Late Neoproterozoic granulite facies metamorphism of the Upper Gneiss unit (Seve Nappe Complex) in the Váivančohkka-Salmmečohkat area, northern Scandinavian Caledonides

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EGU General Assembly 2021

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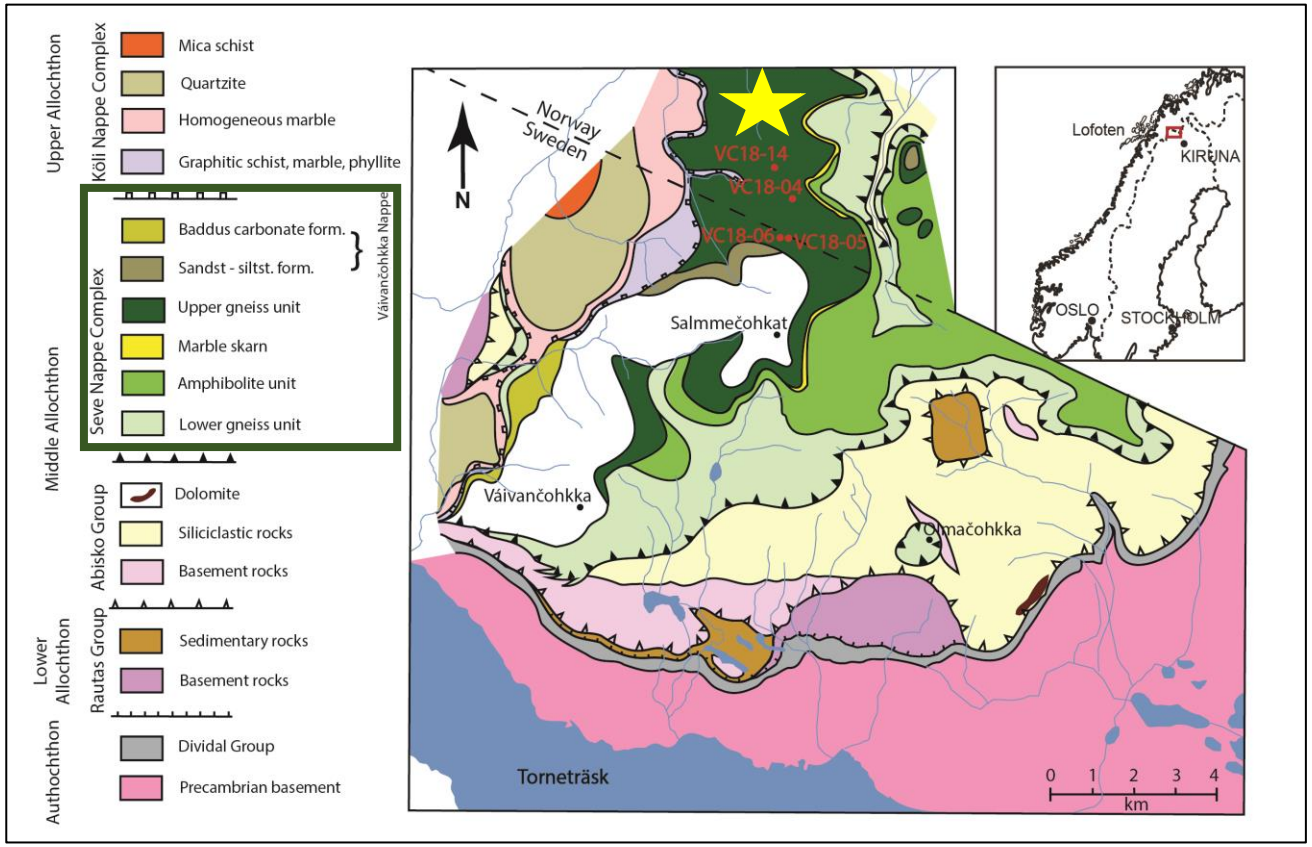
Uniwersytet Wrocławski

