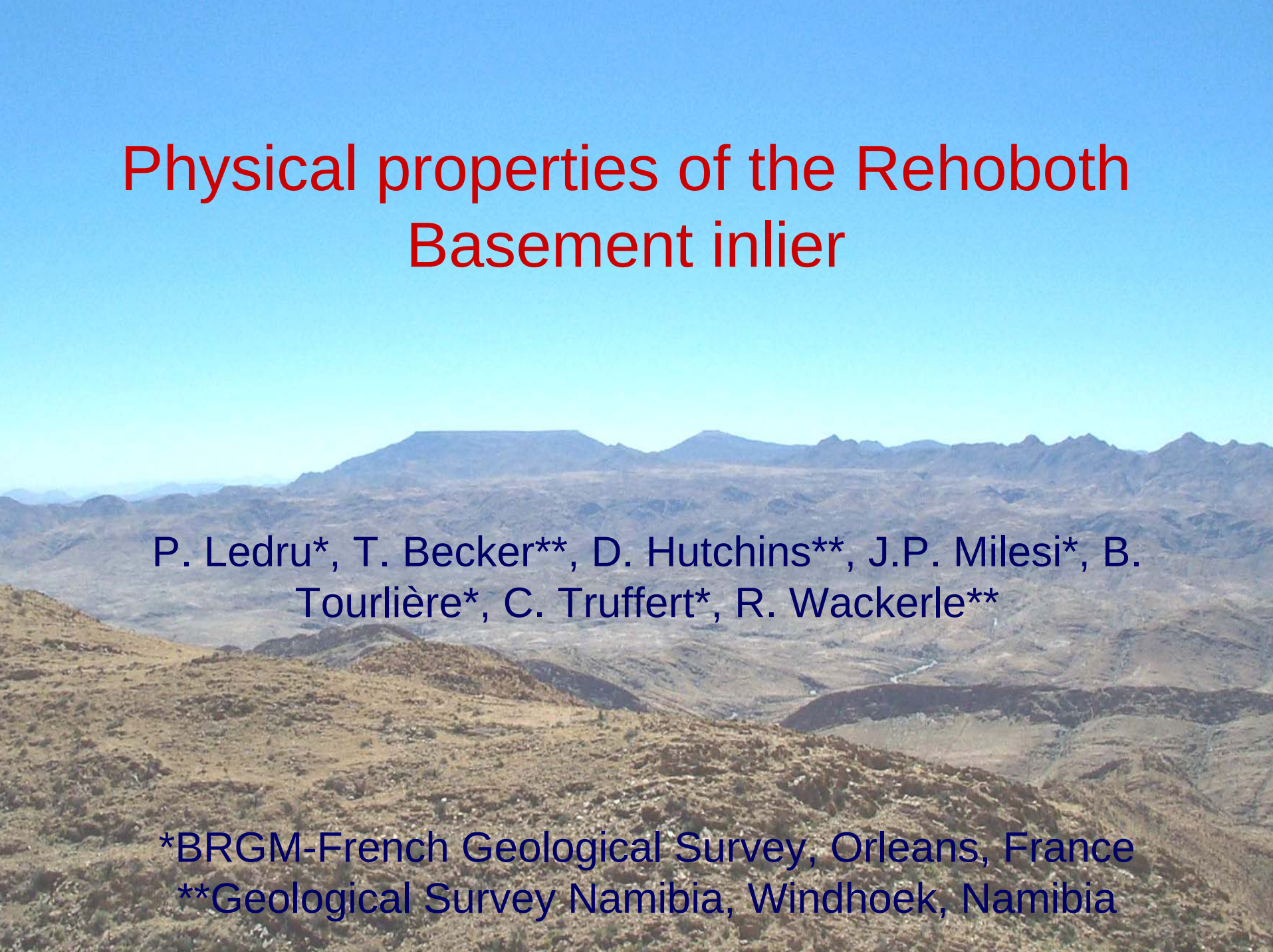
Physical properties of the Rehoboth Basement inlier



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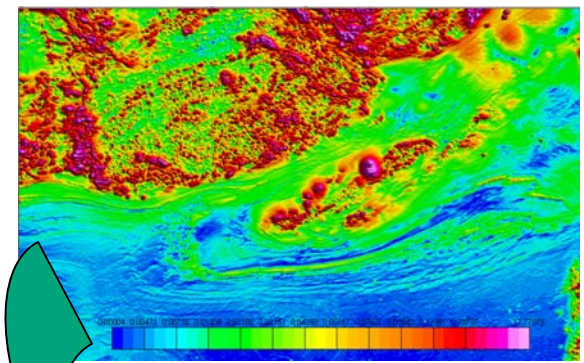
*BRGM-French Geological Survey, Orleans, France
**Geological Survey Namibia, Windhoek, Namibia

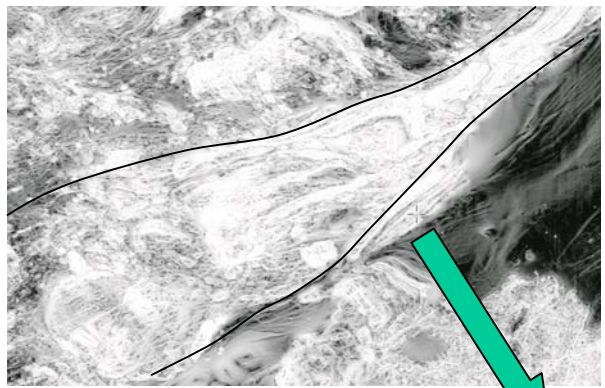
Crustal blocks and accretionnary process

- The definition of crustal accretionnary process during the Precambrian relies mainly on the ability to correlate local lithological composition and structural pattern to significant tectonic events on a crustal-scale
- Radiometric and magnetic high-resolution airborne geophysical surveys constitute a unique source of regional-scale information enabling provisional lithological and structural mapping

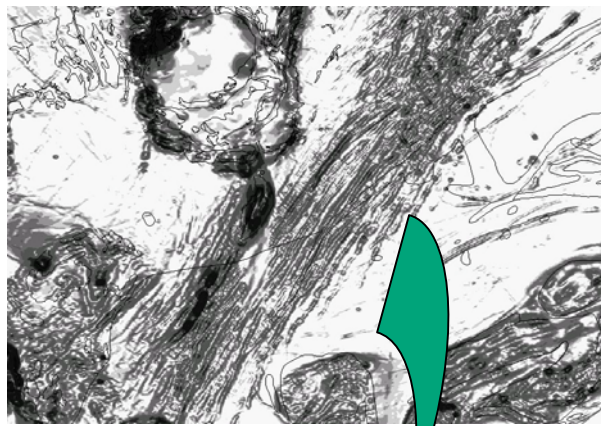
A geophysical signature for each lithological and structural elements



