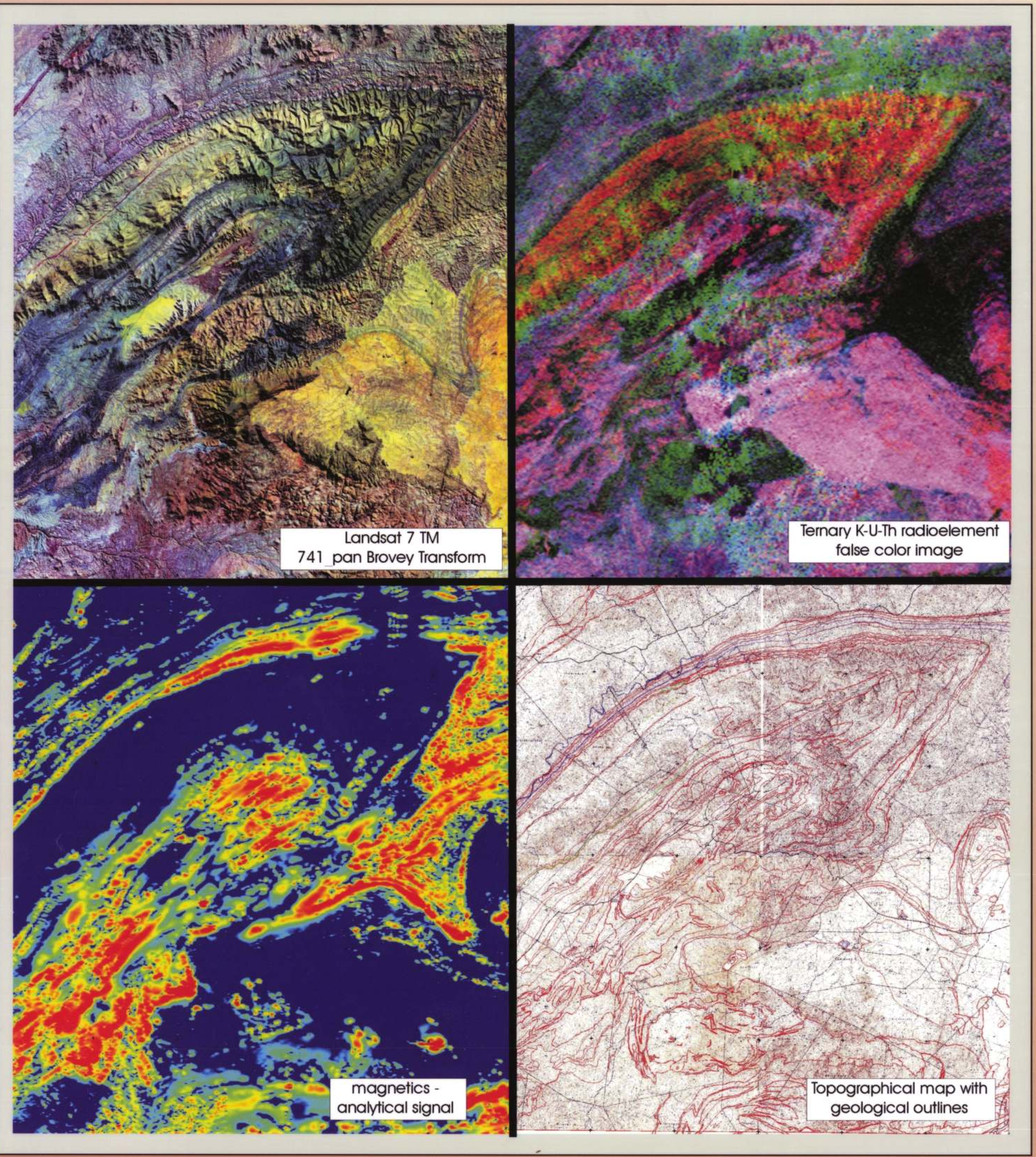
