation of reservoir (prospecting & evaluation)

Mineral exploration

1. Definition and objectives:

2. Stages of mineral exploration:

   2.1 Province scale - area selection

   2.2 Political, sovereign and other associated risks

   2.3 Target generation - Regional Scale:

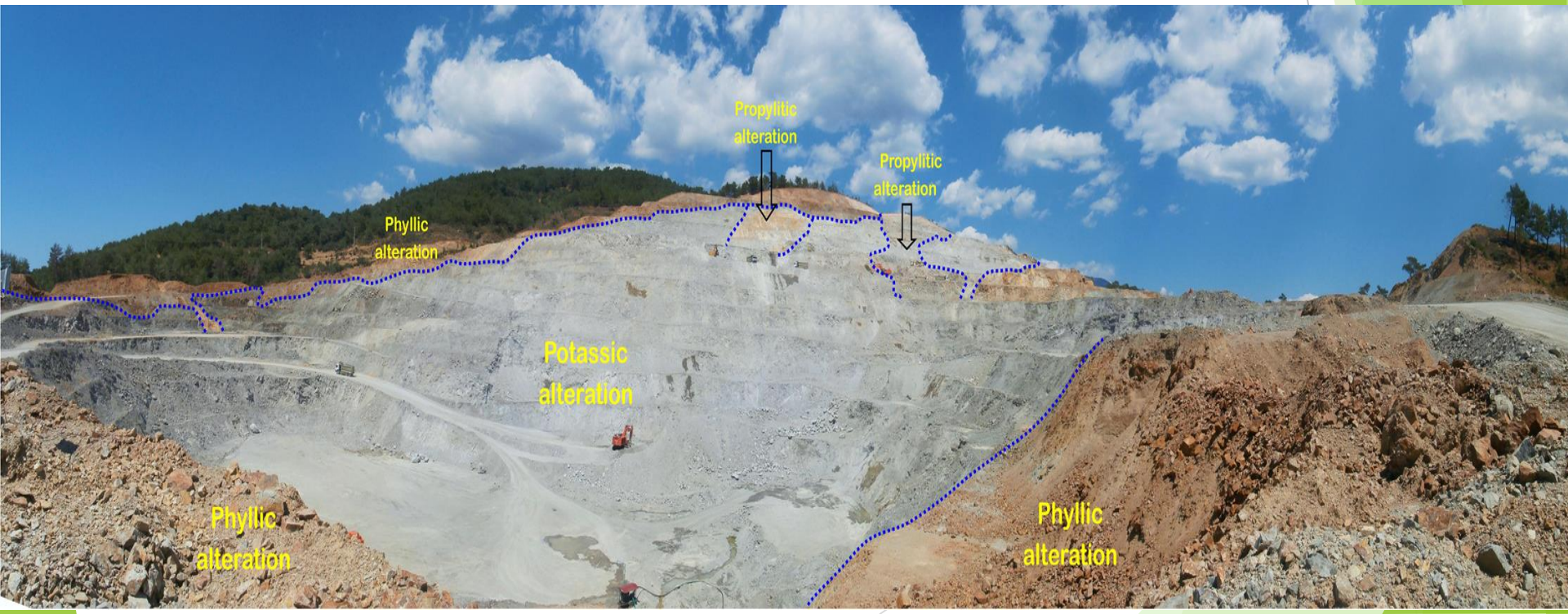
      2.3.1 Geophysical methods

      2.3.2 Remote sensing

      2.3.3 Geochemical methods

Mineral exploration

is the process of finding ores (commercially viable concentrations of minerals) to mine. Mineral exploration is a much more intensive, organized and professional form of mineral prospecting and, though it frequently uses the services of prospecting, the process of mineral exploration on the whole is much more involved.



What are the objectives in exploration?

- Establish baseline/background conditions
- Find alteration zones
- Find ore body
- Determine if ore can be mined or leached
- Determine if ore can be processed
- Determine ore reserves
- Locate areas for infrastructure/operations
- Environmental assessment
- Further understand a target deposit
- Refine exploration models

2.1 Stages of mineral exploration

Mineral exploration methods vary at different stages of the process depending on size of the area being explored, as well as the density and type of information sought. Aside from extraplanetary exploration, at the largest scale is a geological mineral Province, which may be sub-divided into Regions. At the smaller scale are mineral Prospects, which may contain several mineral Deposits.