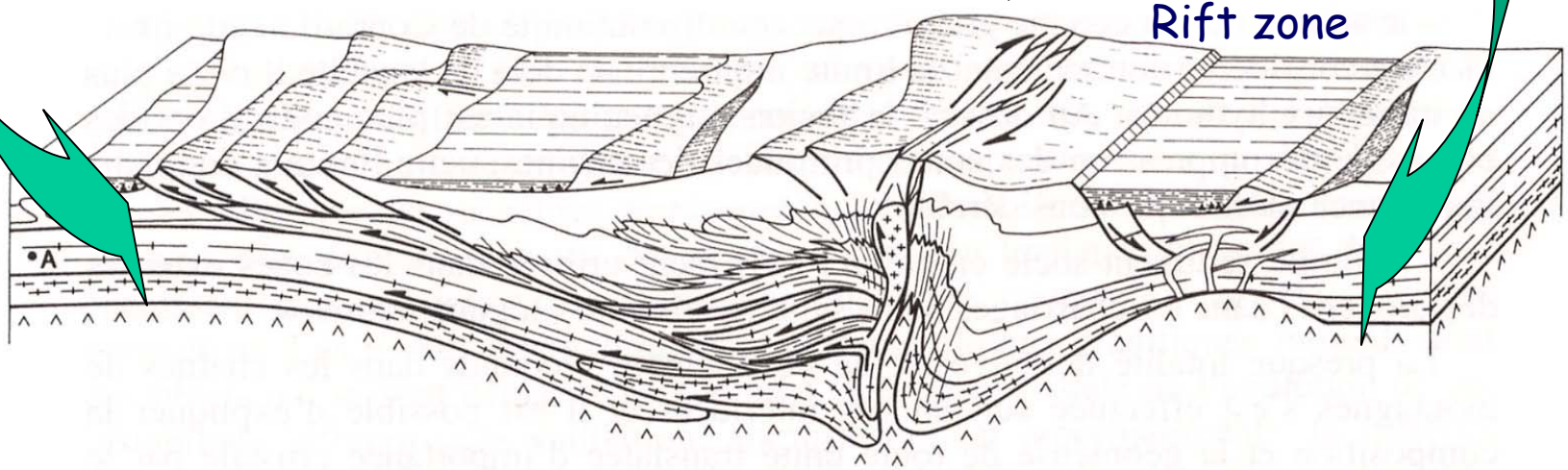
Fold and thrust belt



Shear zone



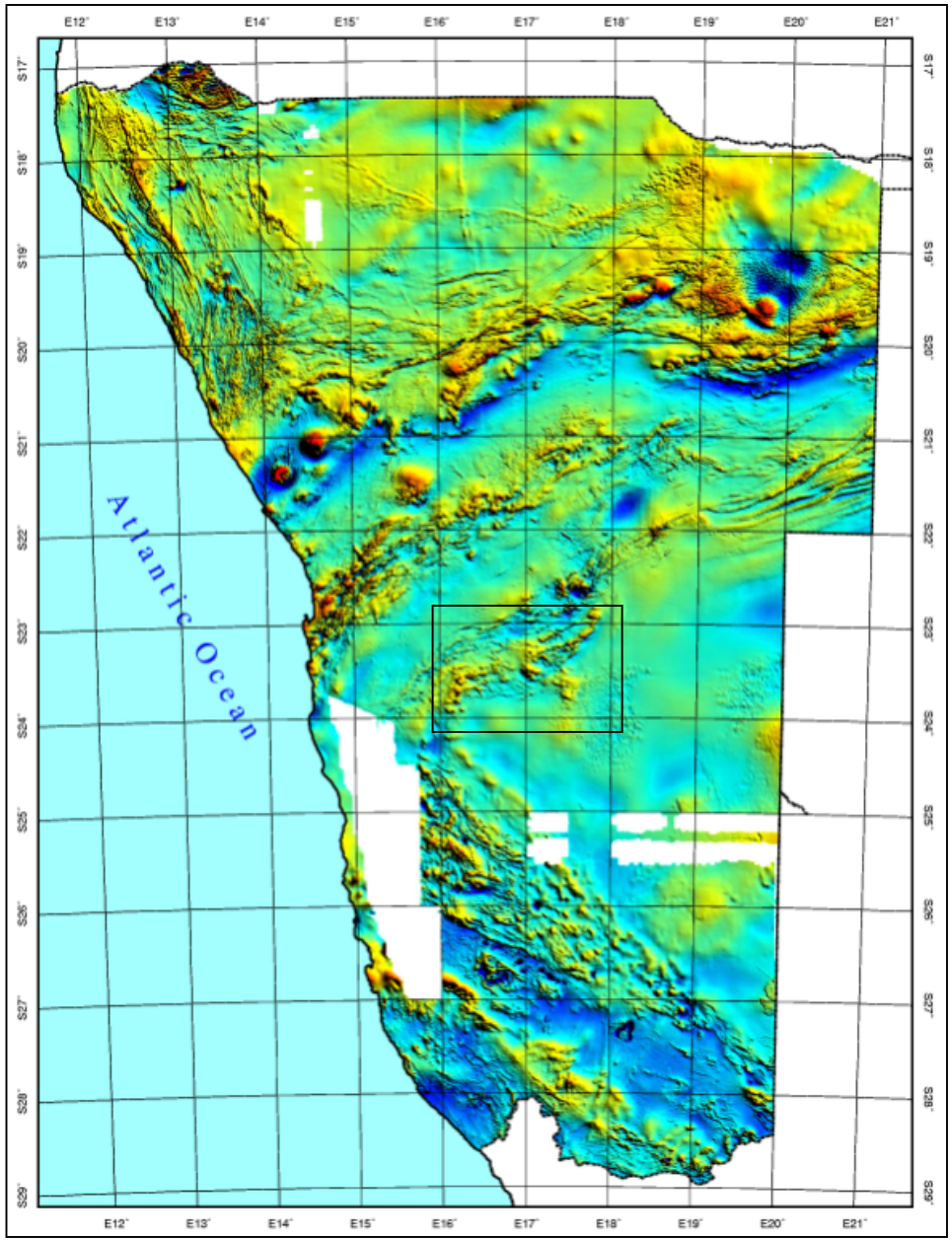
Rift zone



An idealistic mountain belt, Choukroune, 1995

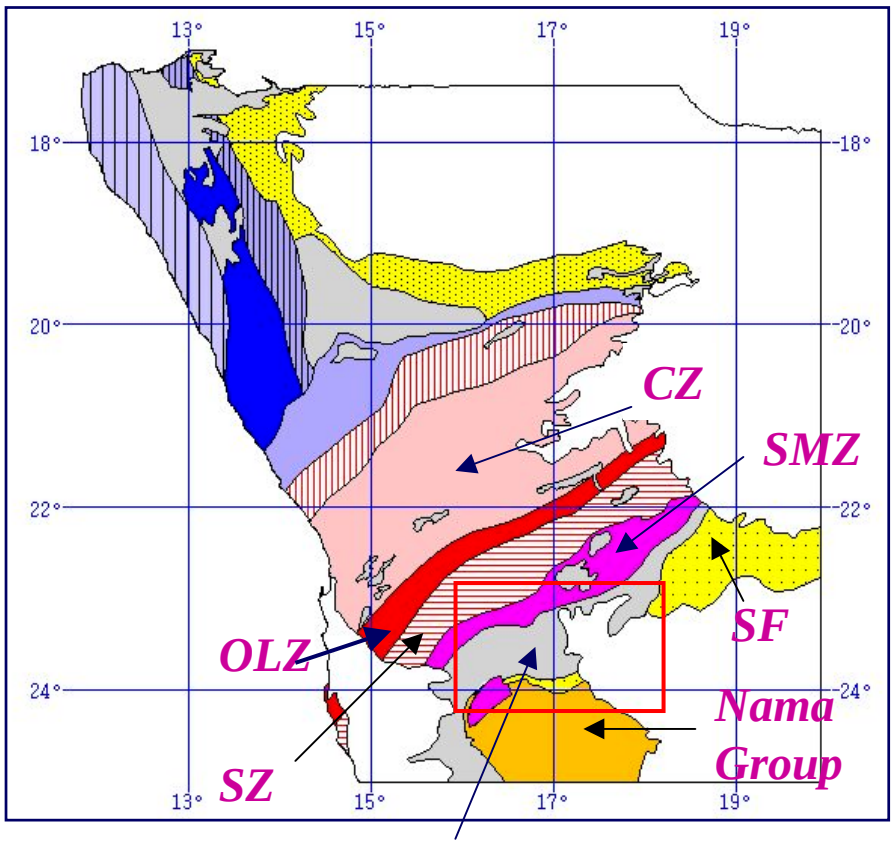
General framework

- The High-resolution geophysical dataset
  - magnetics
  - radiometrics



The aeromagnetic map of Namibia

Geological framework



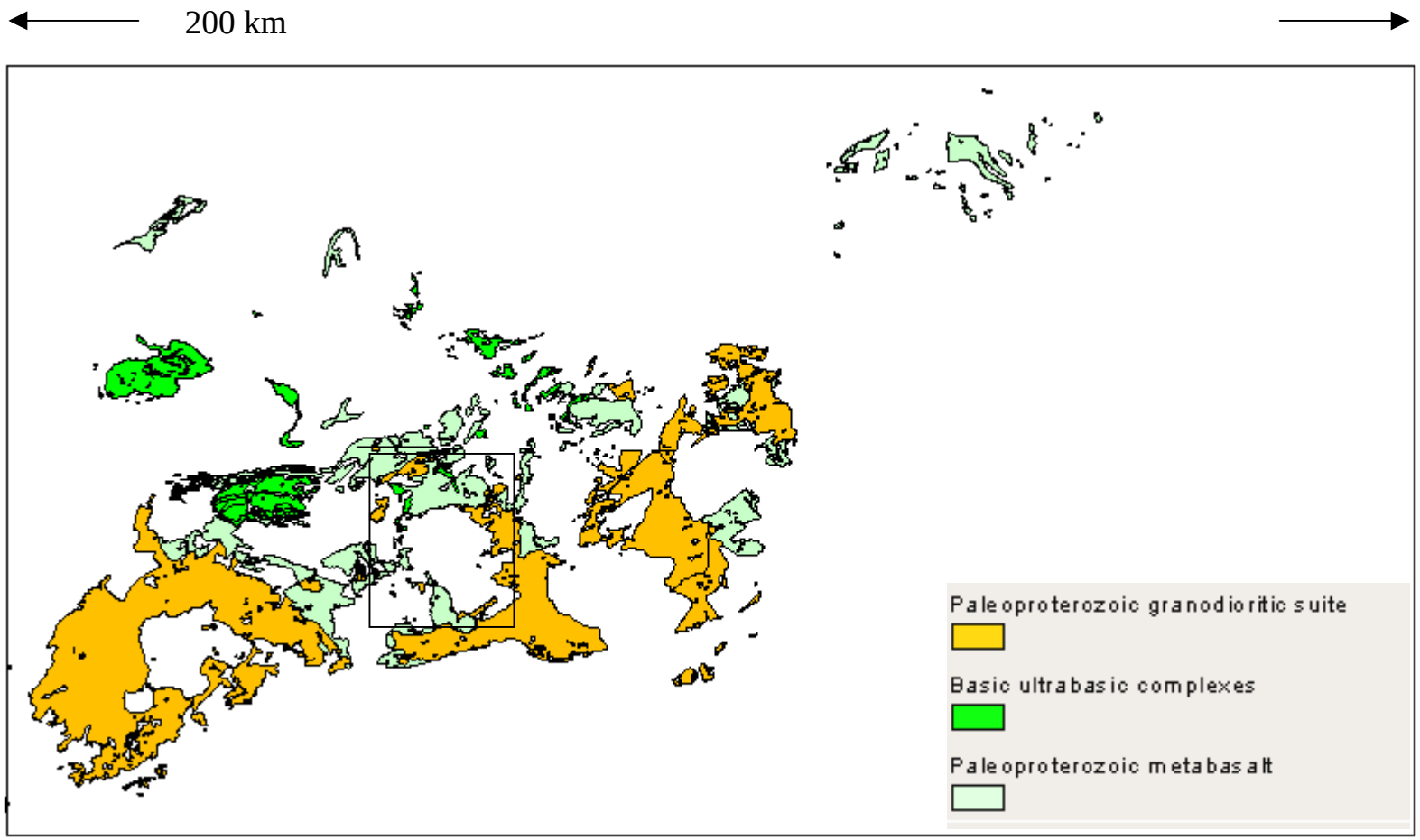
Tectonostratigraphic zones of the Damara Orogen (Miller, 1983)

- The Southern branch of the Damara belt
  - A south marginal zone (SMZ) including tectonised Damaran sequences
  - A Pre-Damara basement composed of Paleoproterozoic and Mesoproterozoic terranes
  - A Neoproterozoic cover sequence and foreland basin (Nama group, SF)
- The Rehoboth area as a case-history

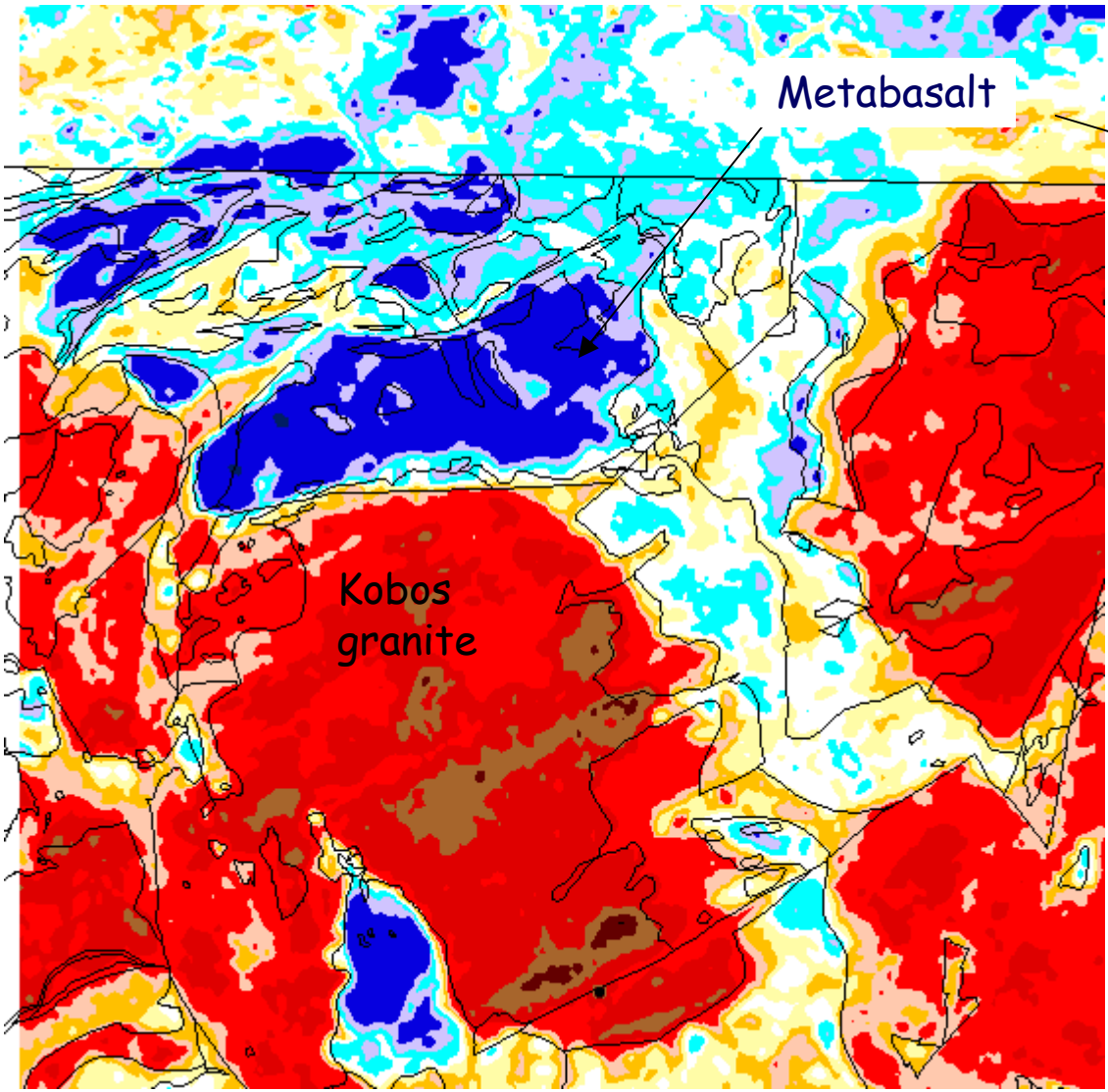
A Late Paleoproterozoic greenstone belt

- Terrestrial and marine sediments, volcanic rocks ranging from pyroclastics with calkalkaline affinity to subalkaline tholeitic flows (Elim Formation), intrusive rocks range from ultramafic and anorthositic complexes (Alberta Complex) to tonalite (Weener Igneous complex and Picksteel granodiorite) and granite
- Interpretation of magnetic and radiometric data provide a new information on:
  - *The extension of radioelement-depleted lithologies, such as mafic lavas and amphibolitic enclaves*
  - *The extent of magnetite-rich metasediments and lavas*
  - *Potassium-rich alteration zones*