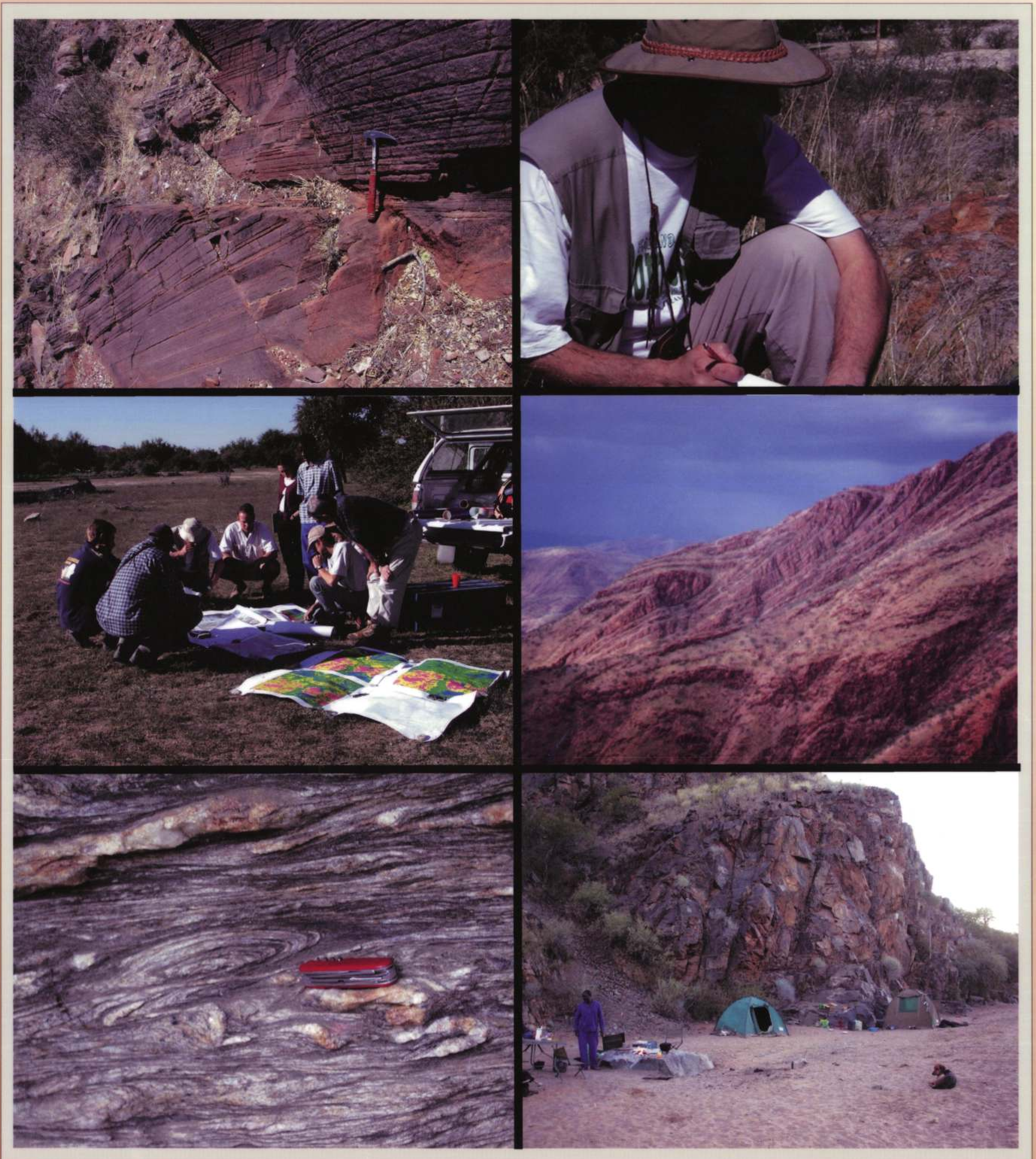
FROM THE ROCK TO THE MAP

