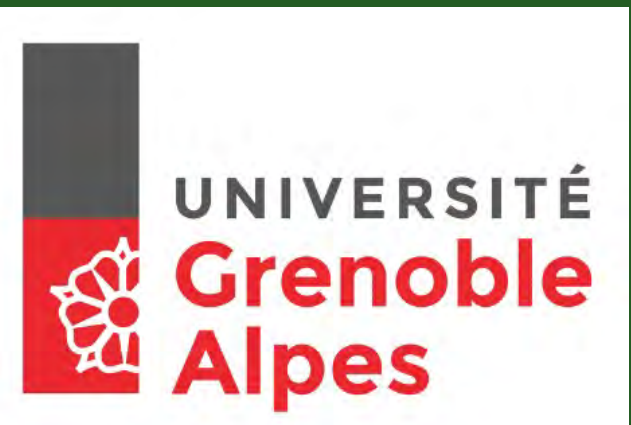


The retrogressed eclogites of the Lacs de la Tempête (NE Belledonne): an example of Carboniferous high-pressure metamorphism in the External Crystalline Massifs (Western Alps)

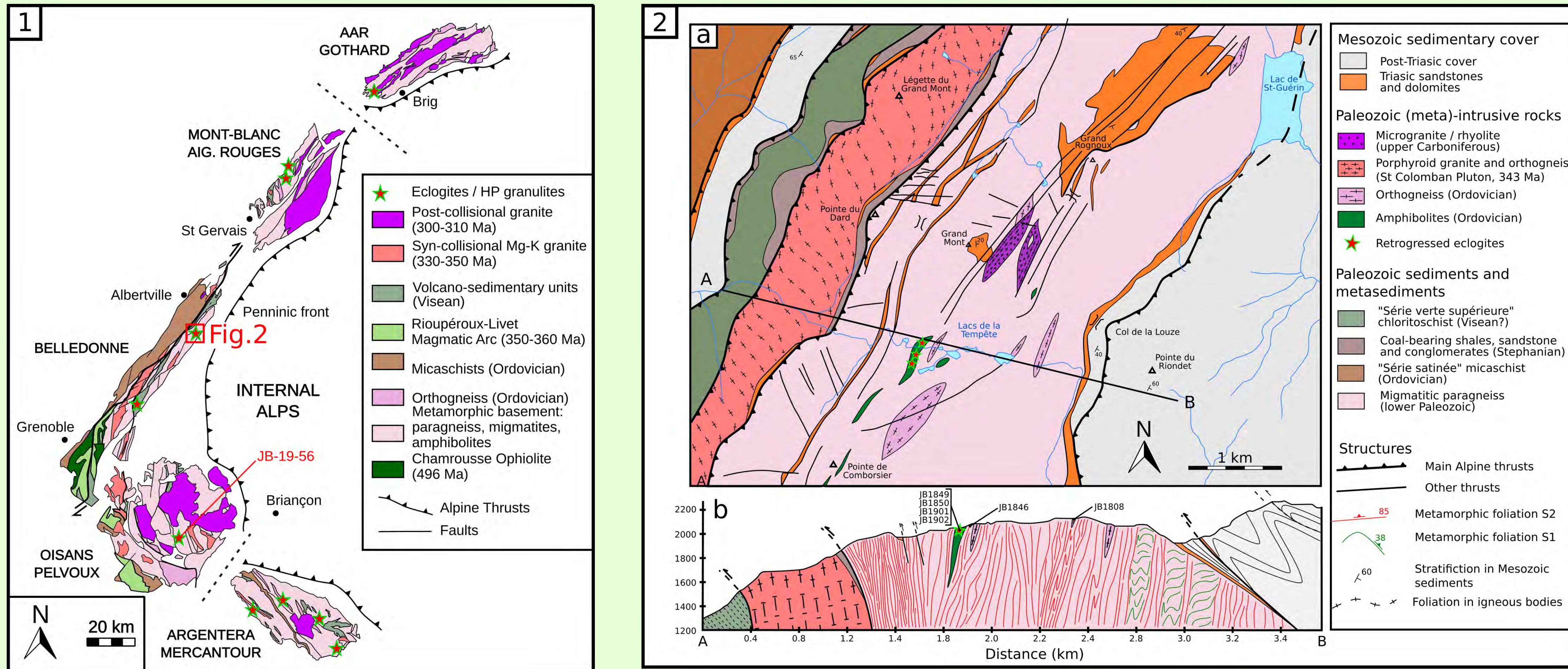


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1 - Geological setting

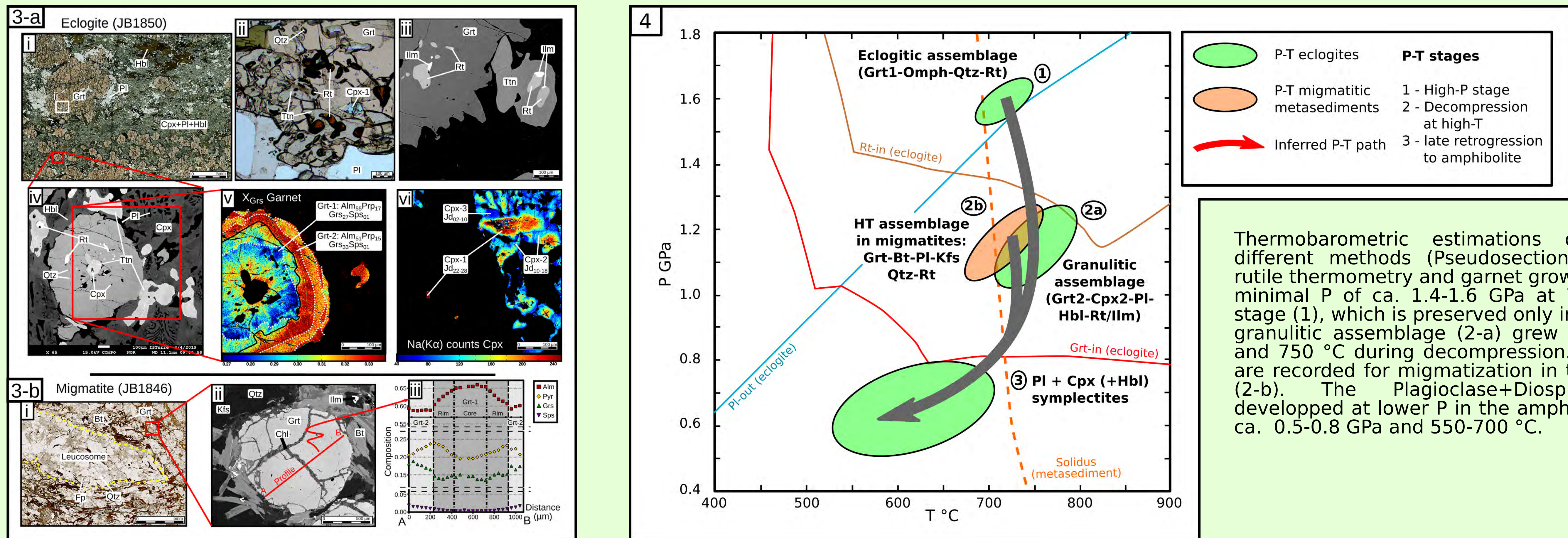
Large portions of the Paleozoic basement involved in the Alpine Orogen are exposed in the External Crystalline Massifs (ECM). They form the basement of the external Alps west of the Penninic thrust, and have only been weakly affected by Alpine tectono-metamorphic reworking. They therefore preserve the older Variscan structures and metamorphic assemblages. The ECM contain numerous relics of Variscan eclogites and high pressure granulites preserved in high grade migmatitic gneisses, indicating that these domains underwent an early HP metamorphic stage during the Variscan Orogeny.



This study mostly focused on the retrogressed eclogites of the Lacs de la Tempête (NE Belledonne). This area exposes high-grade migmatitic metasediments with intercalated lenses of orthogneiss and garnet-bearing amphibolites, preserving locally eclogitic assemblages. The dominant subvertical structure (S2) was acquired lately during the Variscan history, and corresponds to a mid-late Carboniferous stage of dextral strike-slip tectonics, that overprints an older flat-lying foliation (S1). Samples were collected in eclogitic boudins preserved in amphibolite lenses and in the surrounding metasediments and orthogneisses (Fig.2). An additional sample of retrogressed eclogite comes from another locality in Oisans (Fig.1).