A Late Paleoproterozoic greenstone belt



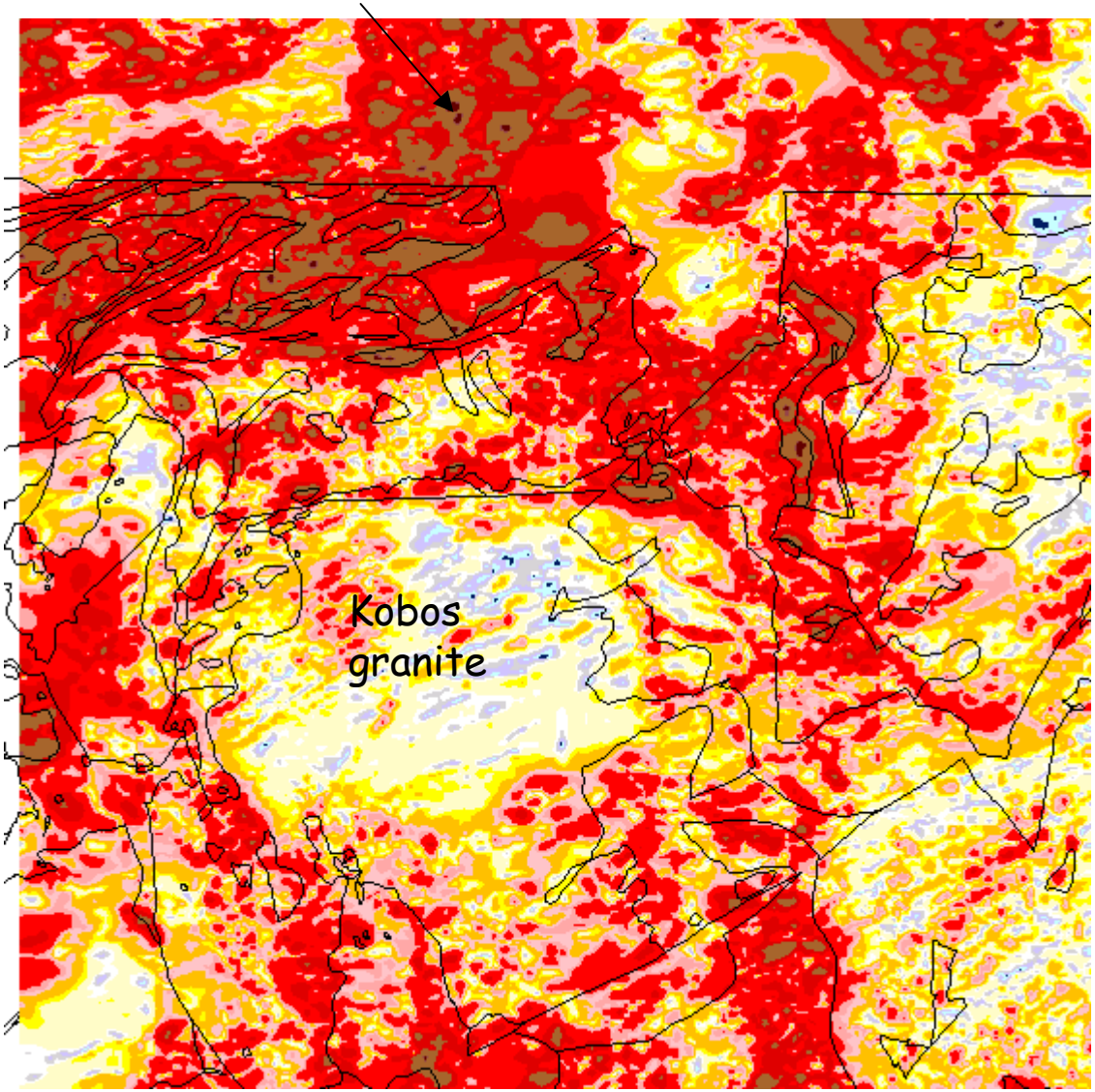
Extension of radioelement-depleted lithologies