The production of a geological map can be subdivided into two stages:
1. Data Acquisiton and Interpretation, 2. Map Compilation using GIS

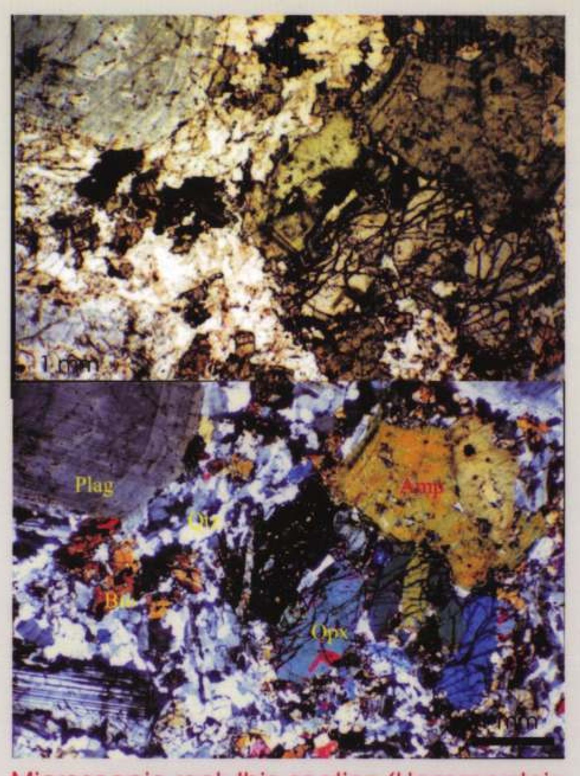
1 Data Acquisition and Interpretation



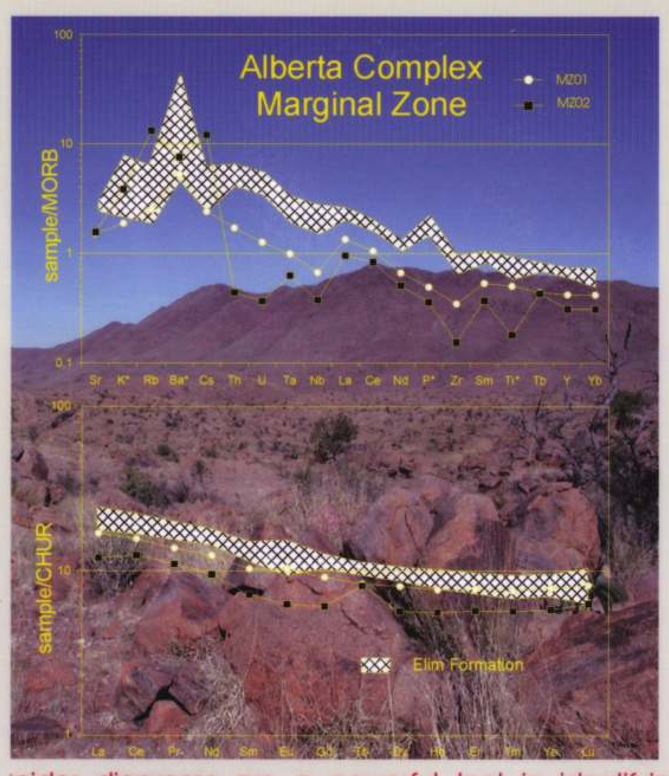
1. After the area of the future geological map is chosen, aerial photos, topographical maps (1:50.000), Landsat 7 TM satellite images and geophysical data are overlain and compared. Highly-specialised Geosoftware allows image processing of any combination of these data on-screen. It involves various steps, of which the most important is image enhancement, i.e. maximising the contrast between individual geological units. Routinely, the Landsat 7 TM 147 band combination sharpened by the panchromatic band, or aerial photos underlain by a topographical map is chosen. Tracing of the geological outlines is done on-screen and followed by a classification of the polygons according to their spectral characteristics (i.e. their colours). A provisional map is printed and forms the basis for the field campaign. In addition, an interpretation map is prepared from geophysical data (airborne high resolution magnetic and radiometric data)



