93: T171. Oblique Motion on the North American Cordilleran Margin I: Jurassic to Paleogene

Inferred Early Jurassic deposition (U-Pb in detrital zircon) followed by Middle Jurassic and Cretaceous metamorphism (Sm-Nd in garnet) of metasedimentary rocks from the southern Peninsular Ranges Batholith, Baja California, Mexico

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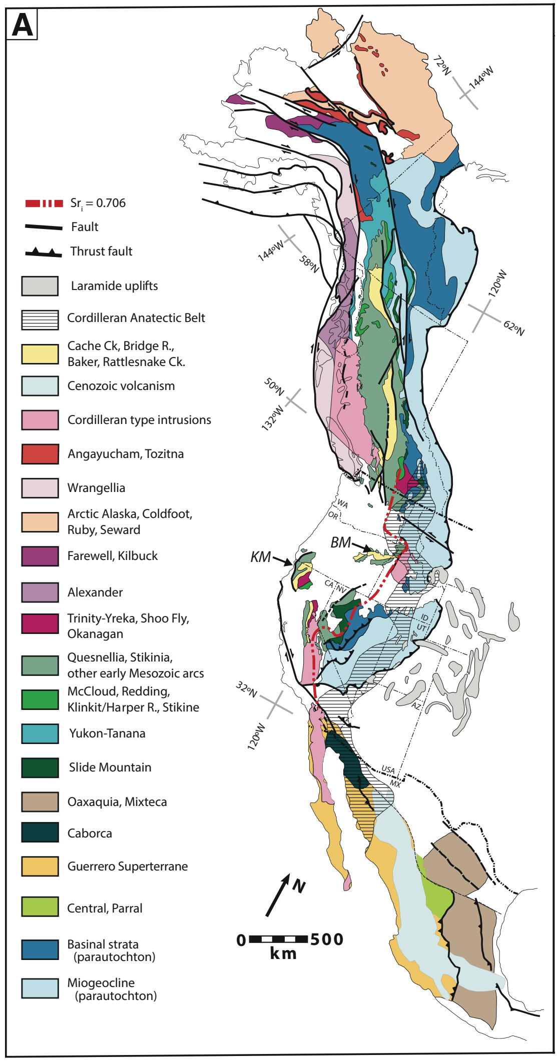
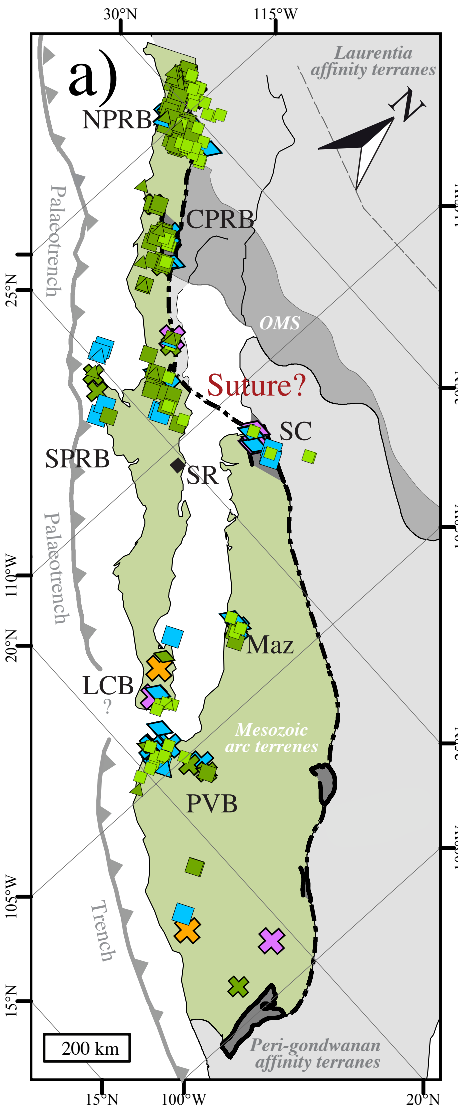
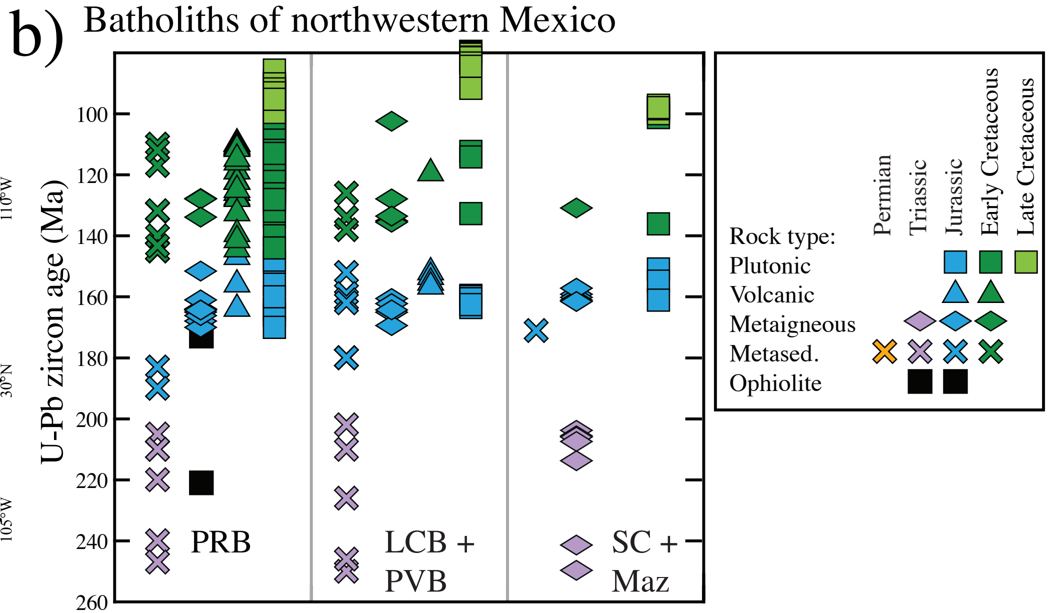
08/23/24

Geologic context: The Peninsular Ranges batholith (PRB)



Tikoff et al. (2023, GSA memoir 220)





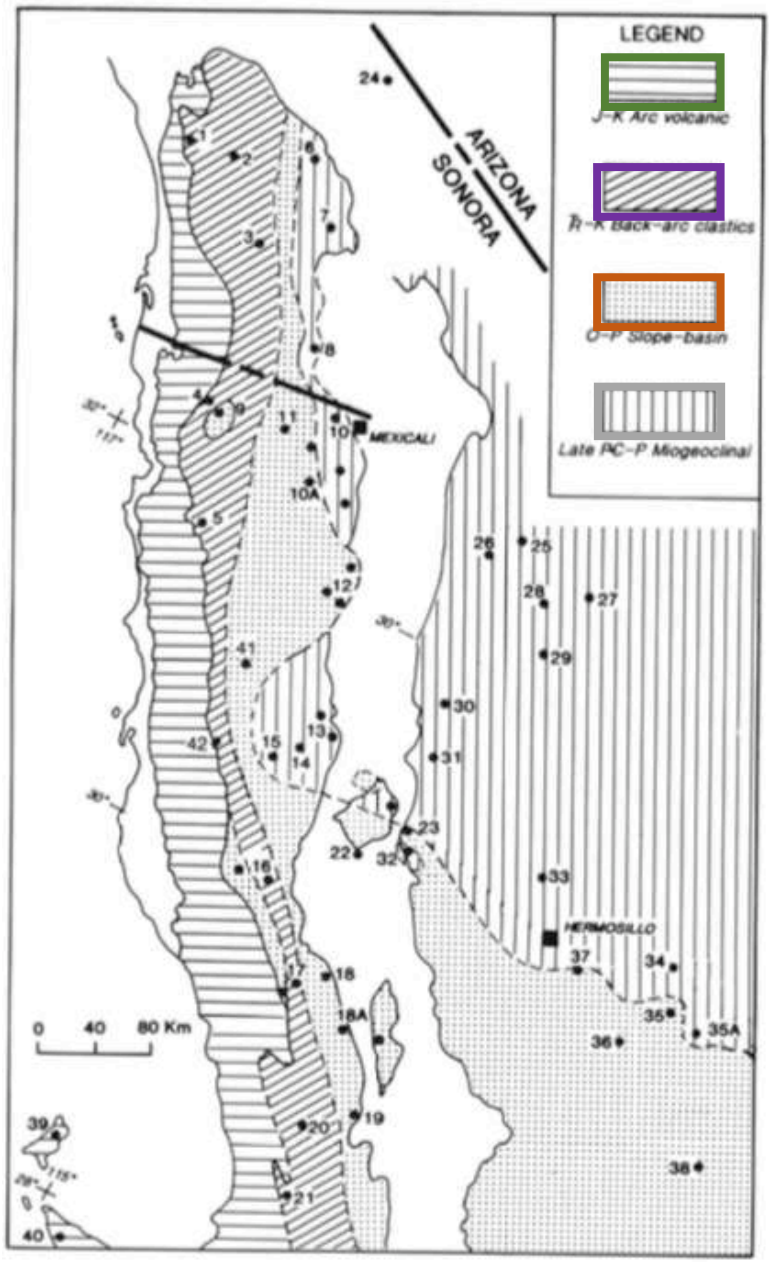
Contreras-López et al. (2021, Lithos)

PRB: Continuous magmatism from **170-85 Ma** developed into a Triassic-Jurassic metamorphic basement

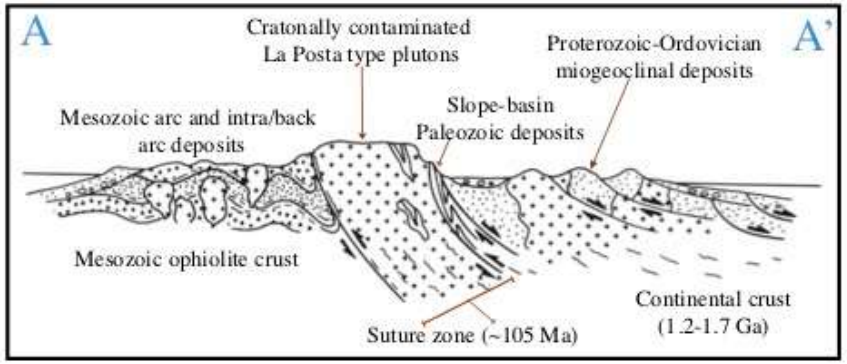
Coeval magmatism with the Guerrero terrane (**LCB, PVB, SC,** and **Maz** regions).