2.2 Province scale - area selection

Area selection is a crucial step in professional mineral exploration.
This selection depends on:

- It should be best,
- most prospective,
- Easy, possibility, cheaply and quickly finding the area in a mineral field, geological region or terrain.
- Area selection is based on applying the theories behind ore genesis, the knowledge of known ore occurrences and the method of their formation, to known geological regions via the study of geological maps, to determine potential areas where the particular class of ore deposit being sought may exist.
- Area selection is also influenced by the commodity (raw materials) being sought; exploring for gold occurs in a different manner and within different rocks and areas to exploration for oil or natural gas or iron ore. Areas which are prospective for gold may not be prospective for other metals and commodities.
- Area selection may also be influenced by previous finds, a practice affectionately named subsurface control or nearology, and may also be determined in part by financial and taxation incentives and tariff systems of individual nations. The role of infrastructure may also be crucial in area selection, because the ore must be brought to market and infrastructure costs may render isolated ore uneconomic.

Political, sovereign and other associated risks

- Any area selected for mineral exploration also carries various forms of sovereign and other associated risks;
- the risk that even if a commercially viable deposit is present, political, environmental and social factors may make the discovery and development of the mineral resource inviable.

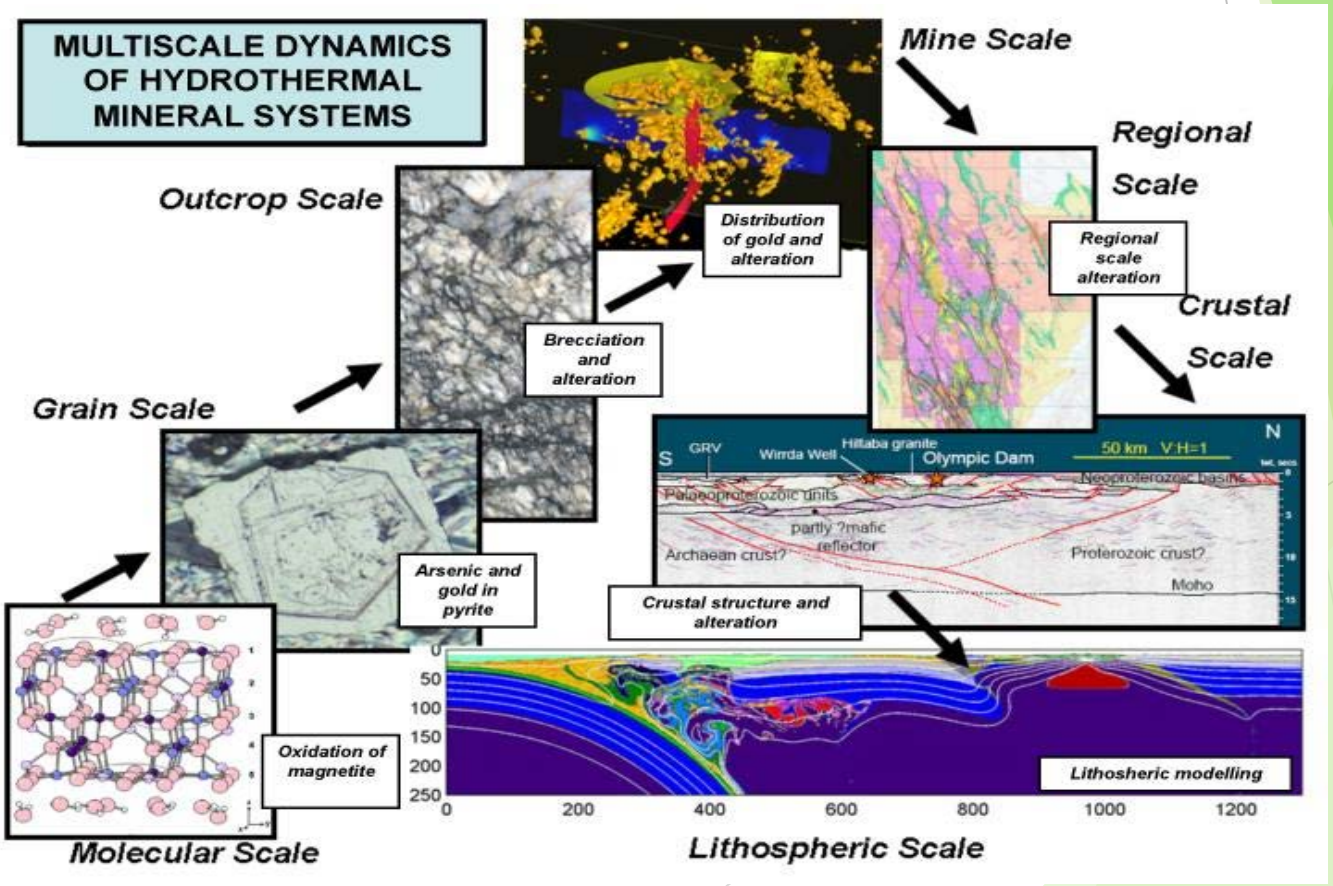
The risks also include,

- a change in the security of licence tenure due to changes in legal, political or other factors;
- changes in local land tenure (such as declaration of various types of conservation zones);
- outbreaks of social unrest within a country or region (including competition for mineral resources by artisanal miners, who may be operating illegally, or from political resistance from local or non-local organizations, who may or may not be represented or supported locally, but who are opposed to certain, or all, forms of mining);
- changes in tax and other financial conditions subsequent to the conditions which were legally in place at the start of exploration;
- natural disasters such as volcanoes, earthquakes, floods etc.

2.3 Target generation - Regional Scale

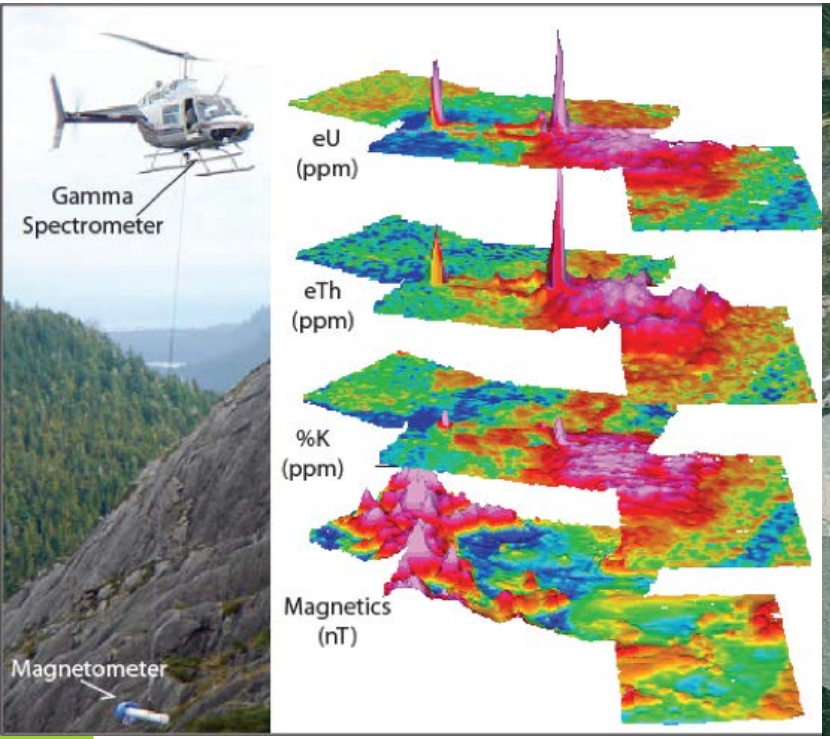
- The target generation phase involves investigations of the geology via mapping, geophysics and conducting geochemical or intensive geophysical testing of the surface and subsurface geology.
- In some cases, for instance in areas covered by soil, alluvium and platform cover, drilling may be performed directly as a mechanism for generating targets.

