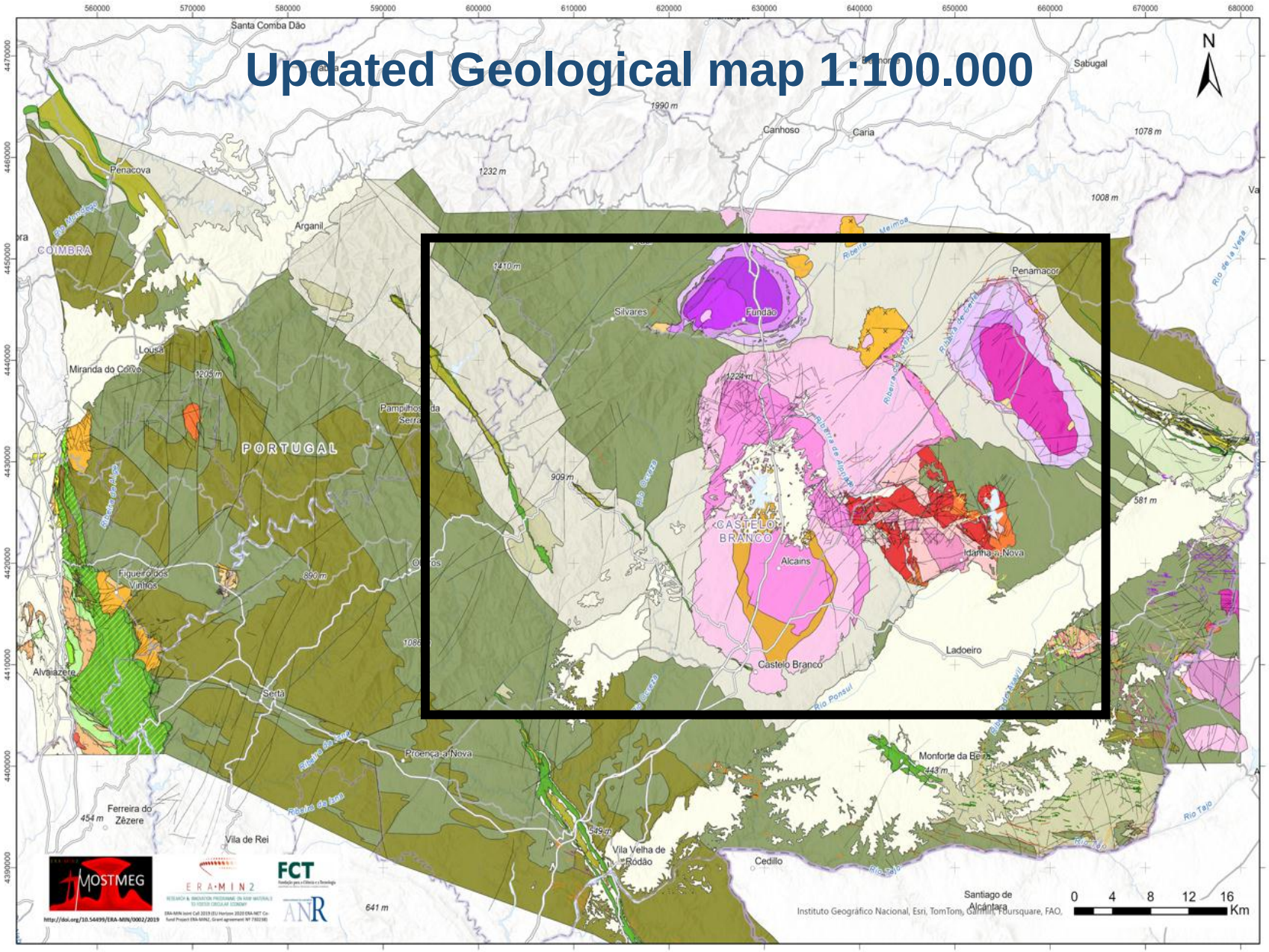
http://doi.org/10.54499/ERA-MIN/0002/2019
https://mostmeg.rd.ciencias.ulisboa.pt/

ERA-MIN Joint Call 2019 (EU Horizon 2020 ERA-NET Co-fund Project ERA-MIN2, Grant agreement Nº 730238)

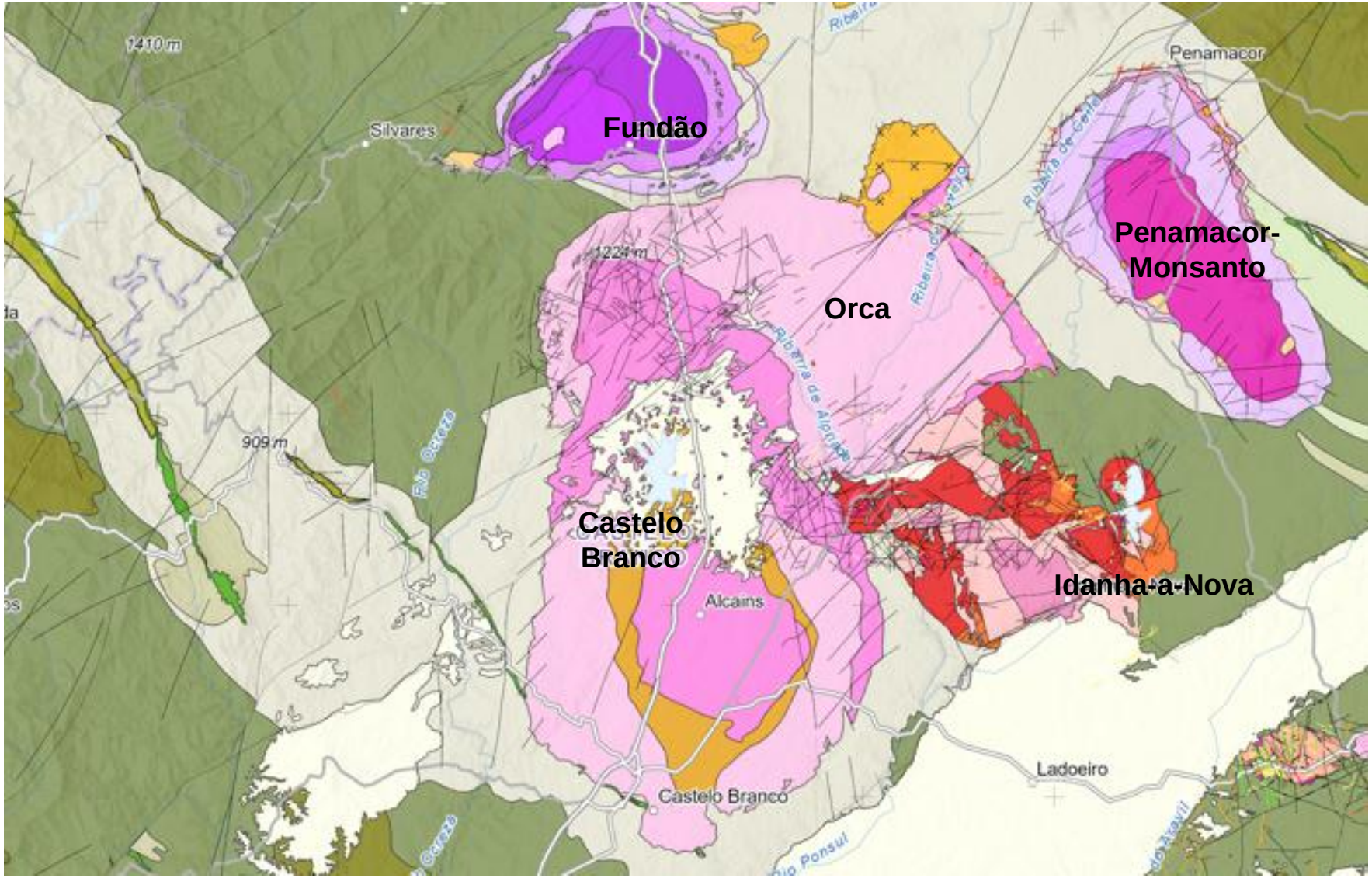
Some details on the geochronology, geochemistry and mineralogy of the Penamacor-Monsanto granite system.

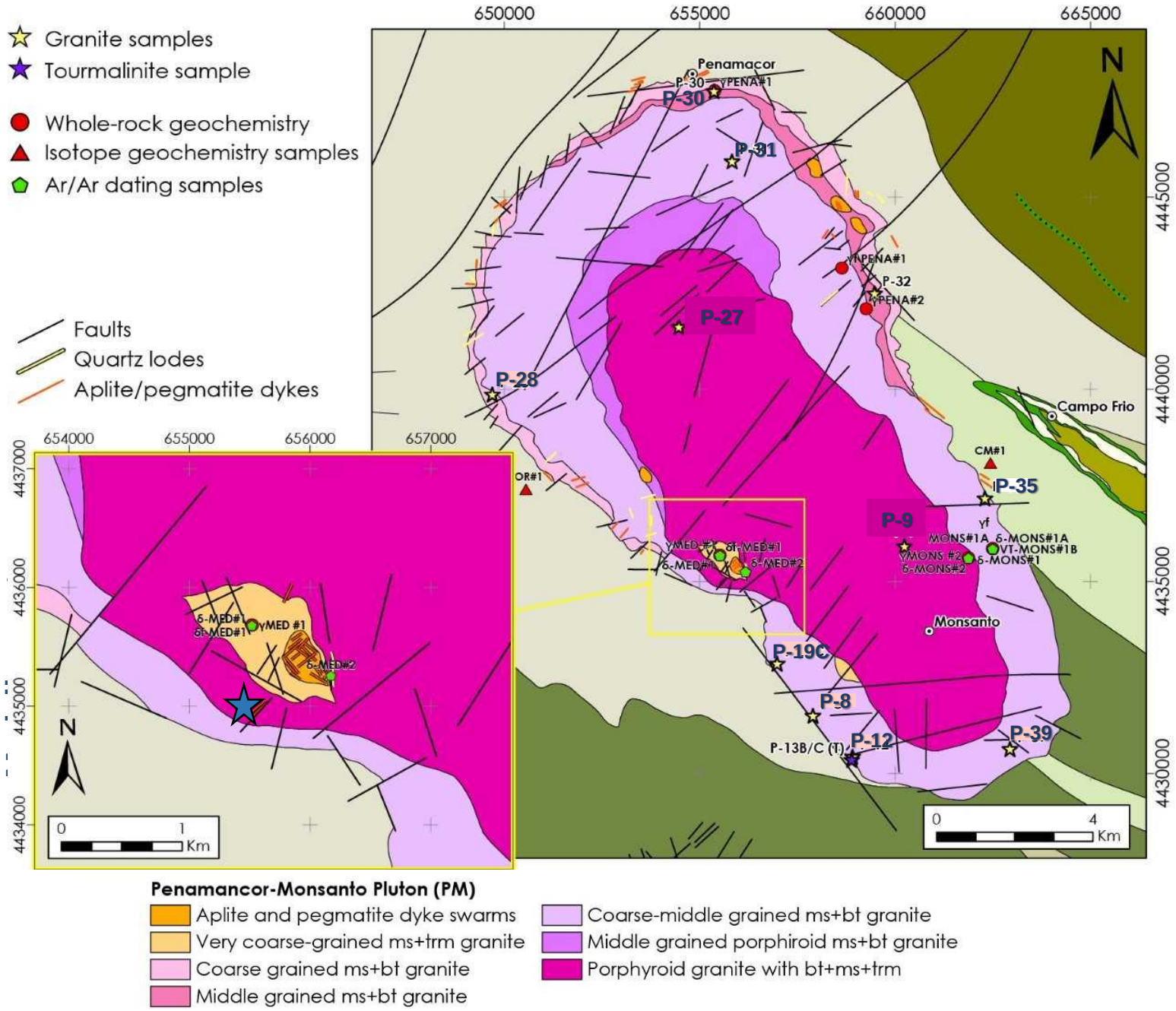
Isabel Ribeiro da Costa; António Mateus, Ivo Martins, Ícaro Dias da Silva; Colombo Tassinari; Maria Helena Hollanda; Michel Cathelineau; Marie-Christine Boiron

Updated Geological map 1:100.000



The Fundão – Castelo Branco – Orca – Idanha-a-Nova – Penamacor-Monsanto sector





The Penamacor-Monsanto pluton is one of the many zoned allochtonous plutons of the monzogranite suite, widespread in the southern sector of the CIZ (Castro *et al*., 2002)

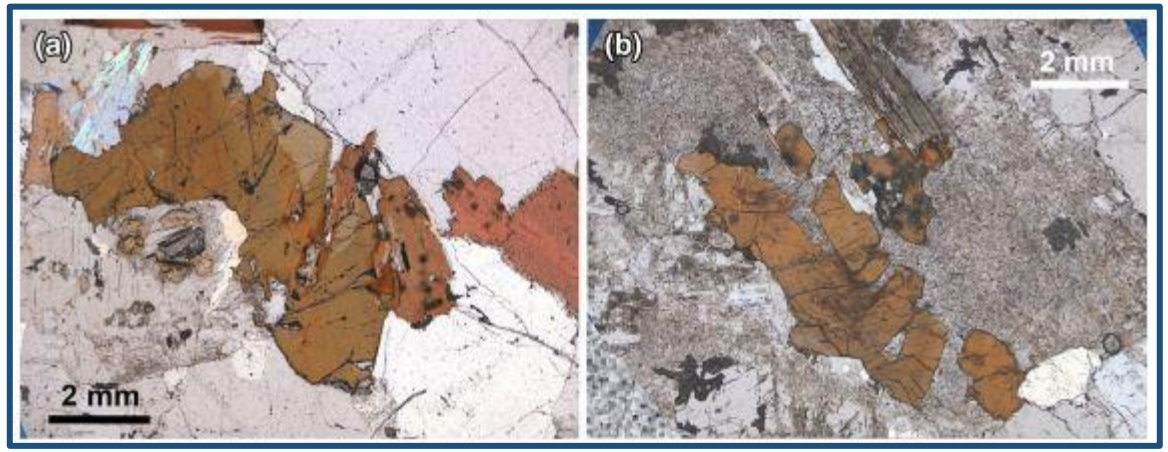
Granitic facies

defined by Neiva & Campos (1992)