SC Triassic magmatism

Geologic context: The Peninsular Ranges batholith (PRB) and its host rocks



Gastil (1993, GSA special paper 279)



Gastil (1993, GSA special paper 279)

J-K Arc volcanics: Middle Jurassic to Cretaceous volcanic-arc rocks and associated sedimentary rocks.

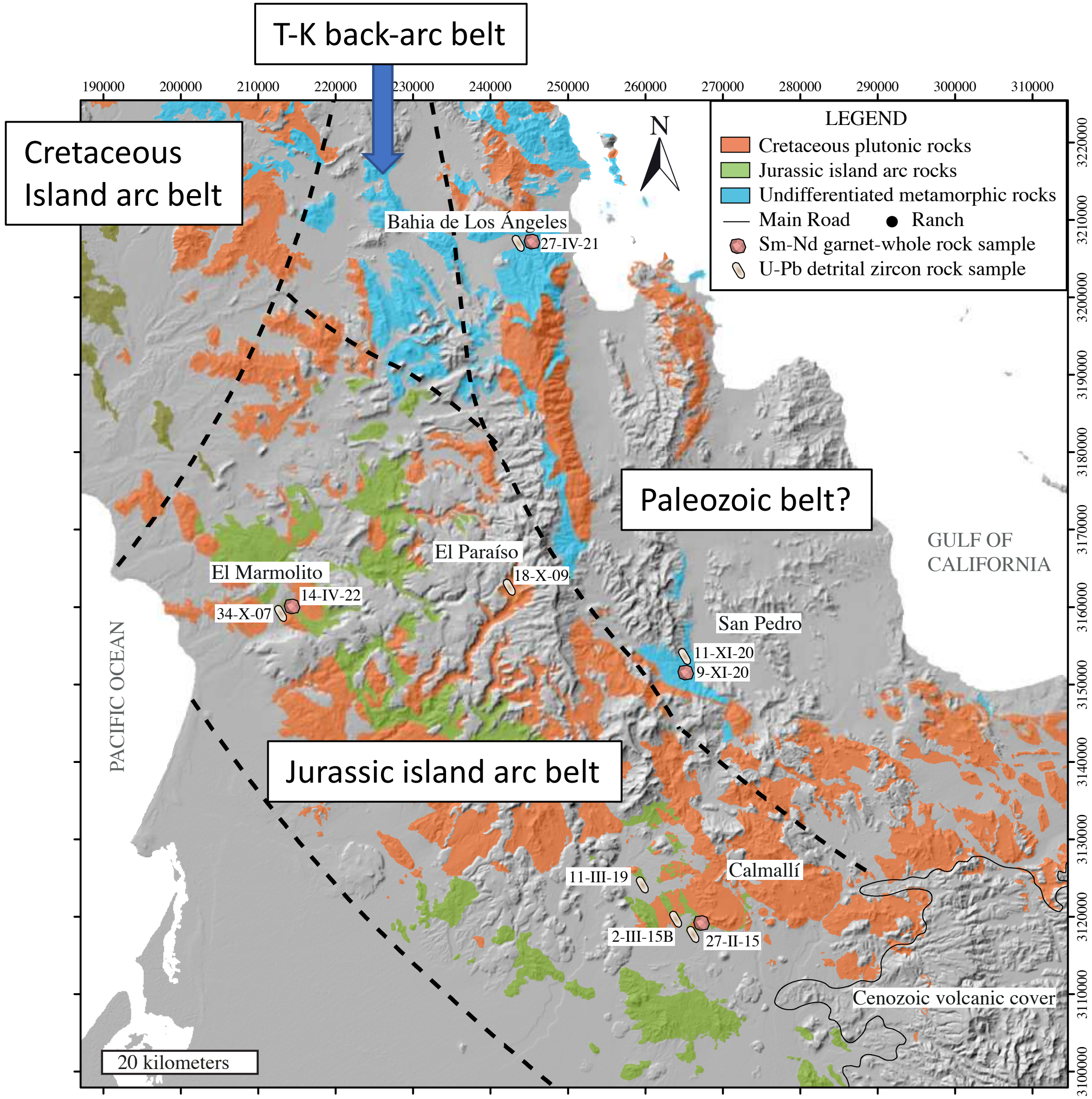
T-K back-arc clastics: Late Triassic to Mid Cretaceous flysch sequence of intra-arc and back-arc.

O-P Slope-basin: Ordovician to Permian thin-bedded carbonate rocks and chert of deep-water paleoenvironments (slope and basin).

Late PЄ-P shallow marine: Upper Proterozoic to Middle Cambrian clastic and carbonate rocks.

North America craton: Paleo to Meso-Proterozoic basement (metasedimentary rocks, granite, and gneiss).

Sampling: metasedimentary rocks of the southern PRB



Objective: to characterize the metamorphic basement of the SPRB by U-Pb detrital Zrn and Sm-Nd Grt-WR geochronology to obtain maximum depositional ages, provenance, and timing of metamorphism, respectively.

7 samples for U-Pb in detrital zircons
4 samples for Sm-Nd in garnet and whole-rock aliquots

Belt	Sample	Coordinates		Locality	Rock type	Geochronology	
		Longitude	Latitude			U-Pb in Zircon	Sm-Nd in Grt-WR
W	27-II-15	-113.3700	28.1806		Bt-Grt paragneiss	✓	✓
W	2-III-15B	-113.4020	28.1800	Calmallí	Bt-Sill paragneiss	✓	
W	11-III-19	-113.4530	28.2259		Bt schist	✓	
W	34-X-07	-113.9253	28.5304	El Marmolito	Bt schist	✓	
W	14-IV-22	-113.9236	28.5312		Bt-Grt schist		✓
W	18-X-09	-113.6328	28.5628	El Paraíso	Bt schist	✓	
E	11-XI-20	-113.3980	28.4751		Bt schist	✓	
E	9-XI-20	-113.3990	28.4793	San Pedro	Bt-Grt paragneiss		✓
E	10-XI-20	-113.3980	28.4751		Felsic dike	✓	
E	27-IV-21	-113.6075	28.9708	Bahía de LA	Bt-Grt paragneiss	✓	✓

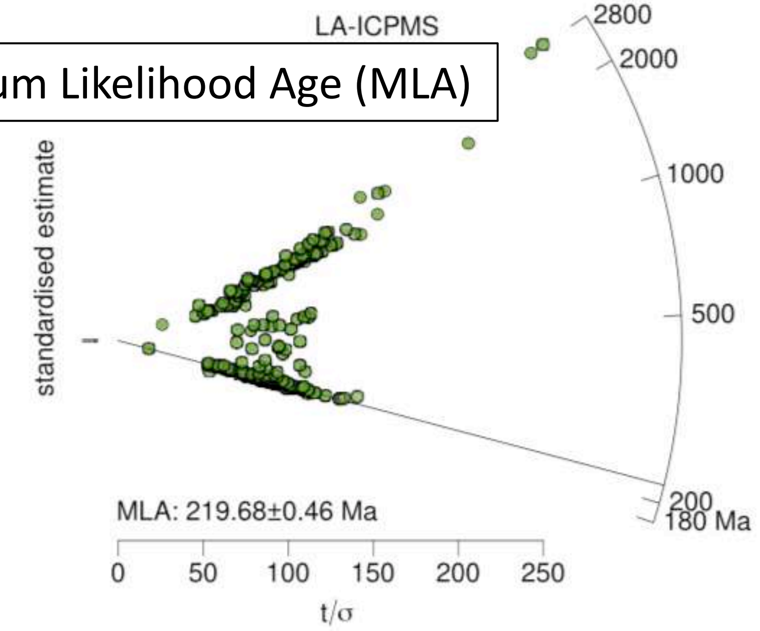
Methodology: U-Pb LA-ICP-MS in detrital zircons

Best age $^{206}Pb/^{238}U$ for Zrn < 800 Ma and $^{207}Pb/^{206}Pb$ for Zrn > 800 Ma.
Concordance filter:
Zrn < 500 Ma Conc. < 70% & > 120%.
Zrn > 500 Ma Conc. < 80% & > 105%

Arizona LaserChron Center

ARIZONA LASERCHRON CENTER

Maximum Likelihood Age (MLA)



Ablation cell: Photon Machines Analyte G2 193 nm – ArF Excimer

2013
Two samples (34-X-07 and 18-X-09)

Spot = 35 µm
N = 100
Nu Instruments® MC ICP MS

2022
Five samples (11-III-19, 27-IV-21, 27-II-15, 2-III-15B, and 11-XI-21)
Spot = 20 µm
N = 315 (except 27-II-15 where N = 45)
Thermo Scientific Element 2 HR SF ICP MS

Procedures according to Gehrels et al. (2008) and Pullen et al. (2018).

Diagrams generated with IsoplotR (Vermeesch, 2018, Geosci. Front.). Radial plots after Vermeesch (2021, Geosci. Front.).

Methodology: Sm-Nd in whole-rock and lixiviated garnet aliquots

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- ~60 mg Garnet aliquots (partial dissolution method; Pollington and Baxter, 2010, EPSL):
  1. Without lixiviated
  2. Lixiviated with HNO_3
  3. Lixiviated with HF
  4. Lixiviated with HNO_3 and HF

- Whole-rock aliquot

Digested and elemental separation by routine procedures (Weber et al., 2012)

Sm-Nd isotope analysis by TIMS with Faraday cups:
Sm 10^{10} Ω preamplifiers
Nd 10^{11} Ω preamplifiers

