Prix de these SGF - Ami Boué

Tracking intra-oceanic arc growth and accretion processes of a Neoproterozoic arc (Pan-African belt, Moroccan Anti-Atlas)

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Sup./Coll.: J. Berger, J-M. Baele, O. Bruguier, N. Ennih, H. Diot, C. Monnier, S. Vandycke

What we get from…

… active arc settings

Geochemical / petrological **coherence** (arc output, input & xenoliths)

Physical picture of arcs via **seismic velocity model**

… arc survivals

Intra-arc magmatic processes (field, geochemical, P-T investigations)

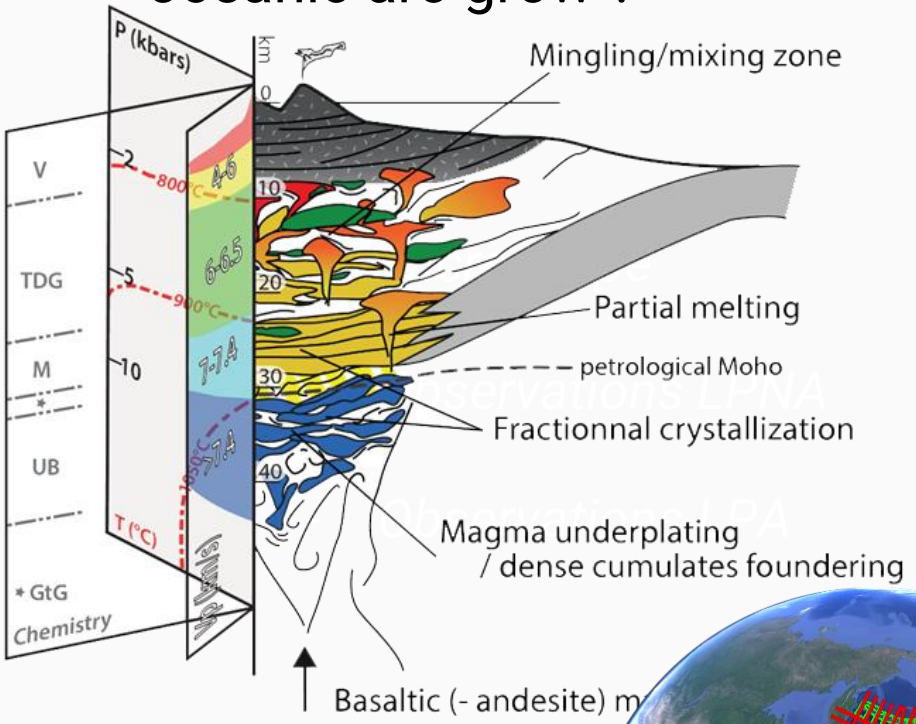
Overprint of **arc-accretion** processes

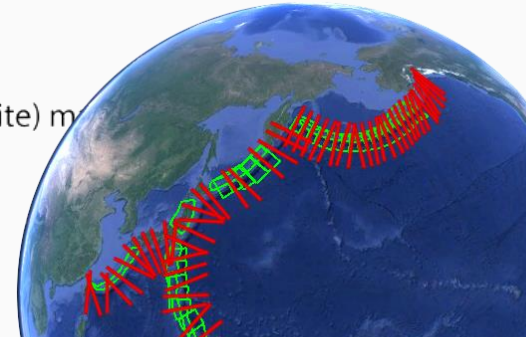
… modelled arcs

Thermo-mechanical geodynamic modelling

Experimental petrology

How, when, where does oceanic arc grow ?

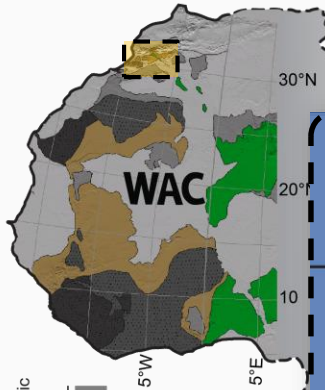


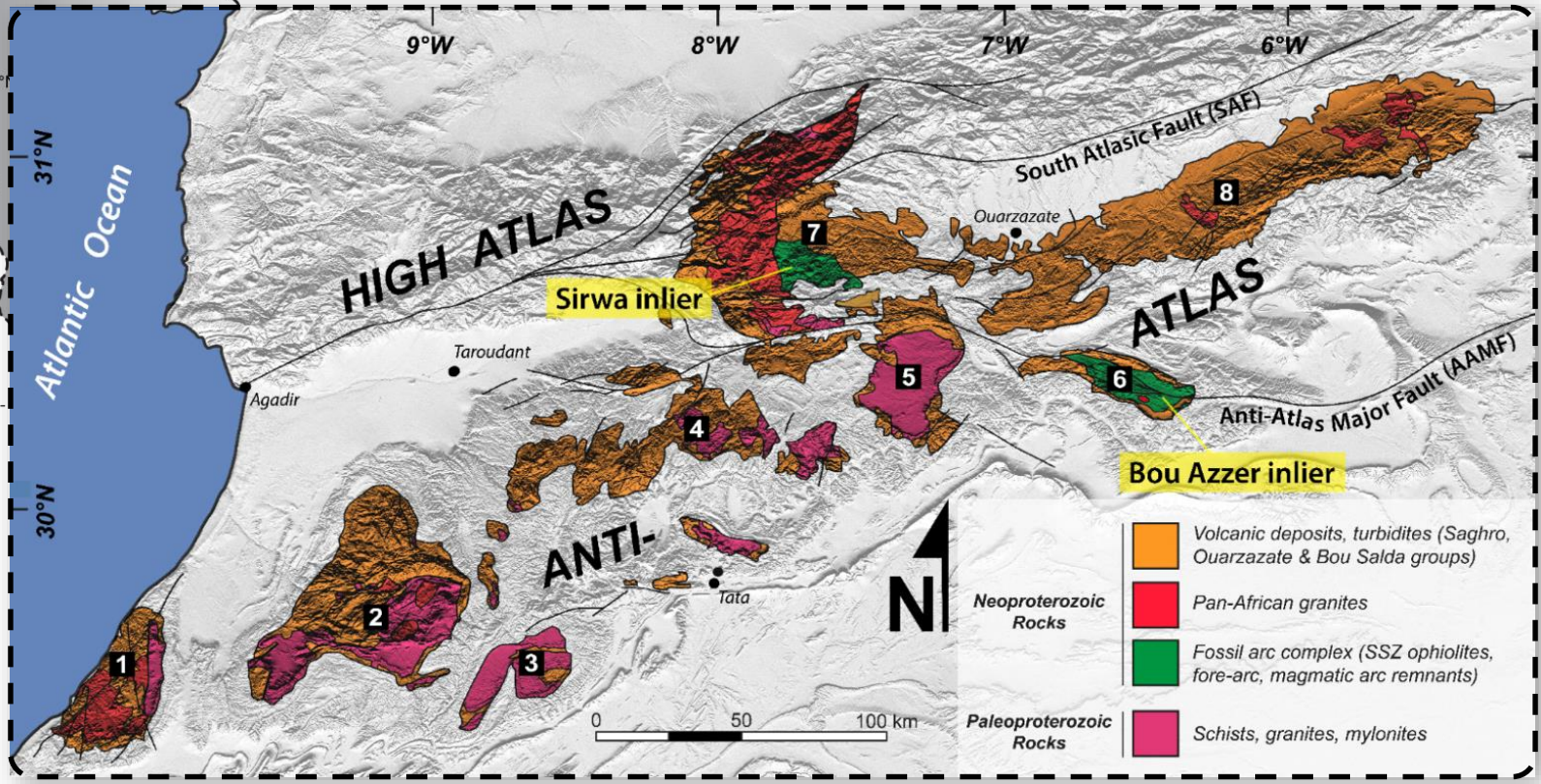


(Kodaira et al., 2007; Stern, 2010; Straub & Zellmer, 2012; Takahashi et al.,2007; Calvert, 2011; Debari & Greene, 2011; Triantafyllou et al., 2017)