PAN Polish Academy of Sciences

Uppsala Universitet

Orogen Dynamics Team

Geological background



Seve Nappe Complex in the Váivančohkka-Salmmečohkat area (*modified after Kathol 1989*)

- Lower gneiss unit: well-developed foliation defined by alternating mica-enriched and quartzofelspathic layers (Hobbs et al. 1976).
- Amphibolite unit: fine to medium grained, foliated, frequently banded amphibolites.
- Upper gneiss unit ★: sequence of pelitic to psammitic gneisses and schists.
- Váivančohkka Nappe: dolerite-intruded psammitic sequence that was metamorphosed in greenschist facies.

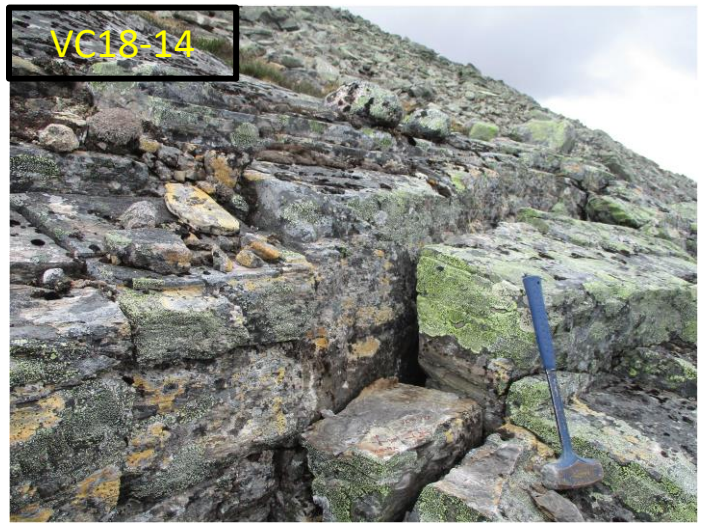
★ Rocks of the **upper gneiss unit** are the main focus of this study

Outcrop scale

Upper gneiss unit

➢ Paragneiss (VC18-05)

- Pervasively foliated and bears features of migmatization.
- Hosts garnet meta-mafic bodies locally transected by leucocratic veins.
- Mineral assemblage: Pl + Qtz + Kfs + Grt + Bt + Wmca. Accessory phases: Zrn + Mnz + Xtm + Tur.



➢ Garnet-mica schist (VC18-14)

- It consists of an alternating felsic and mafic layers with differing grain size.
- Felsic layers: fine grained; mineral assemblage: Pl + Qtz + Ep*+ relicts of Wmca.
- Mafic layers: Grt + Bt + Ilm + Ep*.

Outcrop scale

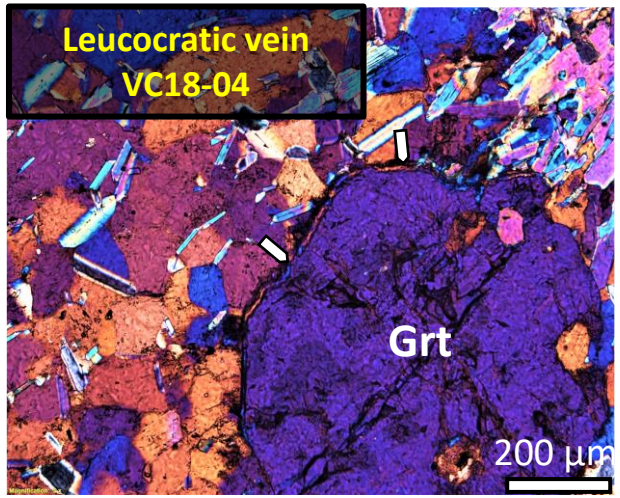
➢ Paragneiss and mica schist hosts lenses of meta-mafic rocks