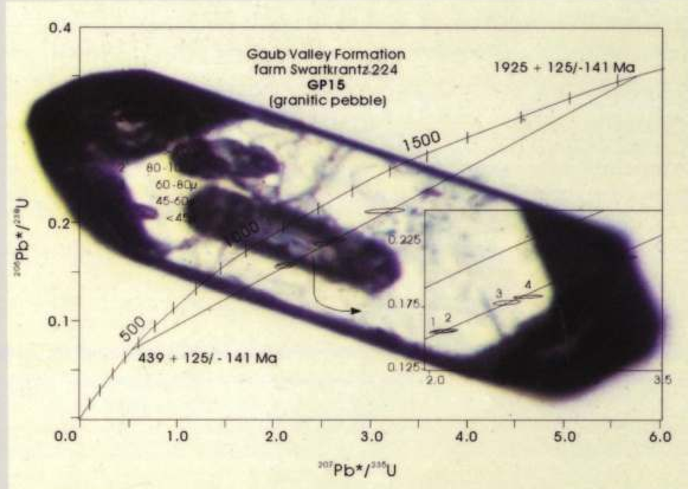
2. The core activity of the mapping geologist is the field work. Careful observation of the rocks is fundamental to all further geological studies, whether it is petrography, interpretation of geophysical data or sophisticated laboratory analyses of rock samples (i.e. geochemical or isotope data). The main activities comprise description of the rock and its structures, interpretation of the rock type (igneous, sedimentray, metamorphic), analysis of the relationship between individual rock types (intrusive, sedimentary or tectonic contacts), the classification and measurement of structural data (planar and linear fabrics), determining the outlines of geological units, the stratigraphy of the area (which rocks are younger which ones are older) and sampling of rocks for further studies.The result of the field work is a provisional geological map with a legend showing the distinct geological units and their relationship to each other. Field work is tough, it often requires extended stays (2-4 weeks) in remote areas under harsh conditions (limited water, no company, heat during the day, cold during the night). However, it is paradise for those, who love nature.



Microscopic rock thin section (Hammerstein tonalite) under normal and polarised light



Spider diagrams are a powerful tool in identifying igneous processes and ancient plate tectonic settings (here the Alberta Igneous Complex)



The U/Pb isotope analysis of zircon grains constrains the crystallisation age of igneous rocks

Presentation of structural data (S1) from the Gaub Valley in Schmidt net diagrams

3. Nowadays, field work is supported and supplemented by laboratory analysis of rock samples. Only a few are listed here, of the more common methods, of which some are performed at the Geological Survey.

- **Microscopic observation** of rock thin sections aims at the determination of the mineral content, their proportions and relationships to each other. A small block of the sample is mounted on a glass slide and ground down to 0.3 mm thickness, where it becomes transparent. The so-called thin section is studied under a polarising microscope where minerals can be distinguished by their specific optical properties. This method helps to identify the rock type, classify it, and to make a first estimate of the pressure and temperature during crystal growth.

- **Geochemical analysis** of rocks or soils reveals the distribution of chemical elements in the sample. The rock is split, crushed and milled to a fine powder, which is fused under temperatures of 1100 deg° C into a glass disk of homogeneous composition. Subjected to x-rays in a XRF-apparatus the elements are excited and emit characteristic wave spectra, whose intensity is a function of the element concentration in the sample. The distribution of elements in the rock assists, for instance, the classification of igneous rocks and constrains the plate tectonic setting during their evolution. Together with the analysis of so-called pathfinder elements this helps in the search of ore deposits.

- **Isotope analysis** of radiogenic and stable isotopes: elements with a proportion of radioactive isotopes (Sm, U, Th, Rb, K, N) and their daughter elements (Nd, Pb, Sr, Ar, C) are separated by ion column exchange or degassing of rock powders or minerals. The isotope ratios of the parent and daughter elements are measured with a mass spectrometer, which allows determination of age data, such as the minimum age of deposition (sedimentary rocks), crystallisation (igneous rocks), age of metamorphism (metamorphic rocks) or the age of orogenic uplift. Similar techniques are applied in the determination of isotope ratios of stable nuclids (S, O, C). Their variation documents changes in temperature (seawater, brines, fluids), constrains mixing processes (meteoric, magmatic, metamorphic), as well as the influence of bioactivity.

- **Microprobe analysis.** A polished thin section of the rock is subjected under vaccuum to a ion beam, which excites the elements of the individual analysed crystal or a small part of it. Again, each element emits a specific spectrum, whose intensity is a function of its concentration in that domain. The composition of many minerals varies systematically as a function of temperature and pressure, which allows the calculation of the metamorphic conditions under which the minerals grew.