Eoarchean tectono-metamorphic signatures recorded on the Isua Supracrustal Belt

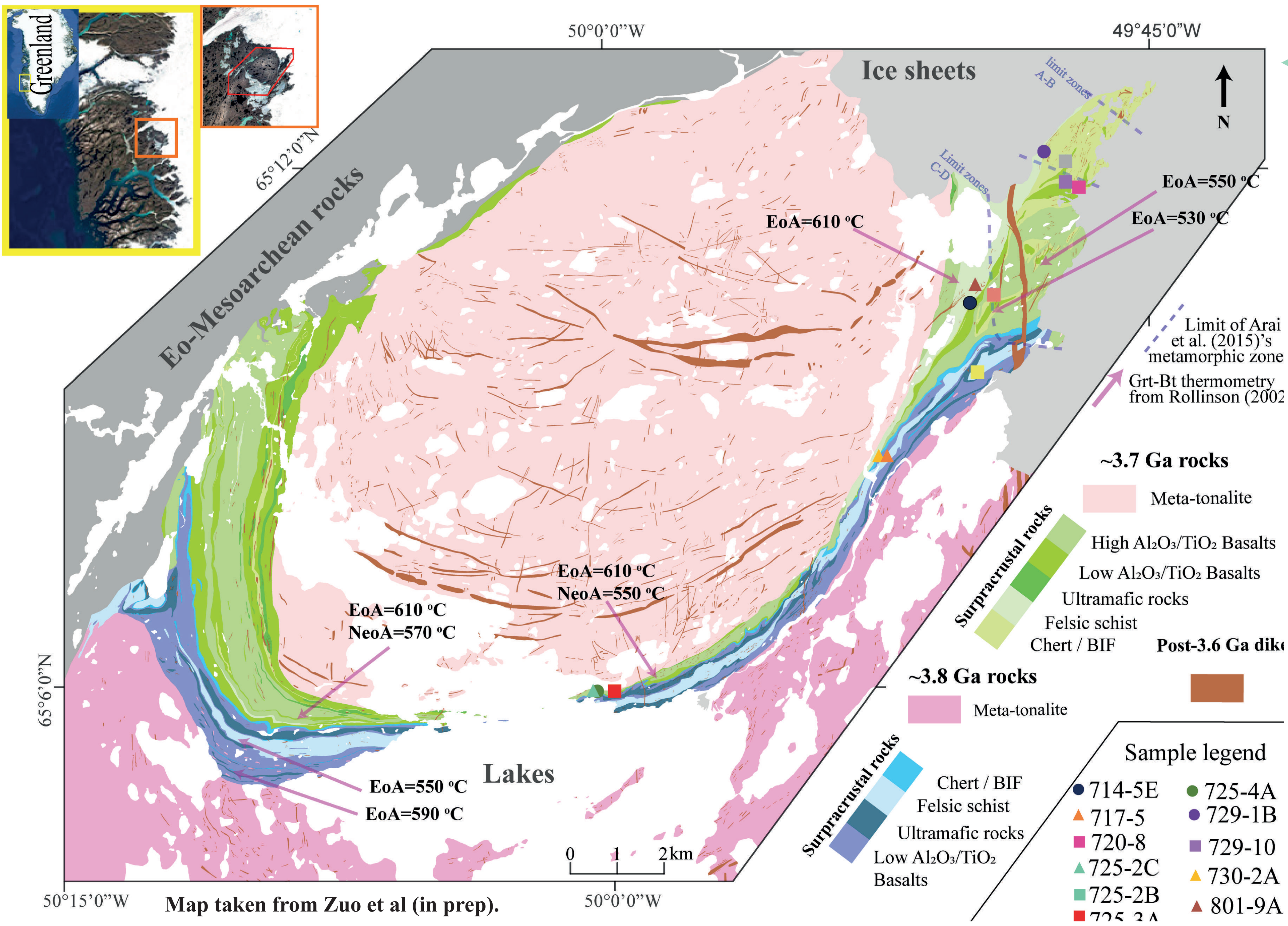
Anthony **Ramírez-Salazar**[1], Thomas Mueller[1], Sandra Piazolo[1], Alexander Webb[2], Christoph Hauzenberger[3], Jiawei Zuo[2], Peter Haproff[4], Jason Harvey[1], Callum Charlton[1]