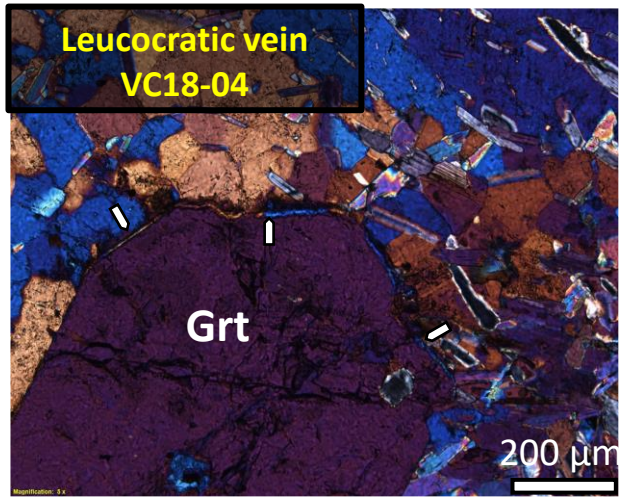
✓ Amphibolite body (VC18-06)
- Previously classified as retrograde eclogite.
- Mineral assemblage: Amp + Grt + Qz ± Ttn ± Rt ± Zo.
- Transacted by leucocratic veins.

✓ Leucocratic vein (VC18-04)
- Mineral assemblage: Pl+ Qz + Wmca.
- Sometimes Ap + Zrn + Ep + Cb.
- Contains mafic enclaves formed by Grt + Bt.
- Does not continue into the host rock.