Penamacor-Monsanto:
mineralogical and geochemical features

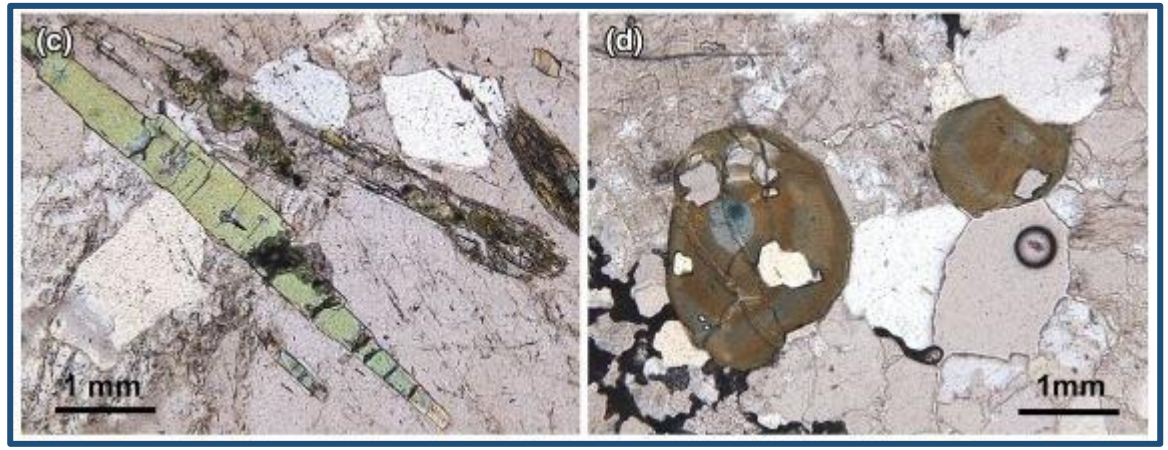
Penamacor-Monsanto granitic rocks: petrographic characterization

(Ribeiro da Costa et al., 2014 – METMOB project)



Tourmaline-bearing two-mica monzogranites

(late, brown tourmaline)

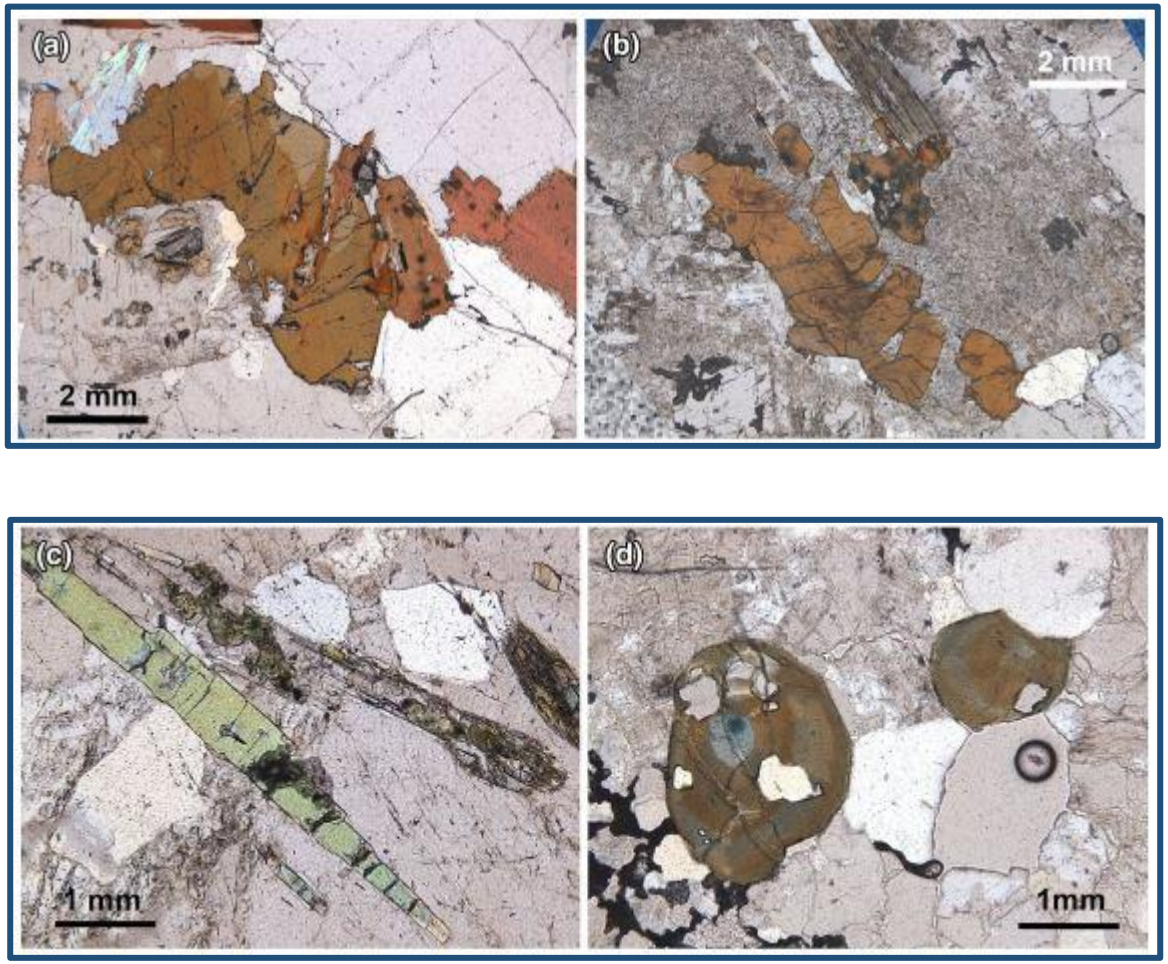


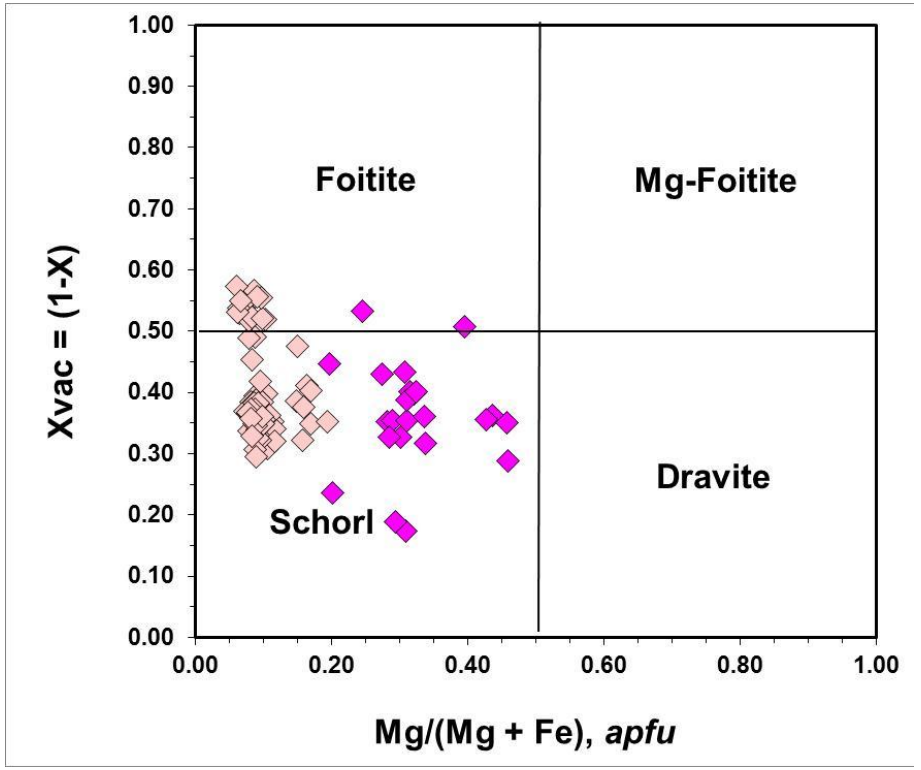
Tourmaline-bearing muscovite granites

(early, blue-green tourmaline)

Penamacor-Monsanto granitic rocks: tourmaline composition

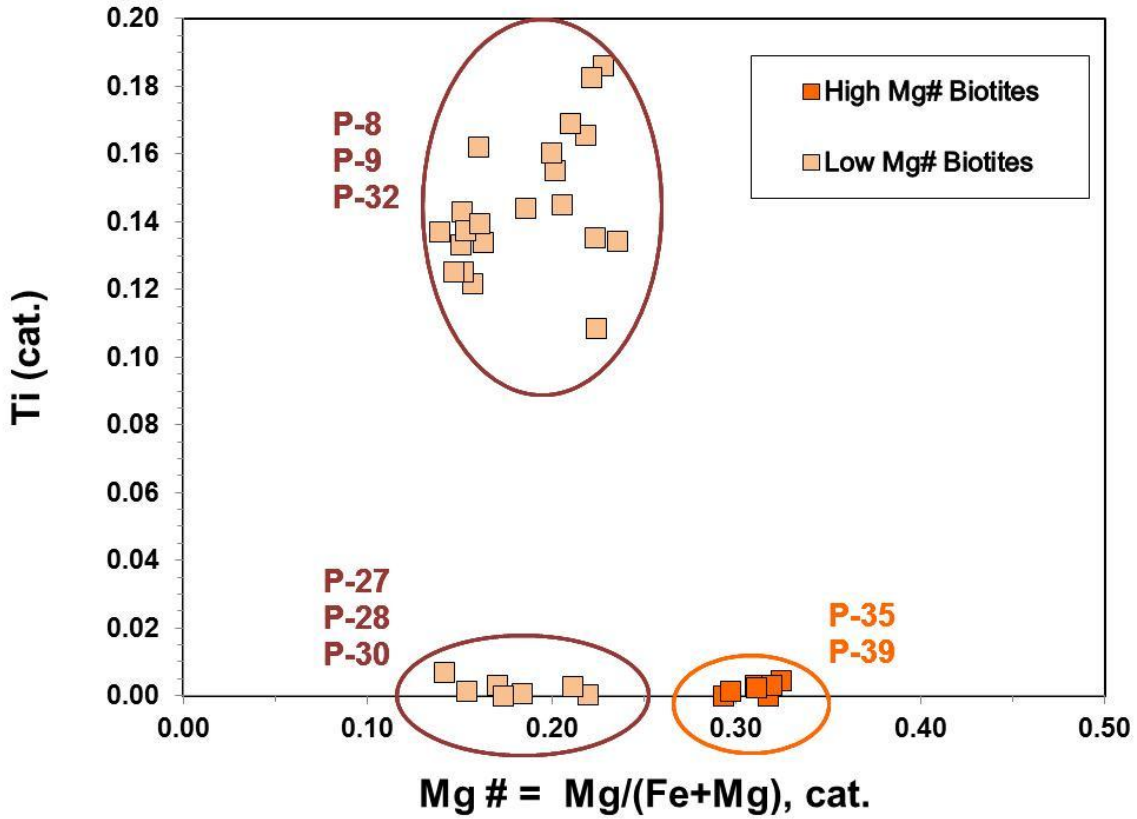
(Ribeiro da Costa et al., 2014 – METMOB project)