The Moroccan Anti-Atlas: a **suitable** area for studying Pan-African Geodynamics

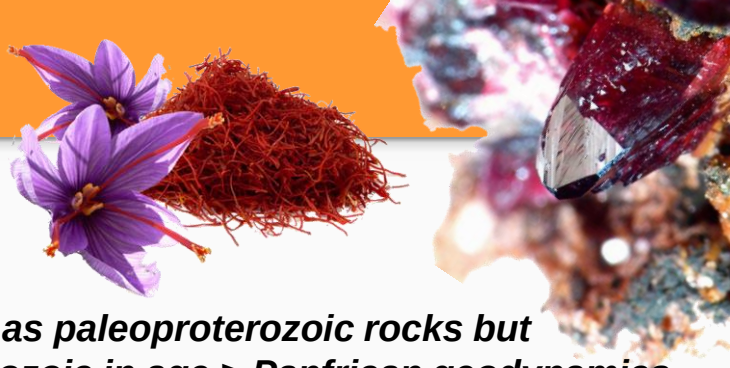
➔ ***Traces of a Neoproterozoic oceanic domain / 120 Ma timespan (760 to 640 Ma) !***





Gasquet et al., (2005)
Triantafyllou et al., (2016)

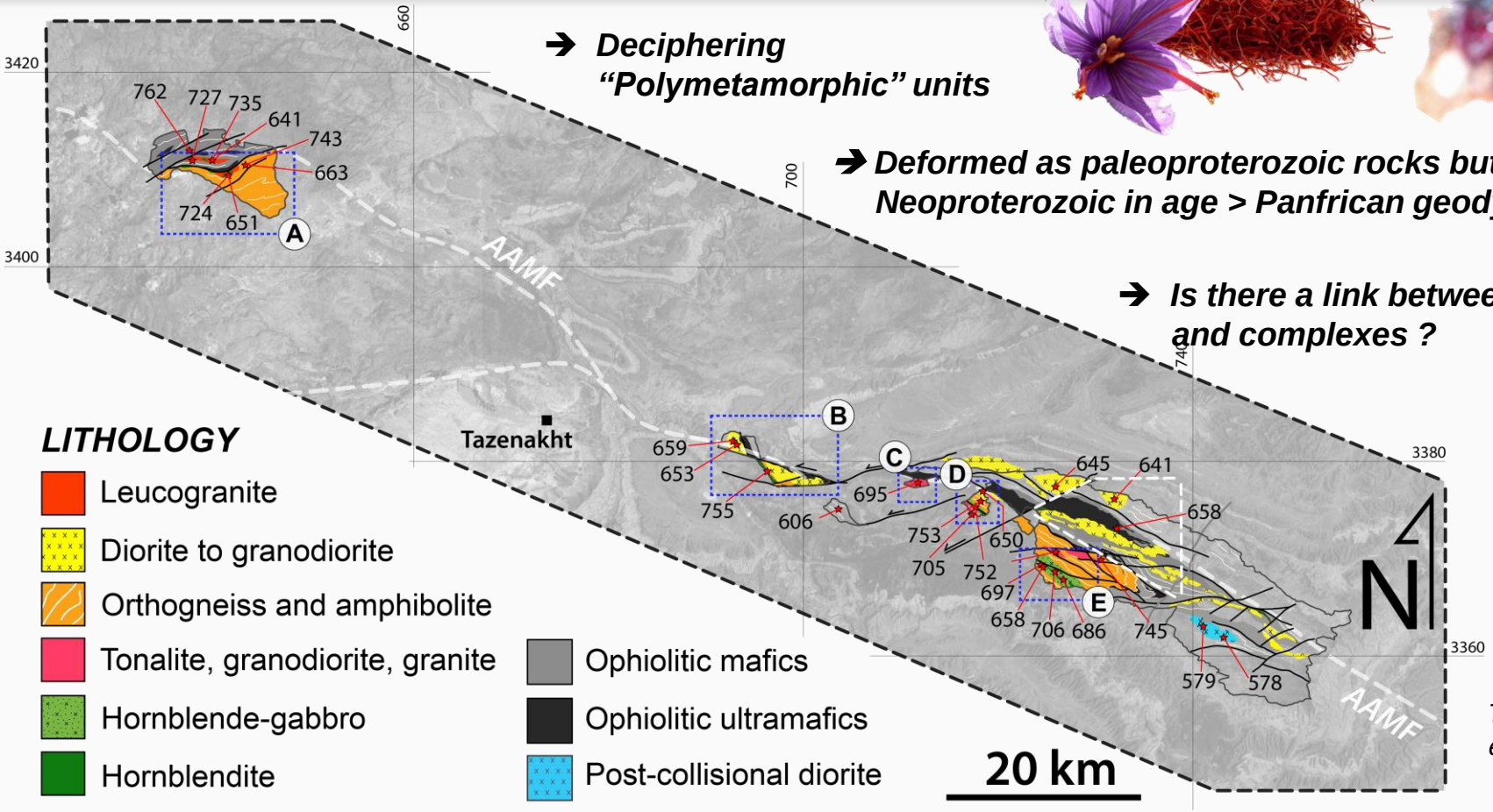
120 Ma of oceanic crust production (760 to 640 Ma)



➔ *Deciphering "Polymetamorphic" units*

➔ *Deformed as paleoproterozoic rocks but Neoproterozoic in age > Panfrican geodynamics*