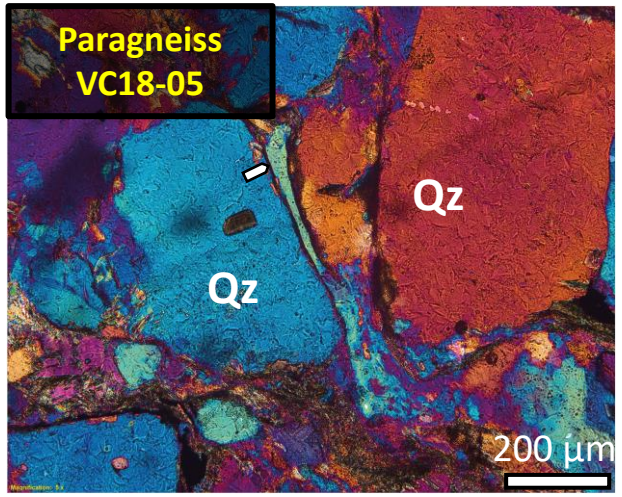
Melt Microstructures

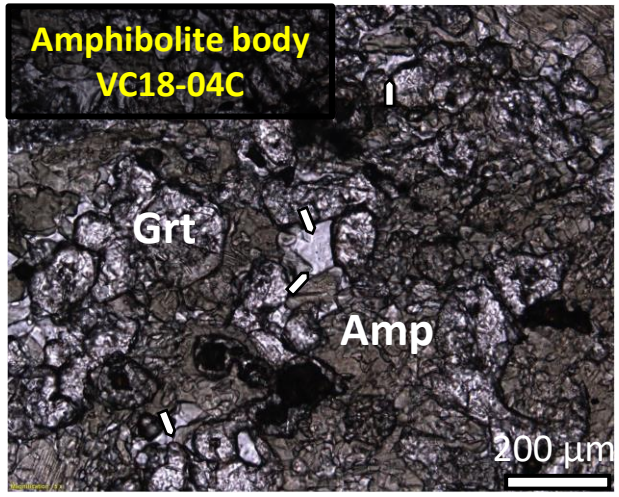
Melt rim around Garnet



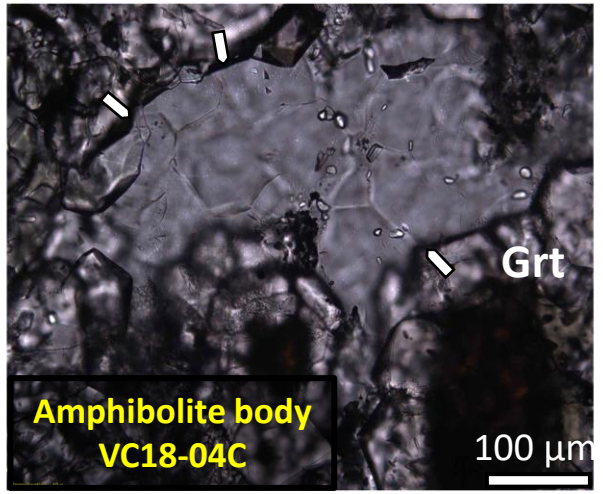


Pseudomorphs after melt