Granite

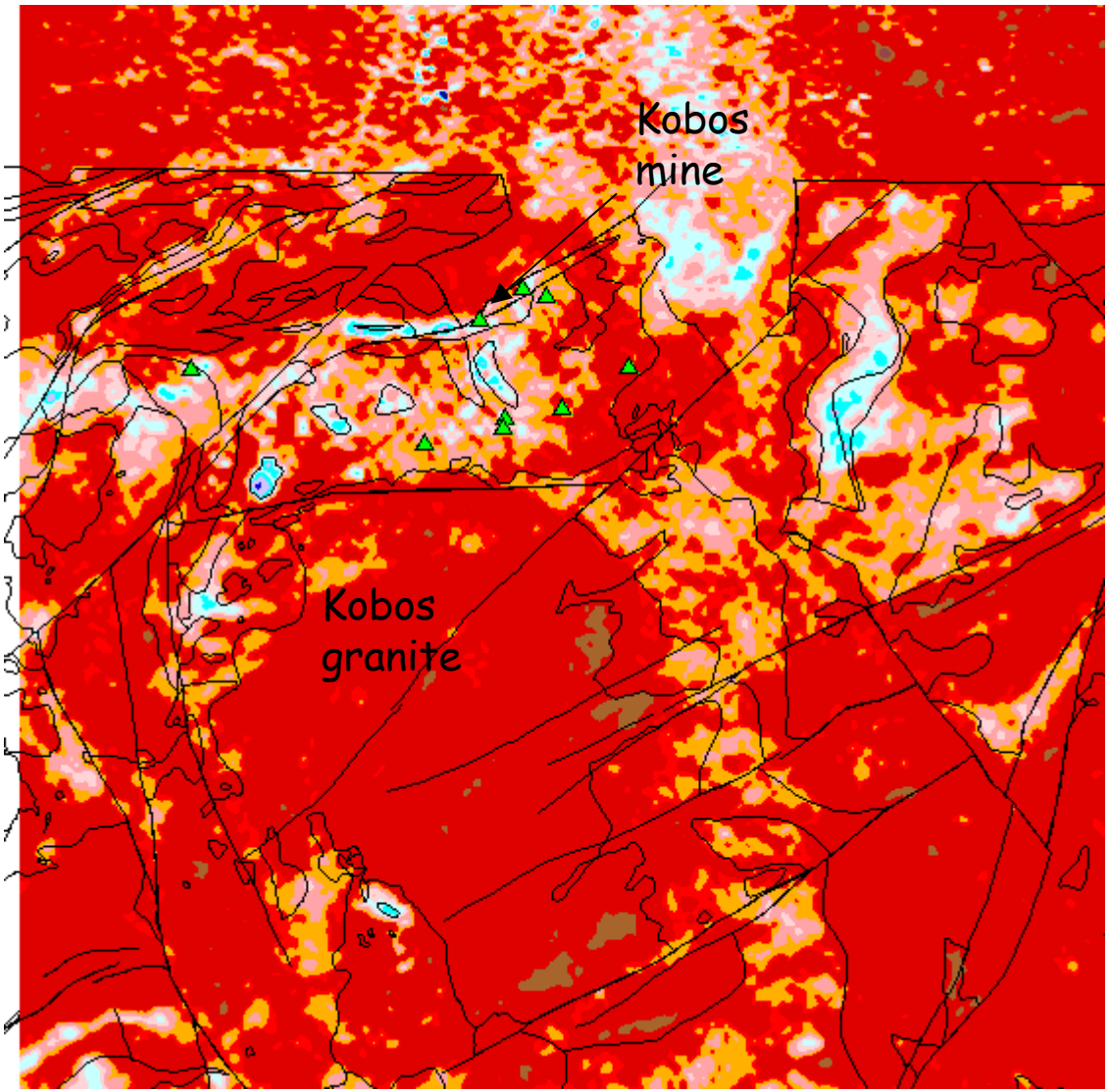
Radioelement, total count

Extent of magnetite-rich metasediments and lavas



Carbonate and magnetite vein system

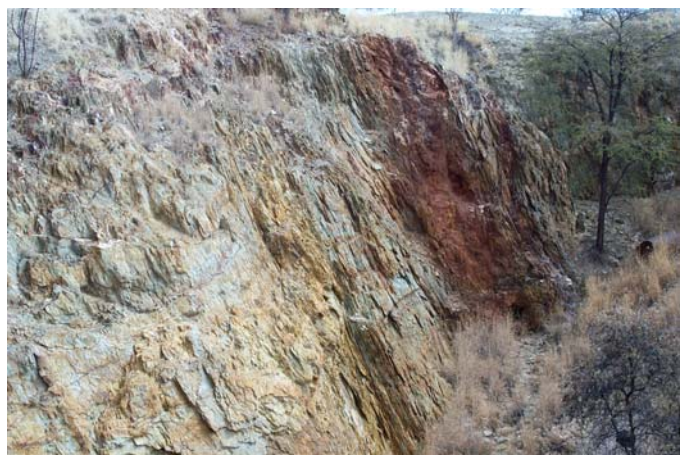
Potassium-rich alteration zones



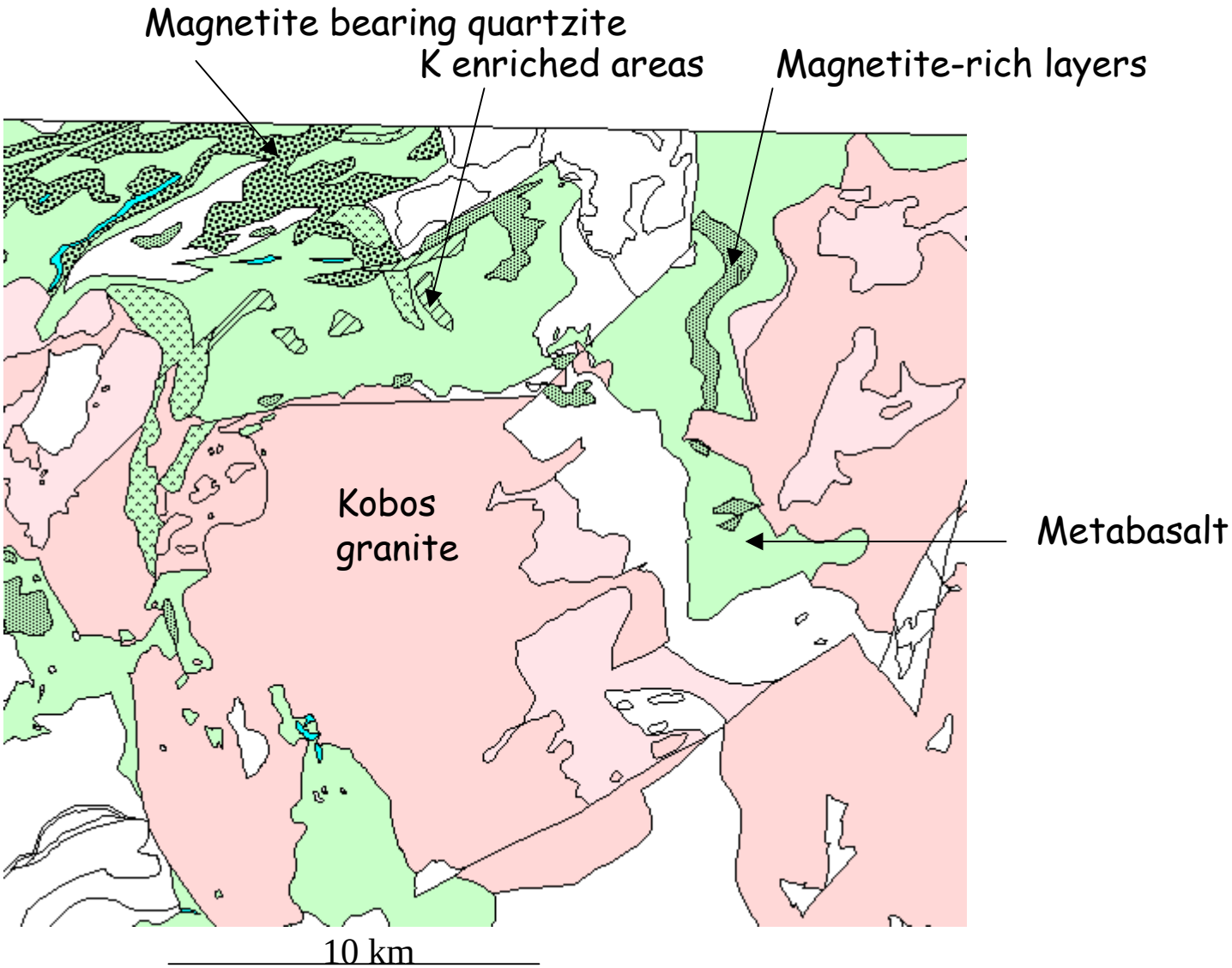
Th/K ratio
indicative of K alteration

K enriched

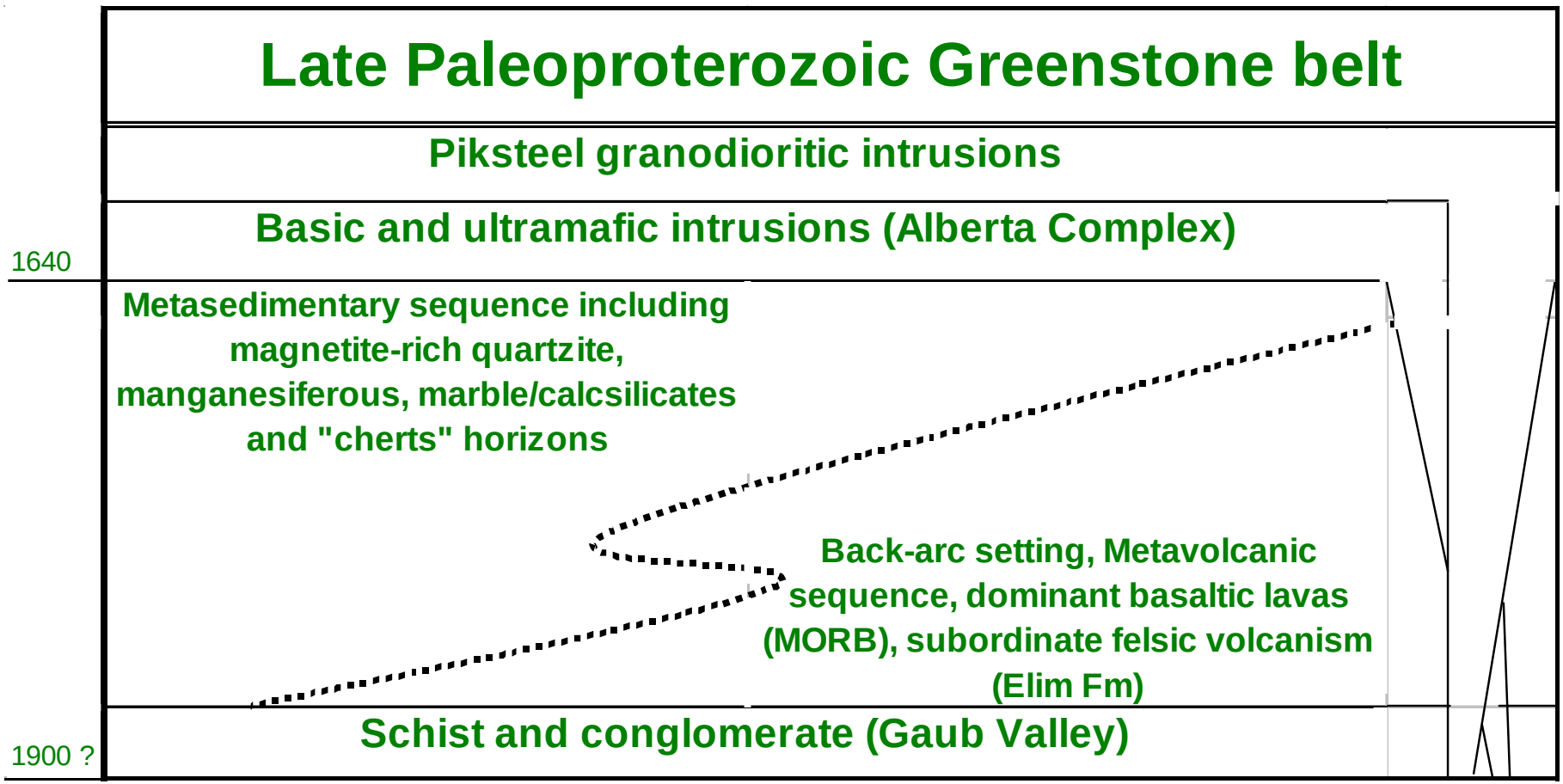
Open pit at Kobos mine



A new map in the greenstone belt (Kobos area)