➔ *Is there a link between inliers and complexes ?*



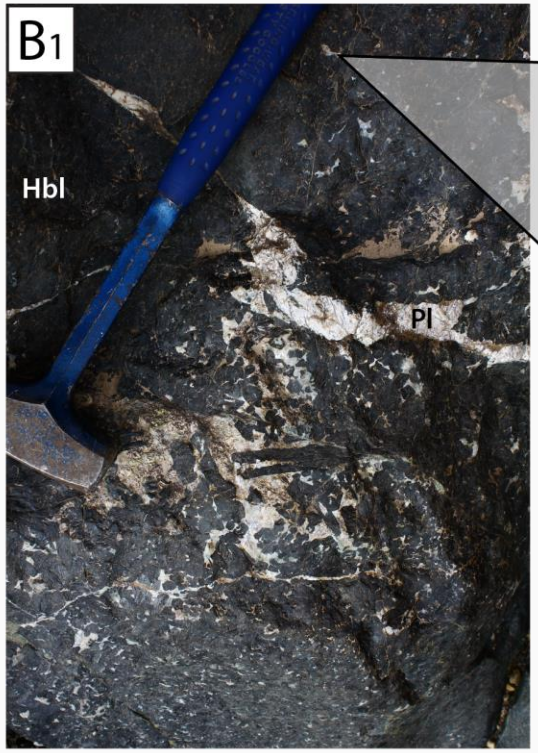
LITHOLOGY

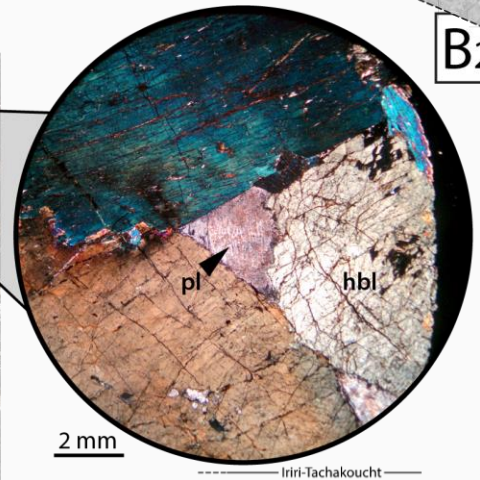
- Leucogranite
- Diorite to granodiorite
- Orthogneiss and amphibolite
- Tonalite, granodiorite, granite
- Hornblende-gabbro
- Hornblendite
- Ophiolitic mafics
- Ophiolitic ultramafics
- Post-collisional diorite

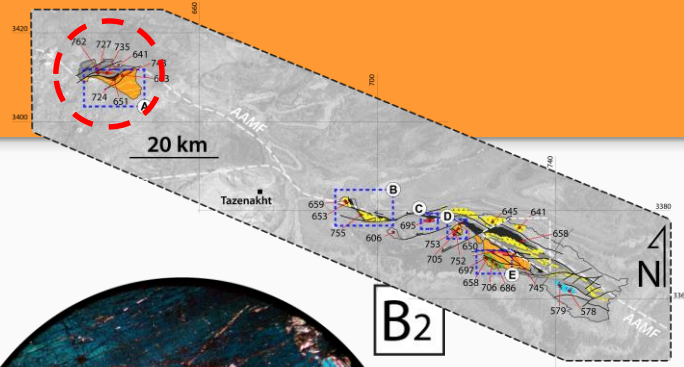
Triantafyllou et al., in prep.

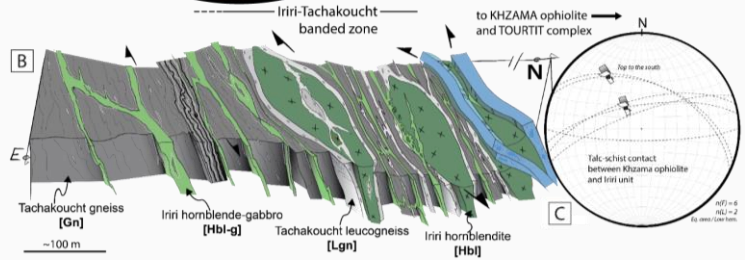
Oceanic arc rocks, structures and field relations

➔ ***Intrusive hydrous mafics (hbl-gabbro) and ultramafics (hornblendites) with oceanic arc signature (IGN n+1)***



