The Rocroi inlier, highlight of grey areas in its geological story using modern tools (U-Pb on Zircon with LA-ICP-MS and Raman Spectroscopy of Carbonaceous Material)

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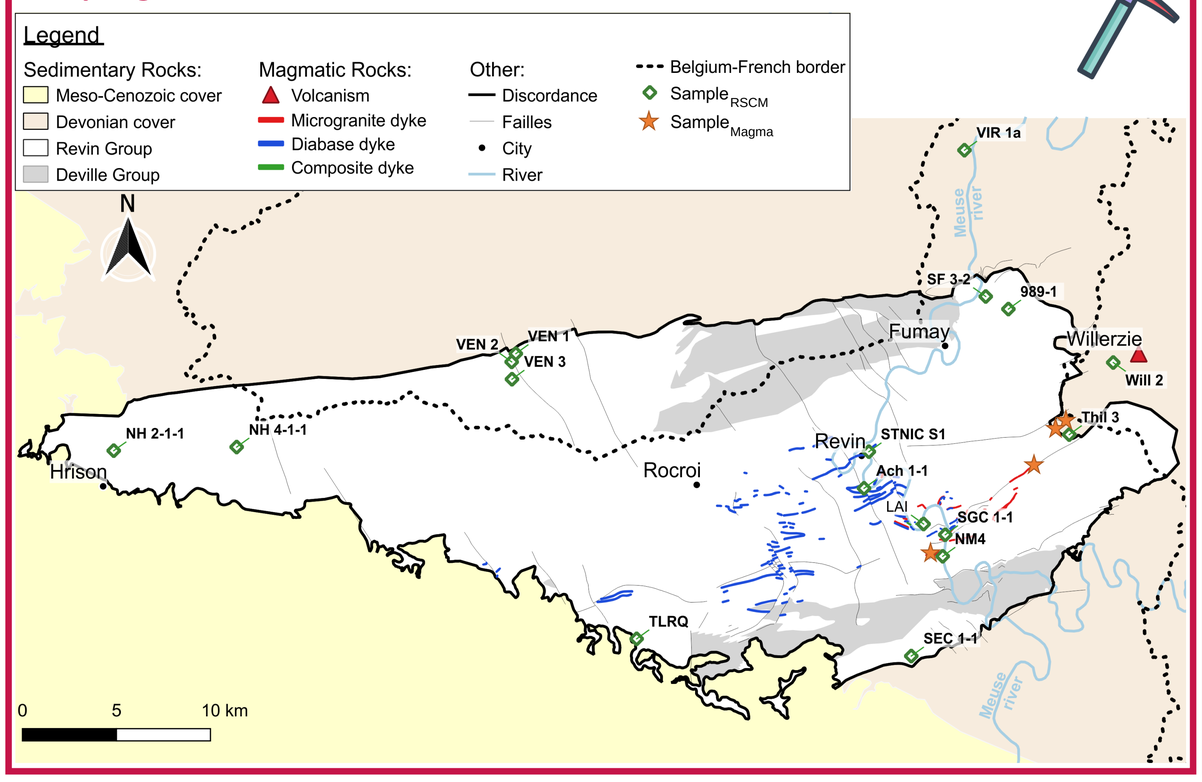
Introduction

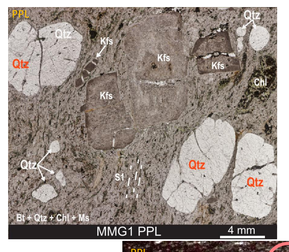
The Rocroi inlier is an ENE-WSW 20 x 70 km elongated antiform belonging to the Ardenne Allochthon at the border between Belgium and France. It is constituted of a ~2km-thick alternation of metapelitic and quartzitic sedimentary pile predominantly Cambrian in age. Two main lithostratigraphic units are distinguished: the Deville (Lower Cambrian) and the Revin Groups (Upper Cambrian to Ordovician). The Devono-Carboniferous series and Meso-Cenozoic series unconformably overlie the Lower Paleozoic basement. The Rocroi inlier is surrounded to the north, east and south by the Devonian cover and to the west by the Meso-Cenozoic series. Concerning the magmatic part, the Rocroi inlier hosts a vein swarm of 144 magmatic veins in its southern half, and volcanic evidences are described in the Willerzie borehole. One hypothesis on the magmatic part is that veins en volcanism are link to the same magmatic event. To support or to reject this hypothesis, we dated 5 magmatic rocks from these two types by U-Pb on Zircon with LA-ICP-MS . Studies of the Rocroi inlier metamorphism are manly based on mineral paragenesis and illite crystallinity of samples collected along the Meuse river, which represents a good representative N-S trend of the eastern part of the inlier. However, data is still lacking in most areas elsewhere and the techniques used to define peak metamorphic conditions can be impacted by retrograde metamorphism, which has been recognized in the Rocroi inlier. To complete the dataset and therefore have a better understanding of the Rocroi inlier evolution, we used Raman Spectroscopy of Carbonaceous Material (RSCM) approach to obtain the maximum (peak) metamorphic temperature reached by the rocks.