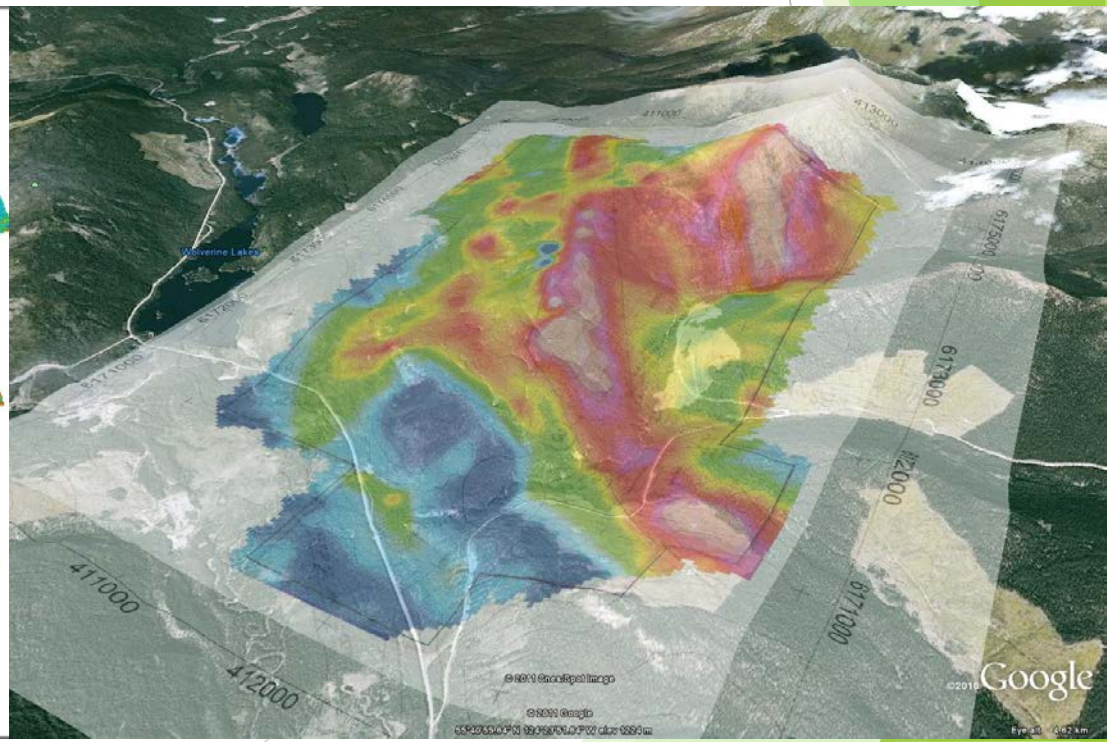
Geophysical methods, Remote sensing, Geochemical methods



2.3.1 Geophysical methods

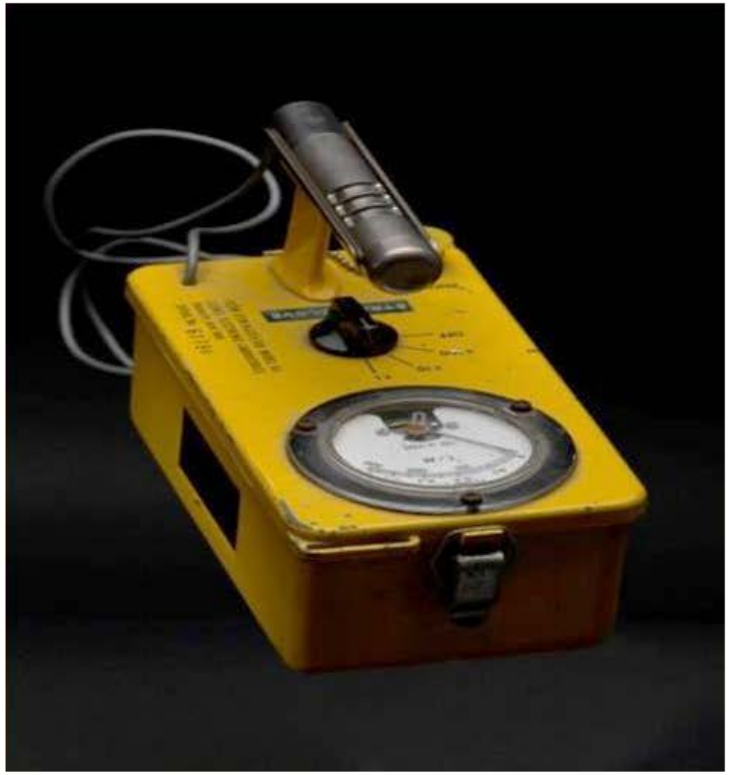
- Geophysical instruments play a large role in gathering geological data which is used in mineral exploration.
- Instruments are used in geophysical surveys to check for variations in gravity, magnetism, electromagnetism (resistivity of rocks) and a number of different other variables in a certain area.
- The most effective and widespread method of gathering geophysical data is via flying airborne geophysics.