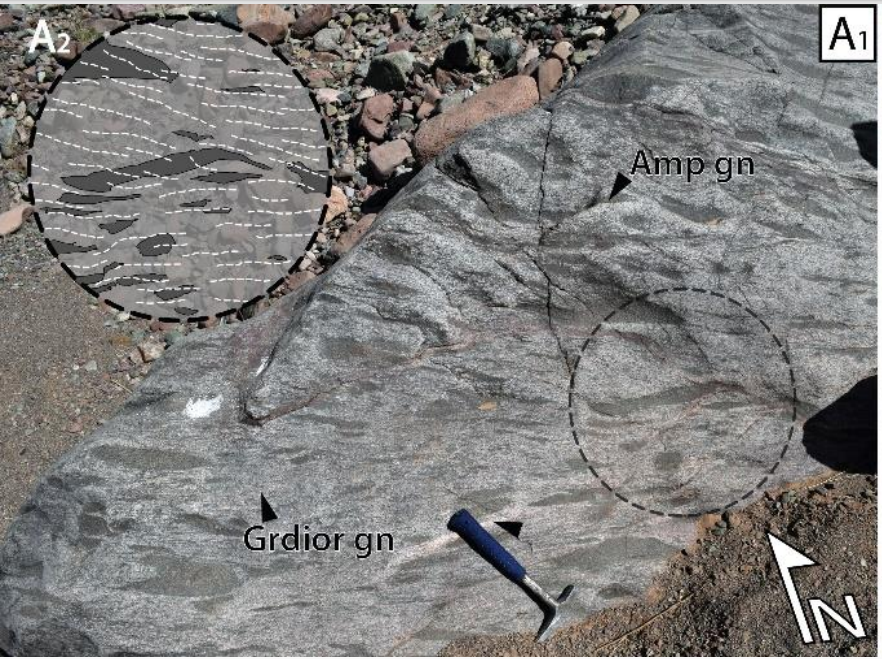


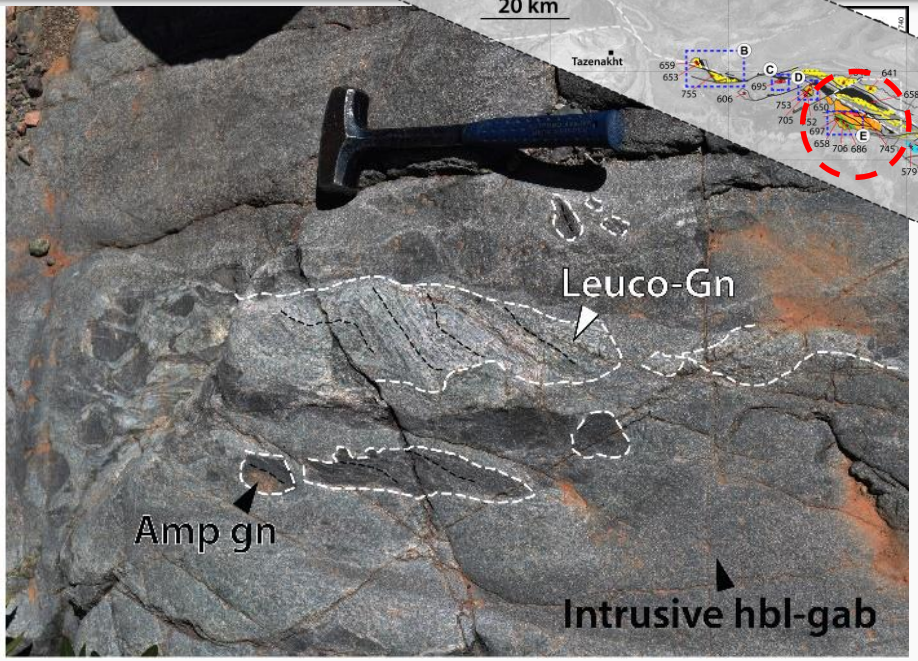


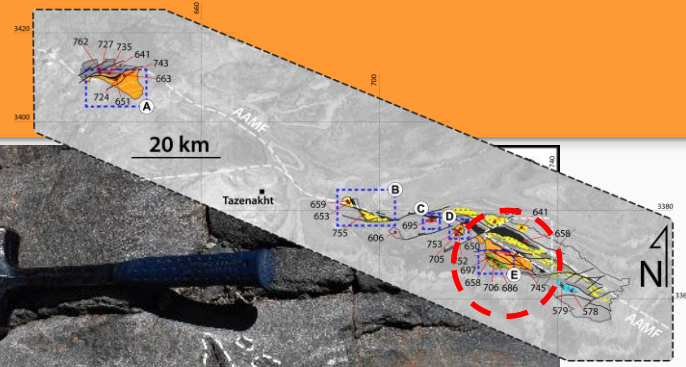


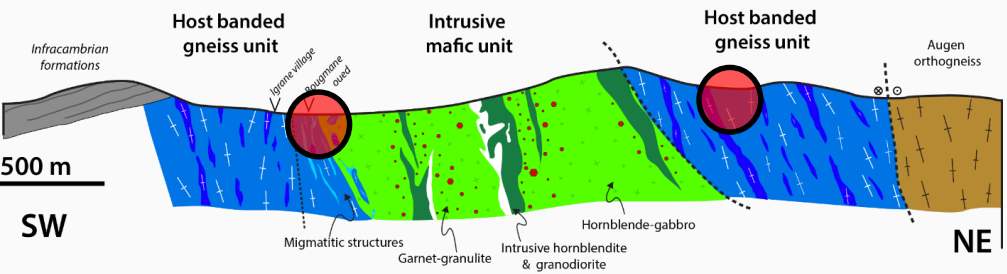
Triantafyllou et al., 2016

Oceanic arc rocks, structures and field relations



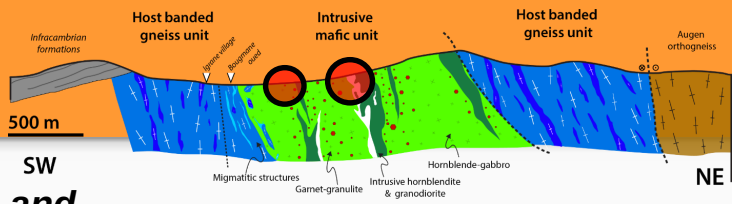




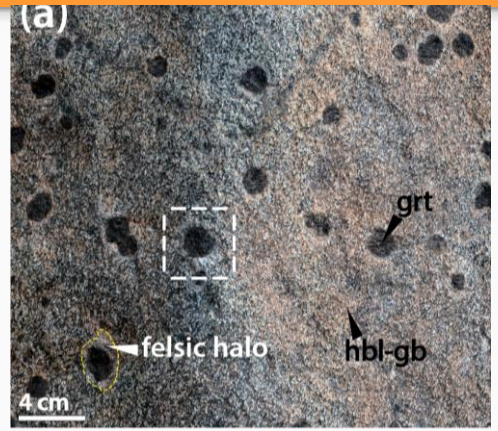


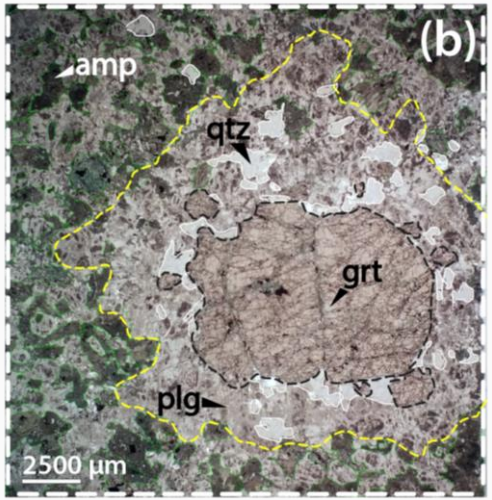
➔ ***Common features:*** *orthogneisses with mingling relics (**IGN1 + D1**) intruded by hydrous magmatic arc rocks (**IGN 2**)*

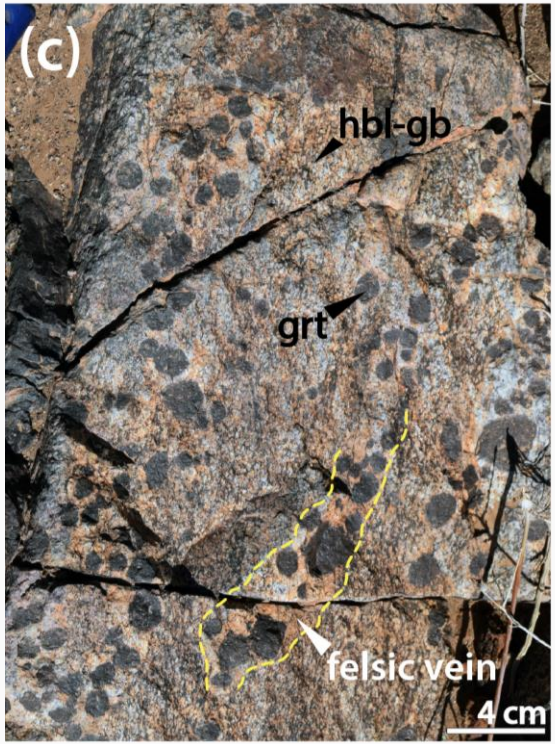
Oceanic arc rocks, structures and field relations