[1] School of Earth and Environment, University of Leeds, Maths/Earth and Environment Building, Leeds LS2 9JT, United Kingdom [2] Department of Earth Sciences and Laboratory for Space Research, University of Hong Kong, Pokfulam Road, Hong Kong, China [3] Department of Earth Sciences, University of Graz, Universitatsplatz 2, A-8010 Graz, Austria [4] Department of Earth and Ocean Sciences, University of North Carolina Wilmington, 601 South College Road Wilmington, NC 28403, USA

@Anthnyy

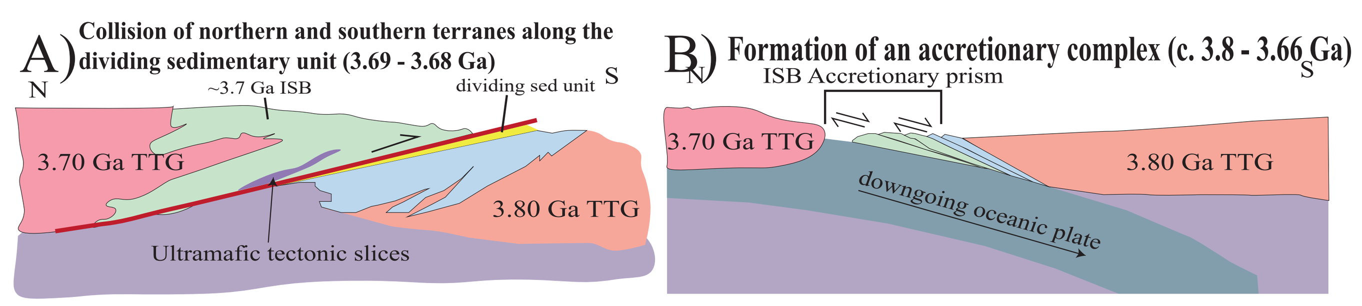
UNIVERSITY OF LEEDS · UNI GRAZ · UNCW University of North Carolina Wilmington

1 Geological setting and tectonic models



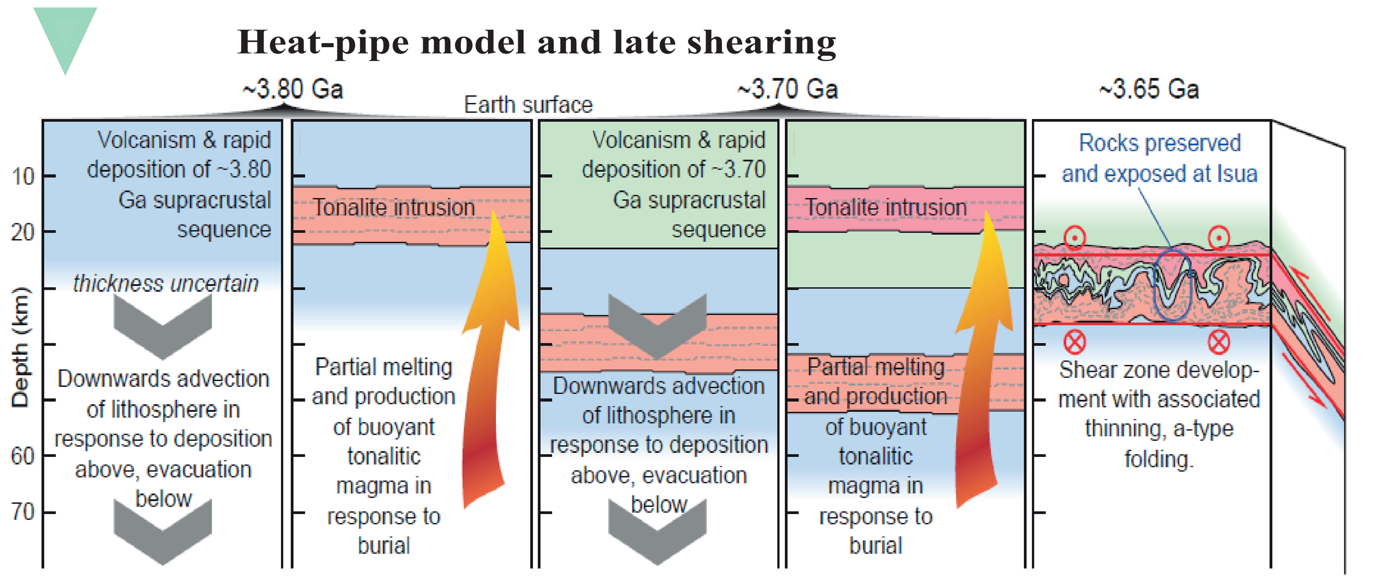
Map taken from Zuo et al (in prep).