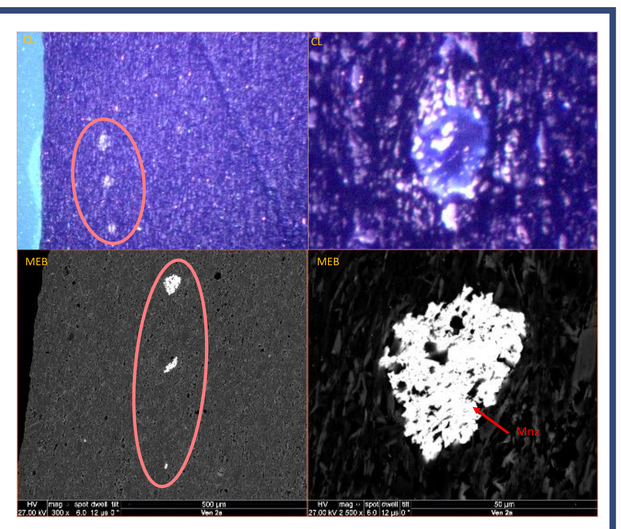
Sampling



Petrographic observations

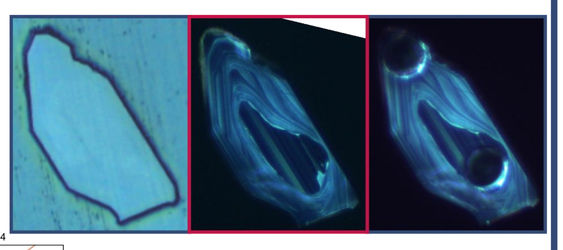
- Deformation in Cambrian basement and in magmatic veins (mainly at margins)
- Authigenic monazite observed in the north half of the Rocroi inlier and destabilized in the south half: T° > 450°C