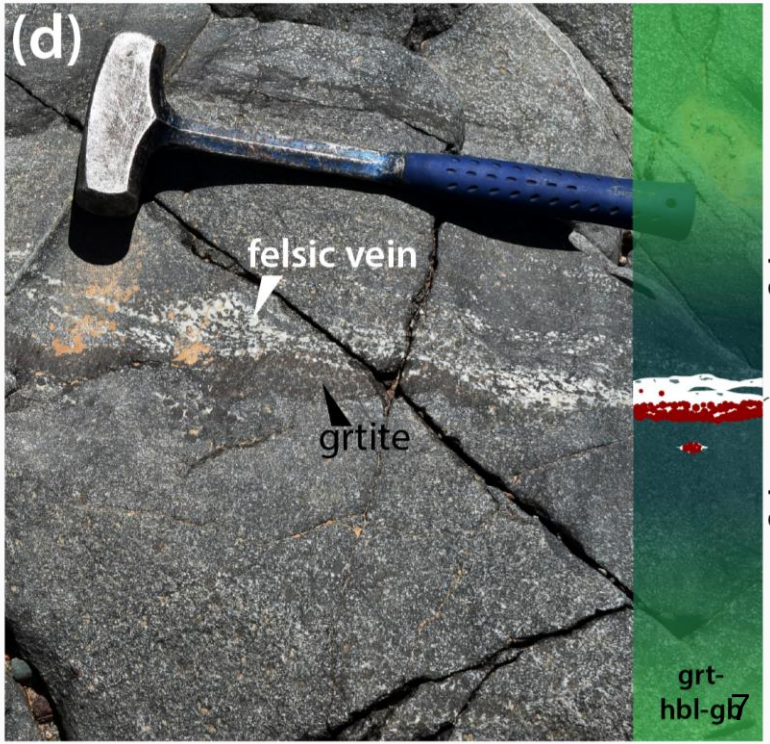


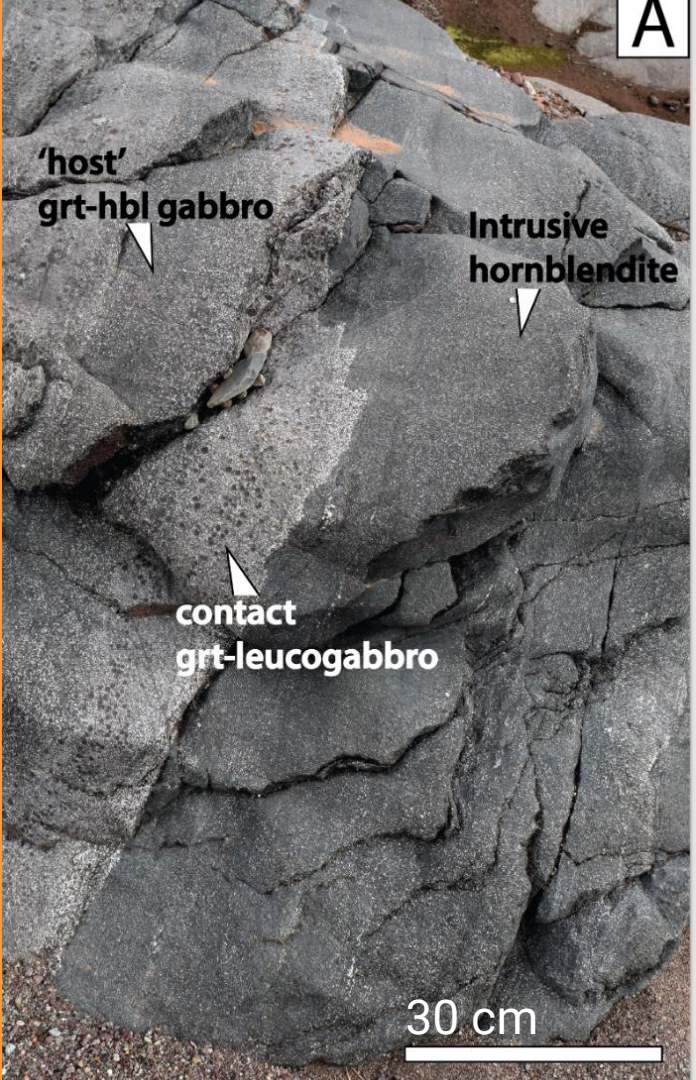
➔ ***Garnet granulite metamorphism and tonalitic melt expelled (closed > open system)***