Nu instruments® TIMS

https://posgrados.cicese.mx/posgrado/laboratorio/159/5/2

Western belt

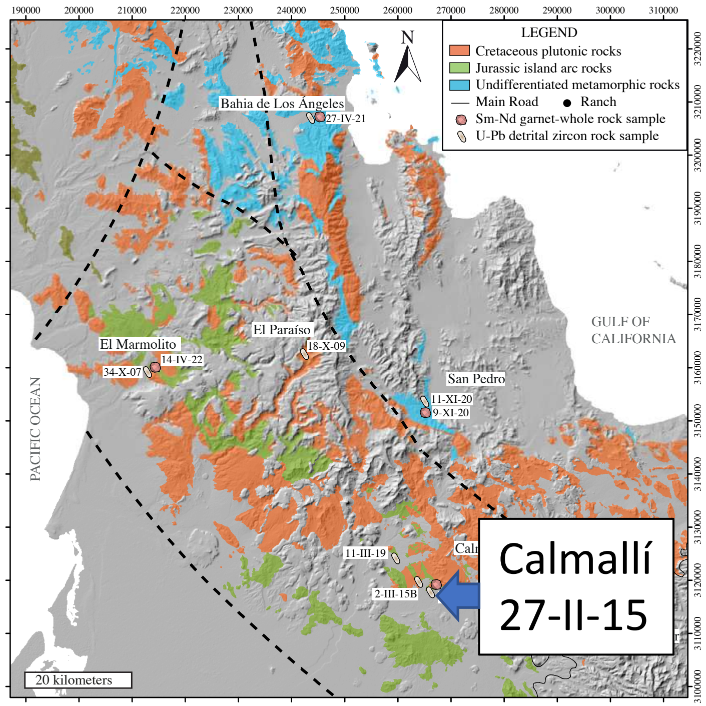
Results: U-Pb and Sm-Nd geochronology

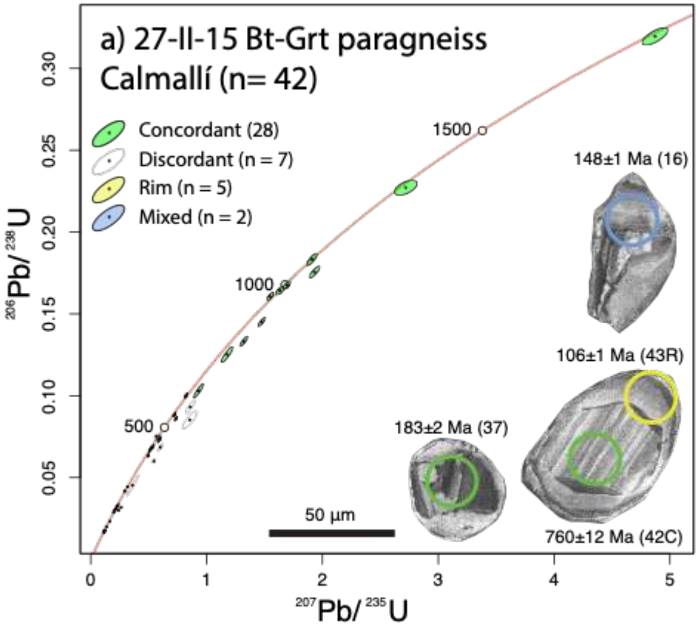
U-Pb apparent ages 105 ± 1 to 1809 ± 12 Ma

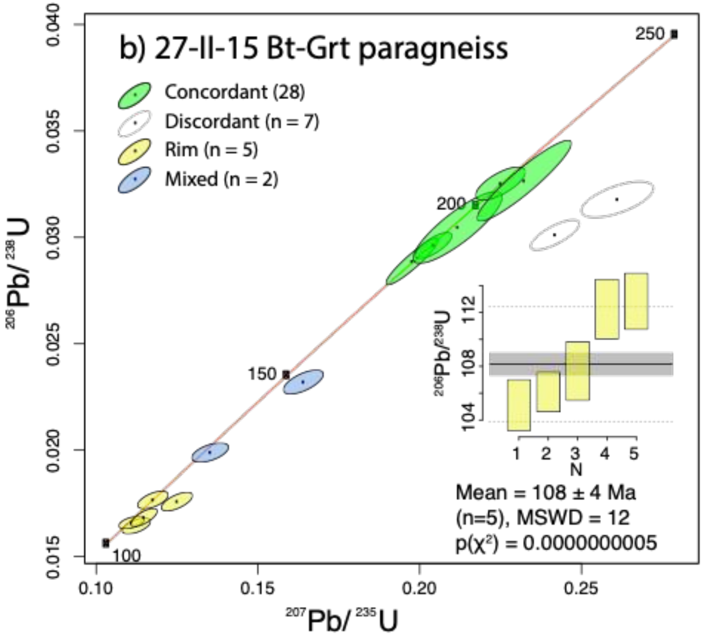
Rims: Mean $^{206}Pb/^{238}U$ age **108 ± 4 Ma**

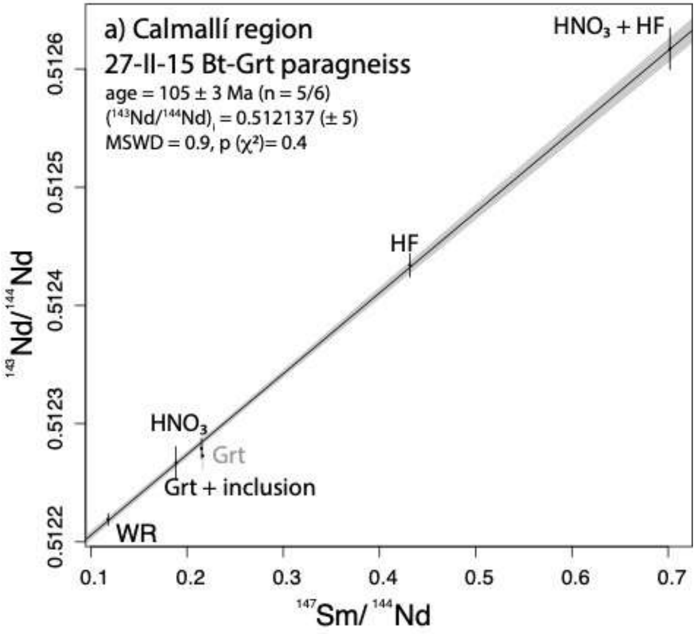
Sm-Nd Grt-WR age: 105 ± 3 Ma

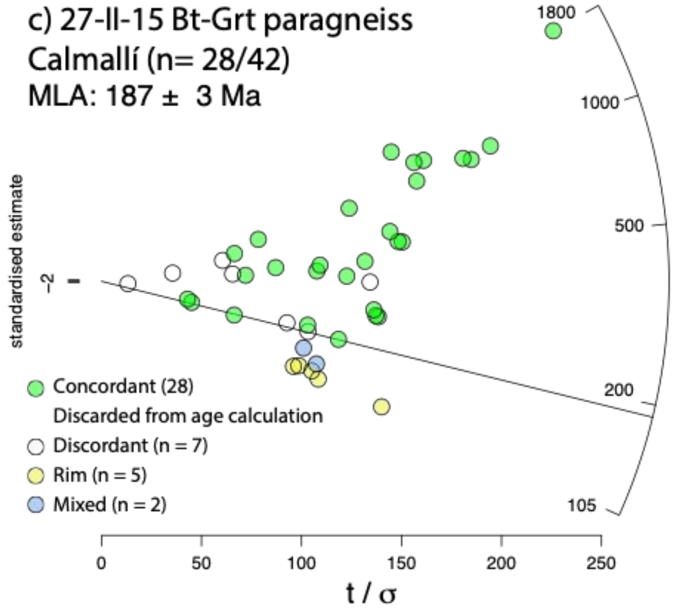
MLA: 187 ± 3 Ma











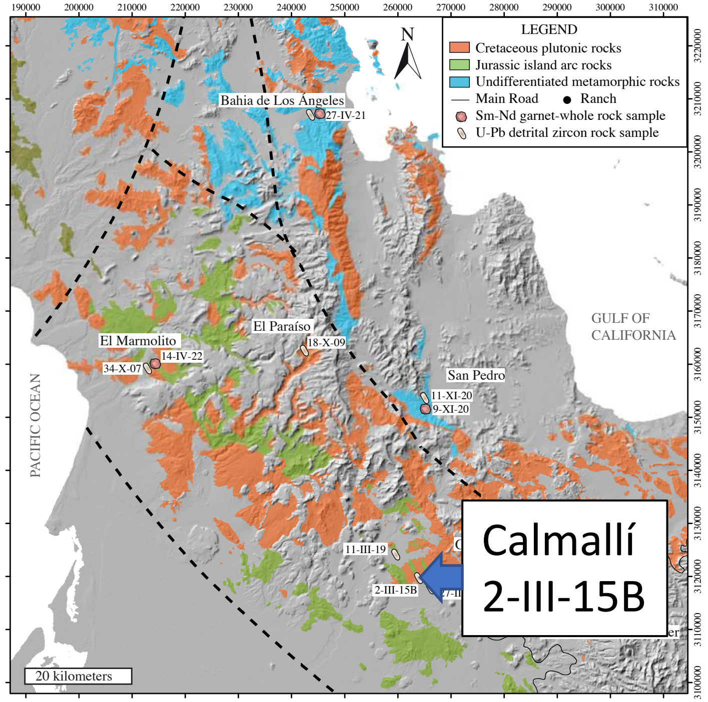
Western belt

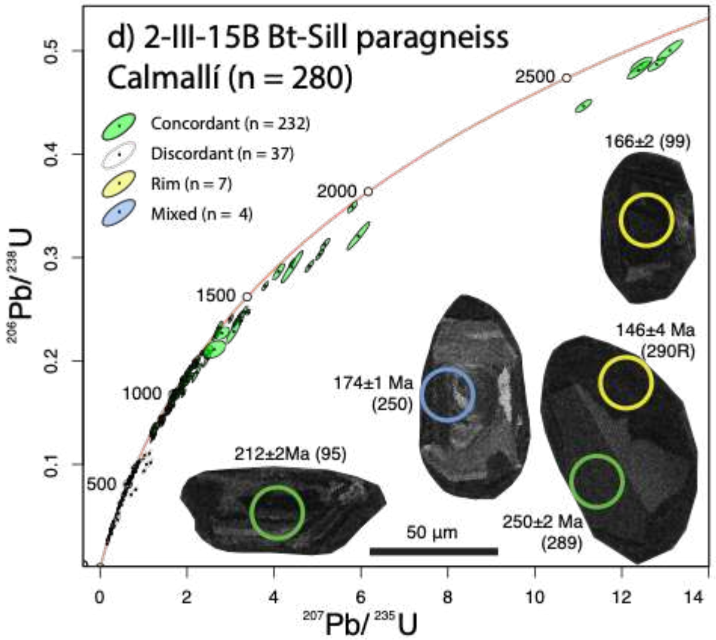
Results: U-Pb and Sm-Nd geochronology

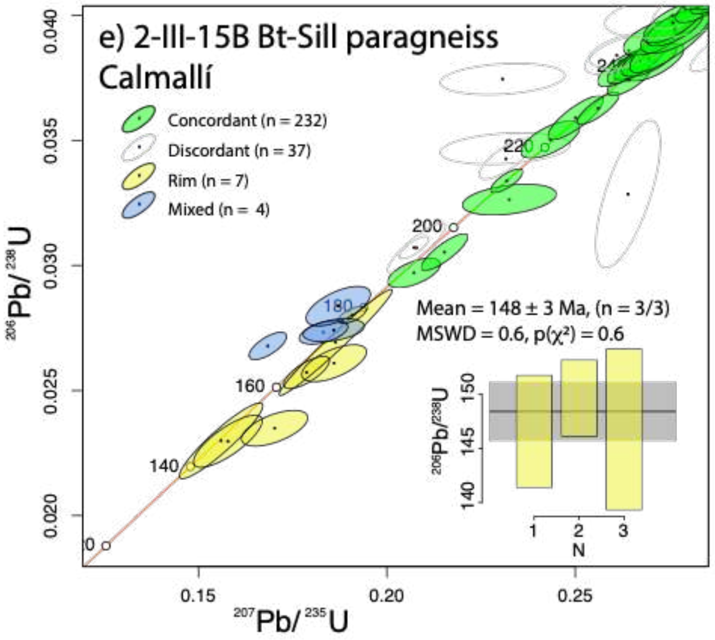
U-Pb apparent ages: 146 ± 3 to 2749 ± 6 Ma