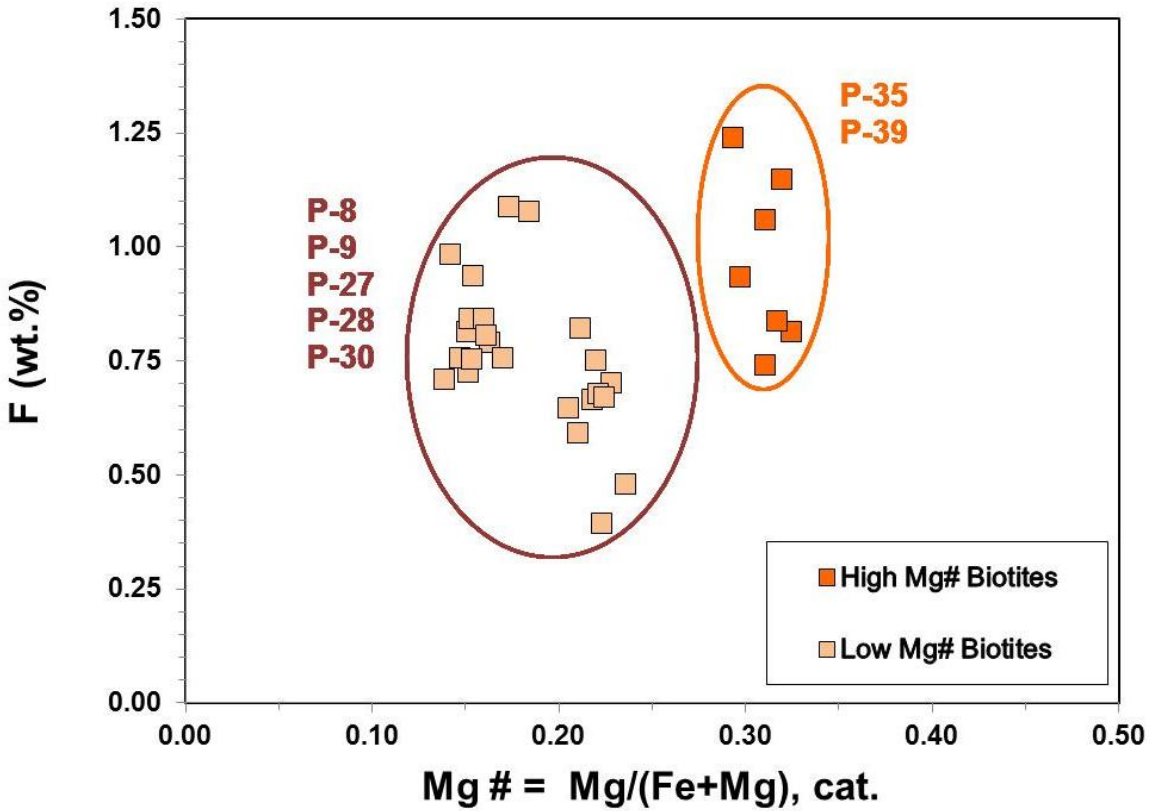




- PM tourmaline in two-mica monzogranites
- PM tourmaline in muscovite granites

Penamacor-Monsanto: biotite composition

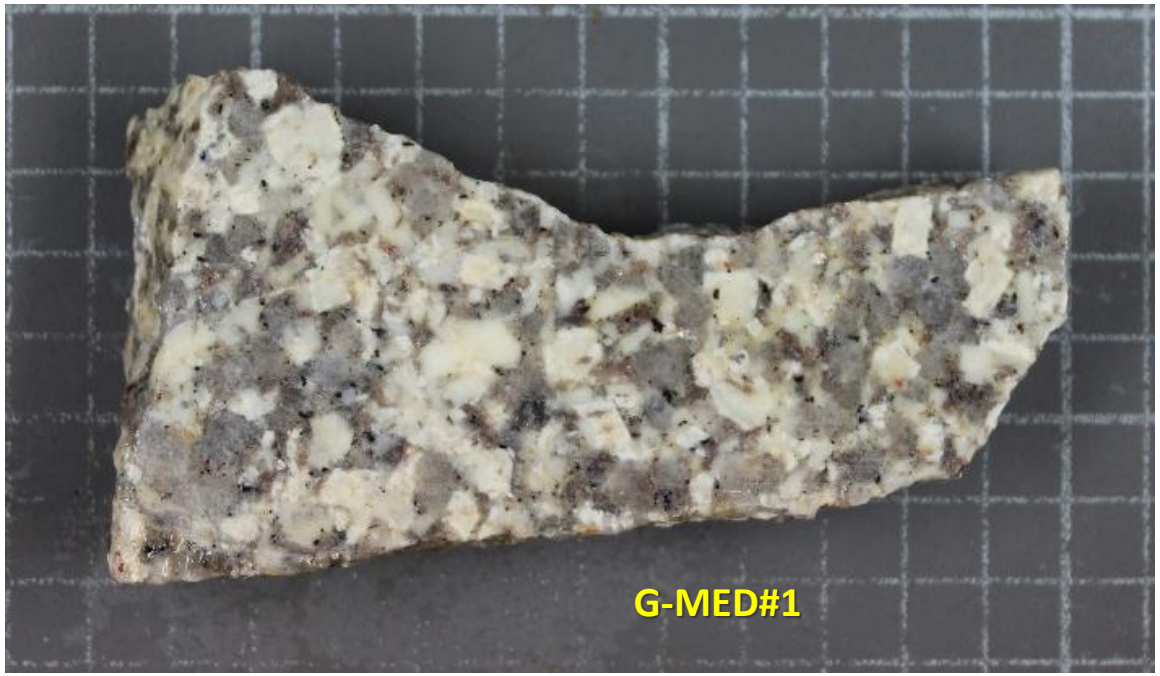


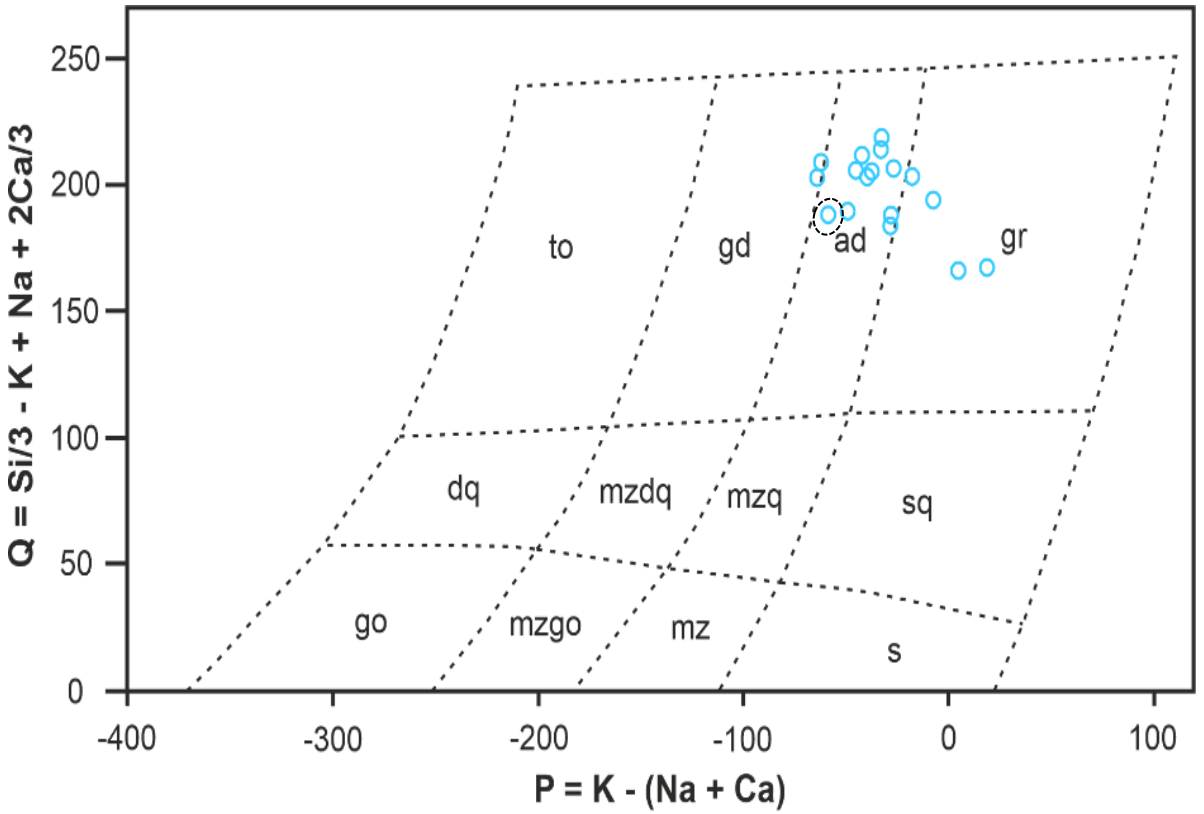


Monsanto: contact between two-mica monzogranite and aplite

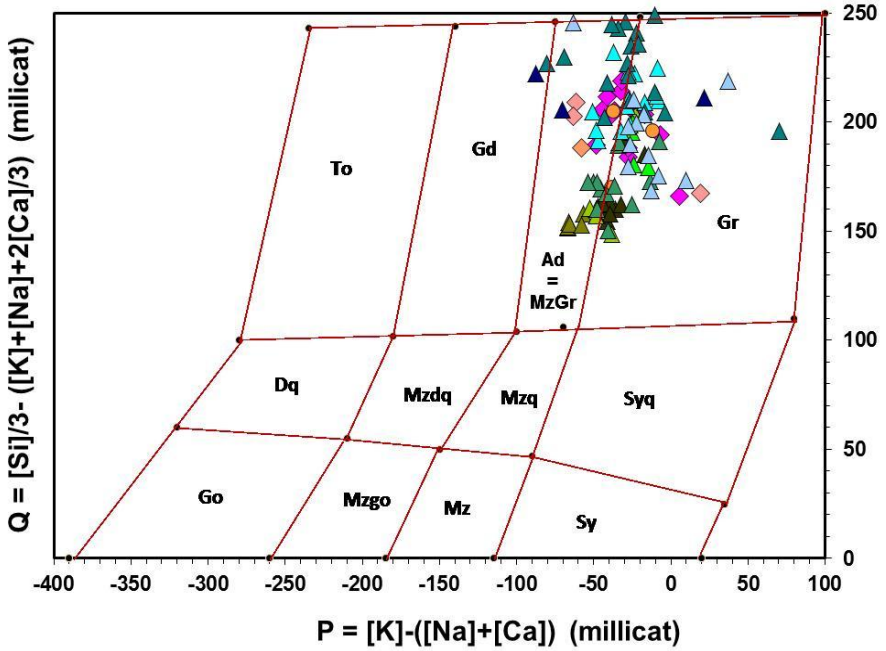
Sample	F	Be	Li	B	Cs	Ba	Nb	Ta	Sn	W	Rb/Sr
G_MONS#1	2400	-	-	-	136.1	196.4	12.4	3.6	87.4	7.1	8.99
G_MONS#2	700	5	255	104	29.9	251	6.4	1.27	12	-	6.12
Gf_MONS#1A	1700	3	458	884	42.4	85	13.7	6.68	60	8	22.72

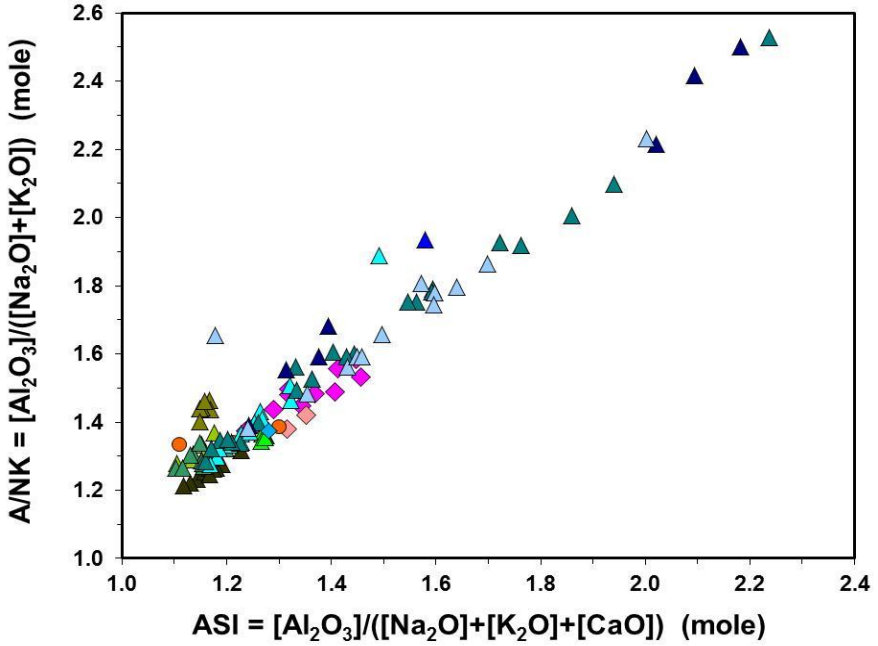
Sample	G-MED#1
F	1400
Be	14
Li	661
B	752
Cs	192
Ba	46
Nb	27.3
Ta	8.83
Sn	391
W	7
Rb/Sr	18.93





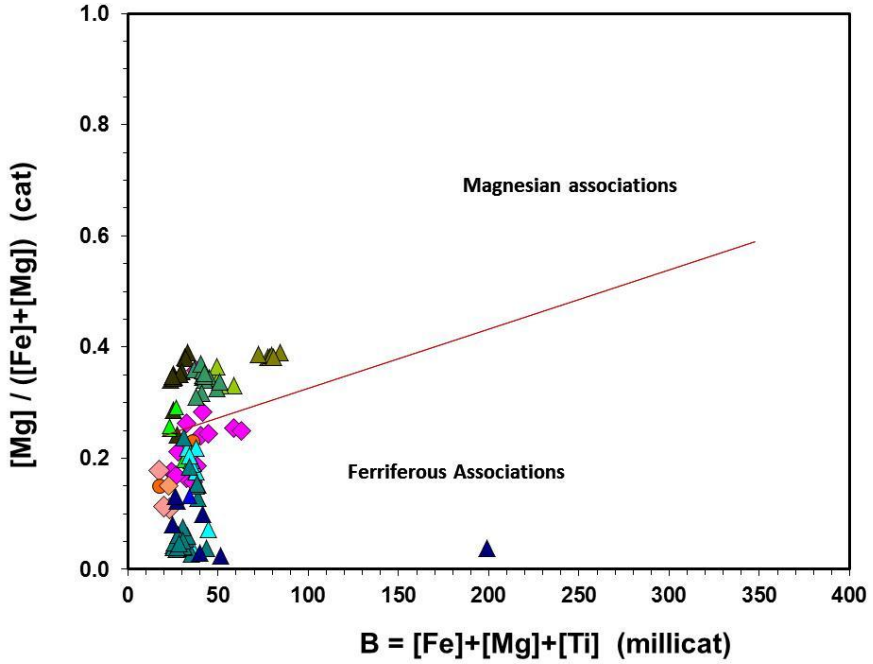
Medelim: more differentiated granite facies

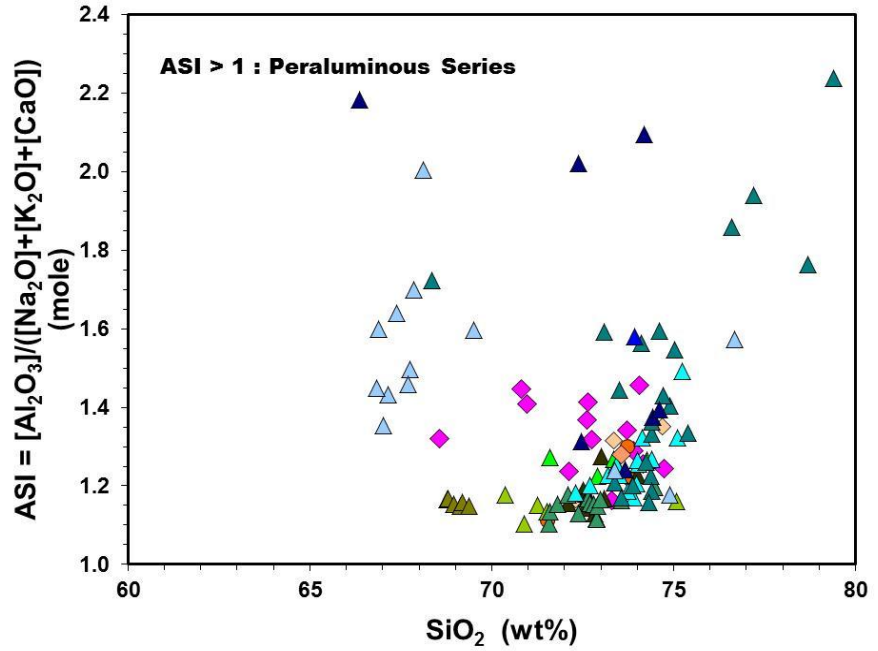




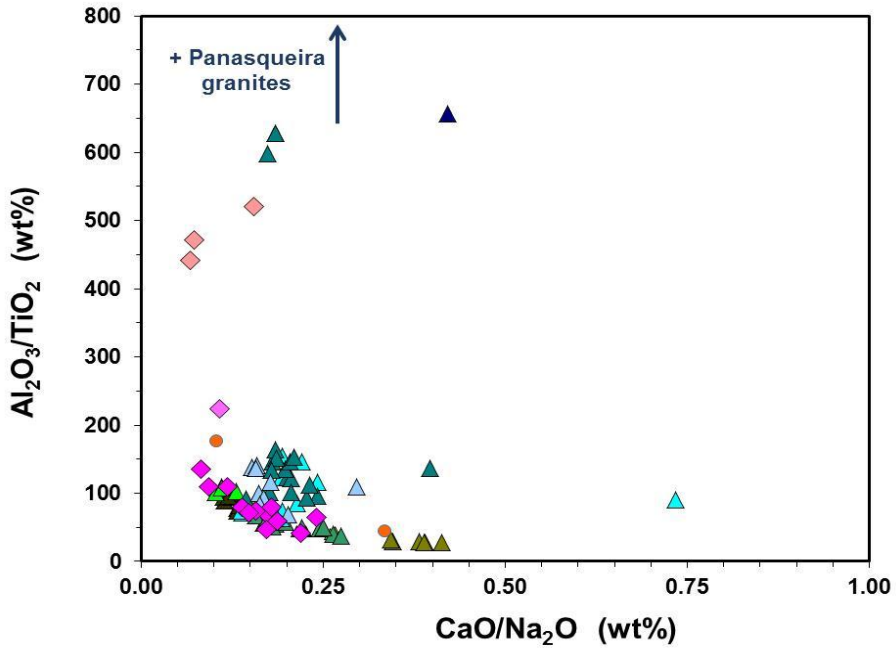
Whole-rock geochemistry: granite classification