Geiger counters and **scintillometers** *are used to determine the amount of radioactivity. This is particularly applicable to searching for uranium ore deposits but can also be of use in detecting radiometric anomalies associated with metasomatism.*

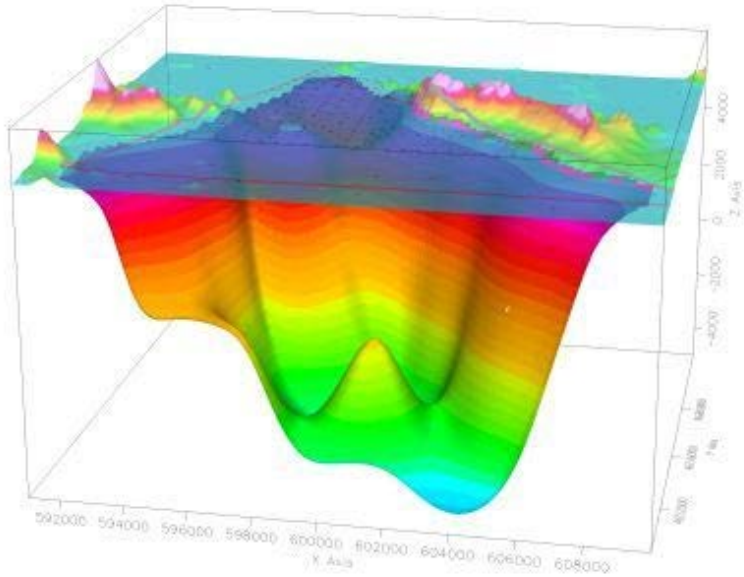
Radioactive minerals like uranium may be found with a Geiger counter.



Airborne magnetometers are used to search for magnetic anomalies in the Earth's magnetic field.

- The anomalies are an indication of concentrations of magnetic minerals such as magnetite, pyrrhotite and ilmenite in the Earth's crust.
- It is often the case that such magnetic anomalies are caused by mineralization events and associated metals.

Ground-based geophysical prospecting in the target selection stage is more limited, due to the time and cost. The most widespread use of ground-based geophysics is **electromagnetic geophysics** which detects conductive minerals such as sulfide minerals within more resistive host rocks.