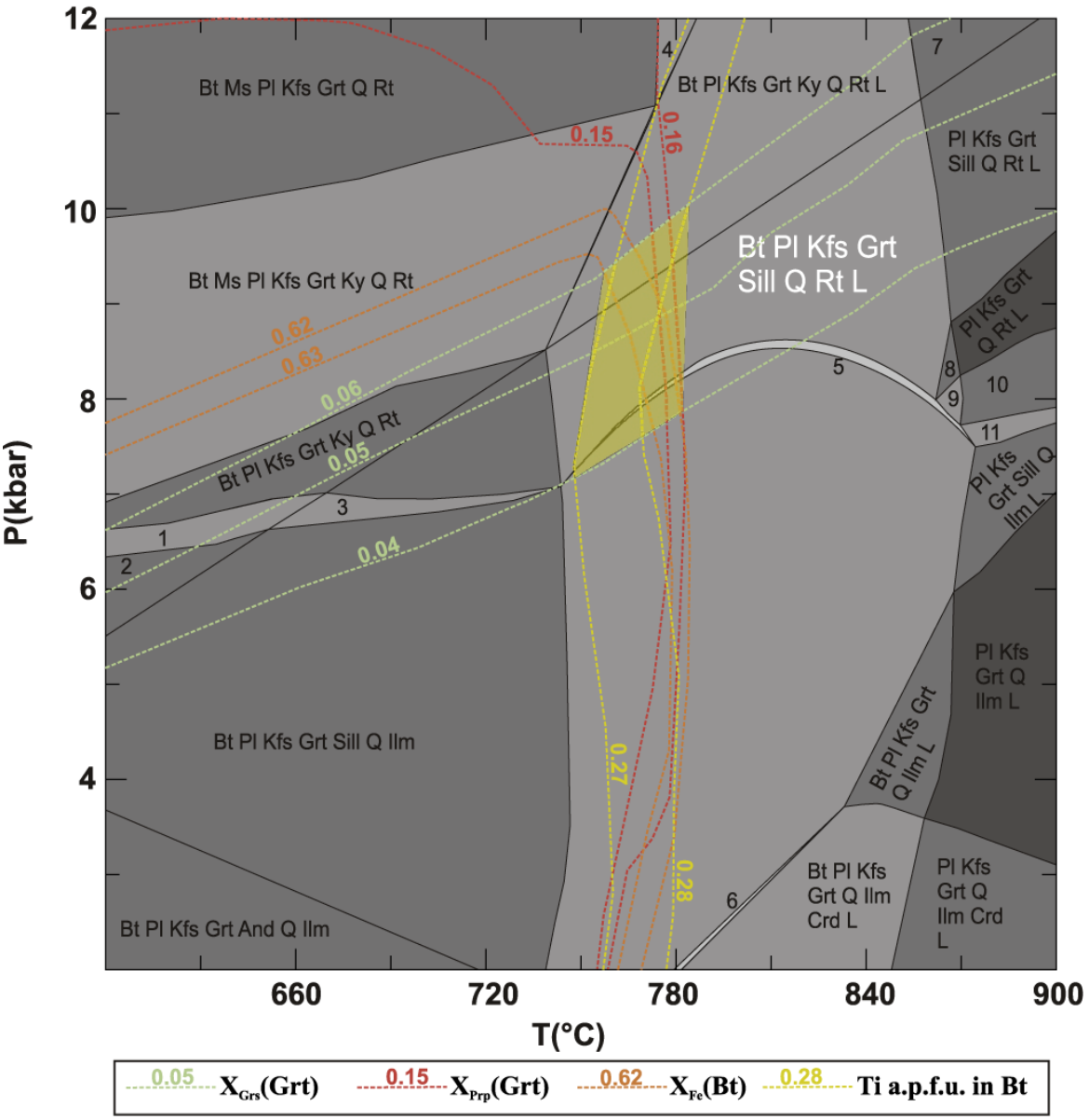


Melt pool

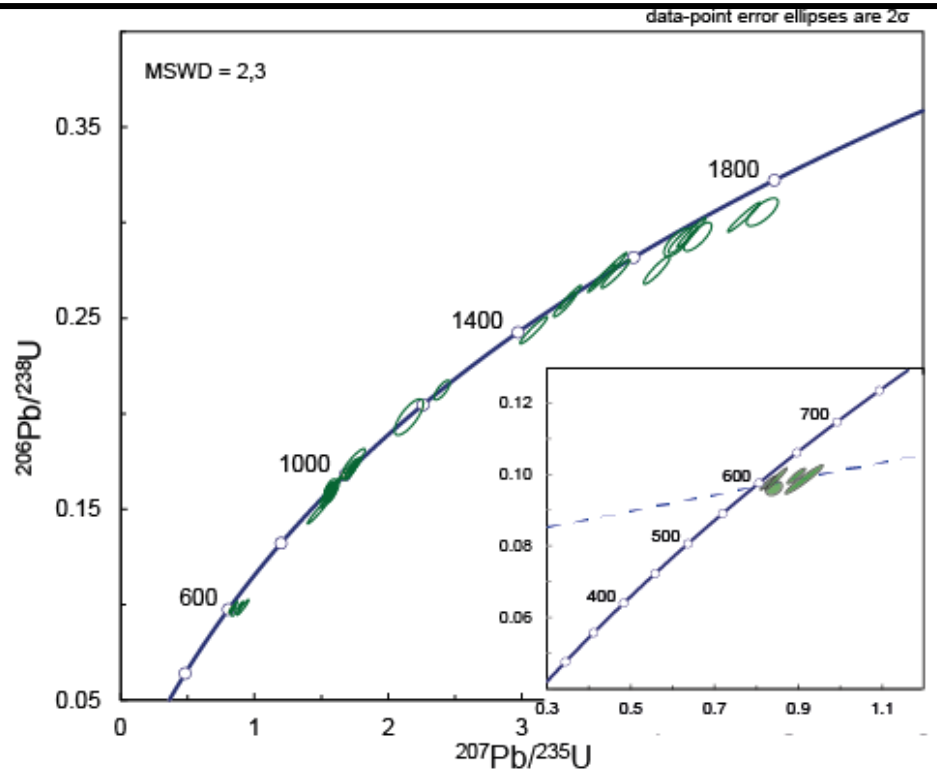


This microstructures bring unambiguous evidences of melt presence during crystallization, thus high temperature metamorphism