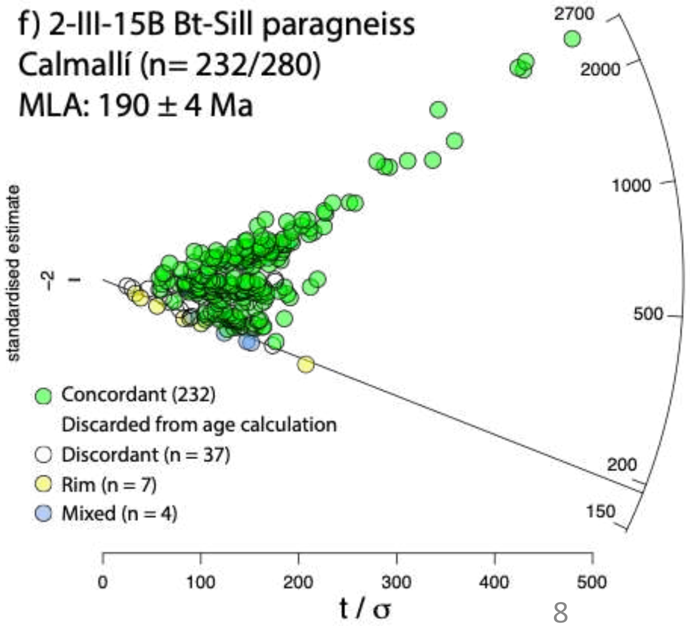
Zrn rims: Mean $^{206}Pb/^{238}U$ age **148 ± 3 Ma**

MLA: 190 ± 4 Ma









Western belt

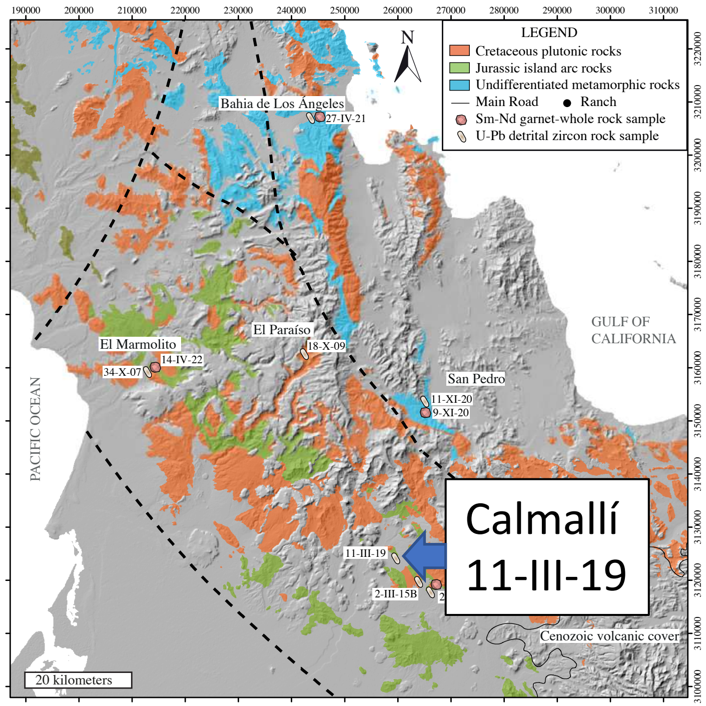
Results: U-Pb and Sm-Nd geochronology

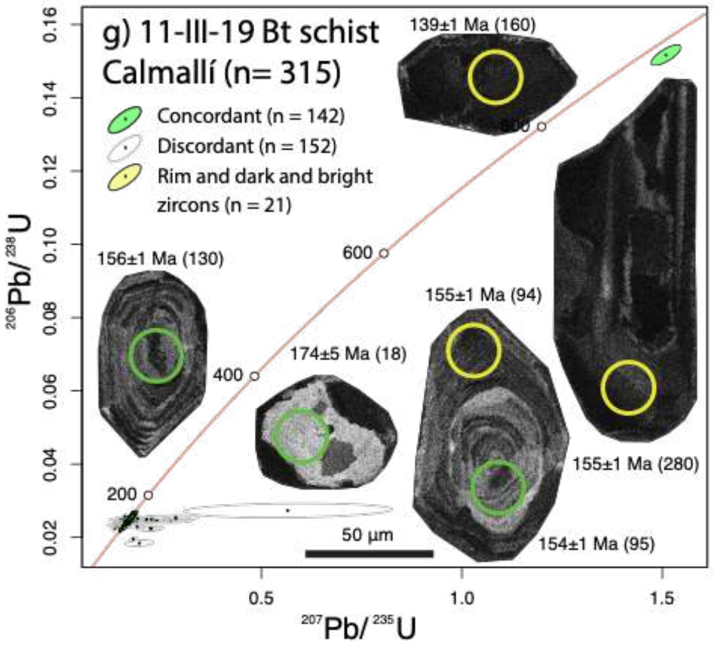
U-Pb apparent ages: 143 ± 2 to 171 ± 1 Ma

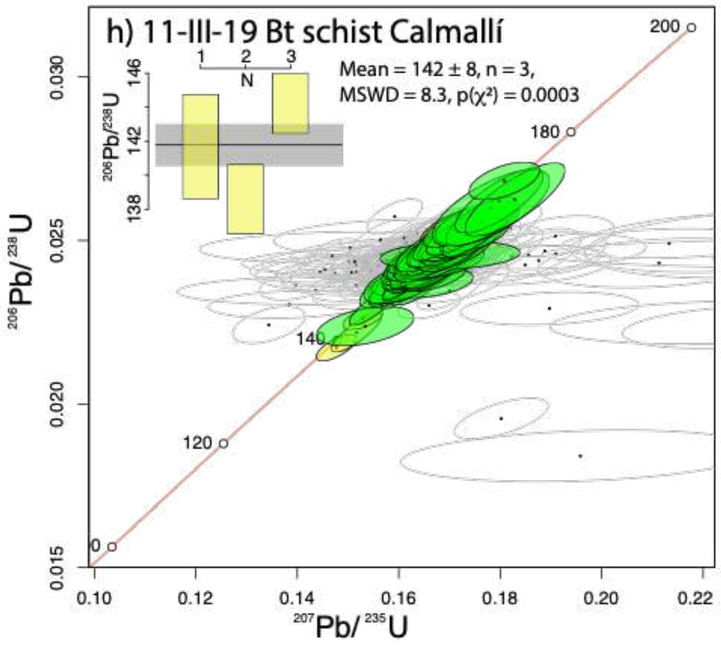
and an older Zrn of 991 ± 13 Ma

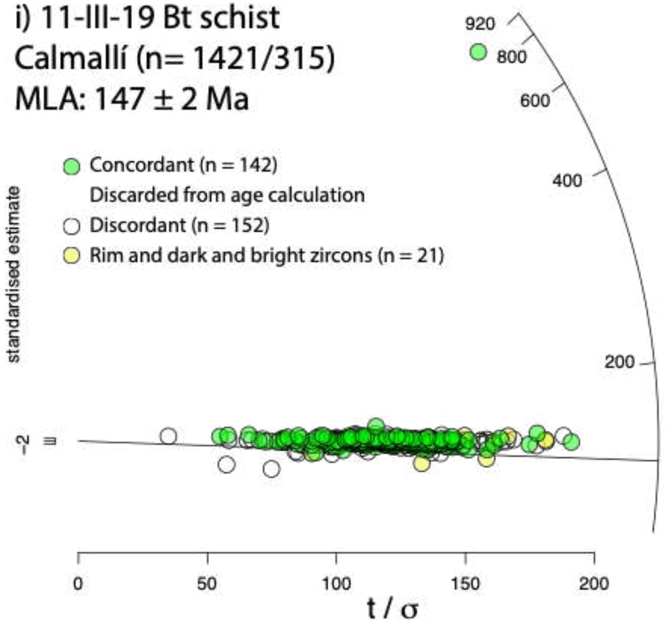
Younger Zrn rims (n= 3): 142 ± 8 Ma

MLA: 147 ± 2 Ma









Zircons highly discordant, Pb loss!
No good MLA estimation!