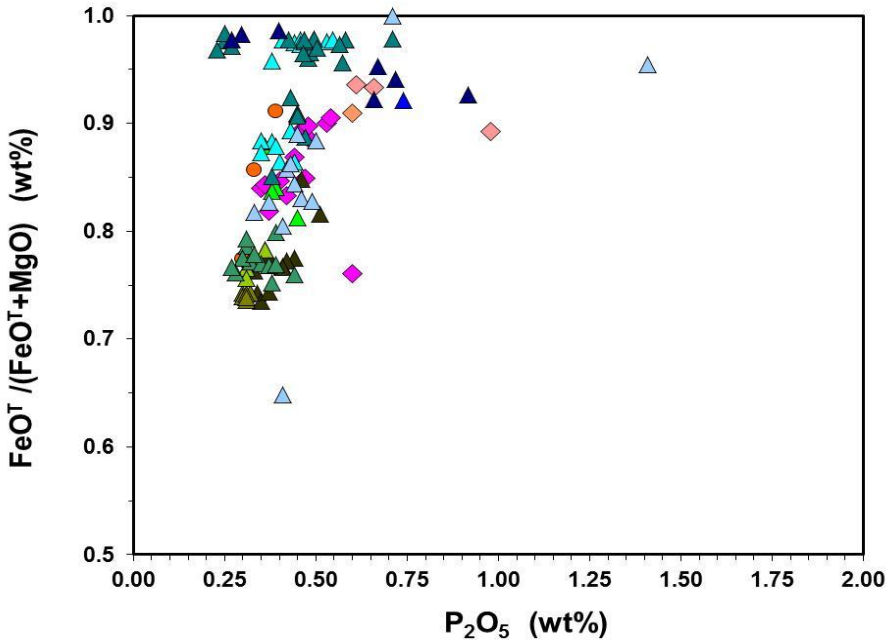
- Castelo Branco (G1)
- Castelo Branco (G2)
- Castelo Branco (G3)
- Castelo Branco (G4)
- Castelo Branco (G5)
- Panasqueira (G1a)
- Panasqueira (G1b)
- Panasqueira (G2)
- Panasqueira (G3)
- Panasqueira (MOSTMEG)
- Orca
- Penamacor-Monsanto (2-mica granites)
- Penamacor-Monsanto (muscovite granites)
- Medelim granite

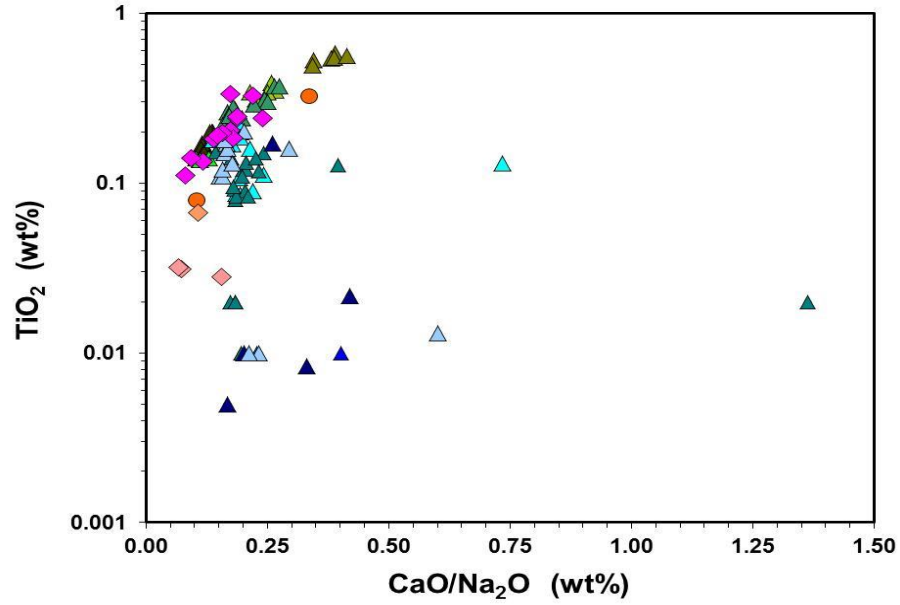


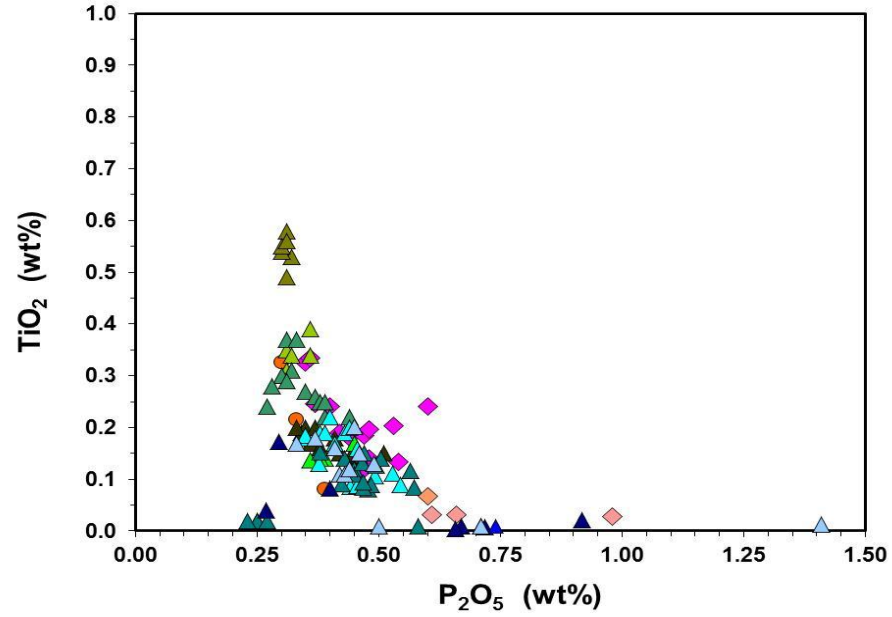


Whole-rock geochemistry: major components









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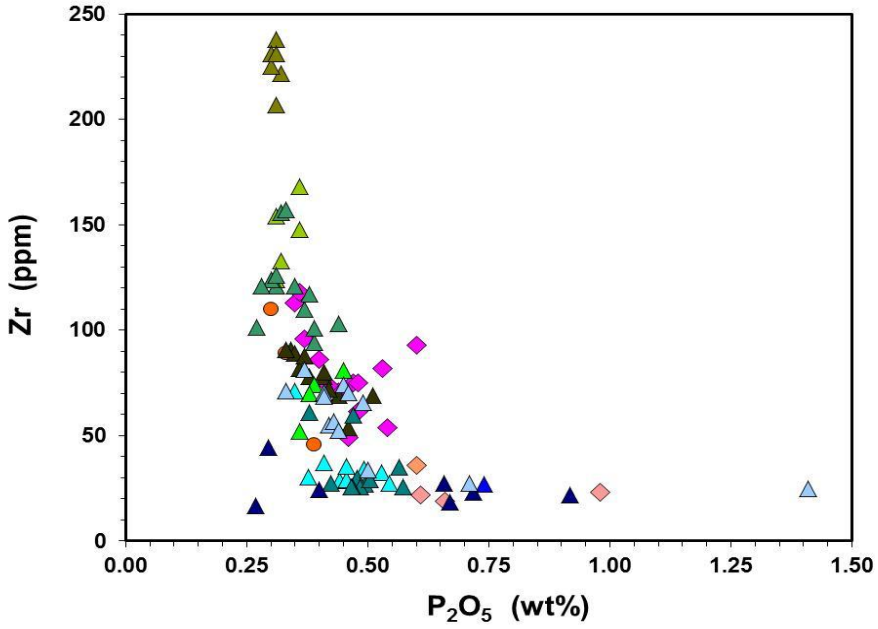
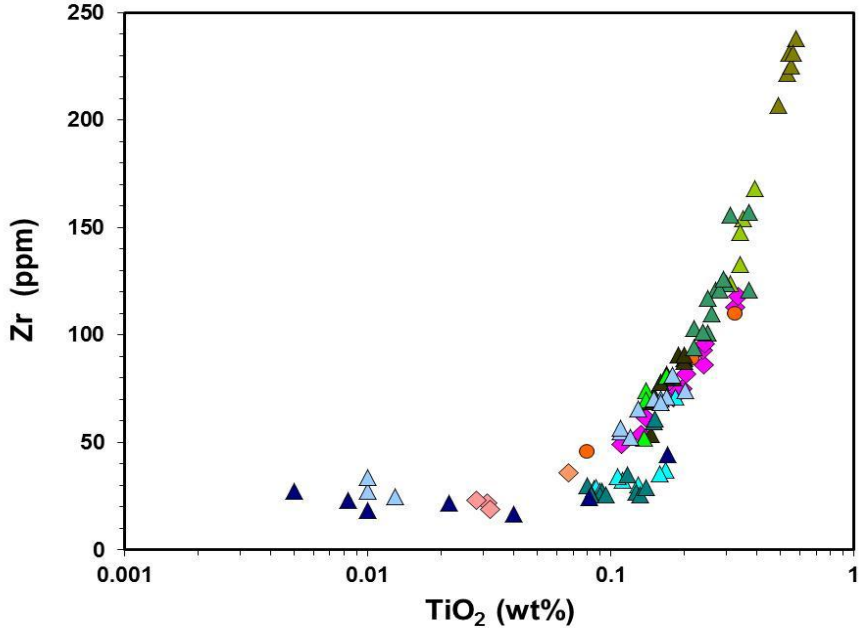
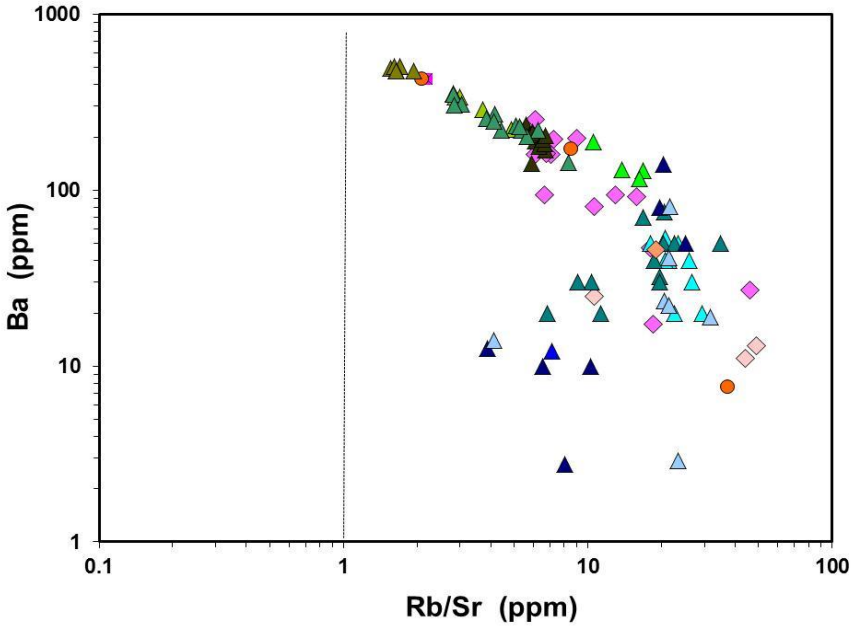
- Orca
- Penamacor-Monsanto (2-mica granites)
- Penamacor-Monsanto (muscovite granites)
- Medelim granite