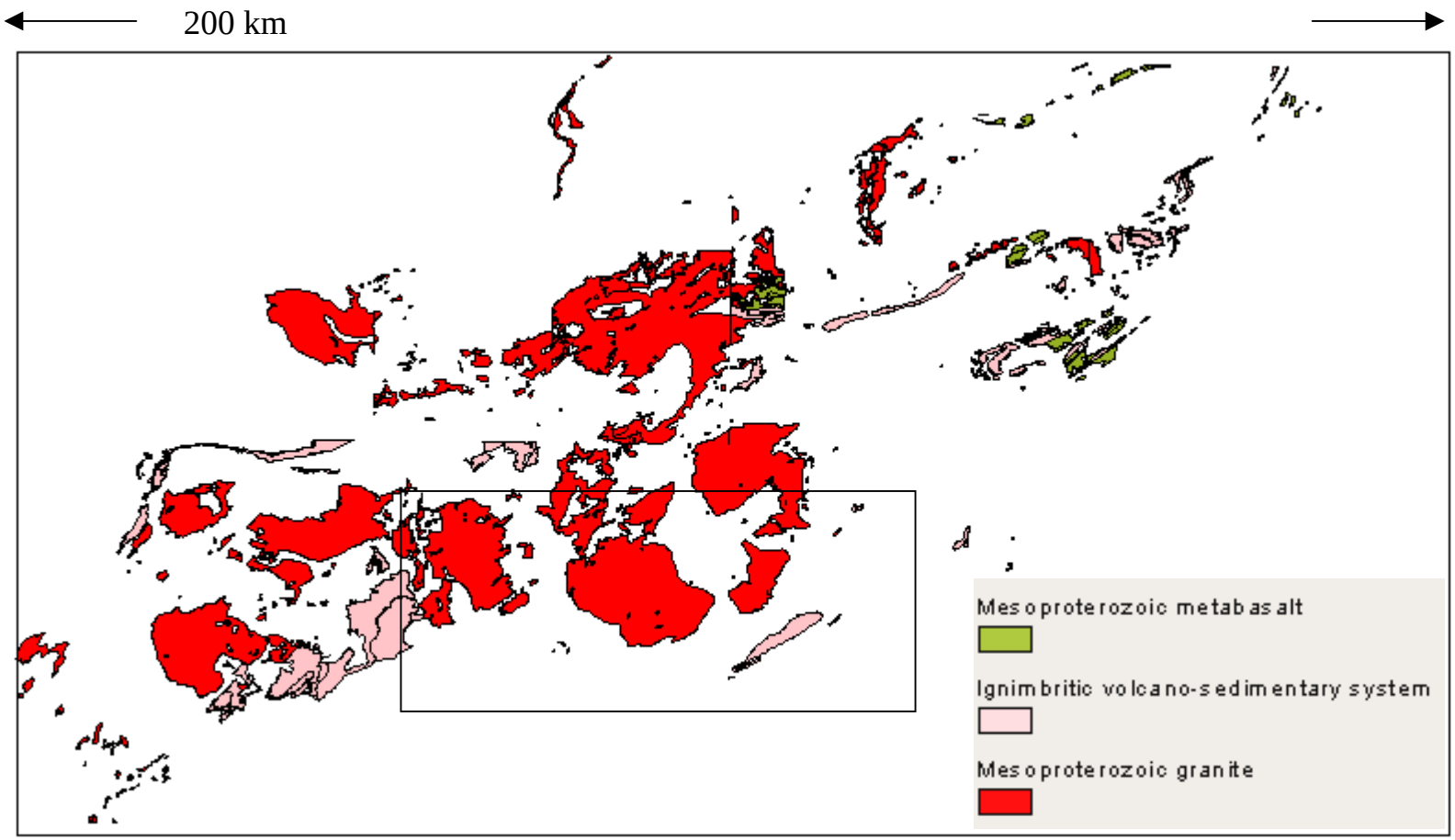
Summary: Lithologies and chronology



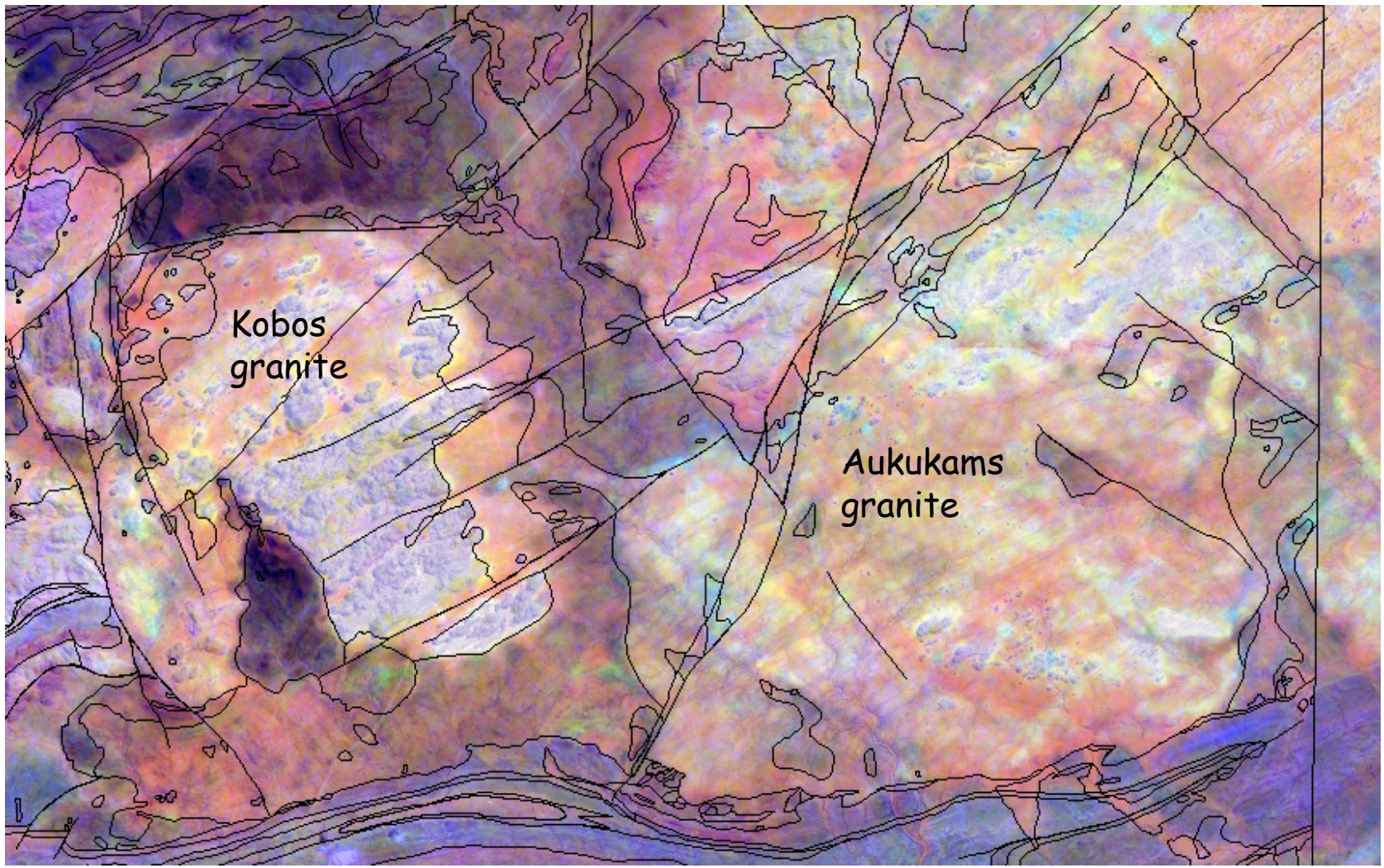
A Mesoproterozoic active margin

- A part of a more than 300 km long belt known as the Sinclair unit
- The basin fill of this belt comprises continental coarse to fine grained siliciclastic sediments with intercalated silicic to mafic volcanic rocks, Coeval intrusives (1.1-1 Ga) range in composition from sub-alkaline granodiorite and gabbro to dominant fine-grained to porphyritic granites
- Interpretation of magnetic and radiometric data provide a new information on:
    - *A major input of radioelement in the crust*
    - *The structural pattern*

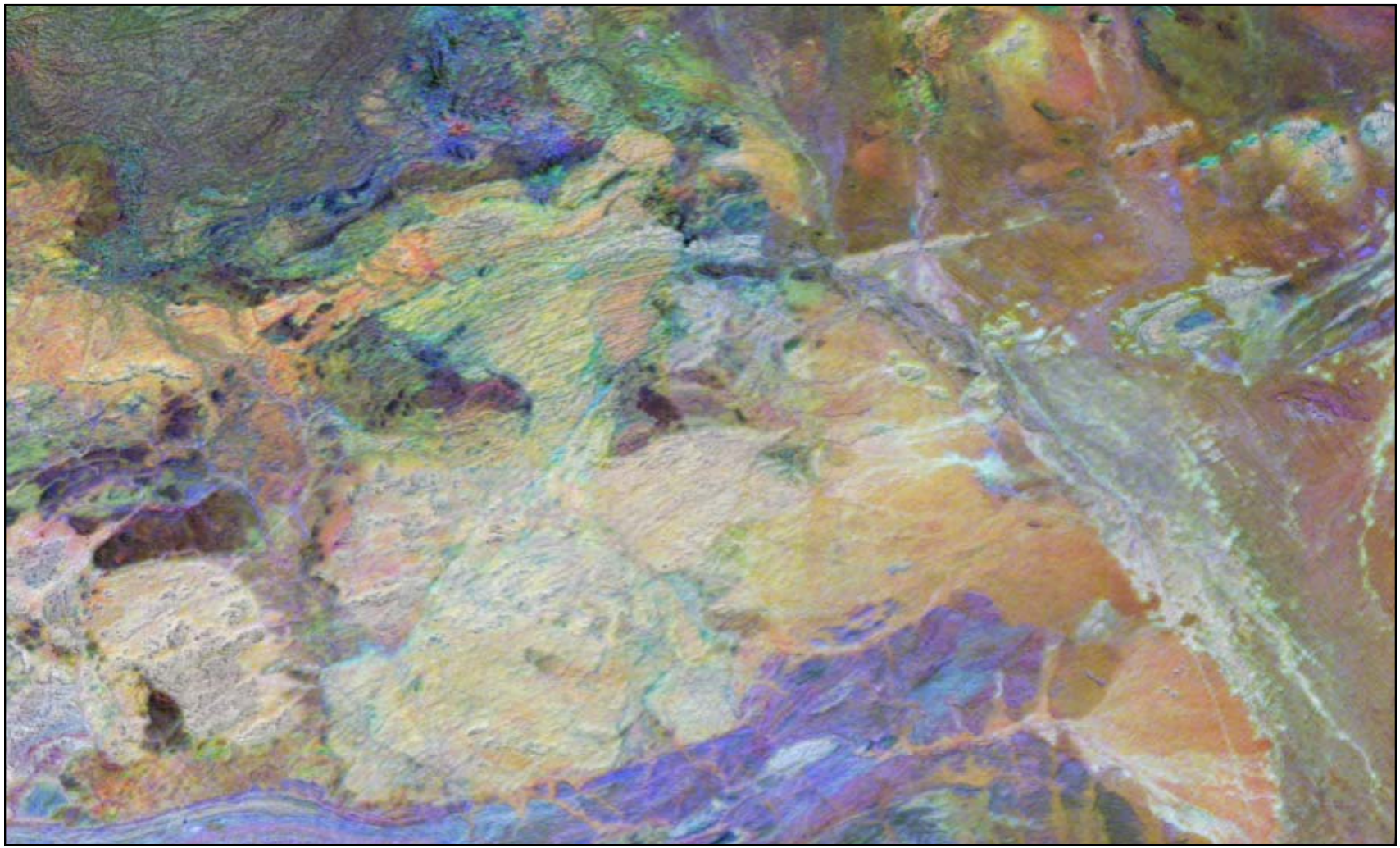
Mesoproterozoic granites and volcano-sediments



Mesoproterozoic granites, volcanics and sediments: a major K input in the crust

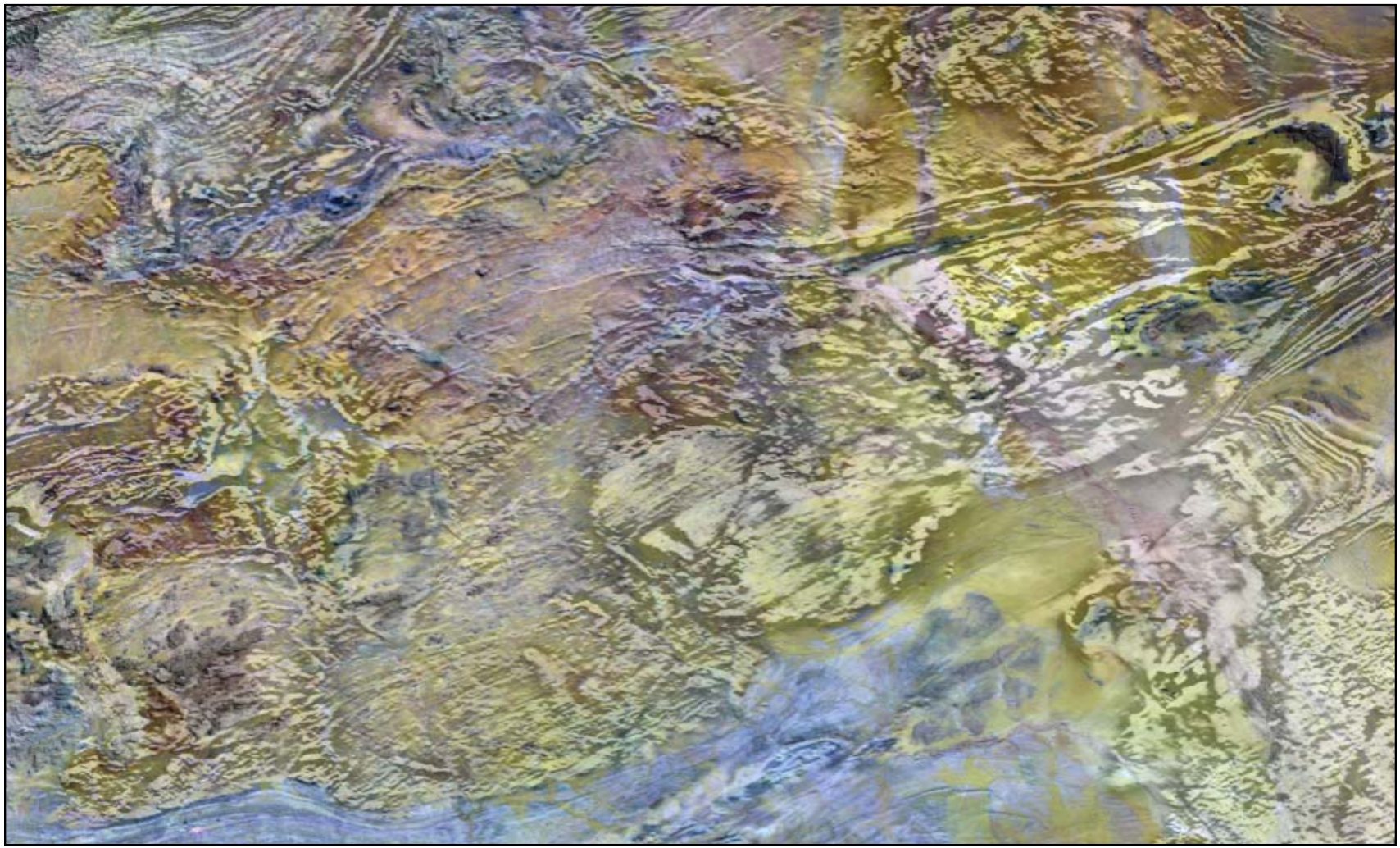


Radioelement, ternary map over Landsat 741



Landsat

Ternary



Landsat

Mag

Summary: Lithologies and chronology

1000 ?