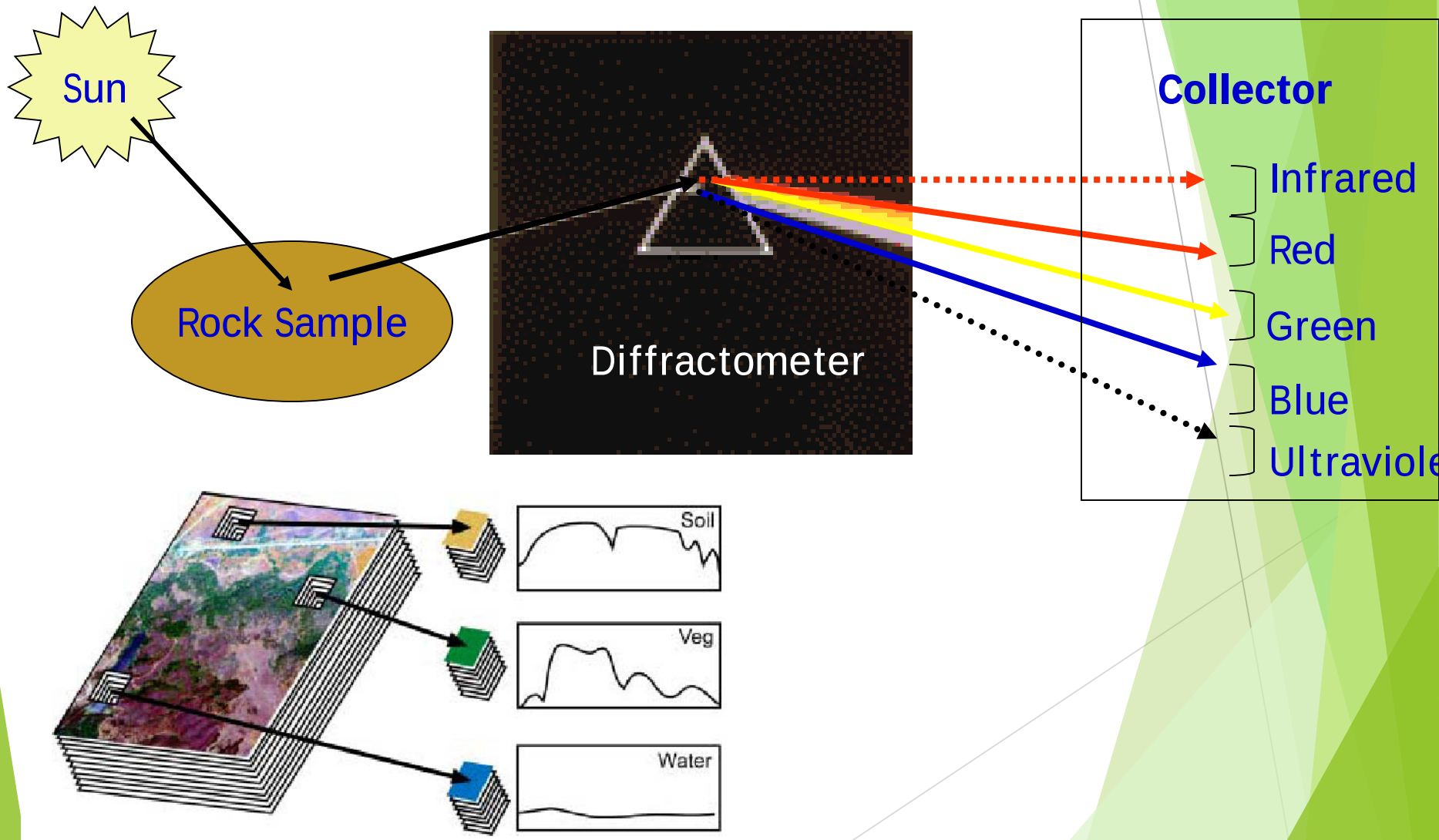


Ultraviolet lamps may cause certain minerals to fluoresce, and is a key tool in prospecting for tungsten mineralization.

2.3.2 Remote sensing

- Since the advent of cheap and declassified Landsat images in the late 1970s and early 1980s, mineral exploration has begun to use satellite imagery to map not only the visual light spectrum over mineral exploration tenements, but spectra which are beyond the visible.
- Satellite based spectroscopes allow the modern mineral explorationist, in regions devoid of cover and vegetation, to map minerals and alteration directly.
- Remote sensing surveys, including aeromagnetic, gravity and satellite data can be used together with field geology and geochemical surveys.
- all integrated using GIS applications, to determine the optimal conditions for the targeting of mineral deposits