Whole-rock geochemistry: trace components







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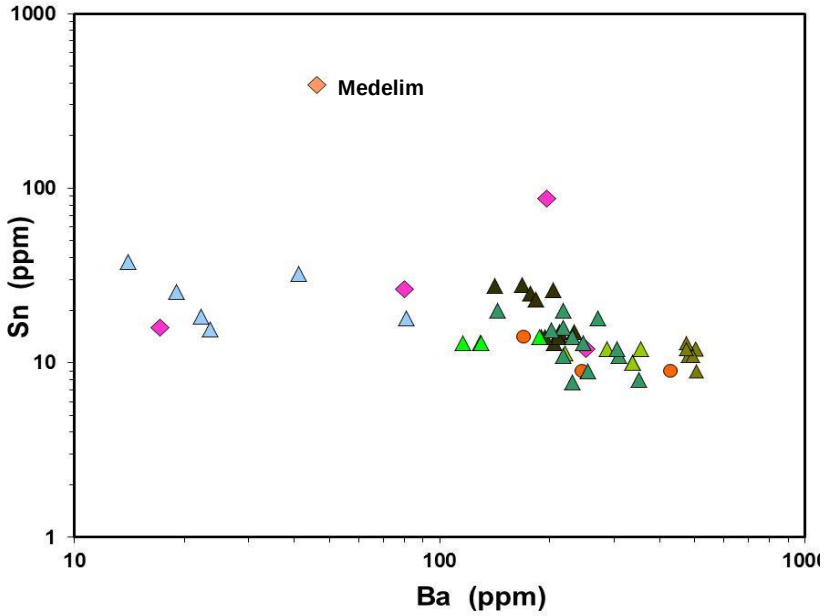
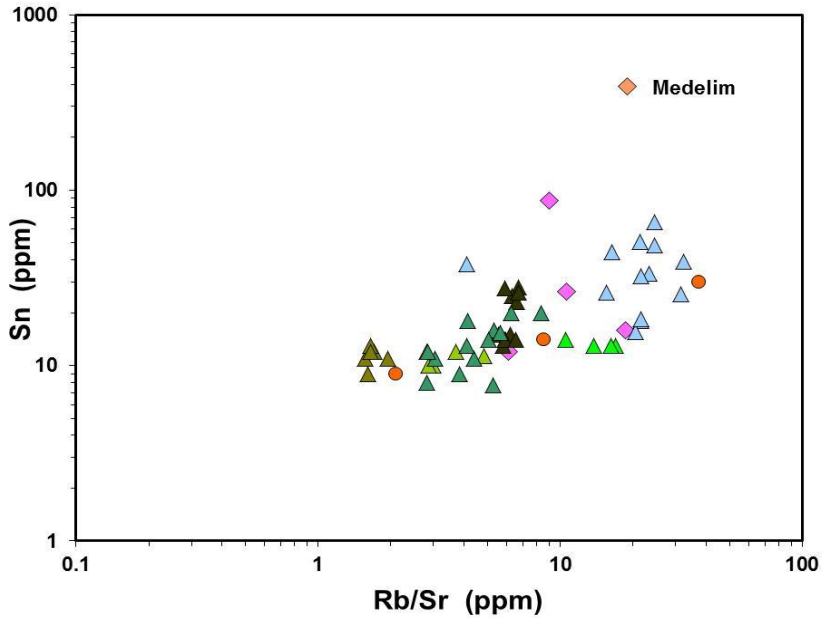
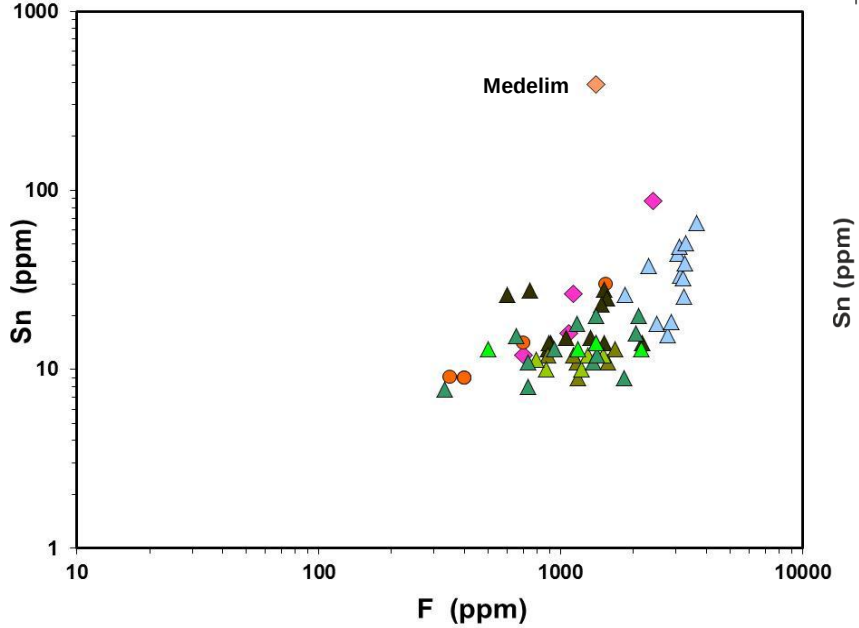
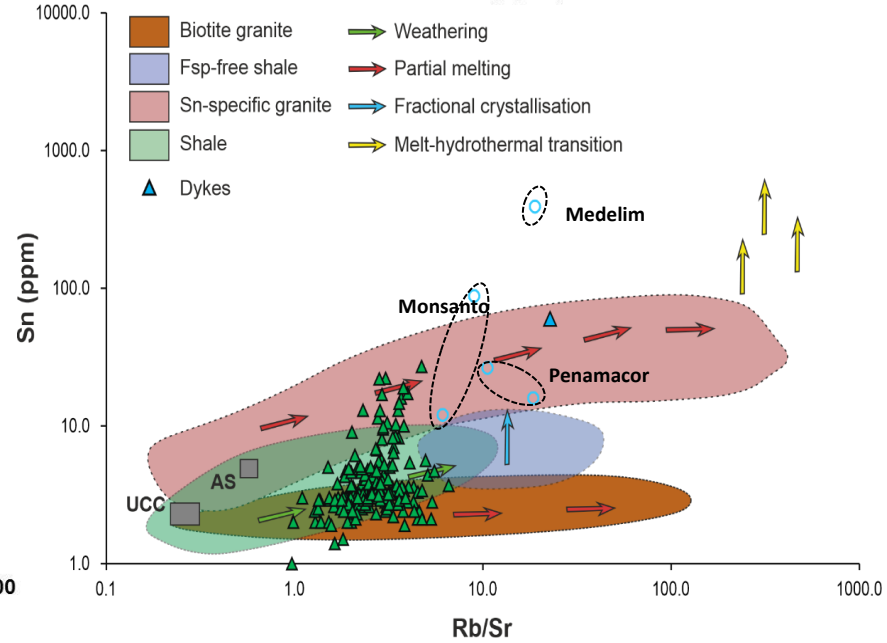
Whole-rock geochemistry: Sn correlations









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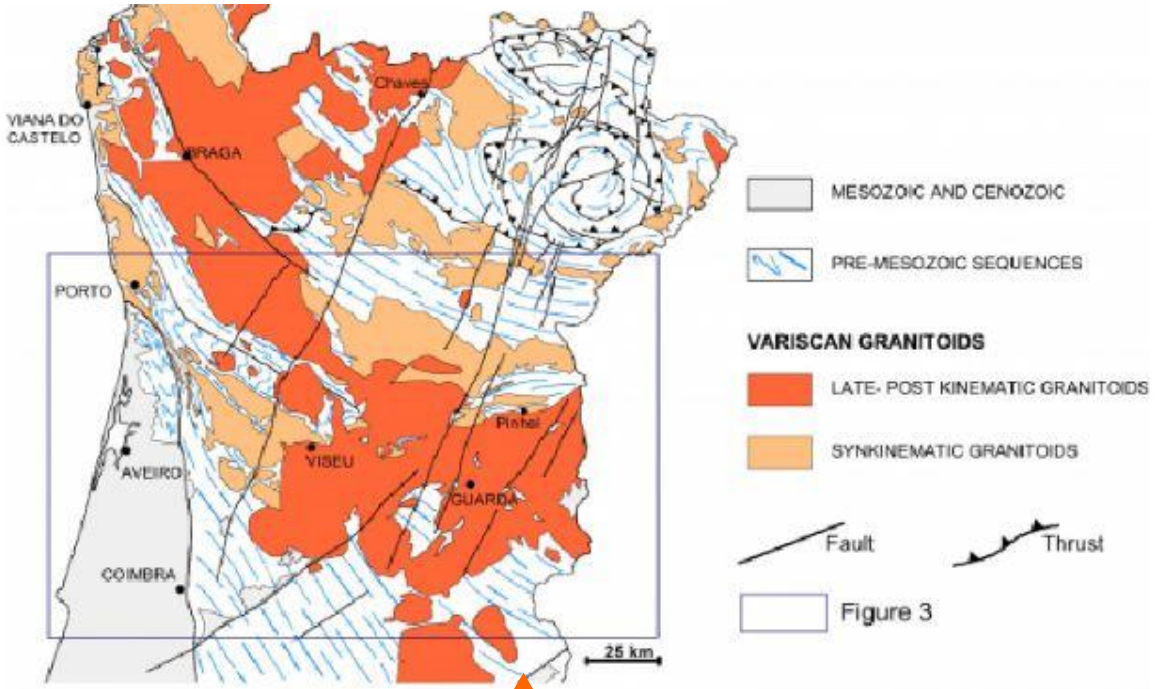
- Medelim granite

Penamacor-Monsanto:
geochronological data

Variscan granitoids
(adapted from Ribeiro *et al.*, 1972)



Variscan deformation phases:

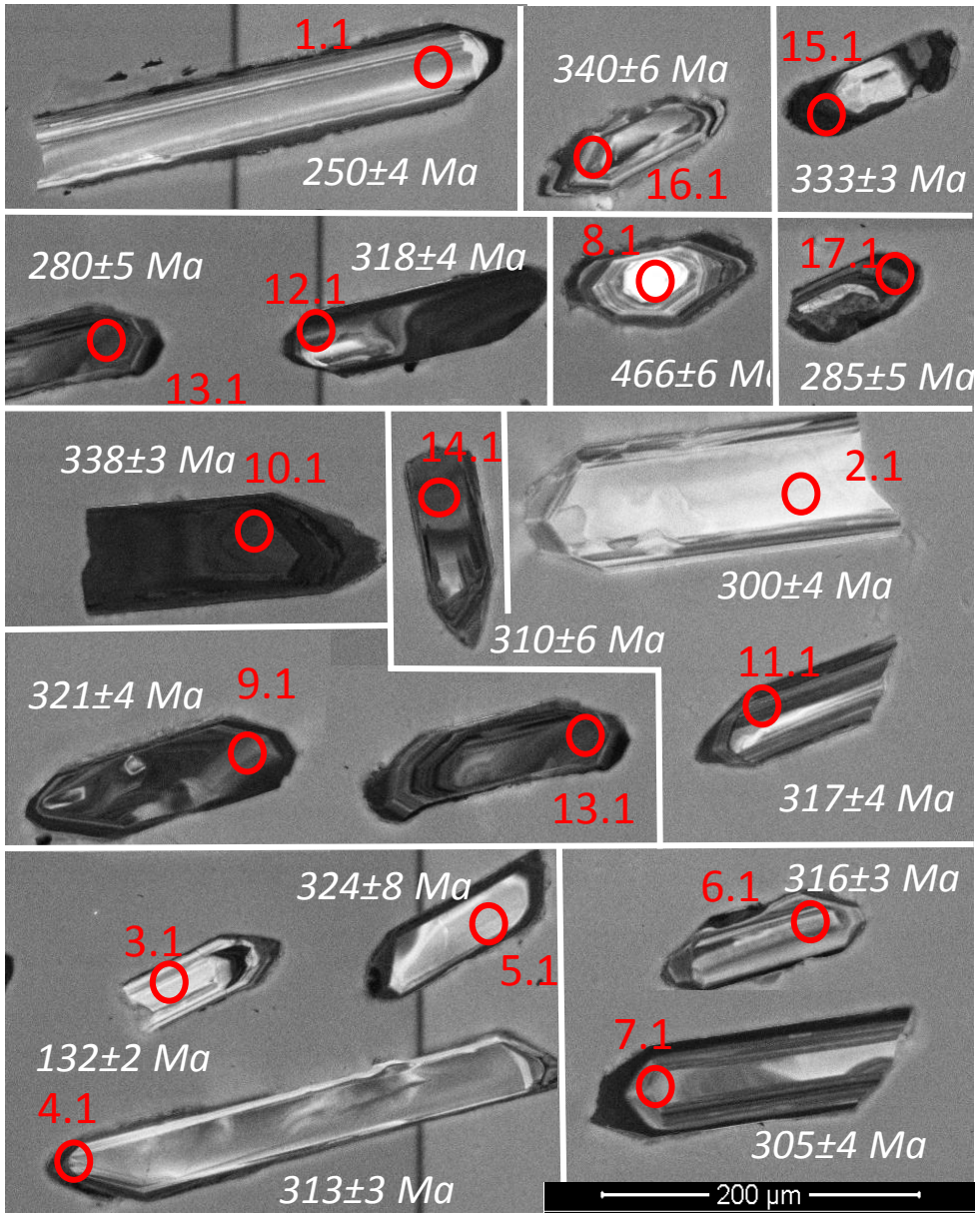
315 – 270 Ma: late- to post-kinematic granitoids

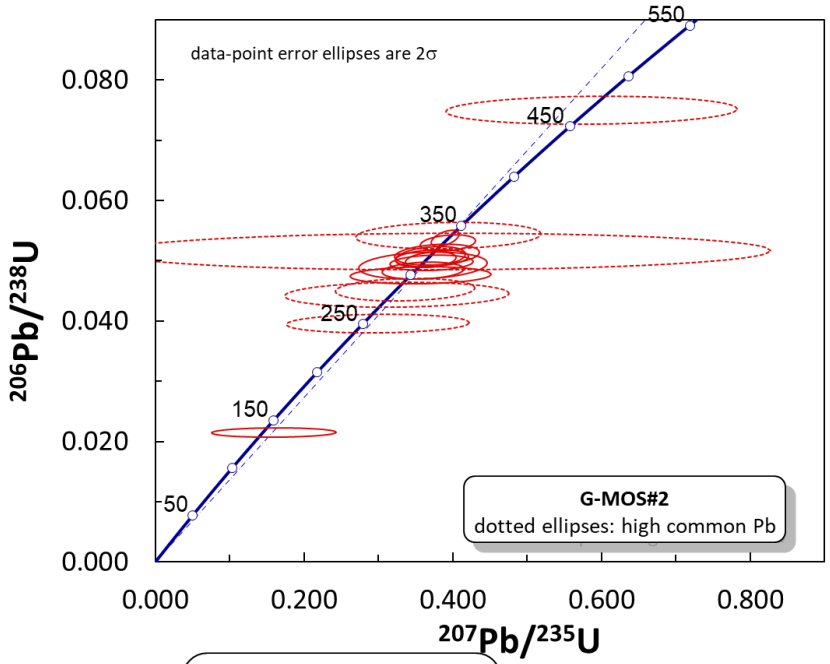
D3 **340 – 320 Ma: syn-kinematic granitoids**
(vertical folding + intracontinental shearing)

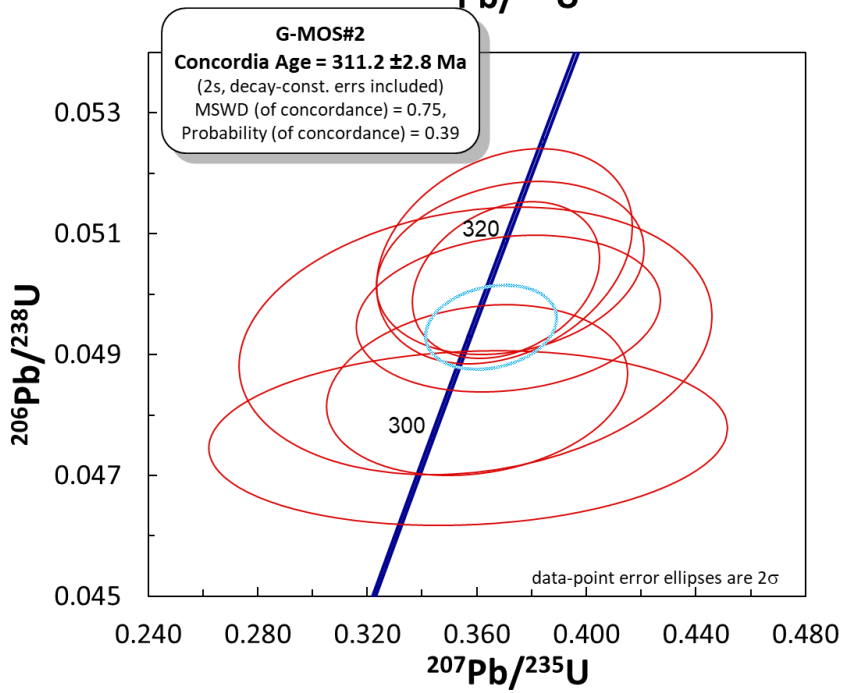
D2
D1 > **Syn-collisional deformation**

The Penamacor-Monsanto intrusion is considered to be late- to post-D3 (Ferreira *et al.*, 1987).