Mesoproterozoic arc>>back-arc system

Dolerite dyke network

Rhyolite dykes cross-cutting basalt dykes

Basalt flow, feeder dykes (back-arc related) (Opdam Fm)

"Competition" with clastic sediments (including Fe-quartzites)

Break: migration of arc to back-arc

Mesoproterozoic ignimbrite system: a major regional marker horizon in an active margin

"Shallow sub-aquatic" ignimbritic volcanic system, related rhyolitic flows and feeder dyke complexes. Laterally passage to volcanoclatic mudstones/sandstones and distal monogenic conglomerates/sandstone (Nuckopf, Langberg, Grauwater, Skumof Fms)

Clastic sedimentary basin. Developed in parallel with the ignimbrite system, sandstones and polygenic conglomerates, that could marked both continental influence and strong tectonic instabilities (clastic pole represented by the Billstein Fm)

Ignimbrite

Parental microgranite and K-rich granite intrusion (Gamsberg granitic suite) showing rhyolite enclaves

1090

1200

Rhyolite, microgranite and Quartz Porphyry dykes

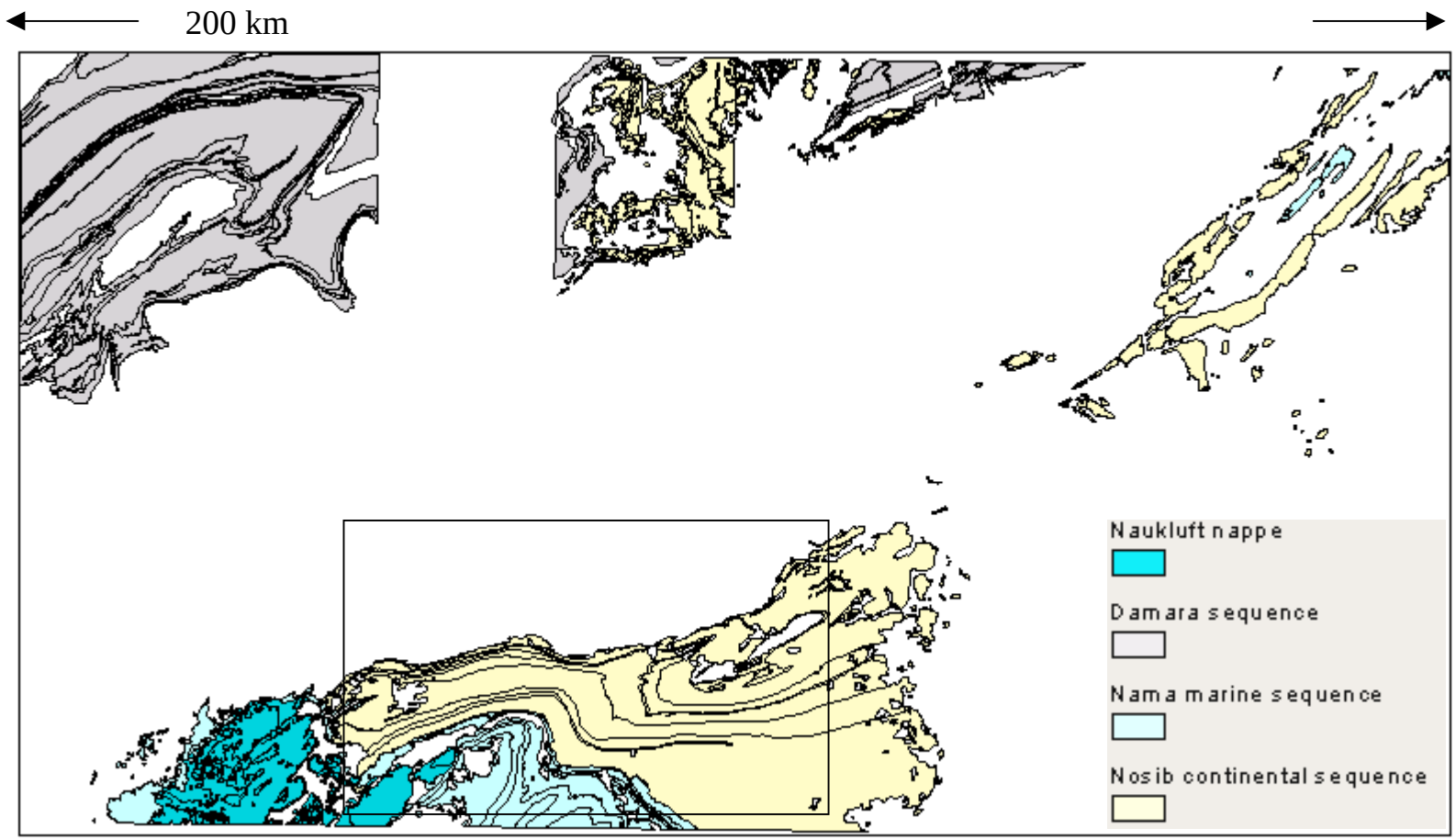
1225

Extensional tectonics in arc-back-arc setting, regional unconformity

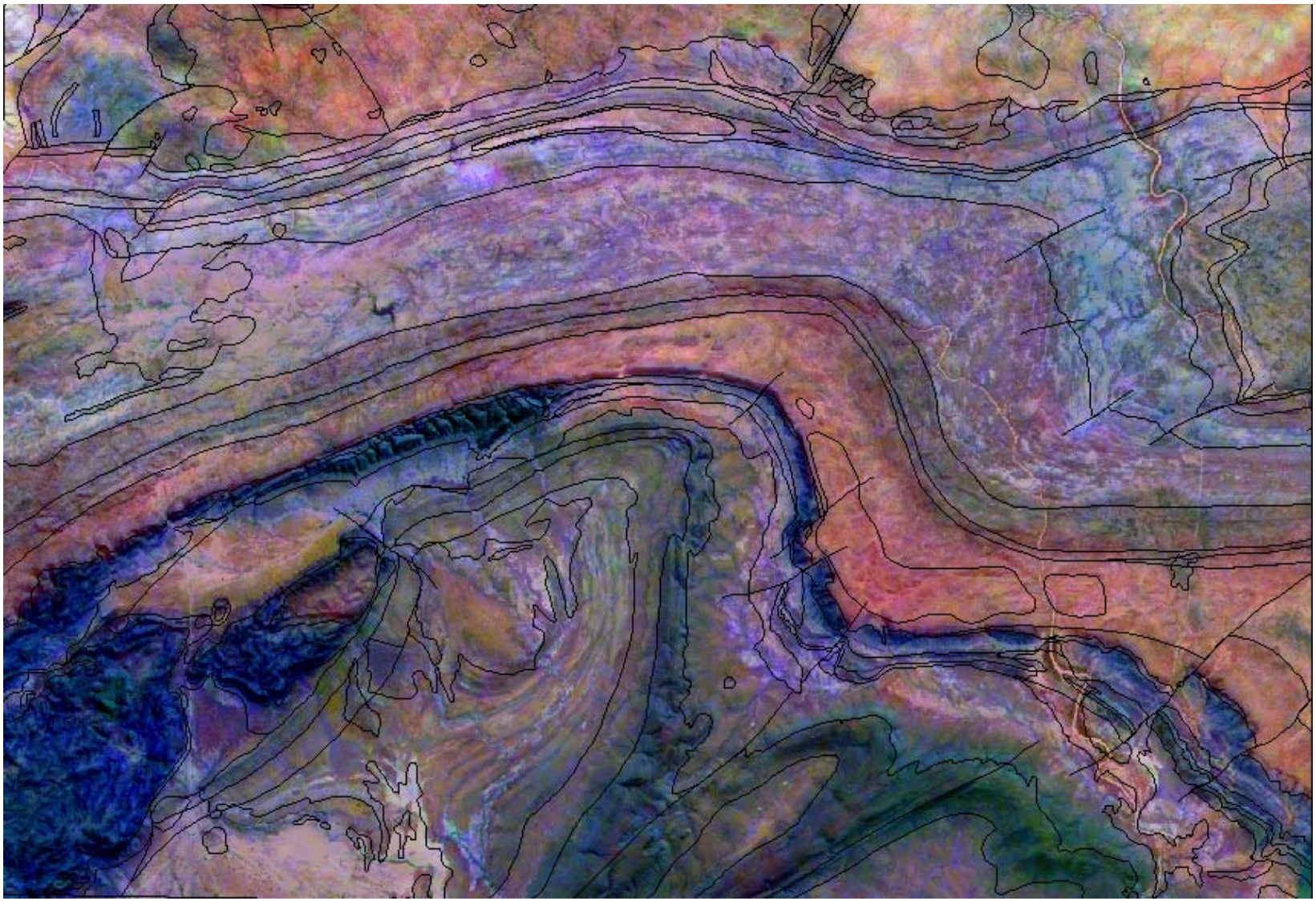
The Neoproterozoic foreland of the Damara orogen

- A basal continental sequence, the Nosib Group (debris flow conglomerates, braided-fan alluvial deltas and lacustrine sedimentation)
- Unconformably overlain by the Late Neoproterozoic to Cambrian Nama Group marine sequence (shale and sandstone, with at its base limestone and stromatolith reefs)
- Interpretation of magnetic and radiometric data provide a new information on:
  - *The sources of sediments and the radioelement distribution*
  - *The structural pattern*
  - *The alteration*

The Neoproterozoic sediments



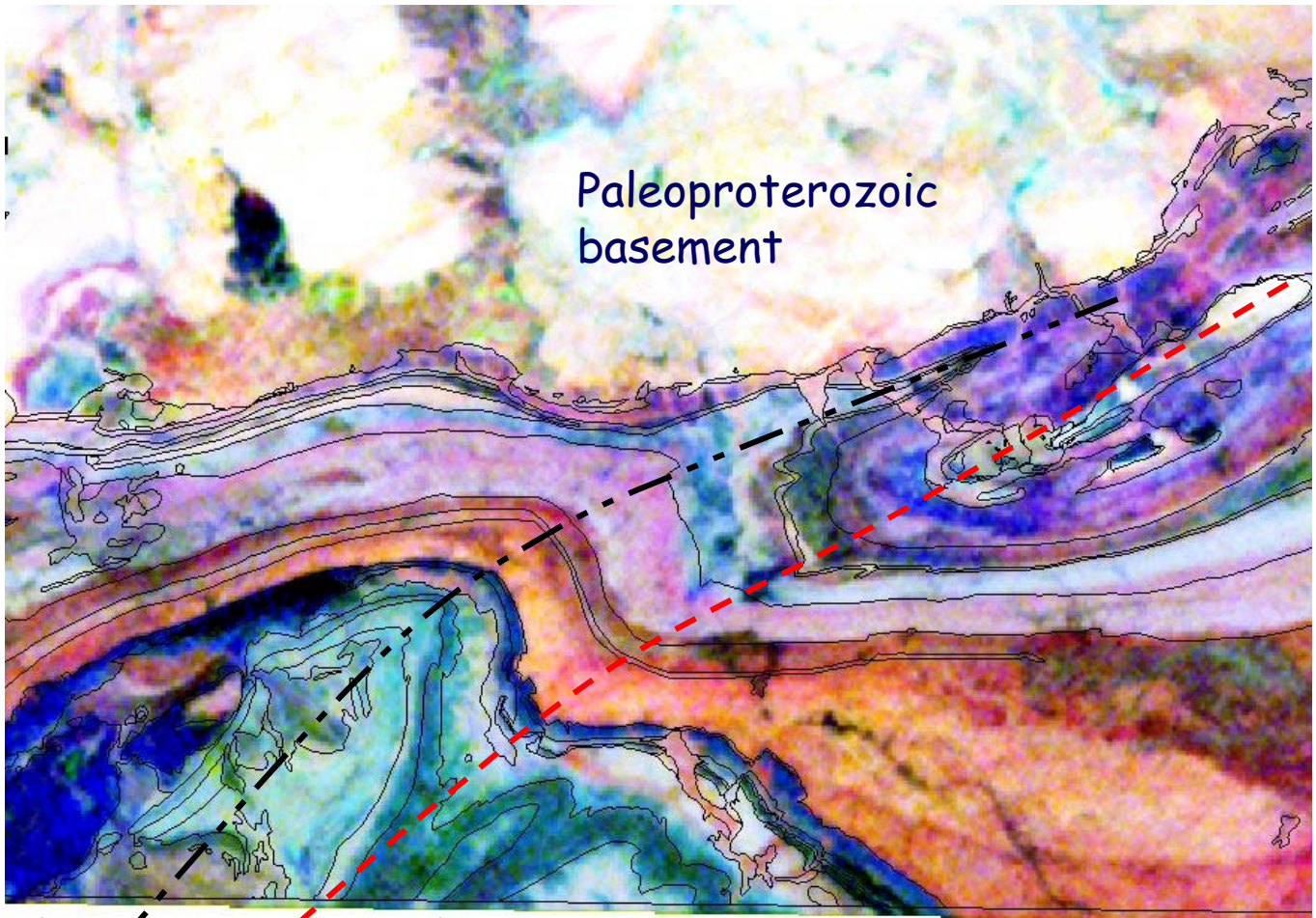
Sources of sediments and radioelement distribution