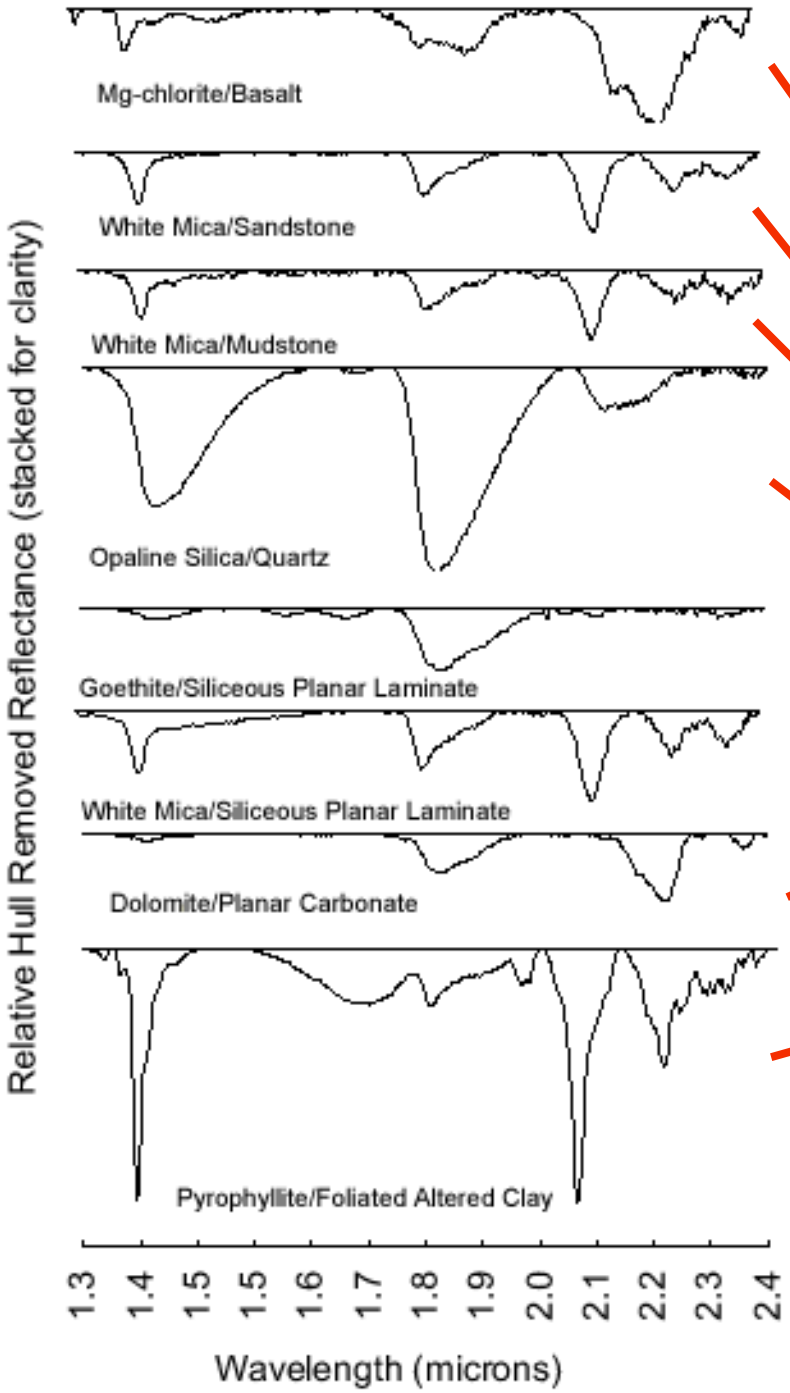
Hyperspectral mapping

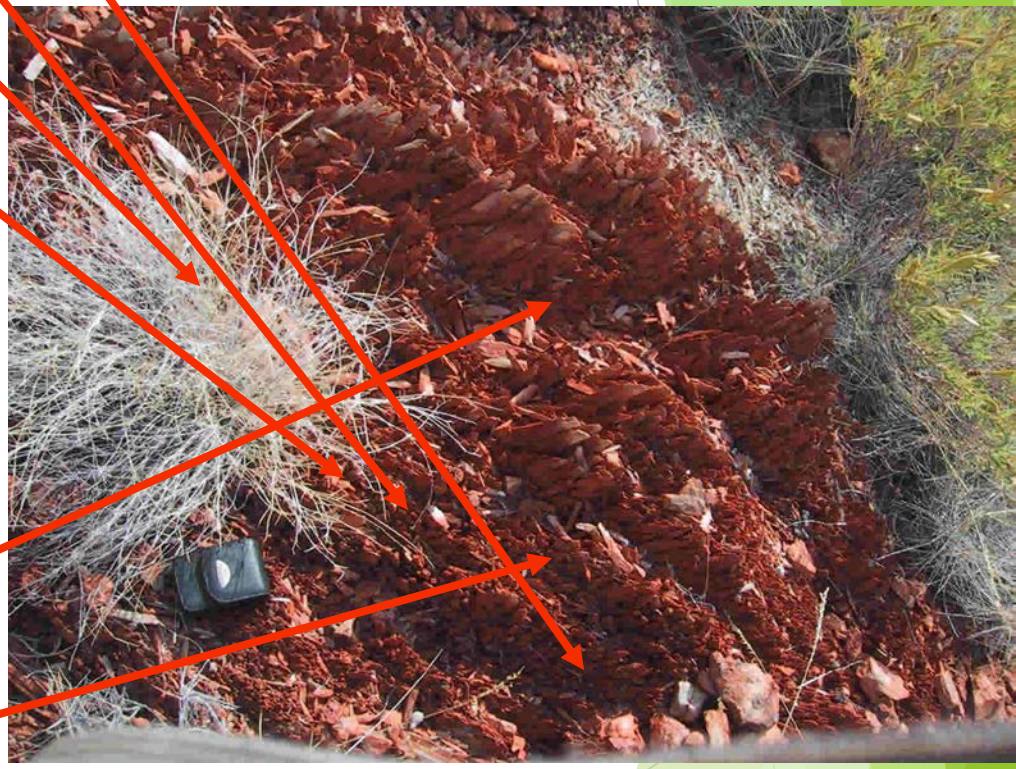


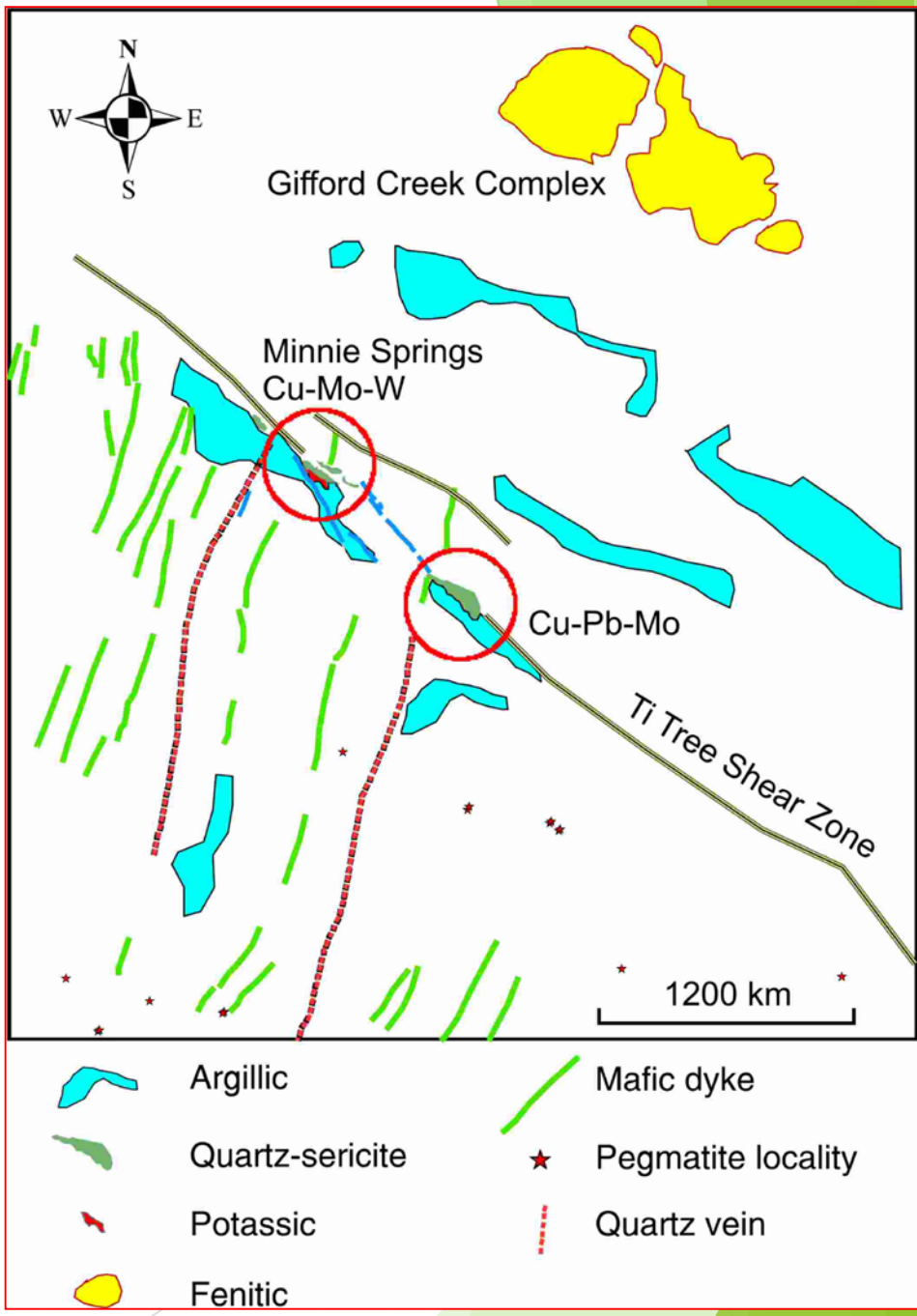
How are the maps created?

- Choose a representative pixel (assisted by fieldwork and spectral libraries)
- Run a spectral fitting algorithm in regions of diagnostic absorption bands
- A similarity index is generated, and a cutoff threshold is determined empirically with assistance from fieldwork

Typical Spectra






N
W
E
S
Gifford Creek Complex
Minnie Springs
Cu-Mo-W
Cu-Pb-Mo
Ti Tree Shear Zone
1200 km
Argillic
Quartz-sericite
Potassic
Fenitic
Mafic dyke
Pegmatite locality
Quartz vein