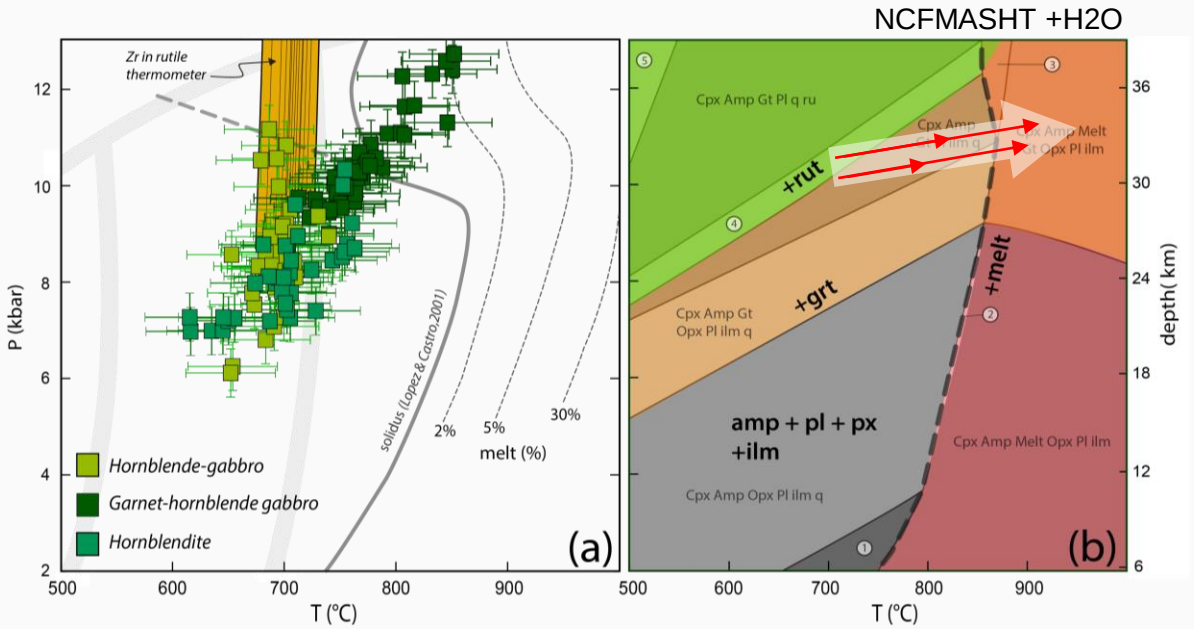






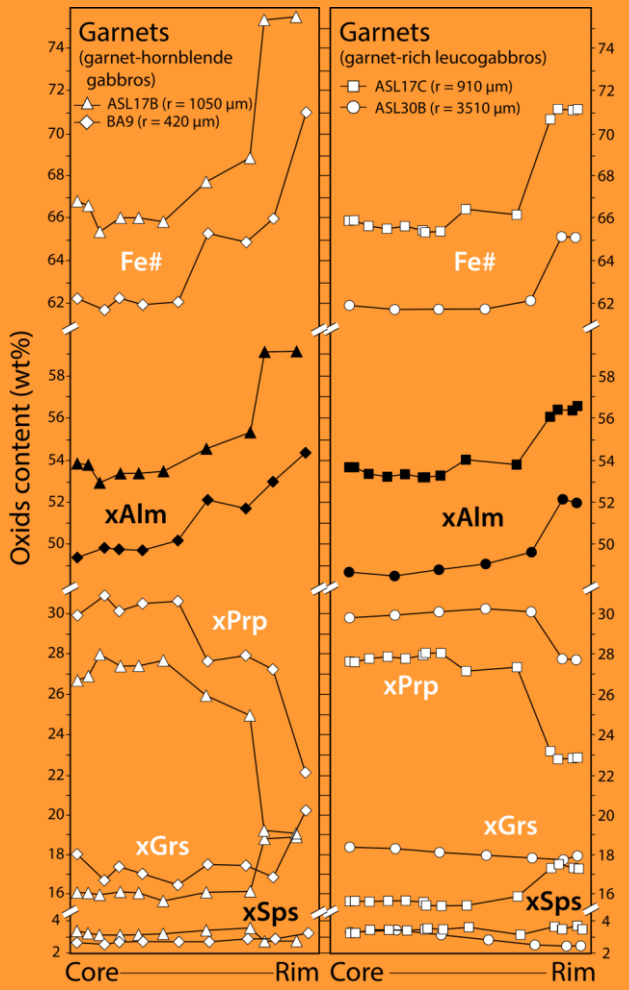


Highlight # 1 : *Moroccan oceanic arc was* ***mature and thick***

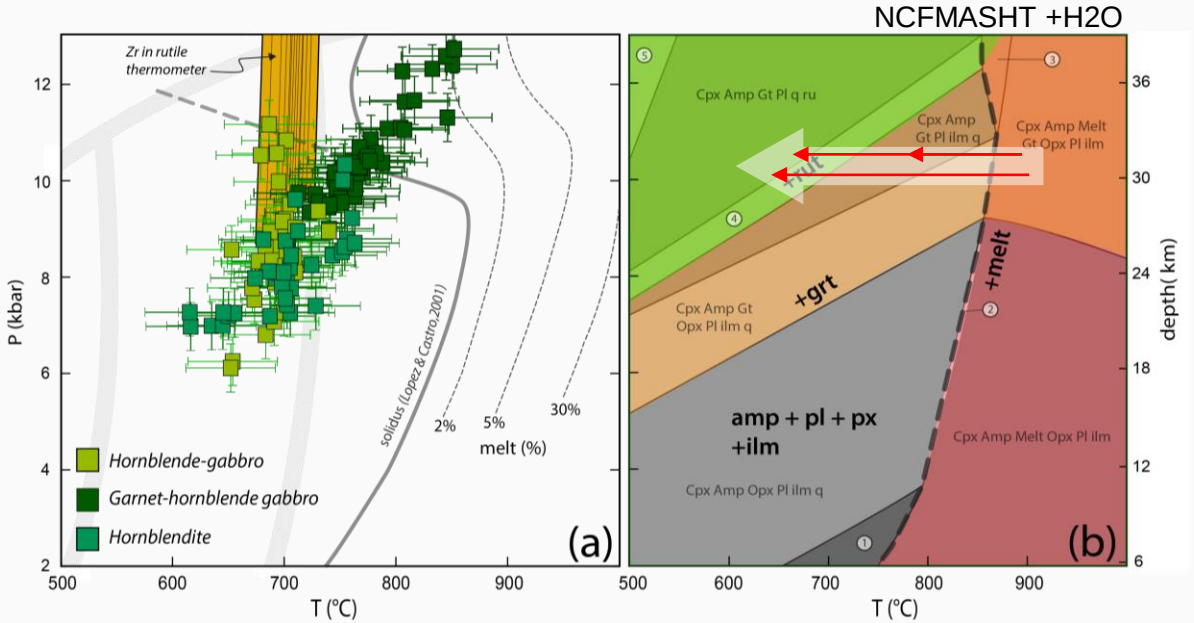


Triantafyllou et al., 2017

- ***8 to 10 kbar under subsolidus T conditions***
- ***Subsolidus to suprasolidus reactions*** *on the field*



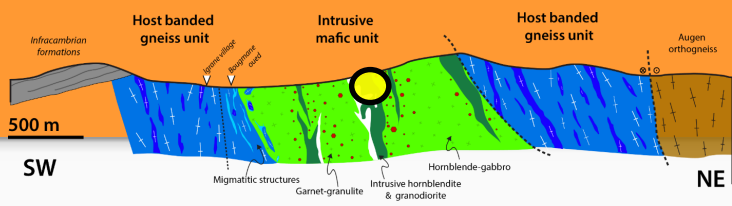
Highlight # 1 : *Moroccan oceanic arc was* ***mature and thick***

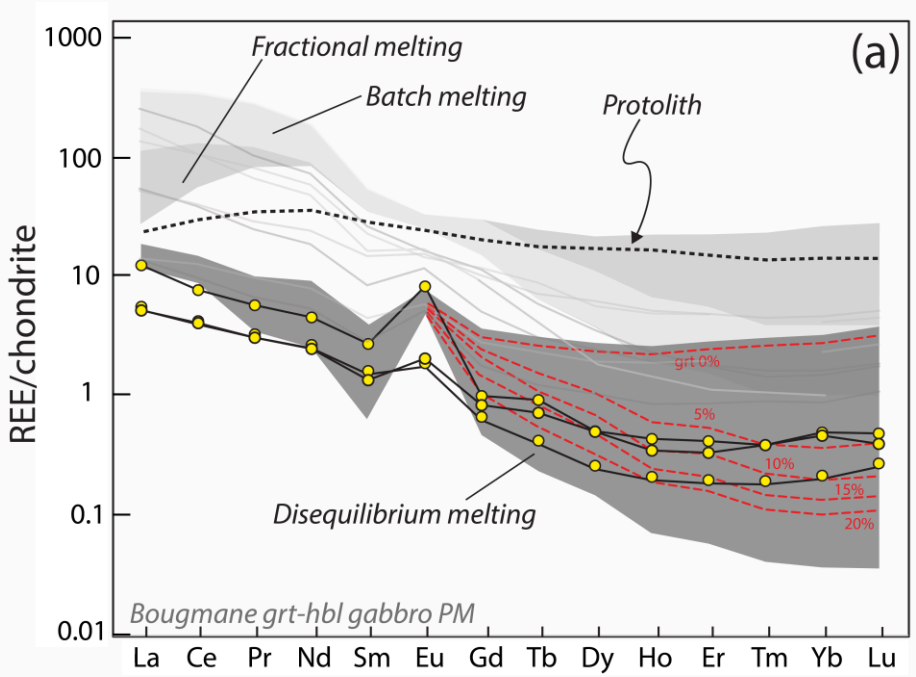


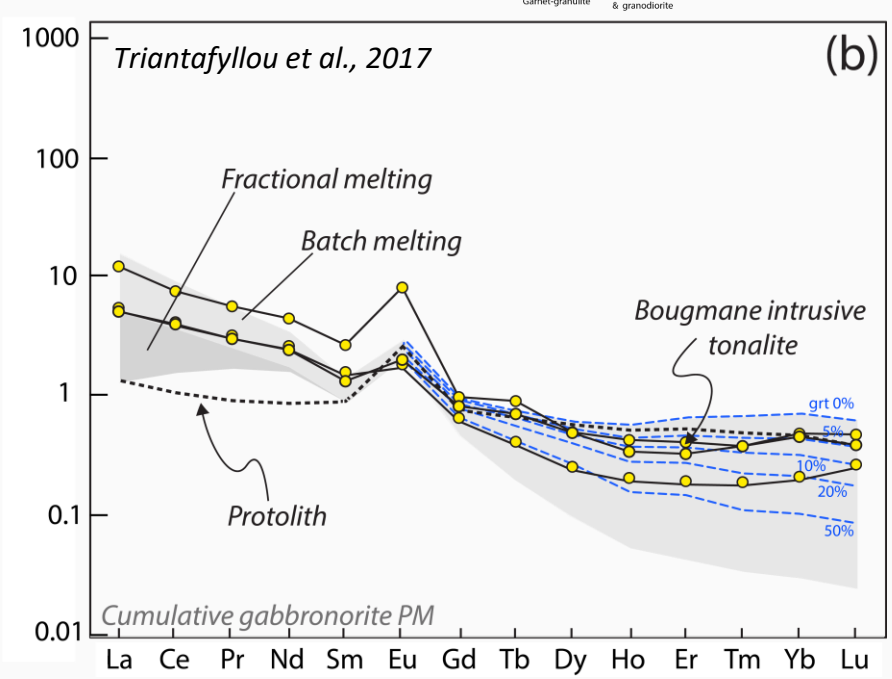
➔ ***Isobaric cooling***
(amphibole reequilibration + partially for garnet + rutile growth)