The metamorphic record of the Isua supracrustal belt (ISB) is poorly understood some works rerport amphibolite facies conditions with no clear spatial variations (Boak & Dymek, 1982; Rollinson, 2002), while others argue for an increase in P-T conditions towards the southwest from 0.3 GPa and 380 ºC to 0.6 GPa and 560 ºC (Arai et al., 2015)



Classic tectonic models explaning the origin and evolution of the ISB invoke subduction-driven events. (A) After Nutman & Friend (2009) and (B) after Arai et. al. (2015)

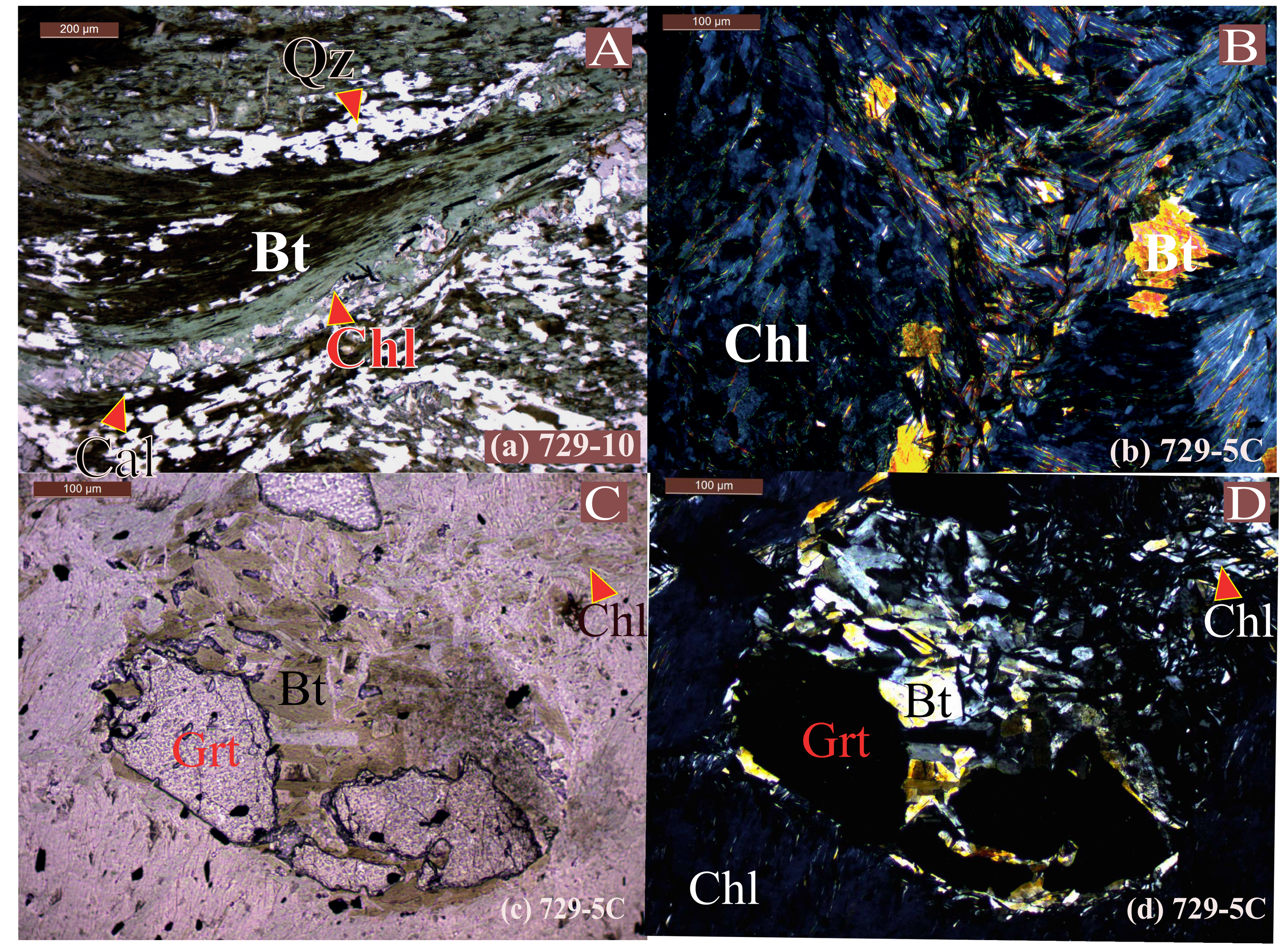
However, recent structural and fieldwork data argue for non-uniformitarian models to explain the geological characteristics of Isua. (C) After Webb et al. (2020)