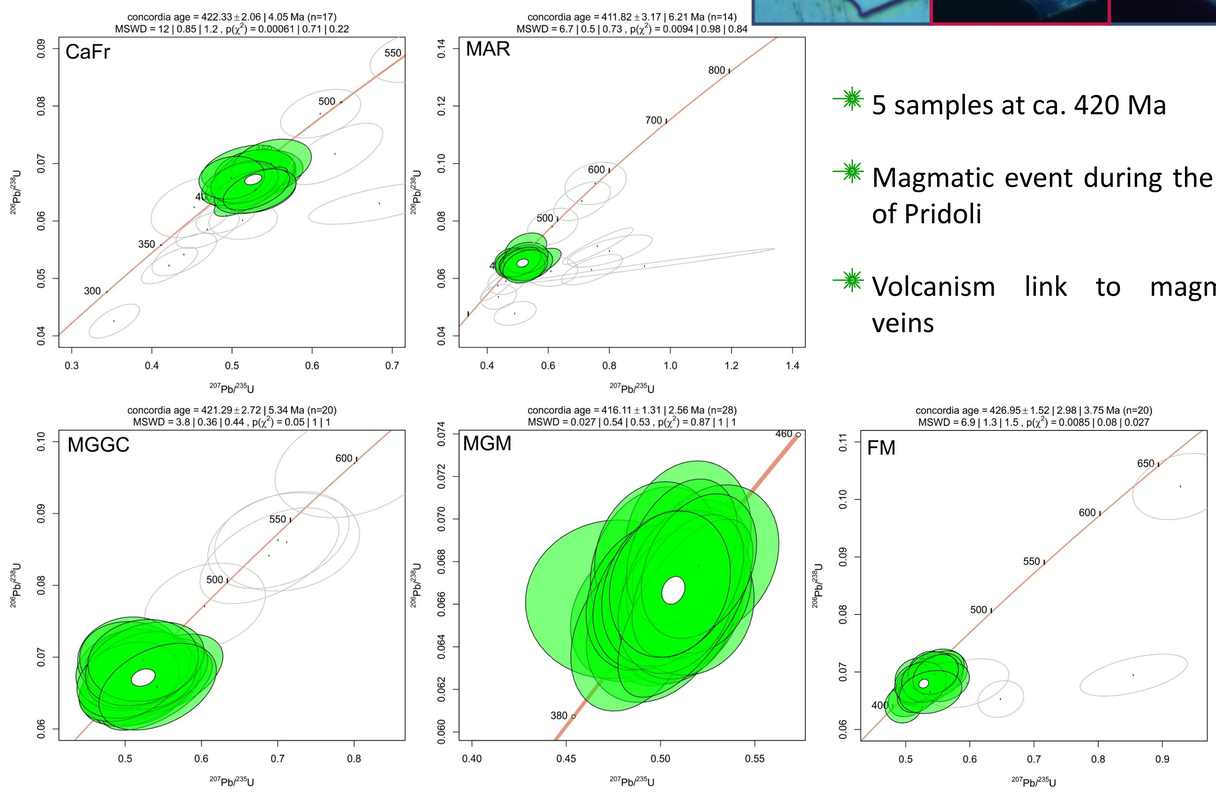




Geochronology

- U-Pb on zircon with La-ICP-MS
  - 5 magmatic samples
  - Hand-picking zircons mounted on epoxy pad
  - Cathodoluminescence imagery to identify zonation(s)

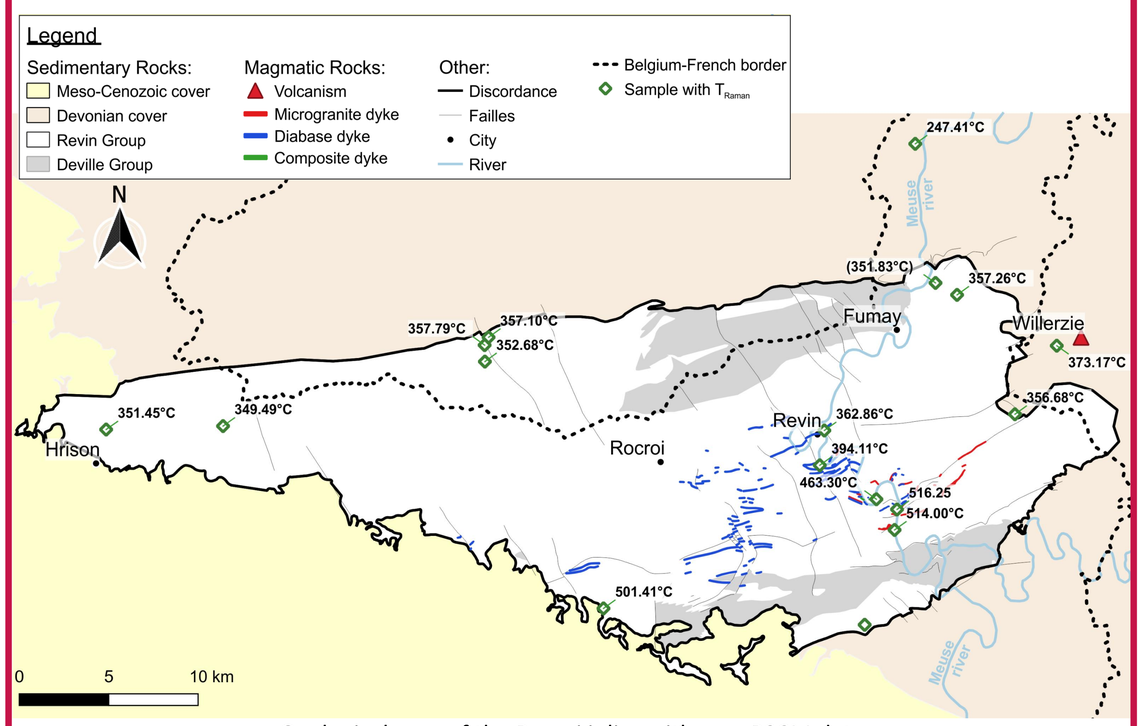




- 5 samples at ca. 420 Ma
- Magmatic event during the end of Pridoli
- Volcanism link to magmatic veins