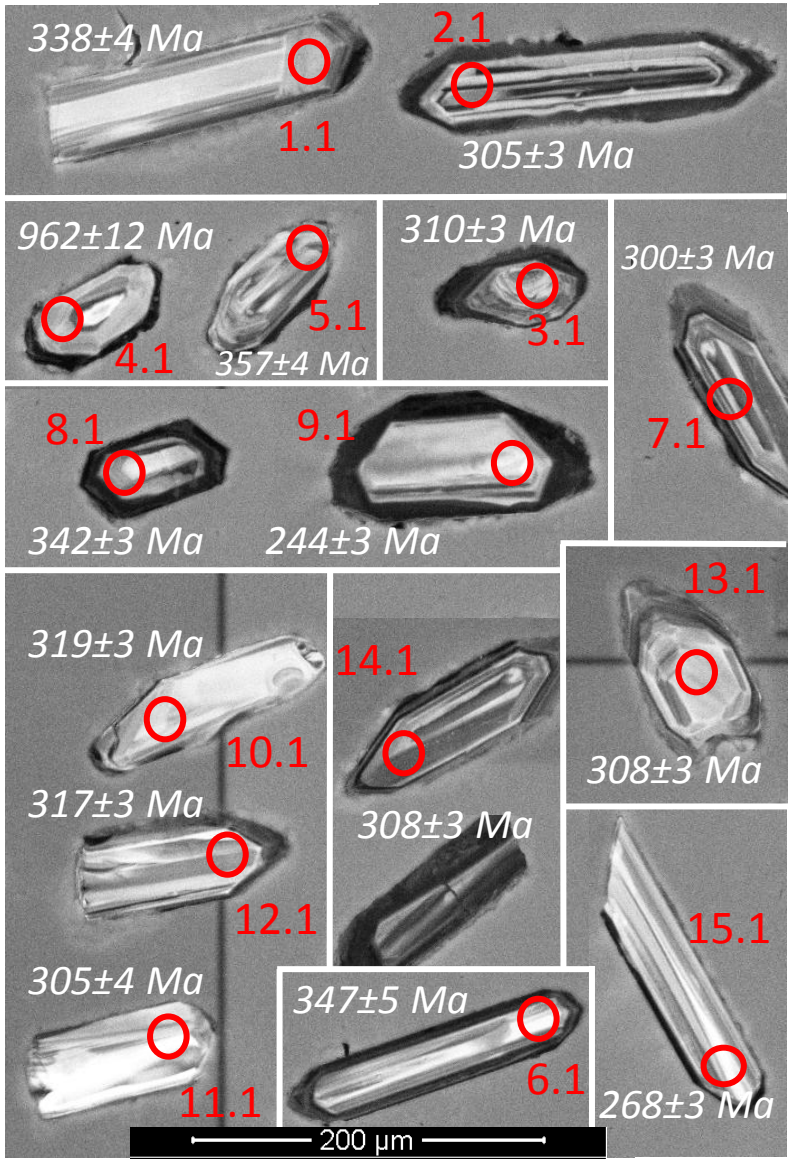
Zircon-based U-Pb geochronology: Monsanto granite

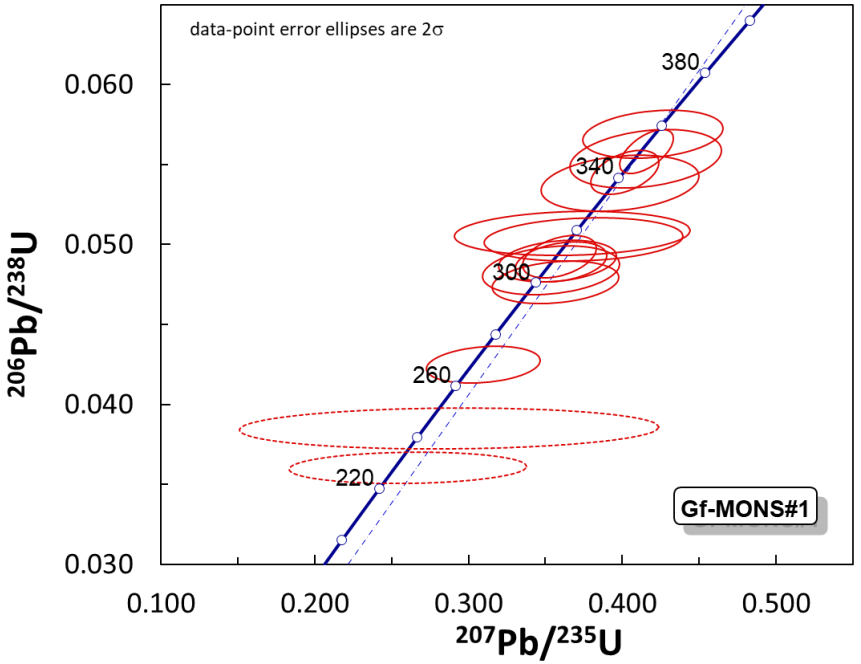


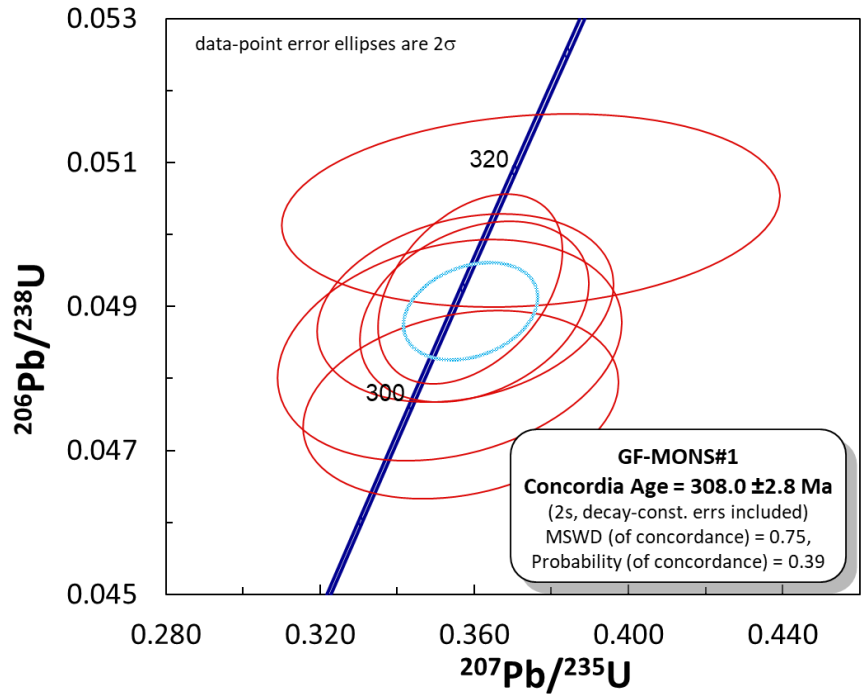




Zircon-based U-Pb geochronology: Monsanto metasomatised facies

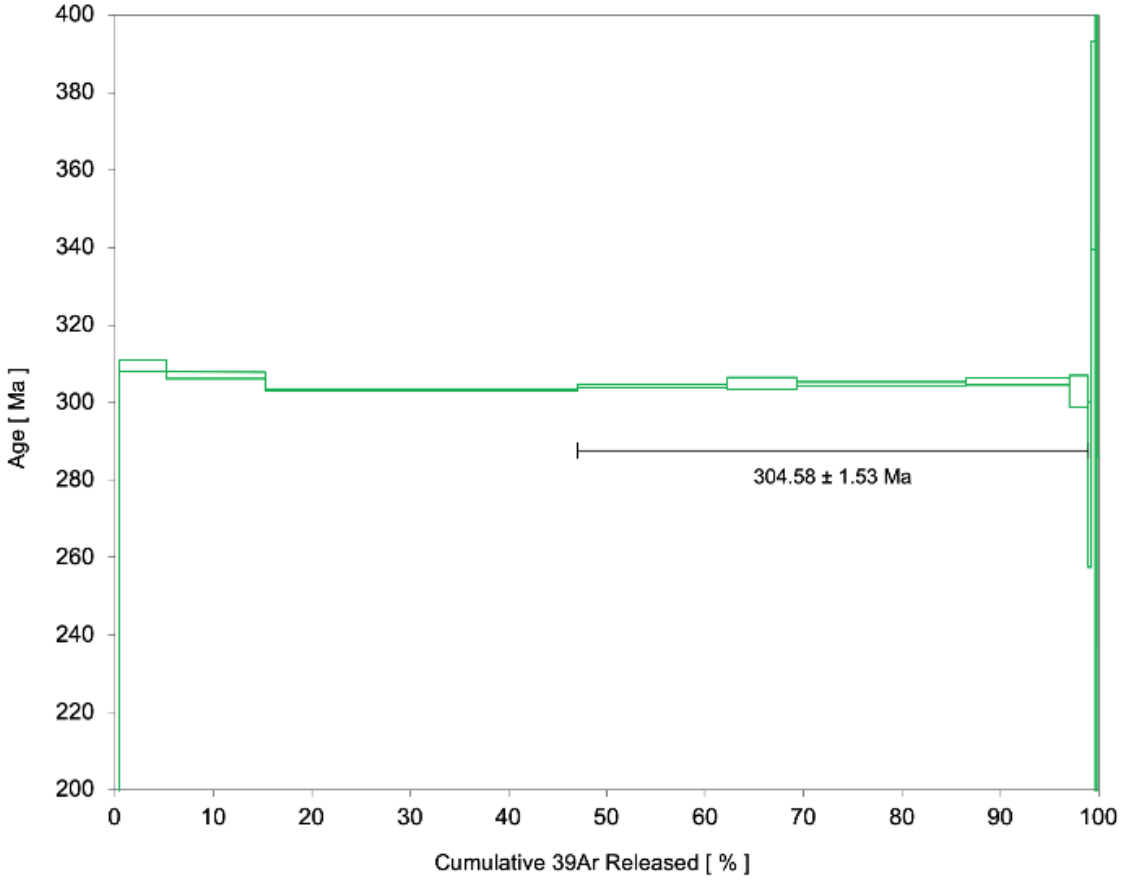




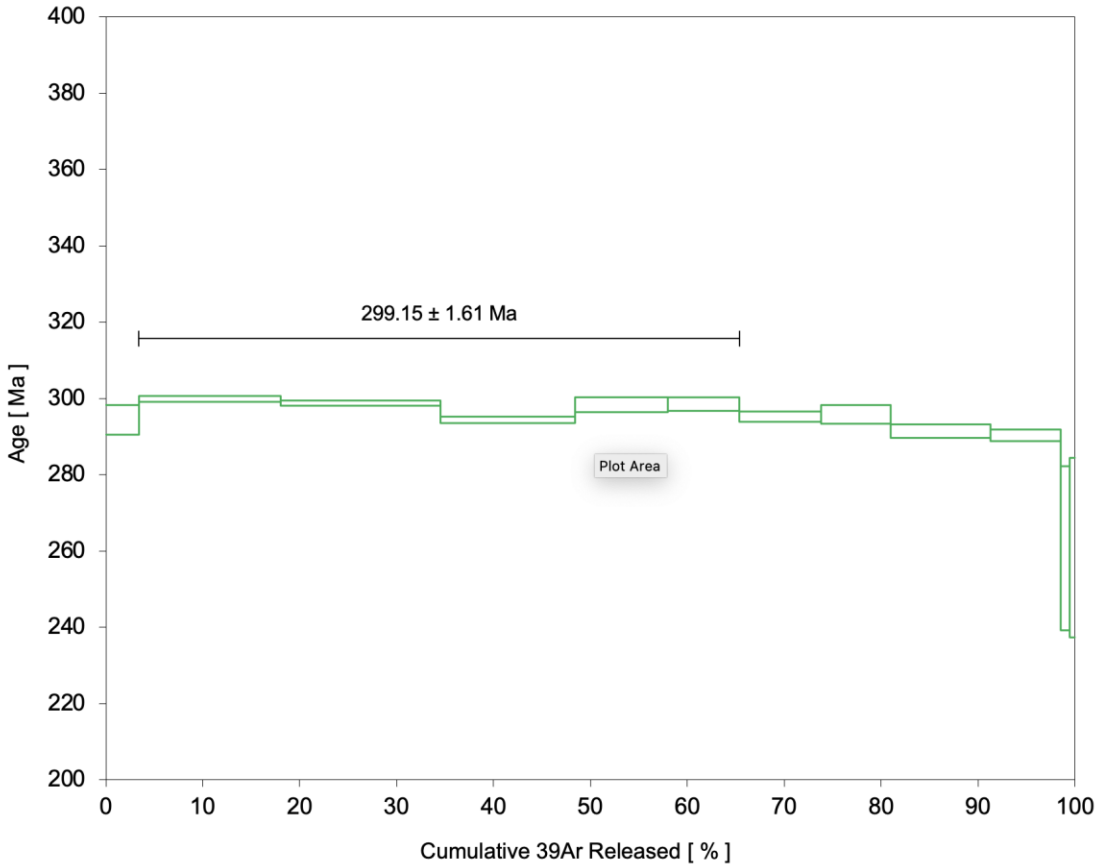


Monsanto granite (G-MONS#2):