2 Petrography

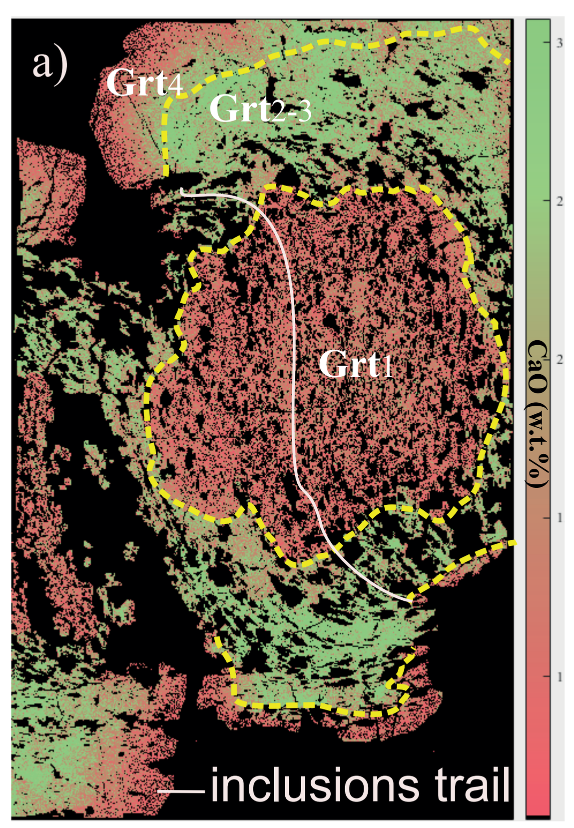
Retrograde chlorite commonly mimicks the foliation by replacing pograde biotite (A). The retrogression is more pervasive in NW part of the belt, where complete chloritization of some samples (B) and pseudomorphs of biotite (later replace by chlorite) after garnet appear.

These onbservations suggest that the greenschist assemblages previously intepreted as prograde (c.f. Arai et al., 2015) could be an artefact of poor preservation.