➔ ***HP 'back & forth' T paths around the solidus***

Highlight # 1 : *Moroccan oceanic arc was* ***mature and thick***

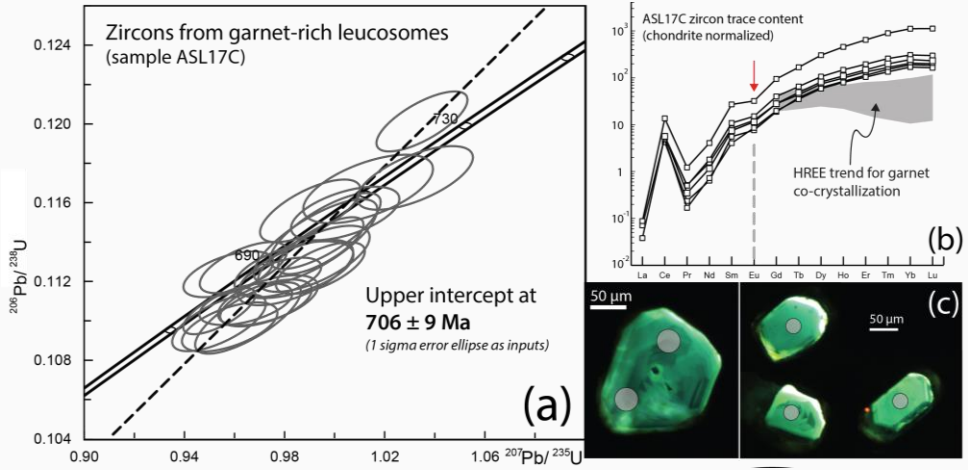






➔ ***700 Ma tonalites*** *are produced by* ***HP partial melting of a mafic rock*** *(+ garnet + rutile in source), i.e. '****adakitic****' signature (high Sr/Y & La/Yb; low Y & Yb)*

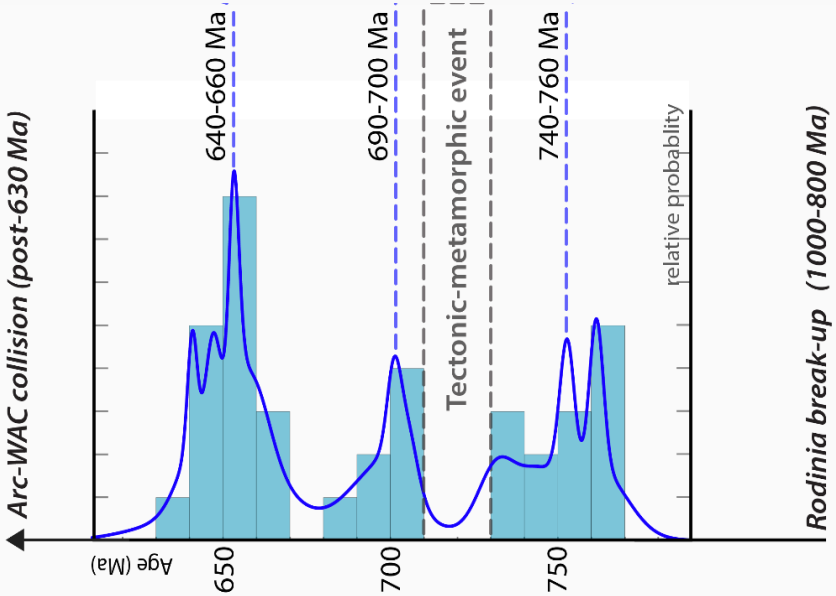
Highlight # 2 : ***Tempo*** *of intra-oceanic* ***arc magmatic pulses***



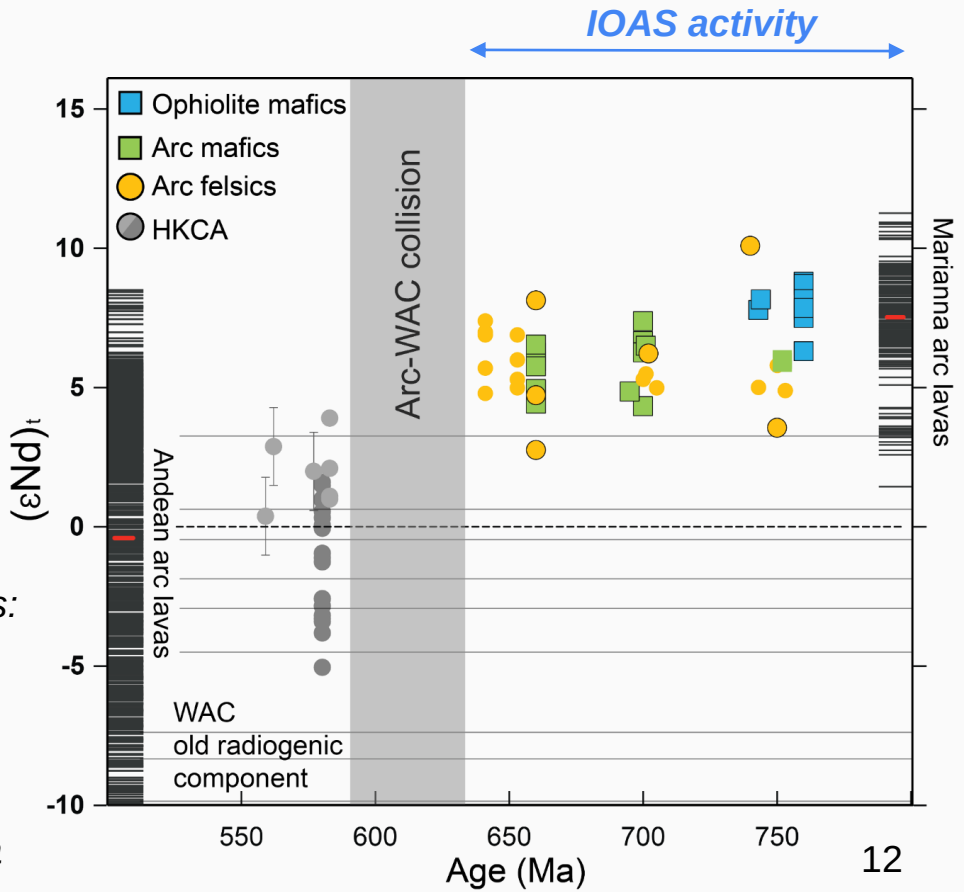
Timing of igneous-metamorphic events: rutile + zircon

- *Orthogneiss protolith* ***: 750 - 740 Ma = Ign 1***
- *Intrusive unit and HP metam****: 710 - 690 Ma = Ign 2***
- *Intrusive unit and HP metam2* ***: 660 - 650 Ma = Ign 3***