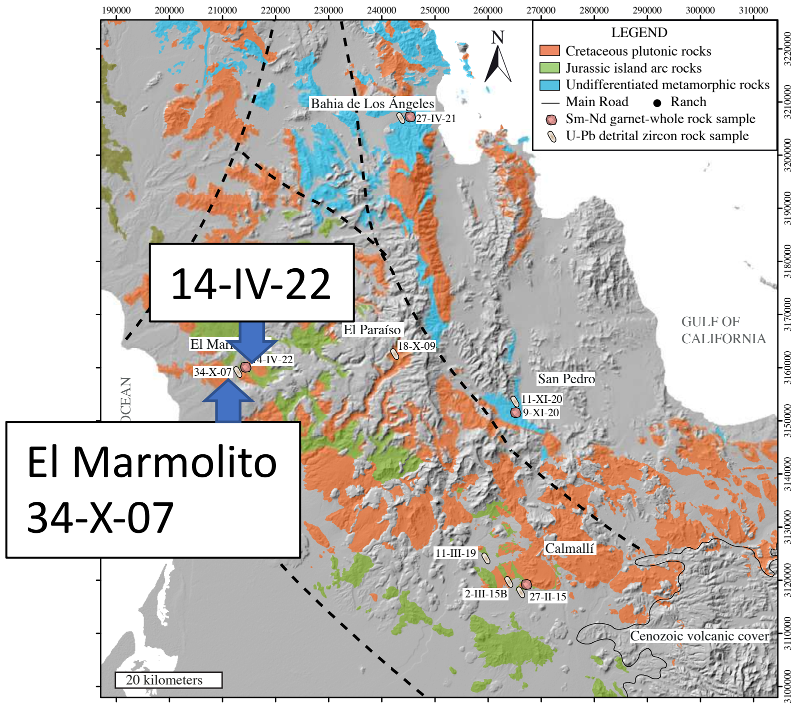
Western belt

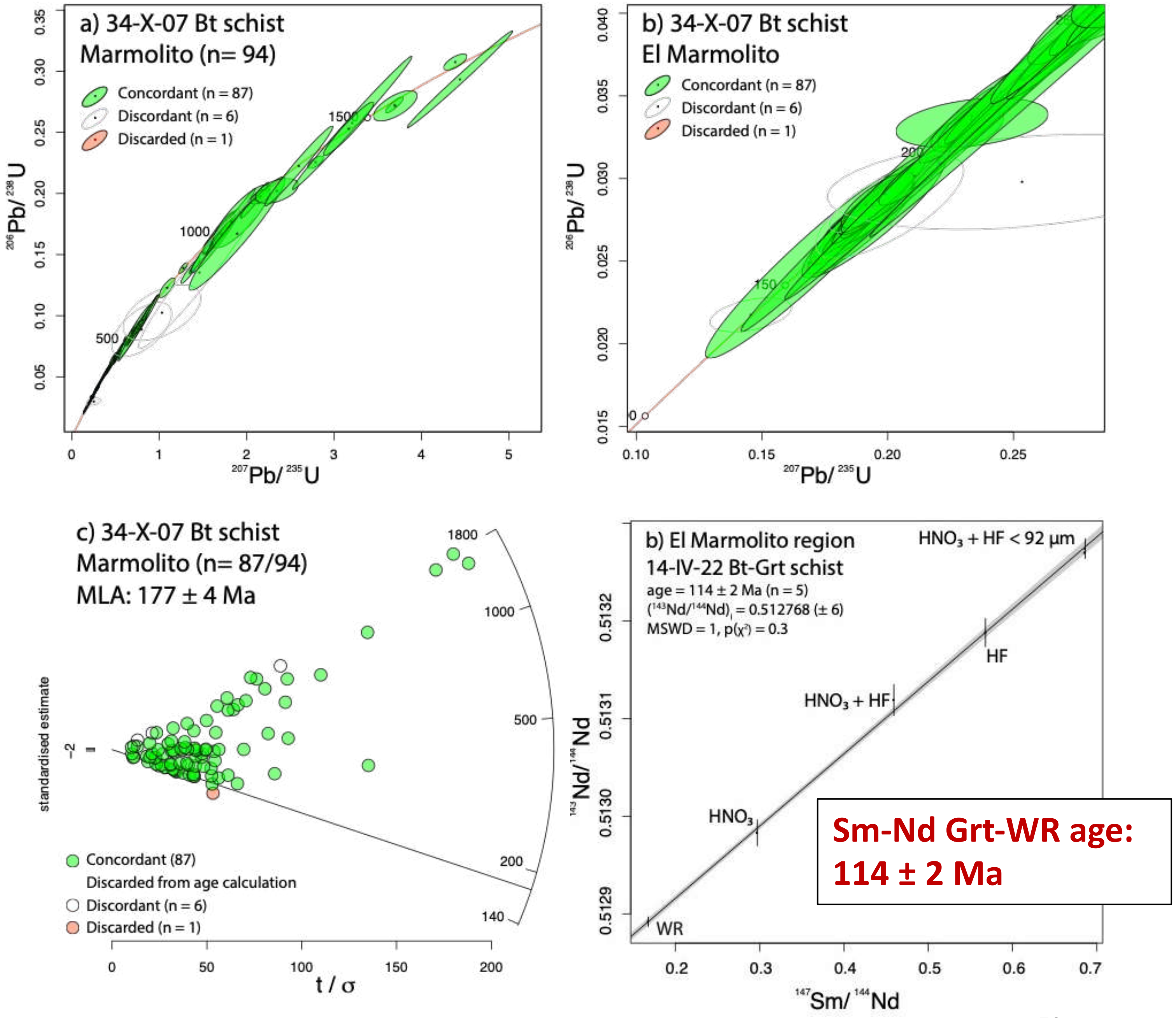
Results: U-Pb and Sm-Nd geochronology

U-Pb apparent ages: 139 ± 3 to 1795 ± 11 Ma

No CT images, but Th/U ratios > 0.4

MLA: 177 ± 4 Ma





Sm-Nd Grt-WR age: 114 ± 2 Ma

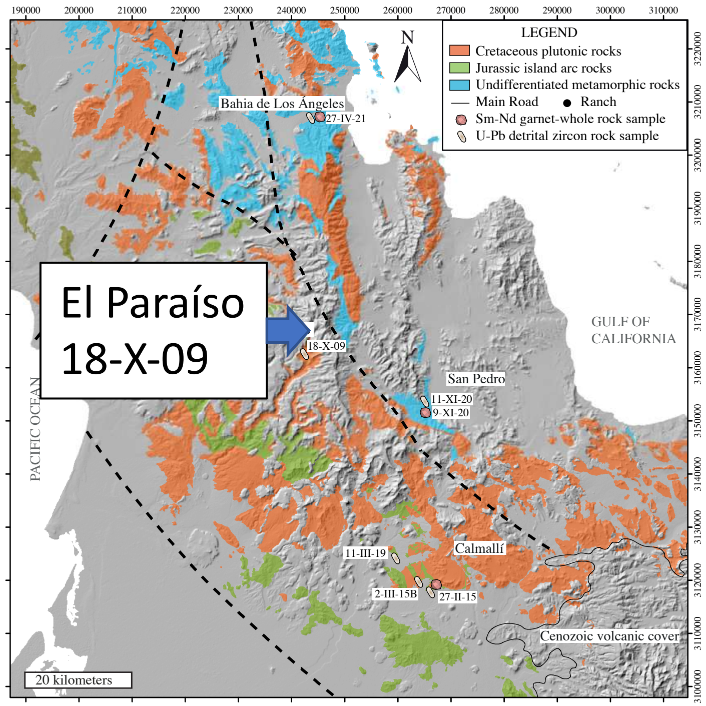
Western belt

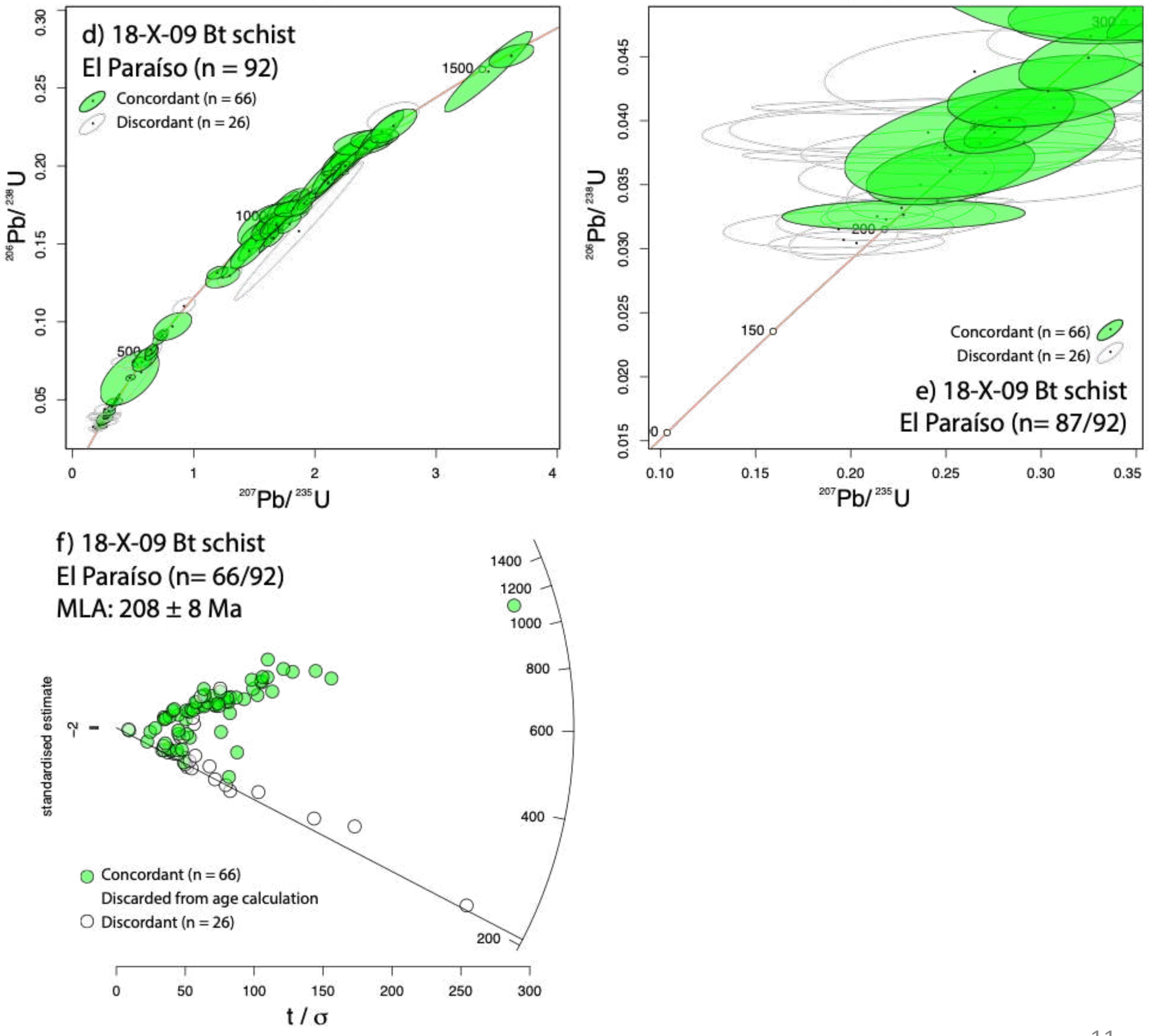
Results: U-Pb and Sm-Nd geochronology

U-Pb ages: 194 ± 2 to 1568 ± 32 Ma

No CT images, but Th/U > 0.1

MLA: 208 ± 8 Ma





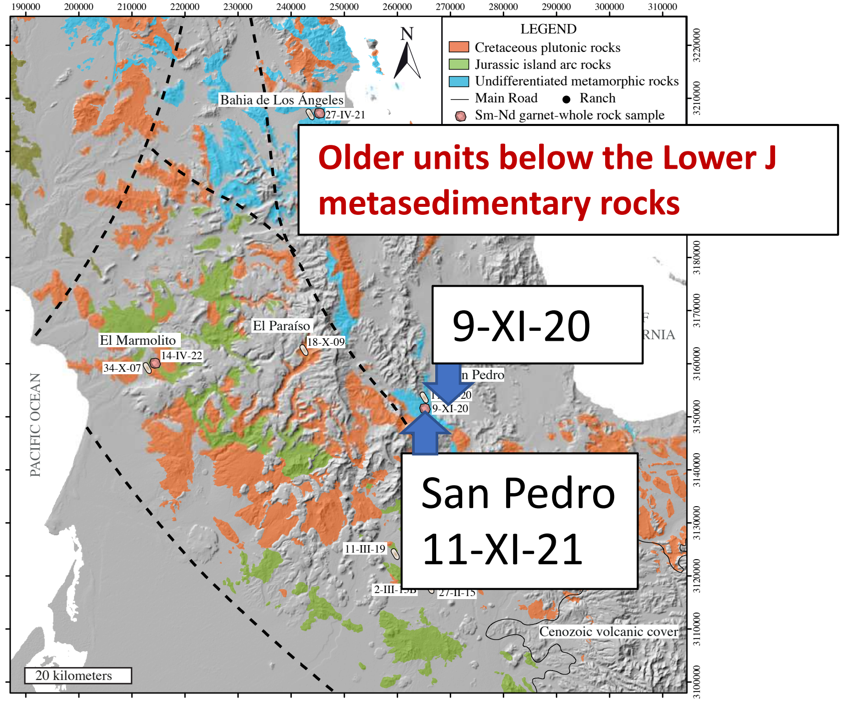
Eastern belt