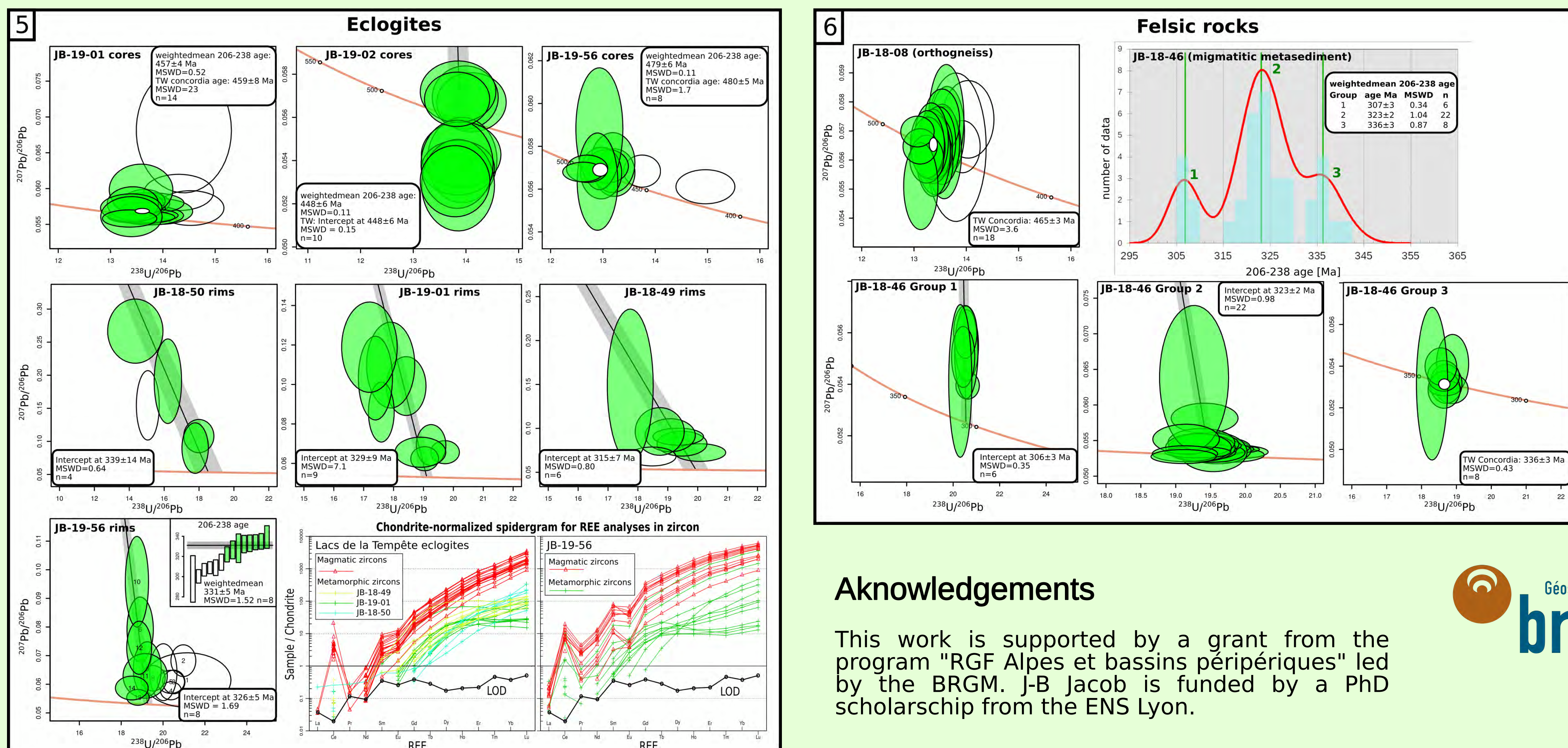
2 - Petrography and P-T evolution of the high-grade formations

The retrogressed eclogites are composed of an early HP assemblage (1) consisting of Ca-poor Garnet (Grt1) + Omphacite (Cpx-1) + Quartz + Rutile, overprinted by a granulitic assemblage (2) consisting of Hornblende + Ca-rich Garnet (Grt-2) + Clinopyroxene (Cpx-2) + Plagioclase + Ilmenite / Titanite. Retrogression to the amphibolite facies (3) is associated with the breakdown of Na-rich Clinopyroxene, which is replaced by Diopside (Cpx-3) + Plagioclase (+Hornblende) symplectites. The migmatitic metasediments mostly consist of an assemblage of Quartz + Feldspar + Biotite (XMg=0.54-0.57) + Garnet, with a few pockets of Quartz-Feldspar leucosomes.



3 - U-Pb dating and REE composition of zircon

U-Pb dating of zircon reveals that the lenses of orthogneiss and retrogressed eclogites derived from Ordovician protoliths. Zircon metamorphic overgrowth in the eclogites and the surrounding metasediments yielded ages between ca. 340-305 Ma. Metamorphic zircon in eclogites mostly show flat HREE patterns indicating a growth in presence of garnet, either during eclogitization or during the later granulitic stage. The absence of Eu anomaly on some grains suggests that they crystallized at HP in the Pl-free domain.



4 - Conclusion

- The internal domain of NE Belledonne preserves relics of a HP stage in the eclogite facies at ca. 1.4-1.6 GPa and 700 °C.
- This early HP stage was followed by near-isothermal decompression into the granulite facies at ca. 1.0-1.2 GPa and 750 °C.
- U-Pb dating of metamorphic zircons yielded mid-late Carboniferous ages for metamorphism.
- Correlating zircon crystallization age with a particular metamorphic stage remains challenging. REE profiles of metamorphic zircons suggests a growth either during the eclogitic or the granulitic stage. Thus, 340 Ma can be considered as the minimal age of eclogitization.

Acknowledgements

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