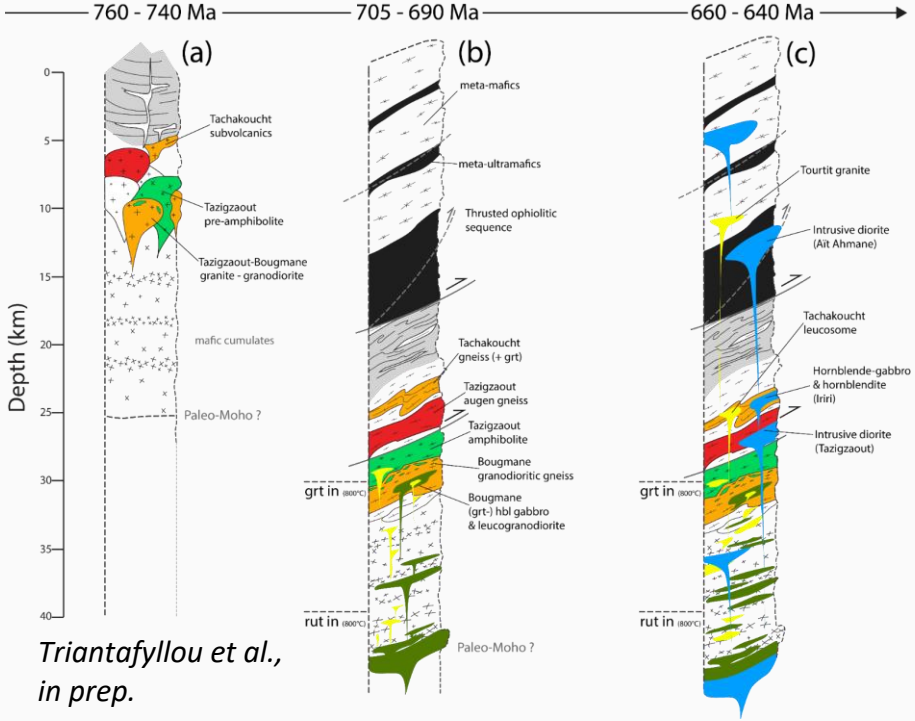
Highlight # 2 : ***Tempo*** *of intra-oceanic* ***arc magmatic pulses***



- *760 to 640 Ma : oceanic arc-related magmatic pulses:* ***120 Ma !***
- ***50 Ma tempo ?***
  Similar to Cordilleran case study ?
- *Accretion - obduction of oceanic blocks* ***post-640 Ma***



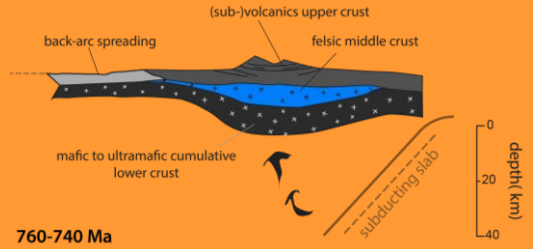
Highlight # 3 : Intra-arc deformation (in IOAS)

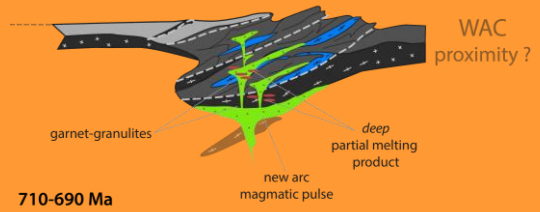


Triantafyllou et al., in prep.

➔ ***Non-accreting oceanic arc in active settings***

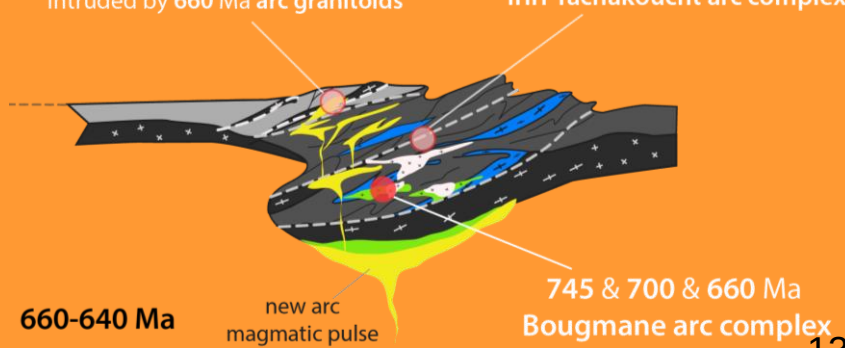
➔ ***What if … intra-oceanic shortening ?***





MAGMA- & TECTONIC-DRIVEN THICKENING

Last oceanic arc-related magmatic pulse ***(IGN3)***



Many perspectives…

… U-Pb flare-ups

Restricted to continental arc systems ?

… Intra-arc deformation (in oceanic domain)

Assess its feasibility by thermo-mechanical-petrological modeling

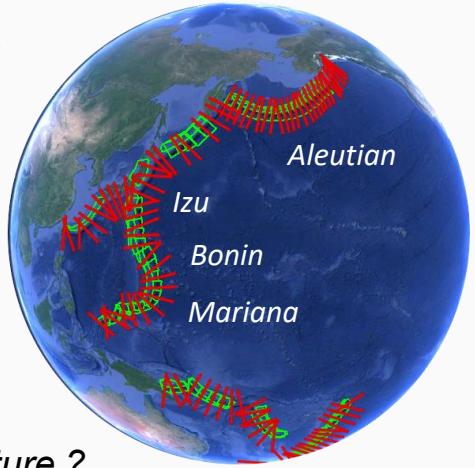
and/or dating ‘exotic’ syn-tectonic mineral phases

… Arc growth processes in the Precambrian

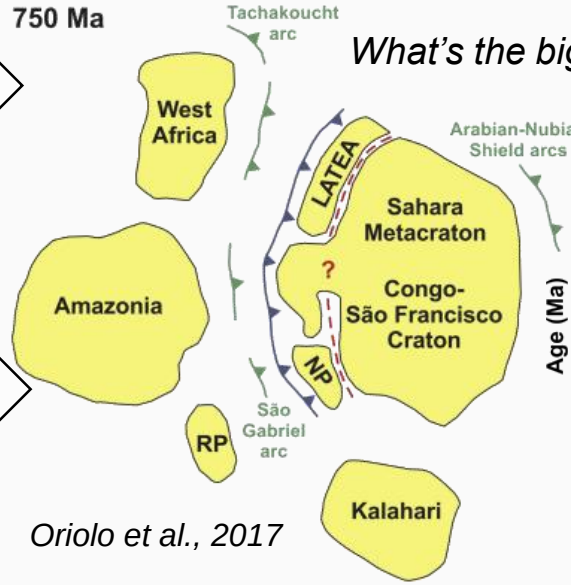
Still gathering the evidences (peri-WAC, ANS arcs, Iranian fields)

Why so…? Scaling the process behind the periodic records ?

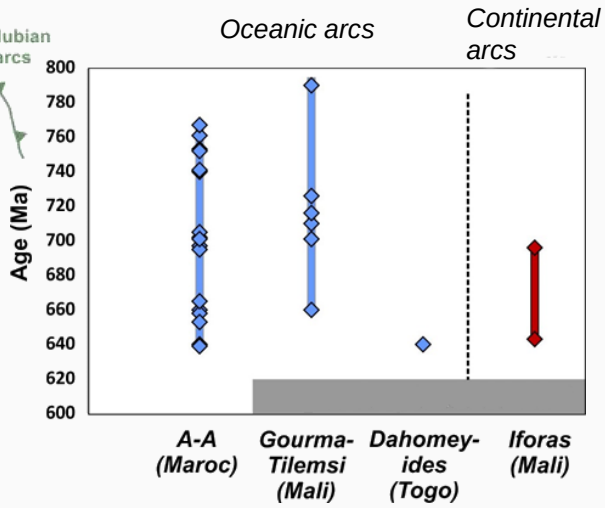
- *Plate tectonics ?*
- *Subduction scale ?*
- *Arc crust / lithosphere ?*



What’s the big picture ?



Oriolo et al., 2017



Thanks for your attention and your support !