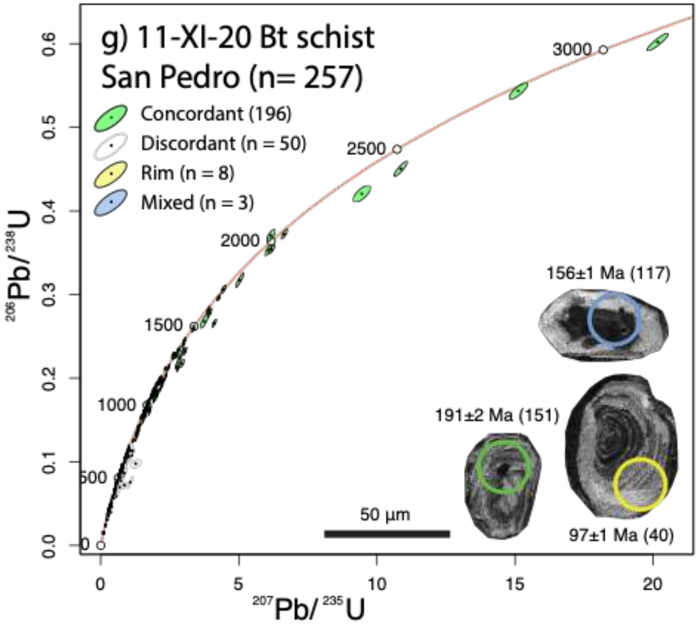
Results: U-Pb and Sm-Nd geochronology

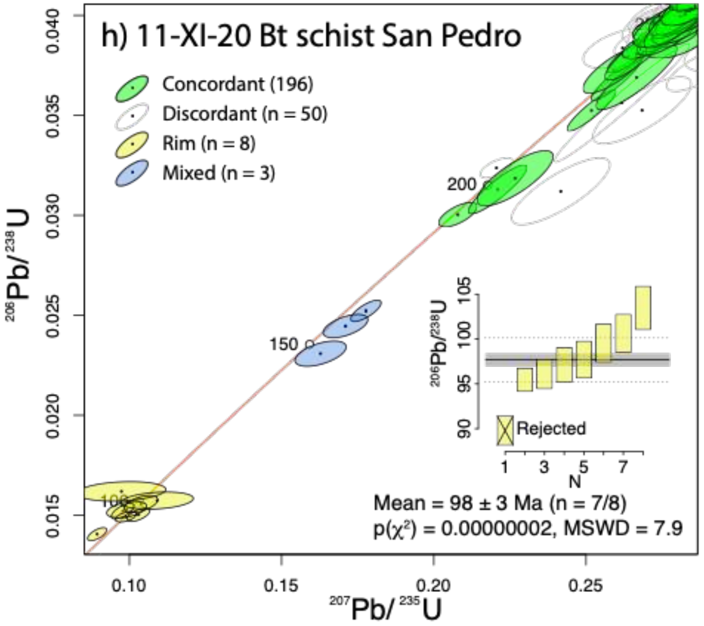
U-Pb ages: 90 ± 1 and 3139 ± 5 Ma

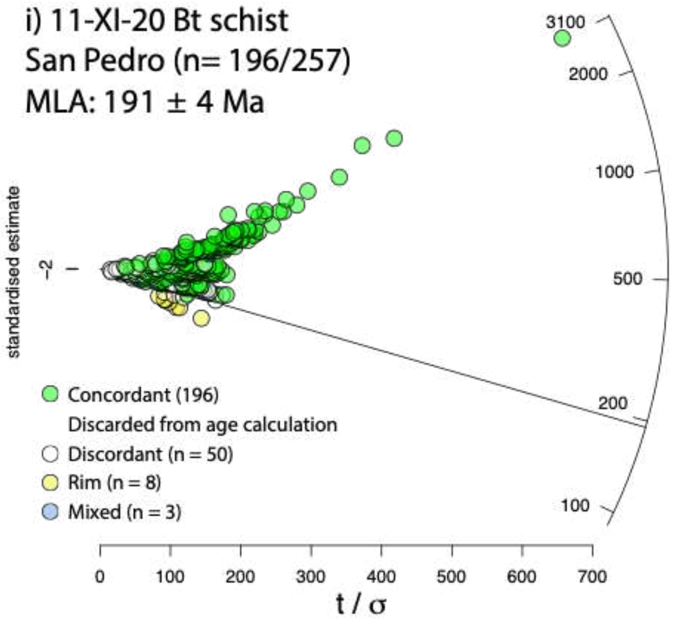
Zrn Rims: Mean age **98 ± 3 Ma**

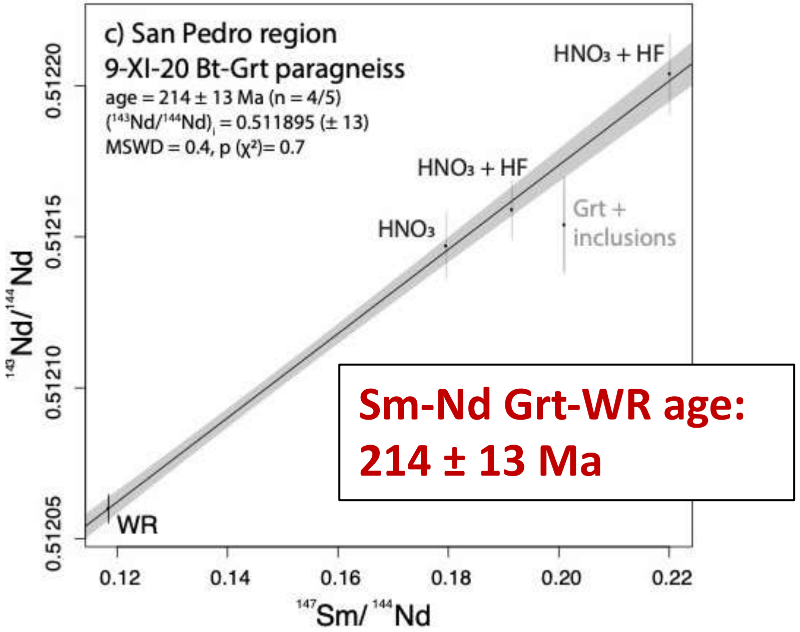
MLA: 191 ± 4 Ma











Eastern belt

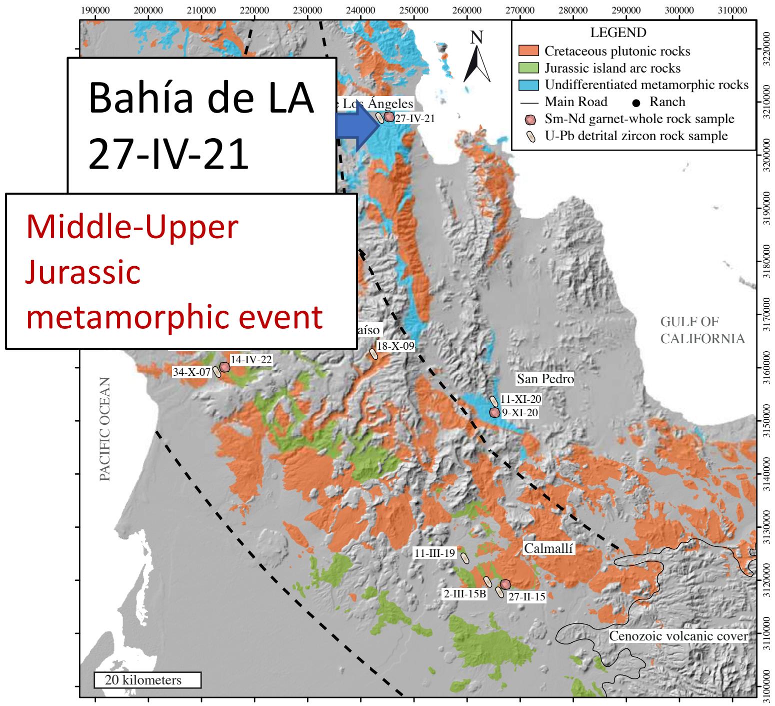
Results: U-Pb and Sm-Nd geochronology

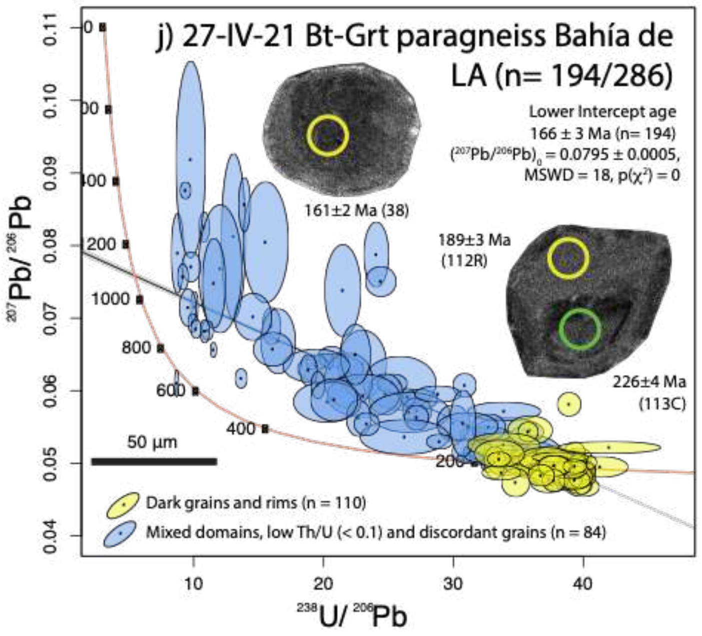
U-Pb ages: 105 ± 1 to 1809 ± 12 Ma

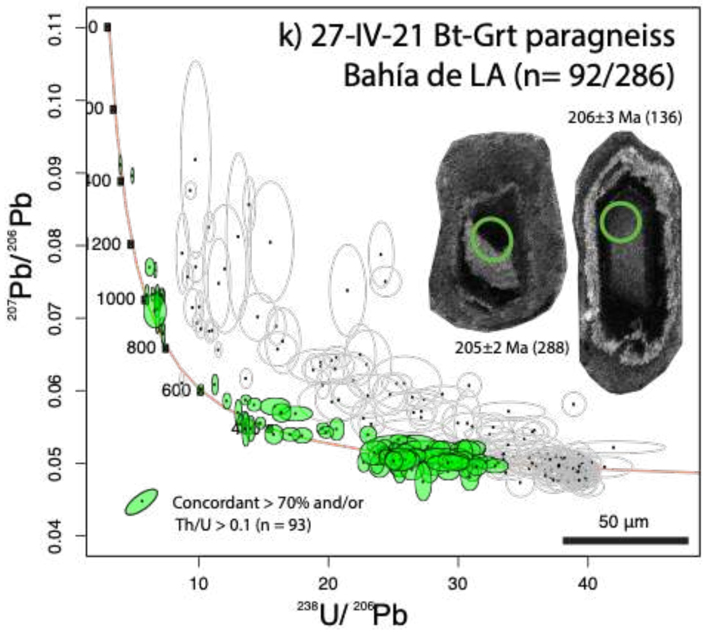
Zrn rims Lower intercept age of **166 ± 3 Ma**