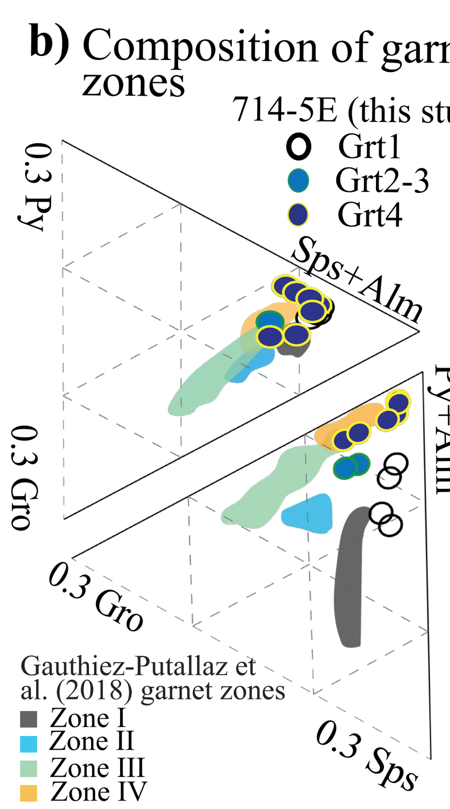


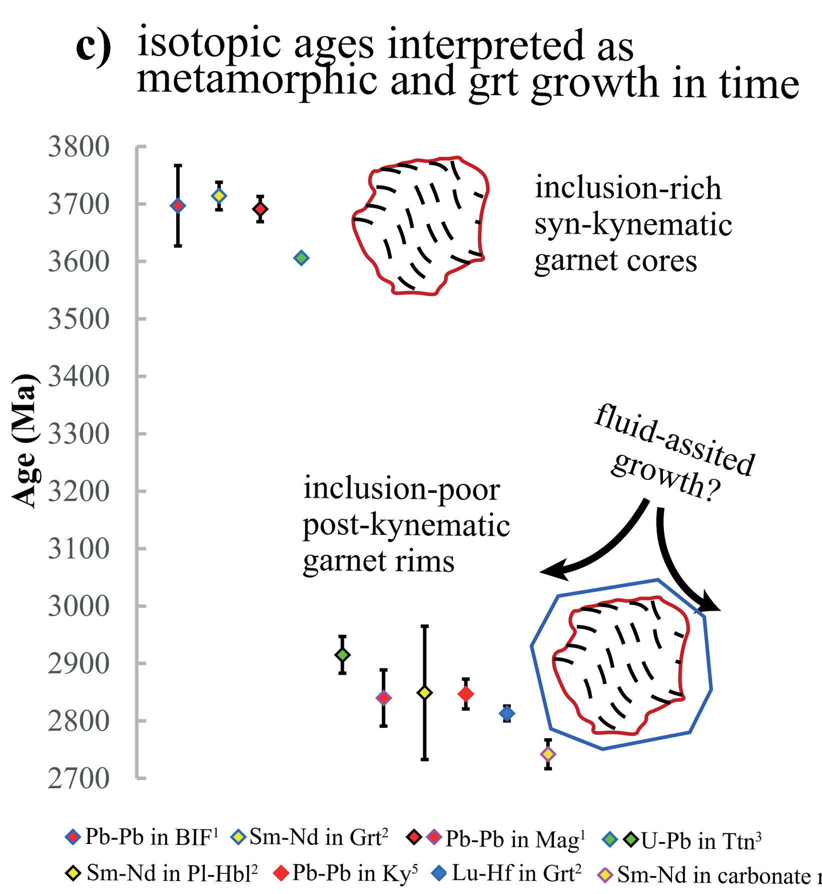
3 Garnet chemistry

The Isua garnets commonly show three (and up to four) distinc chemical zones, typically interpreted to represent three different tectono-metamorphic events (Rollinson 2002, 2003; Gauthiez-Putallaz et al., 2020). Our data (a) is consistent with the chemical zones, and when compare our data (b) with samples of other studies that share similar mineralogy and chemistry, it is clear that the garnets recorded the same changes in chemistry; however our micro-structural analysis reveals that the the core and annuli grew in the same deformation event. We propose then that the complex chemistry of the Isua garnets can be explain with only two metamorphic events in the Eo and Neoarchean (c)