P-T estimates

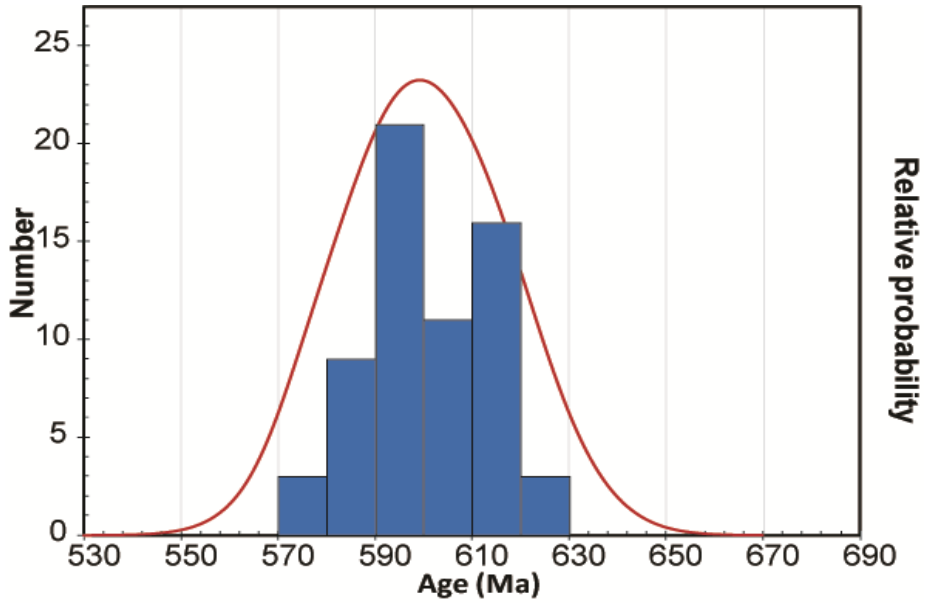


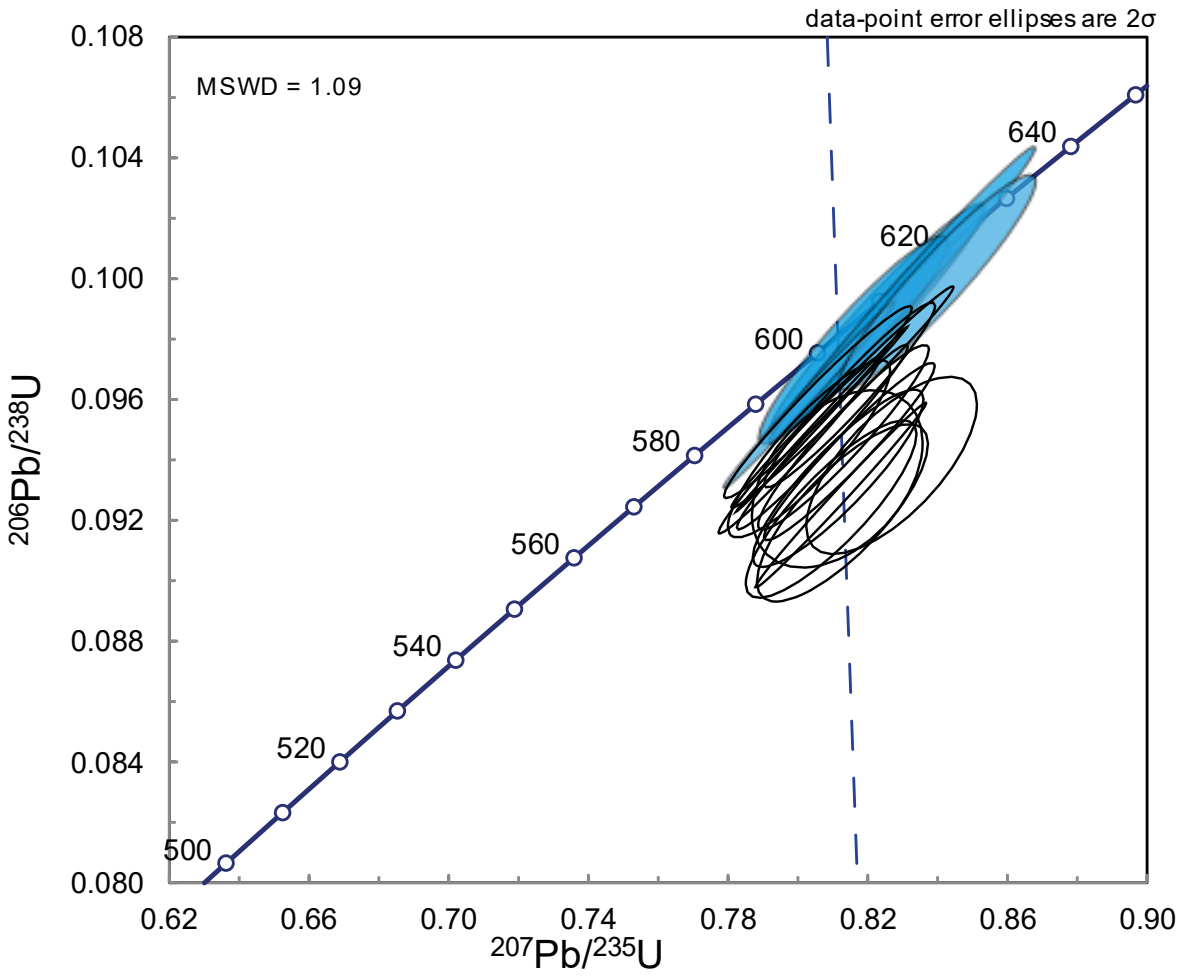
- P-T conditions of garnet core growth: **7 - 9.5 kbar** and **750 - 780°C**
- Phase equilibria calculation based on chemical composition of minerals of paragneiss (VC18-05a)
- Perple_X 6.9.0 software package
- Thermodynamic dataset (Holland & Powell 2004: hp04ver.dat)
- Calculations performed in the Na_2O–CaO–K_2O–FeO–MgO–MnO–Al_2O_3–SiO_2–H_2O–TiO_2 (NCKFMMnASHT) system
- Solution models: Grt and W-mica (Holland & Powell 1998); Bt (Tajcmanova 2007); Sa (Thompson & Hovis 1979), Pl (Newton et al. 1980), Ilm (White et al. 2000) and melt (Holland & Powell 2001)
- H_2O content of ca. 0.3%.
- stability field of Grt + Bt + Pl +Kfs + Sil + Rt/Ilm + Qz +melt