10 km

Radioelement, ternary map over Landsat 741

Structural pattern



Neoproterozoic
Foreland of the
Damara orogen
(S margin)

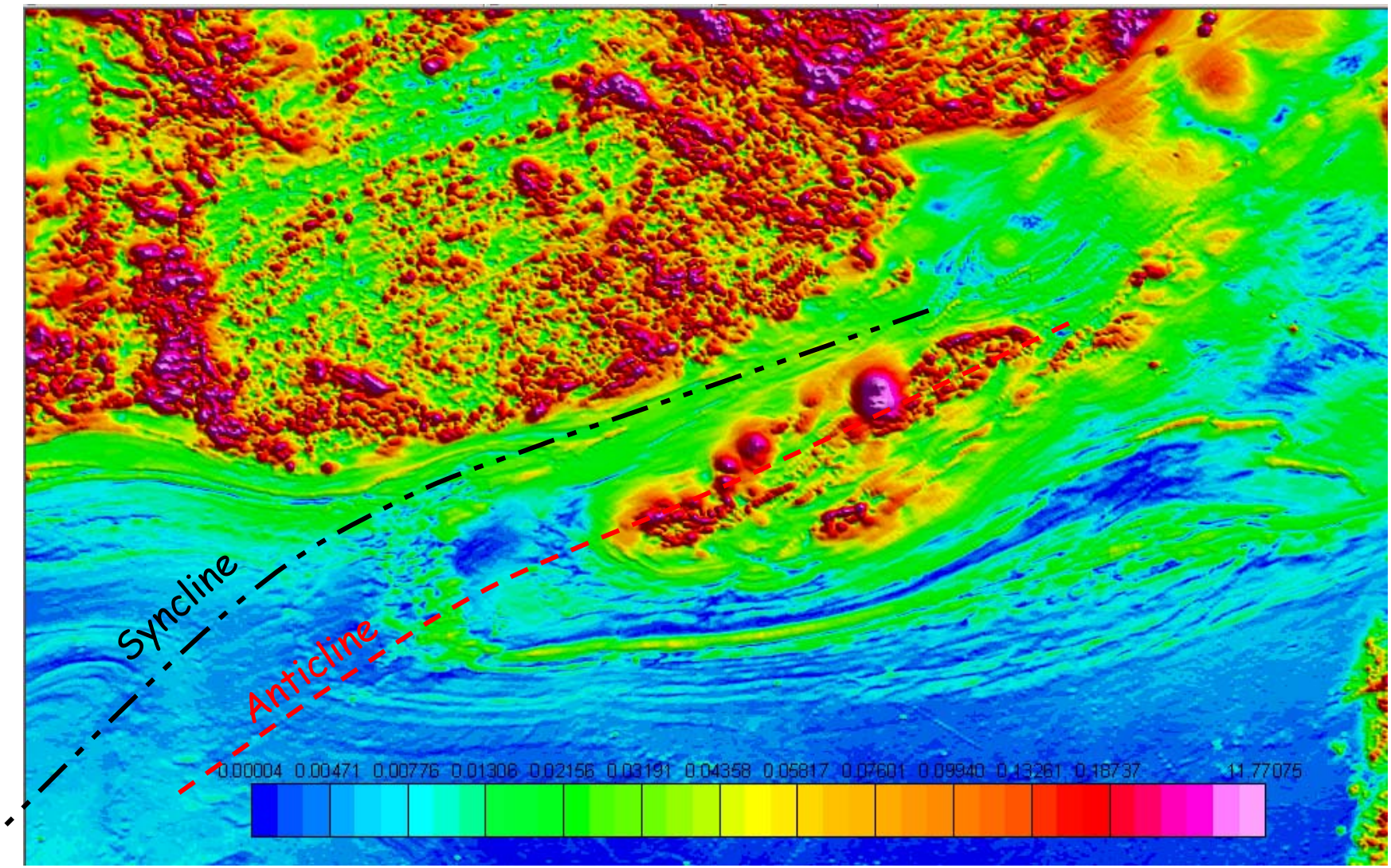
Syncline

Anticline

10km

Ternary map of radioelements

Structural pattern

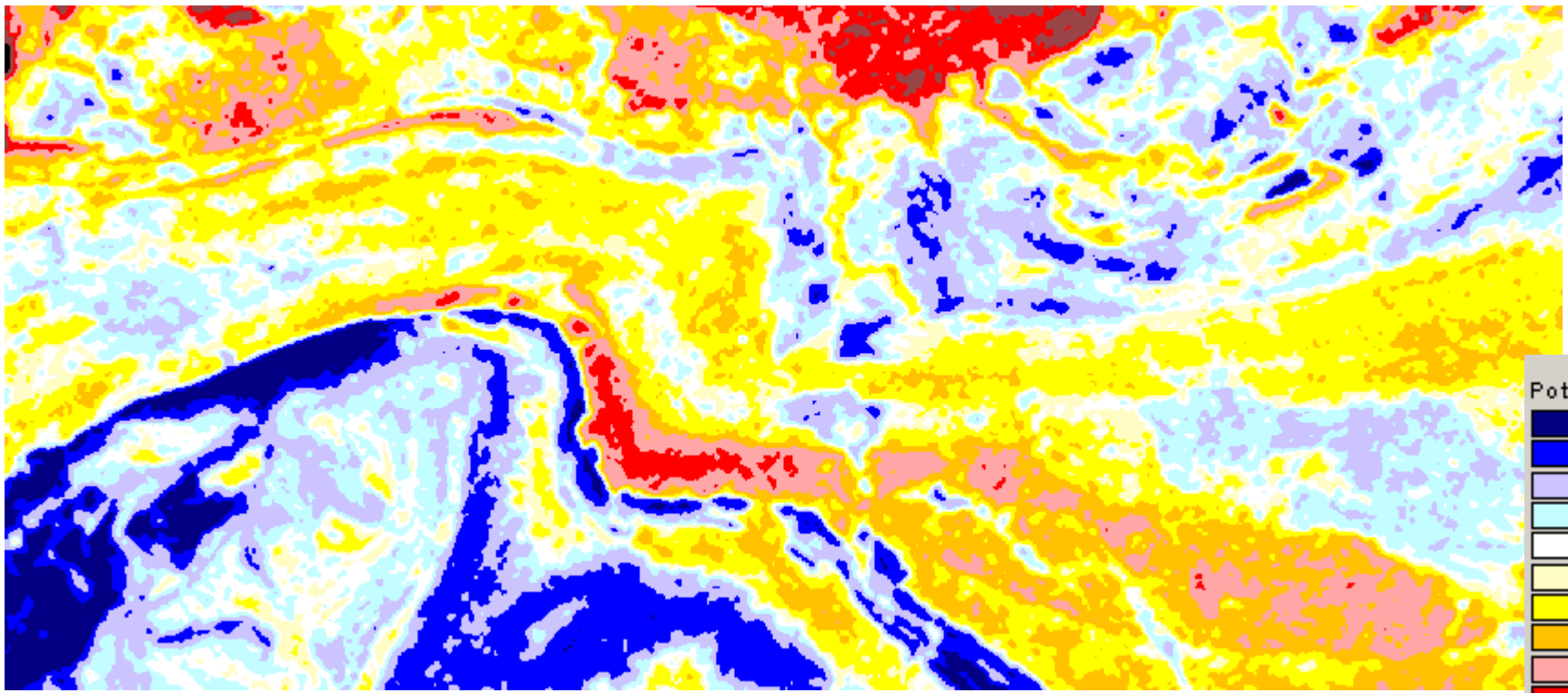


10km

Analytical signal of the magnetic field

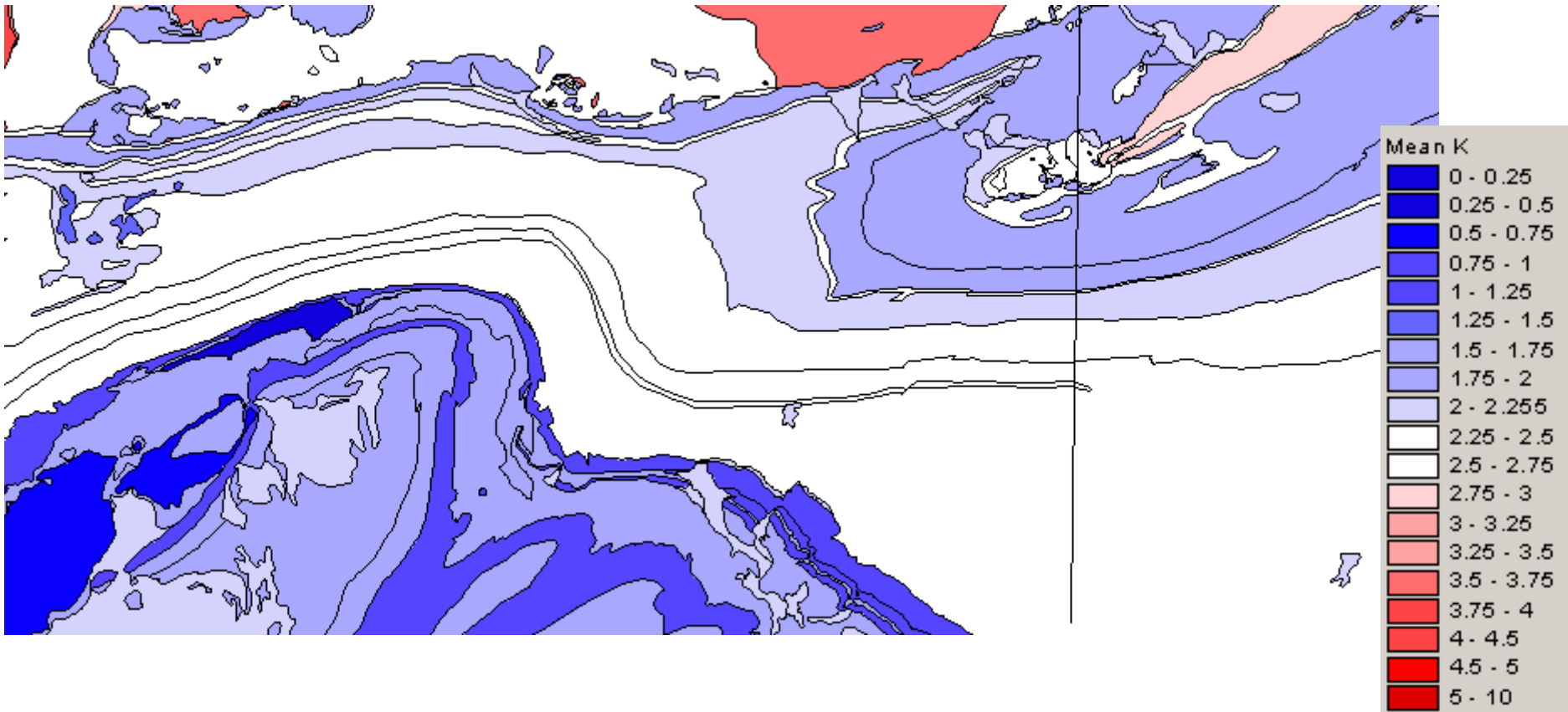
Evaluation of alteration processes through radioelement depletion vs enrichment