Ar/Ar muscovite (plateau) age: 304.6 ± 1.5 Ma

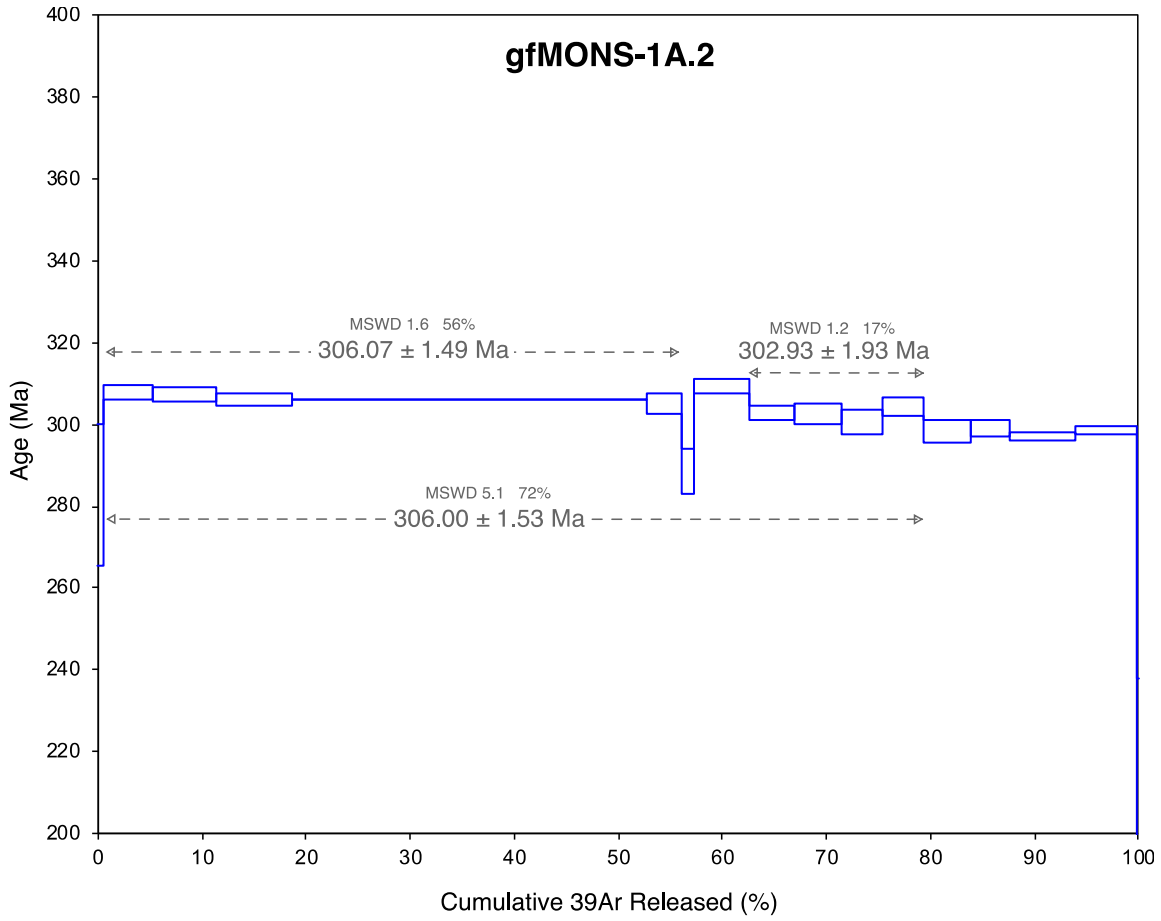


Ar/Ar biotite age: 299.2 ± 1.6 Ma

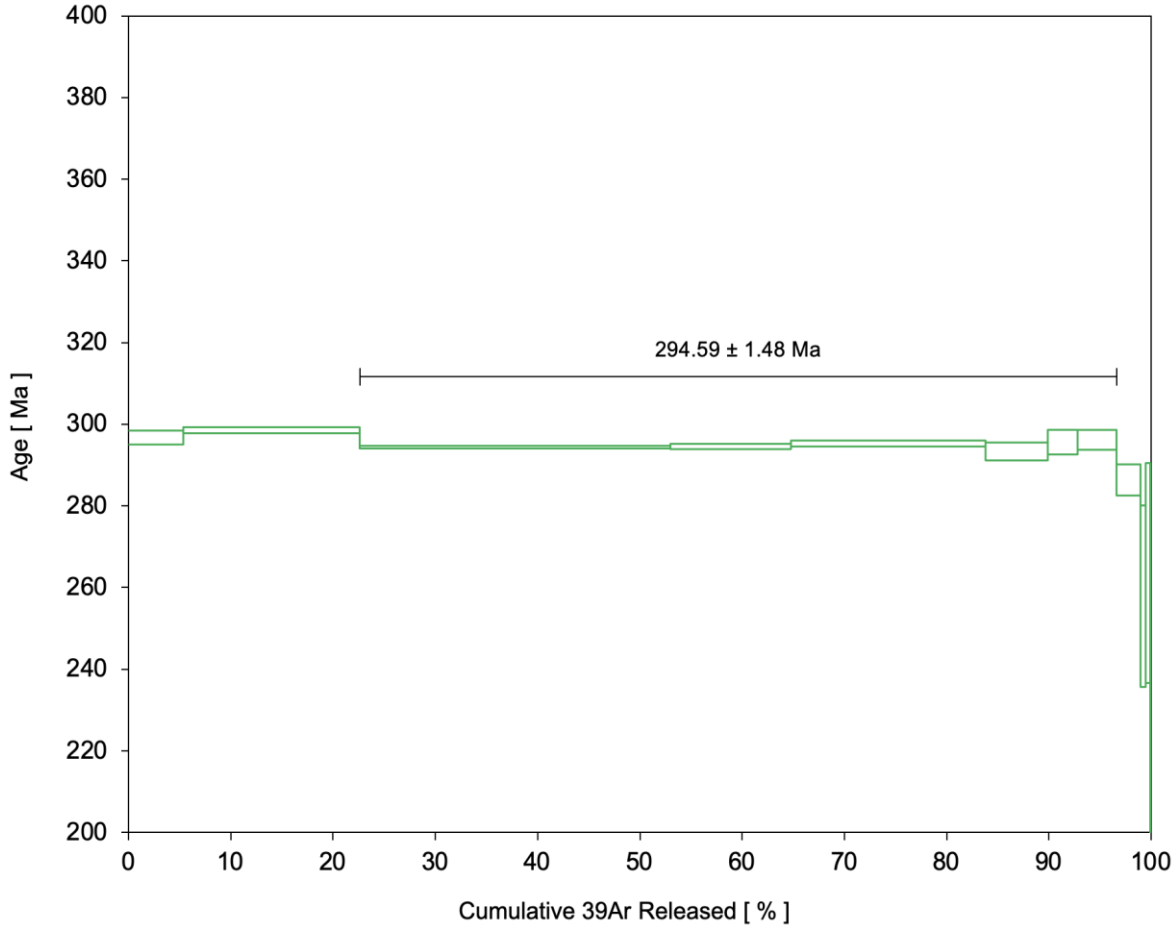


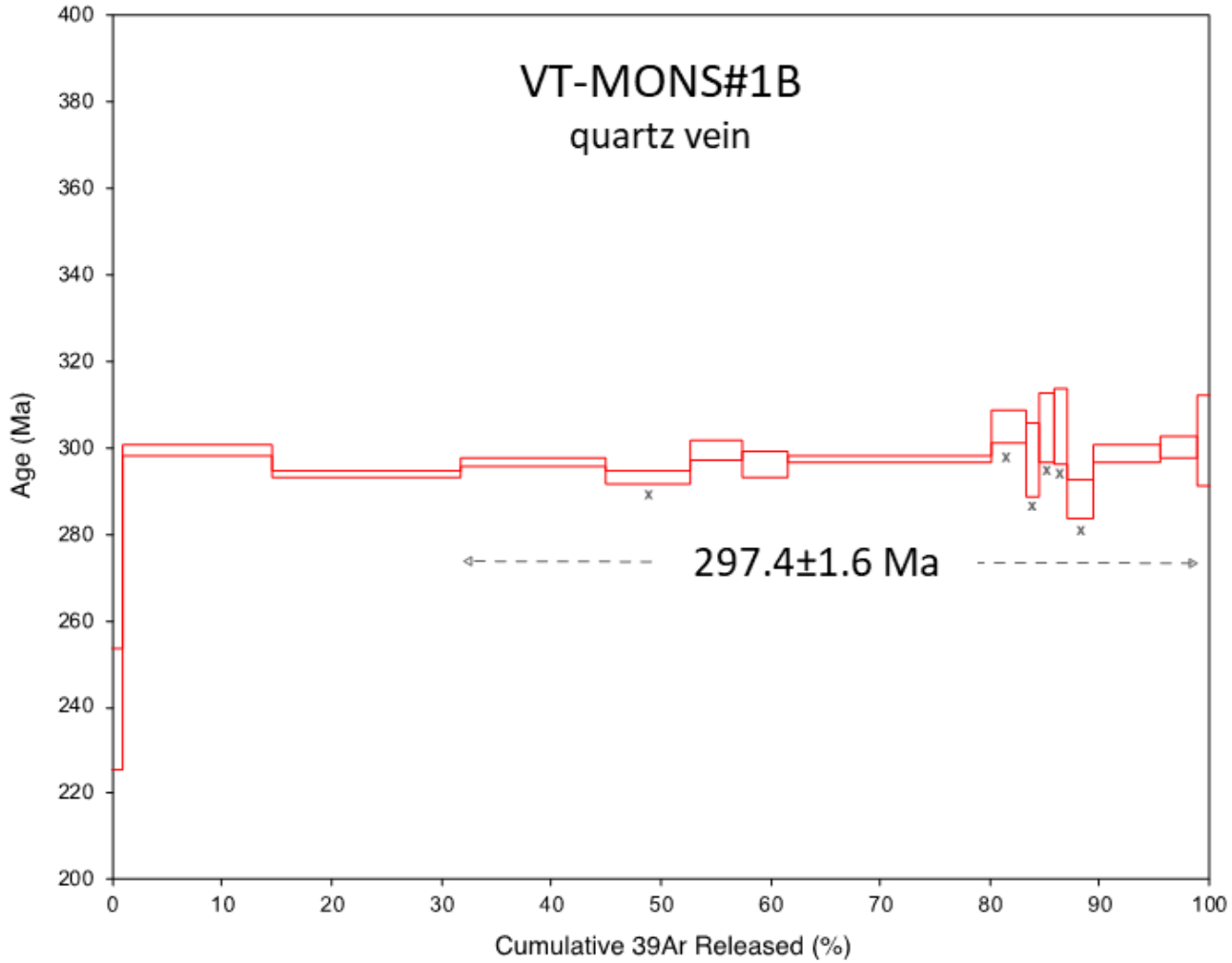
Penamacor-Monsanto pluton: Ar/Ar muscovite (plateau) ages

Pegmatite body: 306.1 ± 1.5 Ma
(G-MONS#1A)



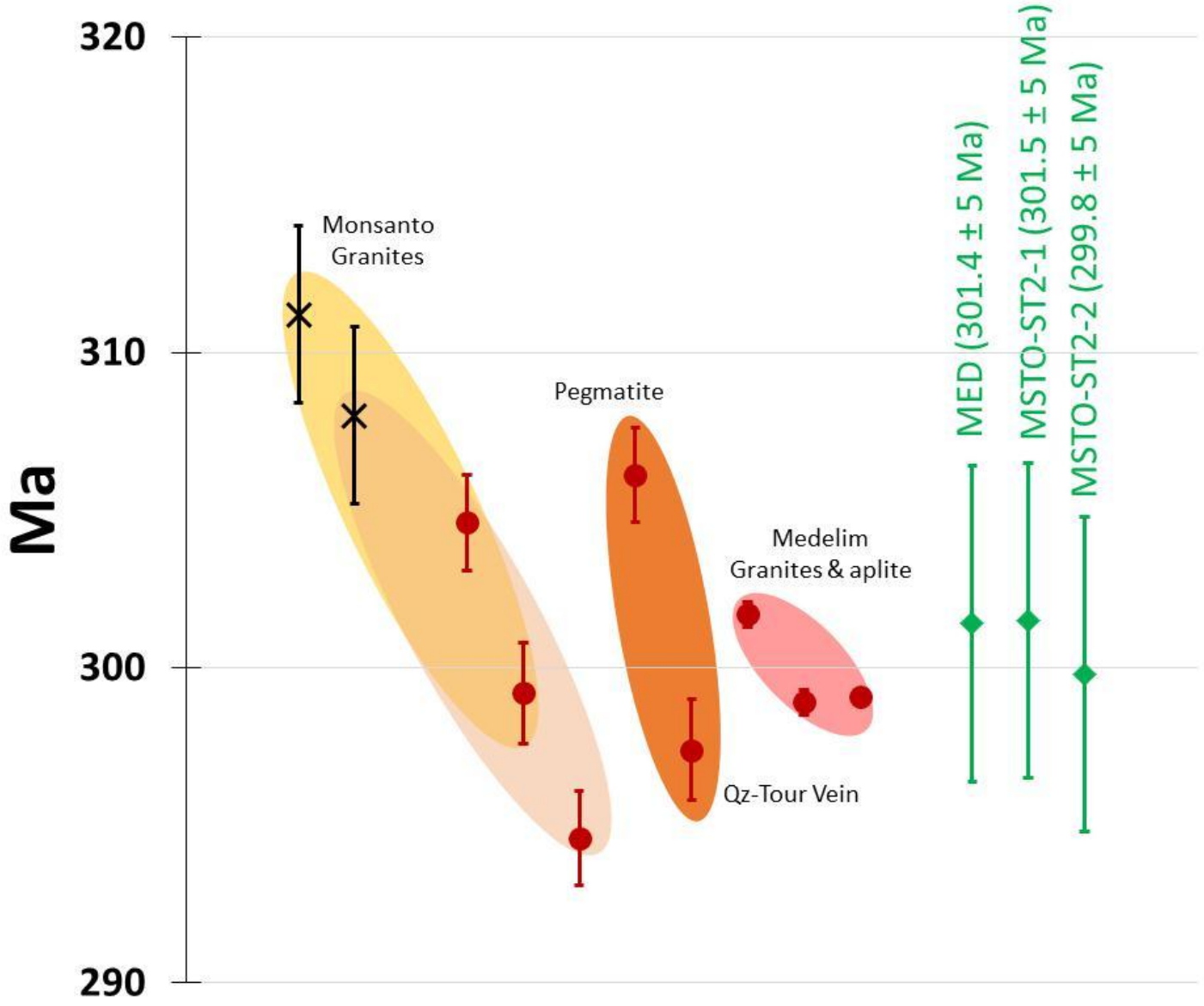
Host metasomatised granite: 294.6 ± 1.5 Ma
(G-MONS#1)





Monsanto: Qz-tourm vein (MONS#1B)

WMA estimate for the muscovite from the quartz-tourmaline vein cutting the metasomatised granite and the pegmatite: 297.4 ± 1.6 Ma



MONSANTO:

***Core Facies** (G-MONS#2)*

- **U-Pb zr (311.2 ± 2.8 Ma)**
- **Ar-Ar bt (299.2 ± 1.6 Ma)**
- **Ar-Ar ms, p.a. (304.6±1.5 Ma)**

***Metasomatised facies** (G-MONS#1)*

- **U-Pb zr (308.0 ± 2.8 Ma)**
- **Ar-Ar ms (294.6 ± 1.5 Ma)**

***Pegmatite** (G-MONS#1A)*

- **Ar-Ar ms (306.1 ± 1.5 Ma)**

Quartz-tourmaline vein (VT-MONS#1B)