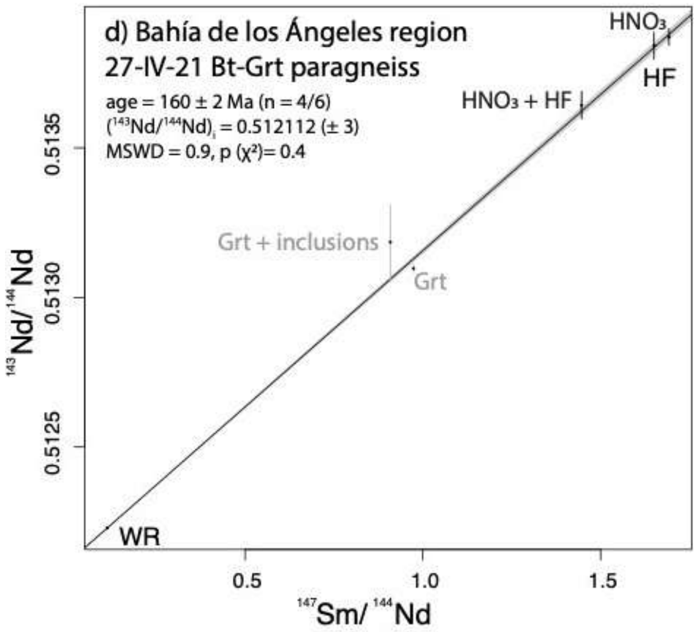
Sm-Nd Grt-WR age: 160 ± 2 Ma

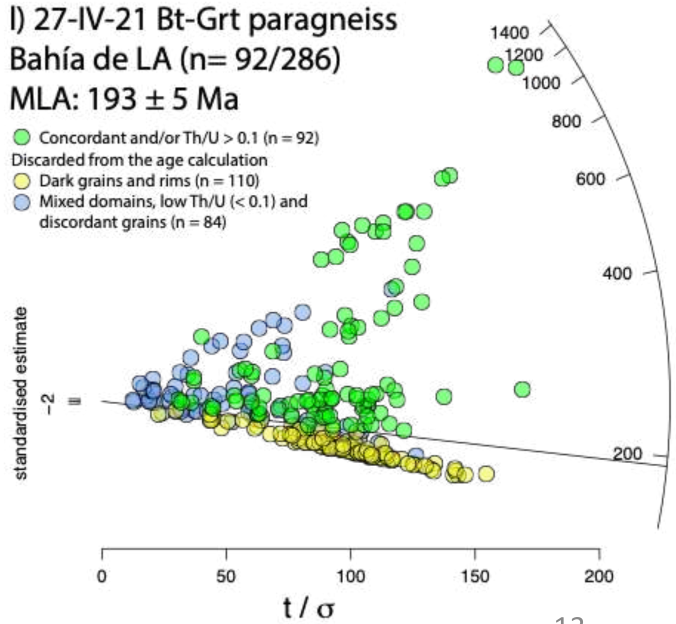
MLA: 193 ± 5 Ma



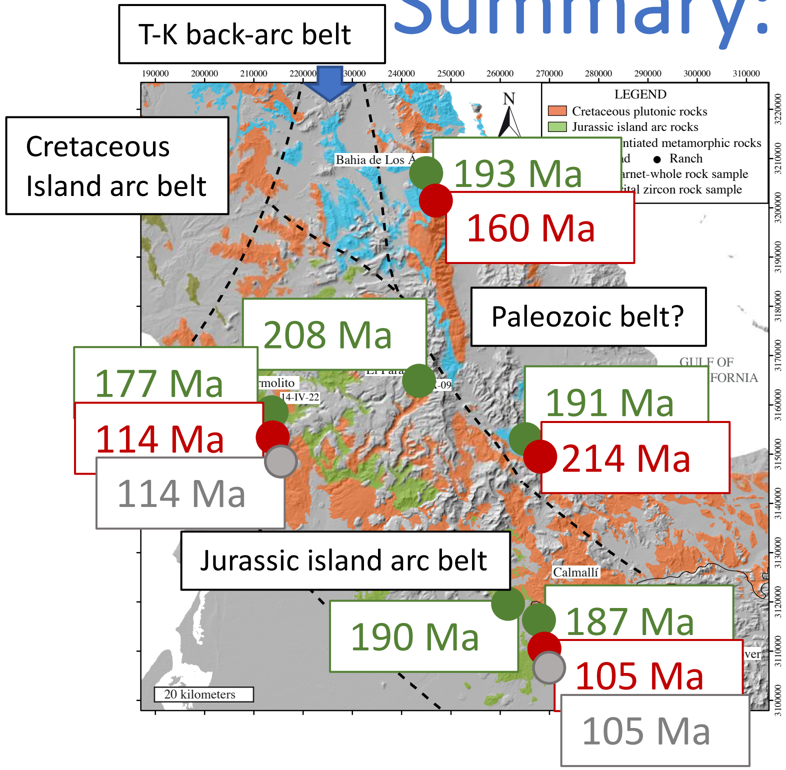


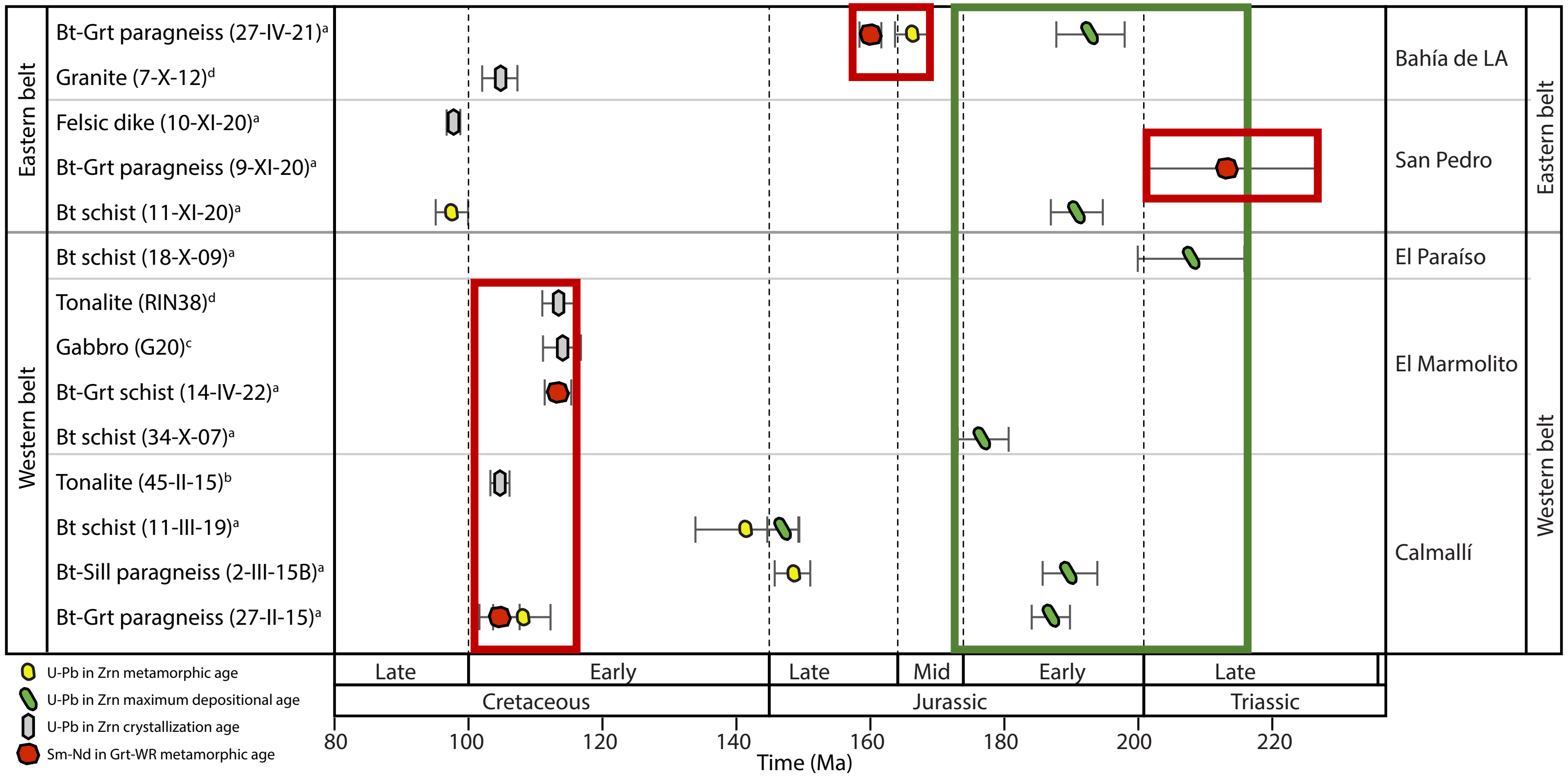






Summary: U-Pb and Sm-Nd geochronology

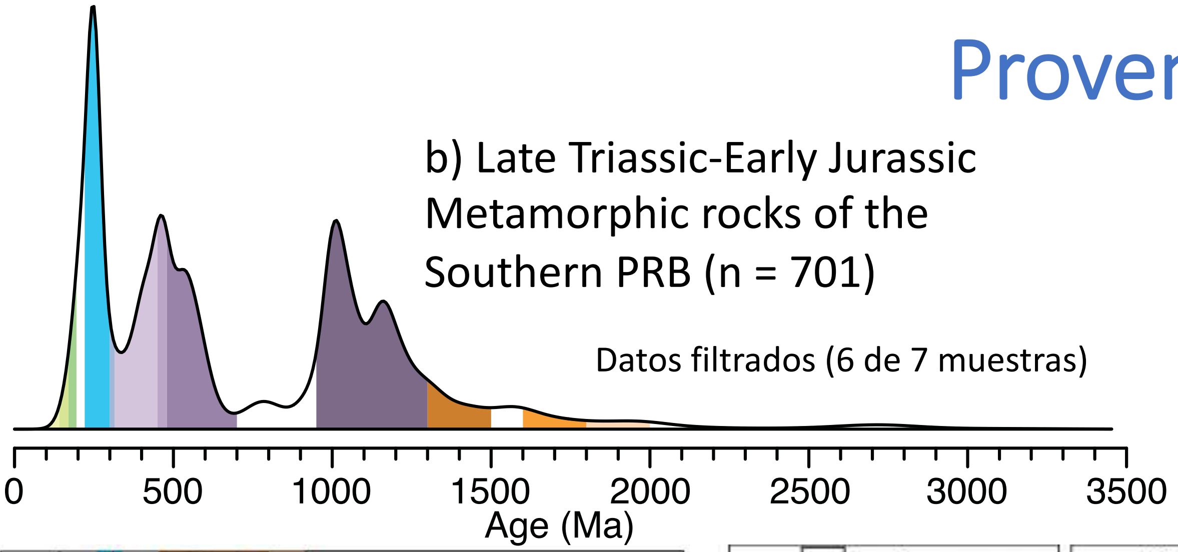




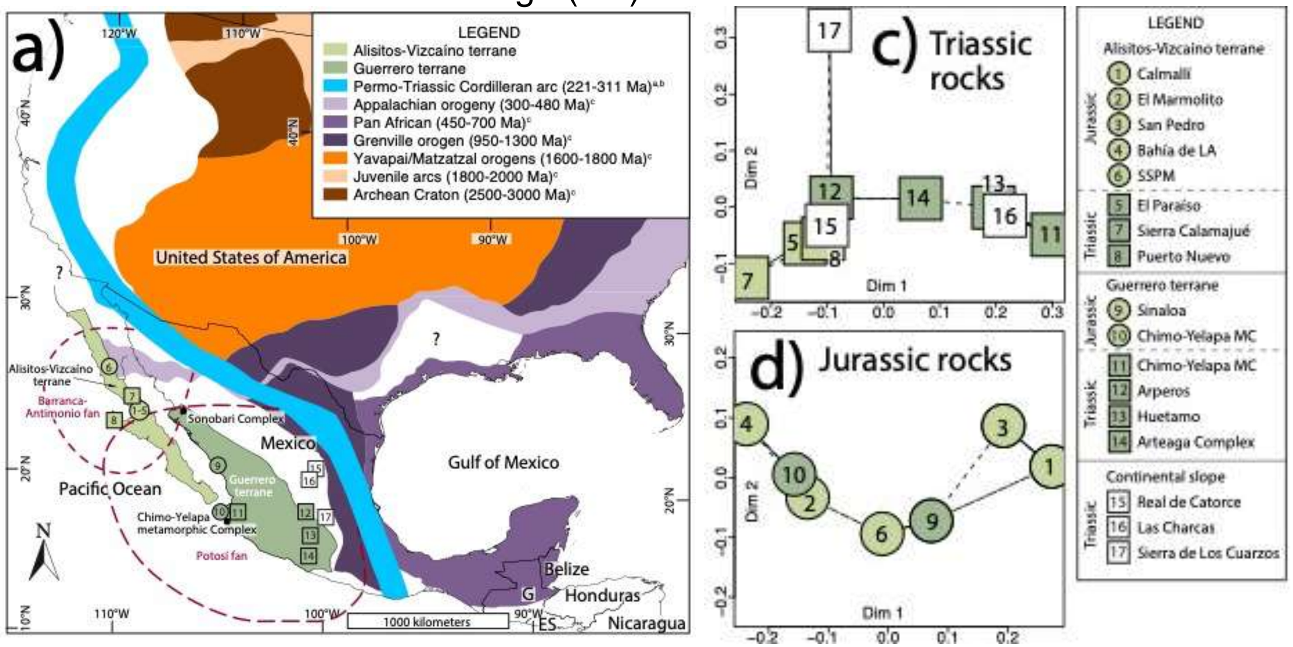
- Metasedimentary rocks of the SPRB show L Triassic and L Jurassic maximum depositional ages.
- **Bahía:** Middle-Upper Jurassic metamorphic event defined by Zrn U-Pb and Grt-WR Sm-Nd ages.
- **Calmallí & El Marmolito:** Garnet growth coeval with K-magmatism.
- **San Pedro:** An older (Triassic) garnet growth event. Related with Triassic magmatism in the continental margin?

[a]Torres-Carrillo et al. (2022, Int. Geolg. Rev.)
[b]Kimbrough et al. (2015, Bull. Geol. Soc. Am. 127)
[c]Contreras et al. (2018, South Am. Earth Sci.)

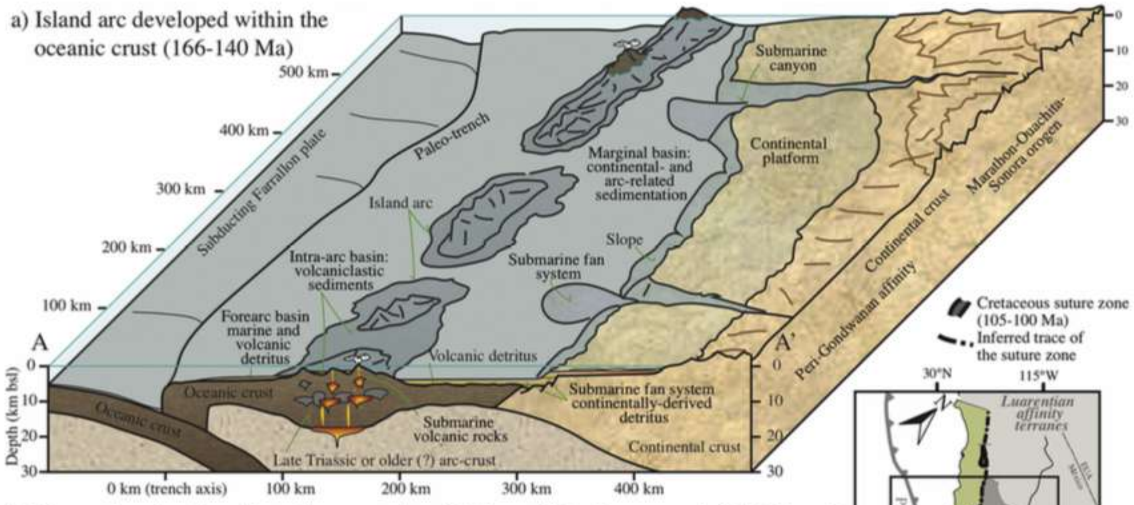
Provenance



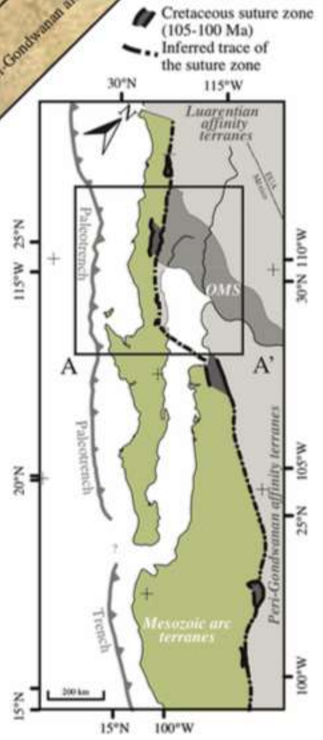
Permo-Triassic Peak: Permo-Triassic Cordilleran arc
Ordovician Peak: Appalachian and Pan African orogens
Neo to Meso-Proterozoic Peaks: Grenville orogen



Modified after Chapman & Laskowski (2019, Lithosphere). Permo-Triassic Cordilleran arc from Arvizu & Iriondo (2015, Boletín la Soc. Geológica Mex).
Barranca-El Antimonio and Potosí submarine fans (Busby, 2023; GSA v 1220).



Contreras-López et al. (2021, Lithos)



Sedimentary protoliths formed in marginal basins that received continentally-derived detritus (Peri-Gondwanan affinity terranes).

Concluding remarks:

- The **PRB** defines a continuous magmatic activity (**170-85 Ma**) developed into a Paleozoic and Mesozoic (Triassic-Jurassic) metamorphic basement.
- The **U-Pb detrital Zrn** geochronology of four samples from the western belt and two from the eastern belt indicates **Late Triassic and Early Jurassic MDA** (208-177 Ma).
- The detrital Zrn **provenance** analysis of SPRB host rocks provides evidence of the **continental influence** in the sedimentation of the protoliths since the **Late Triassic.**
- The **Sm-Nd Grt-WR** rock geochronology allowed us to identify **four metamorphic** events in the southern PRB, **coeval with magmatism**.

Thanks for your attention! Questions?

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