Measured Potassium (airborne HR survey)



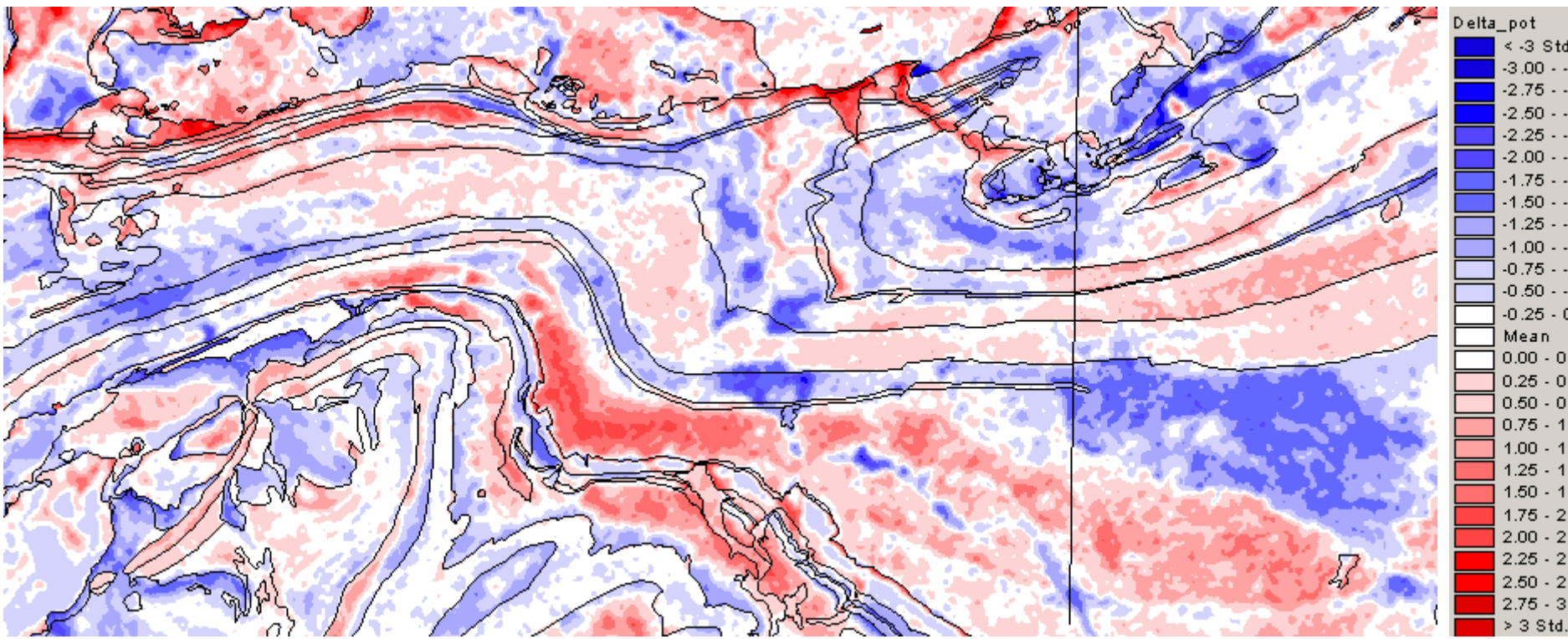
Calculation of a radioelement mean value for each lithologies

Mean Potassium within each lithological unit

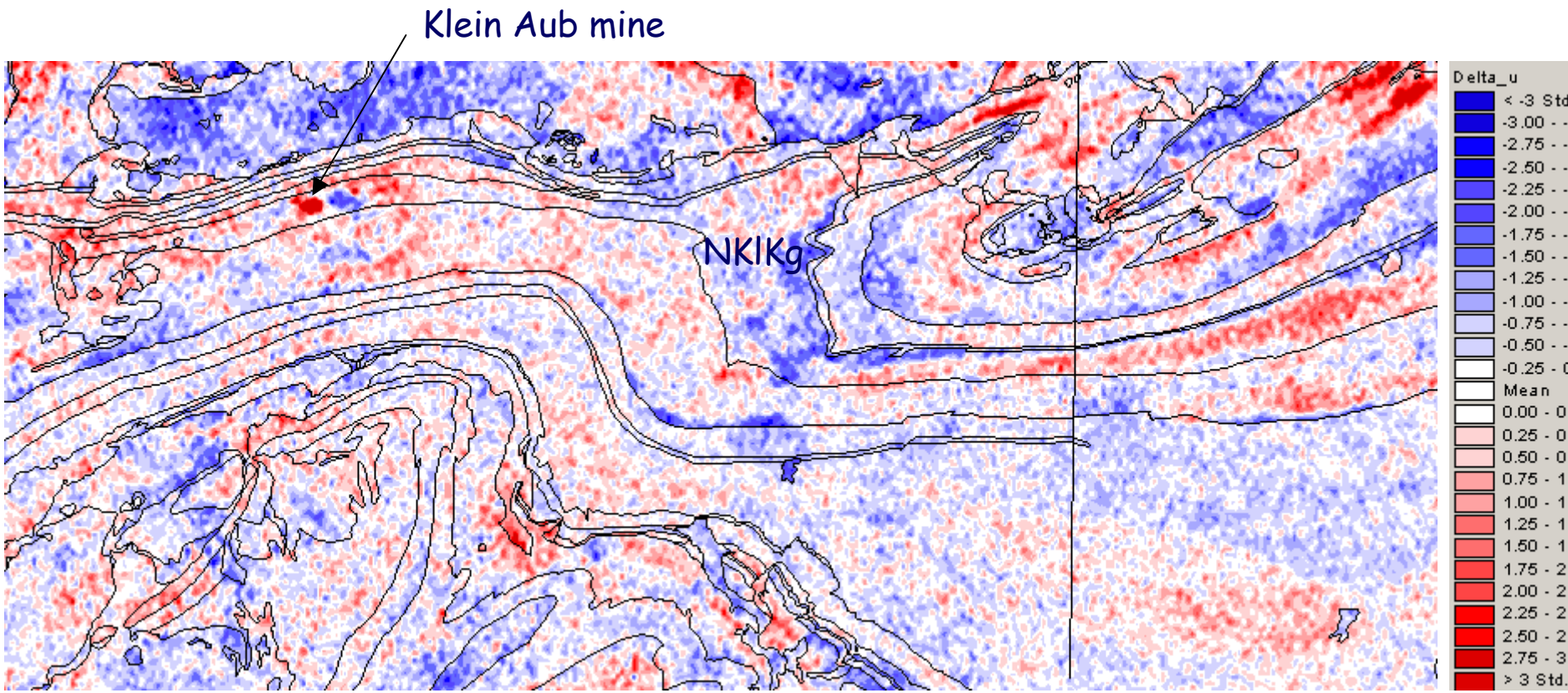


Calculation of the variation within each lithologies, depletion vs enrichment

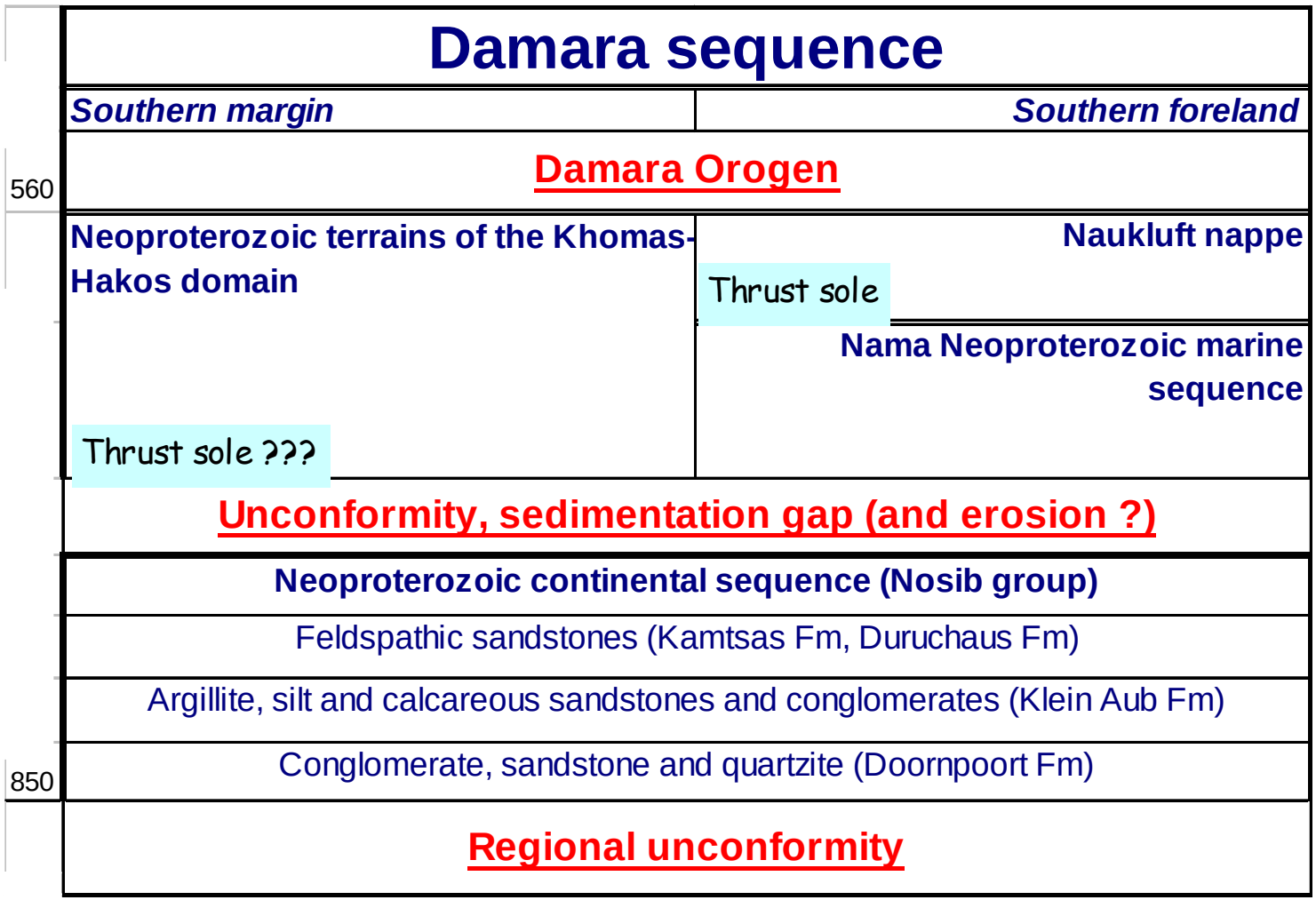
Variation of potassium content within each lithologies



Calculation of the variation of the Uranium content within the Klein Aub formation



Summary: Lithologies and chronology



Conclusions

- High-resolution airborne radiometric and magnetic geophysical data from Namibia provide new datasets that can be used for producing interpreted geological maps

- Physical properties of the main lithotectonic units and the overall structural pattern give new insights on the successive accretionnary processes already envisaged by geologists
- Alteration processes can be quantified and used to evaluate the existence of hydrothermal systems or weathering processes