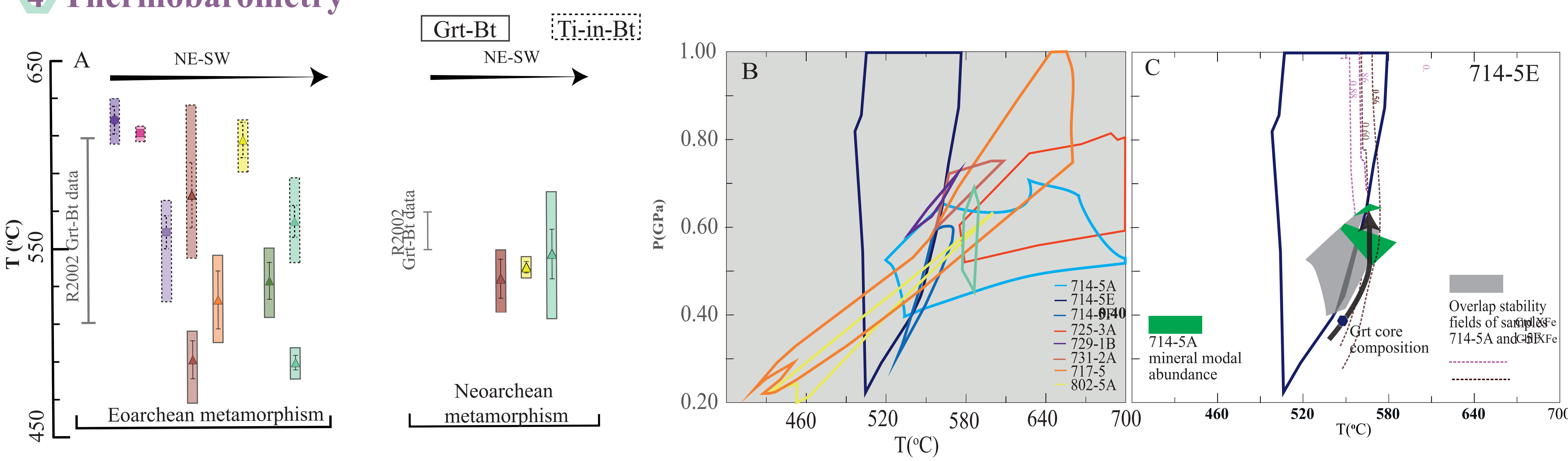


Garnet compositional map processed with XMapTools (Lanari et al., 2014)





4 Thermobarometry



Both classic (A) and phase equilibria thermobarometry (B) show no clear increase in P-T conditions from NE-SW and neither from the 3.8 to the 3.7 Ga belts. Our thermobarometric data suggest that the ISB followed a near-isothermal prograde path (C) and reached peak metamorphic conditions at 550-600 ºC and 0.60-0.65 GPa for the Eoarchean event. **Our results are consistent with the non-uniformatiarian tectonic model for the evolution of the ISB.**

References: Arai et al. (2015) Tectonophysics, 662, 22–39. Boak & Dymek (1982) ESPL, 59(1), 155–176. Gauthiez-Putallaz et al. (2020) Chemical Geology, 537, 119474. Lanari et al. (2014) Computers and Geosciences, 62, 227–240. Nutman & Friend (2009). Precambrian Research, 172(3–4), 189–211 Rollinson (2002). GeoSoc Special Publication, 199, 329–350. Rollinson, H. (2003) Precambrian Research, 126(3–4), 181–196 Webb (2020) Lithosphere, 12(1), 166–179. **References in fig. 3(c)** (1)Frei et al. (1999).Geochimica et Cosmochimica Acta, 63, 473-488. (2) Blichert-Toft & Frei (2001). Geoc. et Cosm. Acta, 65(18), 3177–3189 (3) Crowley et al. (2002). Bulletin of the GSA 114(10), 1311–1325. (4) Grau et al. (1996) Chemical Geology, 133, 225-240. (5) Rosing & Frei (1999) Journal of Conference Abstracts, 4, 144 (6) Shimizu (1990) Geochimica et Cosmochimica Acta, 54, 1147-1154.