- LA-ICP-MS: zircon U–Pb isotope
- 42 analyses located in the zircon cores and overgrowths
- Weighted average age for overgrowths: **602.1 ± 5.1 Ma** (n=5) and upper Discordia intercept age: **594 ± 11 Ma** (n=5)

- EPMA
- Monazite: *in-situ* the Th-U-total Pb method. The studied blasts were located both in the matrix and as inclusions in garnet
- A Total of 63 analyses were obtained from 34 grains
- **599.0 ± 3.1 Ma** (MSWD=1.19)





- LA-ICP-MS
- U–Pb isotope data was obtained from a total of 22 analyses located both in zircon cores and rims.
- Weighted average age: **603.8 ± 7.7 Ma** (n=5) and upper Discordia intercept age: **605.7 ± 8.2 Ma** (n=22)

➢ Summary

- ✓ Melt microstructures have been observed at microscopic scale in the gneiss from Upper Gneiss Unit
- ✓ P-T estimates: 7-9kbar; 750-780 °C.
- ✓ Geochronology of paragneiss (VC18-05a)
  - ❑ U-Pb: 602.1 ± 5.1 Ma (zircon)
  - ❑ In situ Th-U-total Pb: 599.0 ± 3.1 (monazite)
- ✓ Geochronology of leucocratic vein (VC18-04a)
  - ❑ U-Pb: 603.8 ± 7.7 Ma (zircon)

➢ Conclusion

- ✓ Rocks of the Upper Gneiss unit underwent **high-temperature metamorphism**
- ✓ Upper Gneiss Unit suffered metamorphism **c. 600 Ma**
- ✓ **No** evidence of Caledonian high-grade metamorphism