RSCM

- 16 samples analyzed
- 3 temperature groups:
  - 247.41°C in the northern Devonian cover
  - Mean value of 370.57 ± 33°C in the north half of the Rocroi inlier
  - Mean value of 510.22 ± 8°C in the south half of the Rocroi inlier
- Homogeneous in a W-E trend
- Abruptly changing along N-S direction
- Consistent with occurrence or destabilization of authigenic monazite



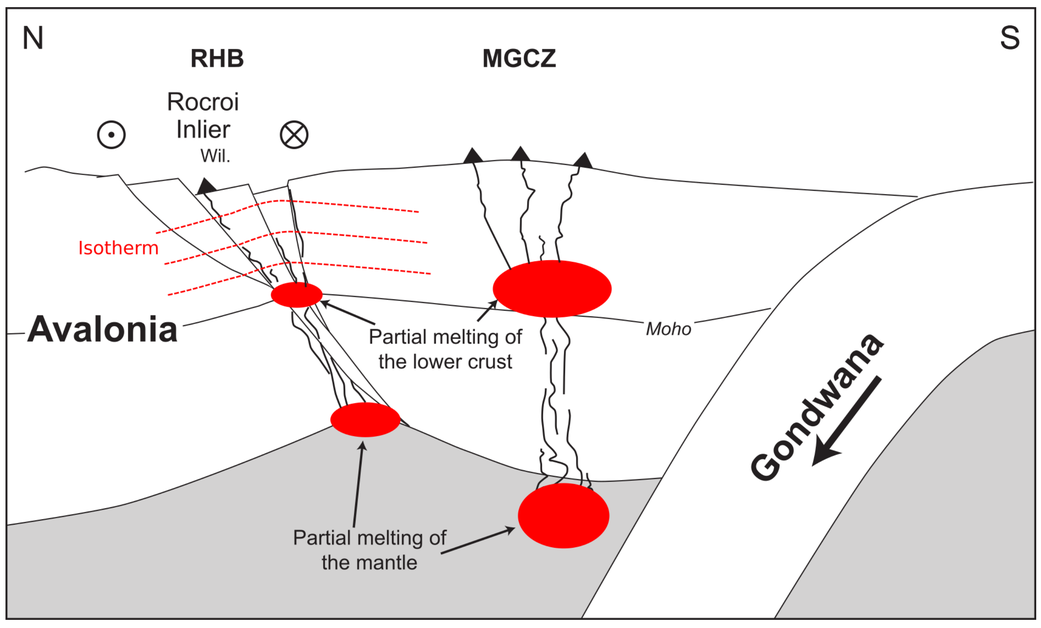
Geological map of the Rocroi inlier with new RSCM data

Discussion and conclusion

- U-Pb geochronology display an upper Pridoli age to the magmatic event
  - Rise of magma driven by faults caused by the start of a basin opening event?
- 2 distinct zones of T° in the Rocroi inlier (North and South)
  - In adequation with Beugnies (1986) and Robion et al. (1999) but not for the T° (higher)
- Temperatures > 500°C in the south half consistent with Robion et al. (1995)
- Min and max geothermal gradient in the north and south: 46 to 64°C/km
  - High geothermal gradient linked to a heat source
    - Magmatic veins?
    - Crust thinning?

→ 2 distinct blocks separated by the Grande-Commune fault. During the Silurian-Devonian back-arc extension event.

IF...



Back-arc basin opening (Pridoli) ➔ Start of the lithospheric extension ➔ Partial melting of the mantle and lower crust ➔ Paroxysm of subsidence ➔ Heating due to hot mantle proximity ➔ Geothermal gradient increase ➔ Regional metamorphism

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