- **Ar-Ar ms 297.4 ± 1.6 Ma)**

MEDELIM:

***Evolved facies** (G-MED#1)*

- **Ar-Ar ms (301.7 ± 0.4 Ma)**

***Evolved facies outer domain** (G-MED#2)*

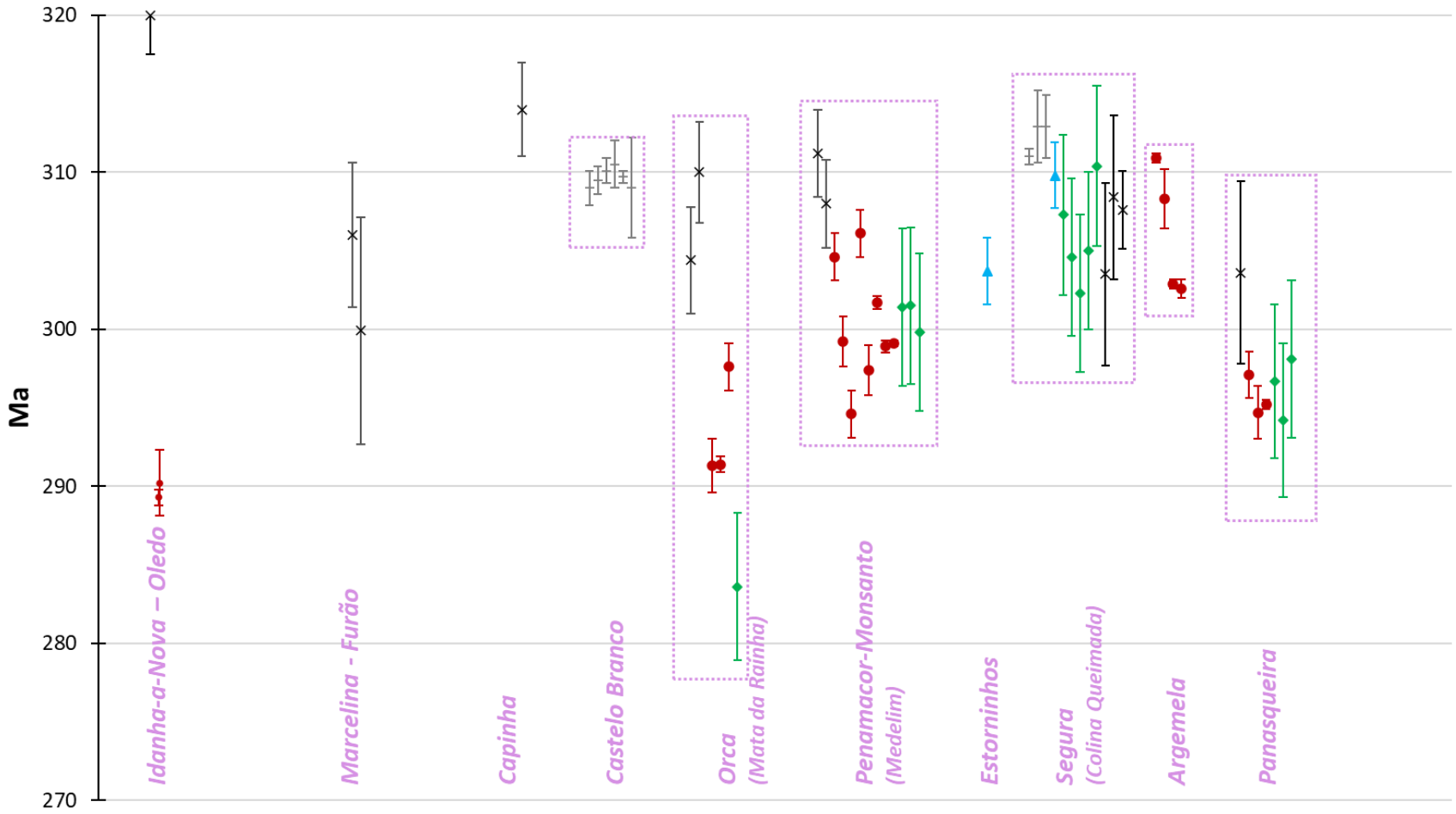
- **Ar-Ar ms (298.9 ± 0.4 Ma)**

***Aplite** (Gf-MED#1)*

- **Ar-Ar md (299.1 ± 0.2 Ma)**

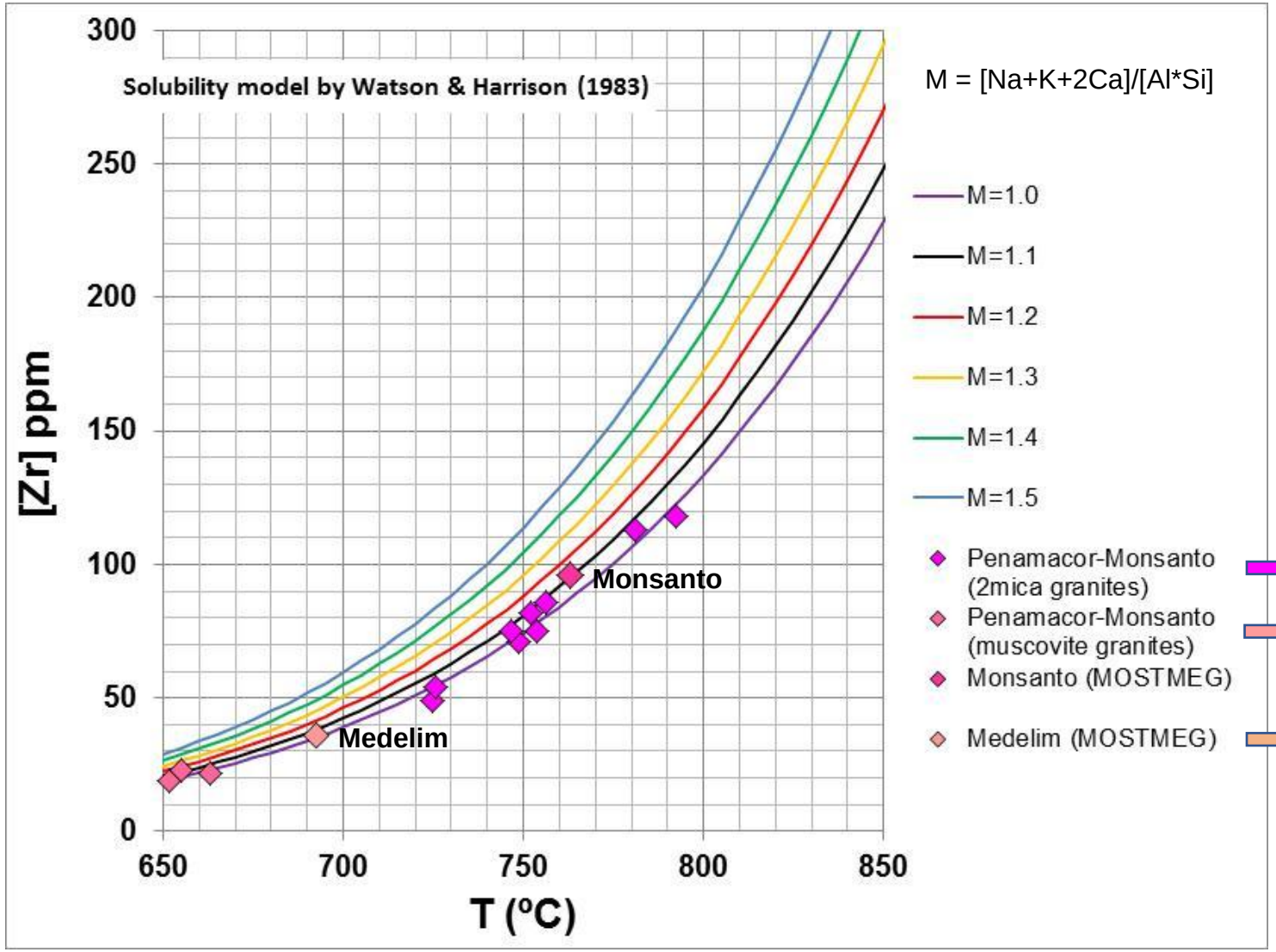
Summary of the geochronological results obtained for granite rocks, aplite-pegmatite bodies and quartz-lodes forming the main Carboniferous systems exposed across the Góis-Panasqueira-Argemela-Segura strip:

- SHRIMP U-Pb in zircon ages and associated errors in black.
- ID-TIMS U-Pb zircon and monazite ages and associated errors in grey bars (data reported *in* Antunes *et al.*, 2008, 2010, 2013).
- LA-ICP-MS U-Pb in zircon and associated errors in blue.
- K-Ar in muscovite and associated errors in green.
- Ar-Ar in muscovite and biotite and associated errors in red.



Penamacor-Monsanto:
geothermometry

Zircon saturation geothermometry (Watson & Harrison, 1983)

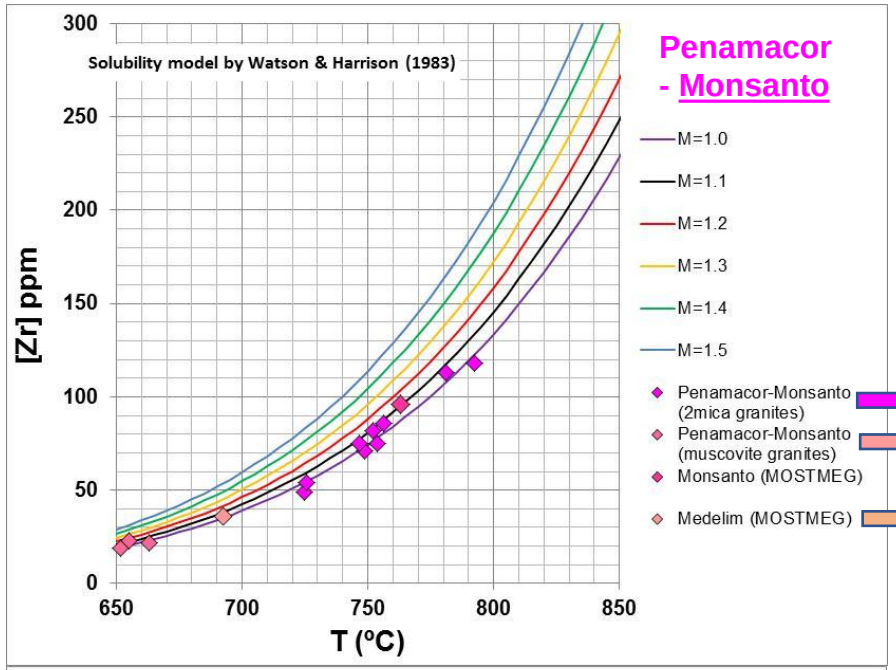


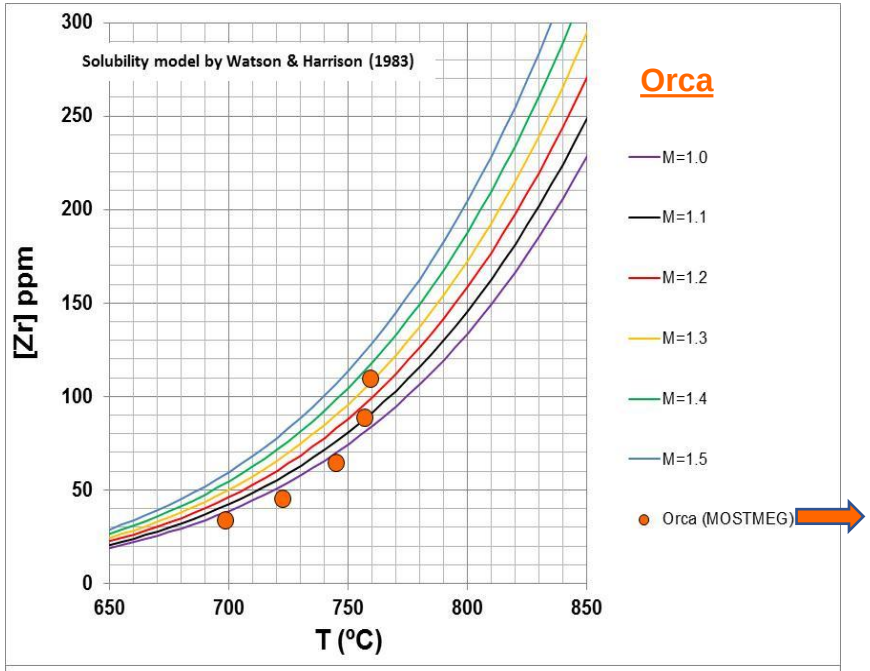
800 – 720ºC (M = 1.0 – 1.1)

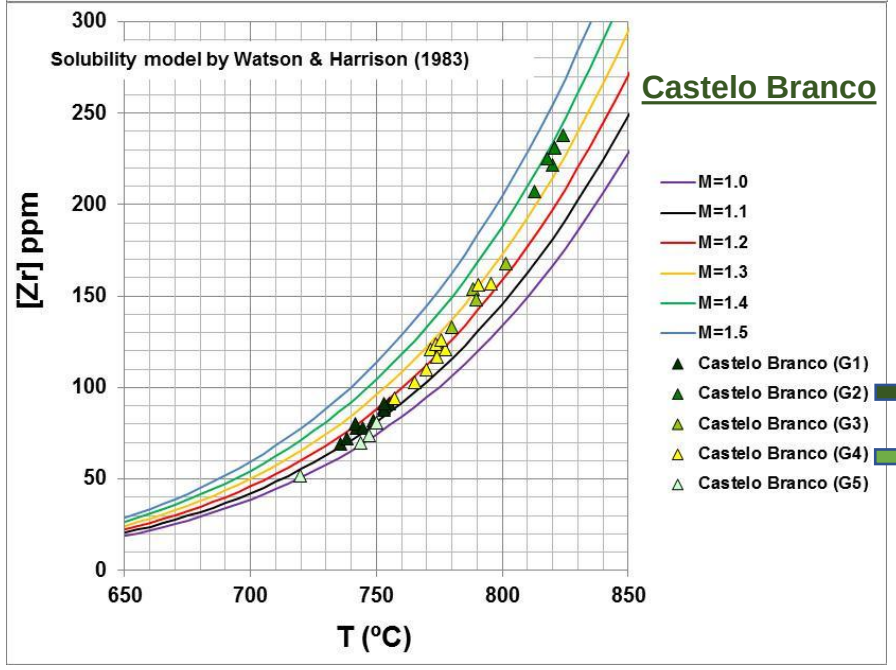
670 – 650ºC (M = 1.0 – 1.1)

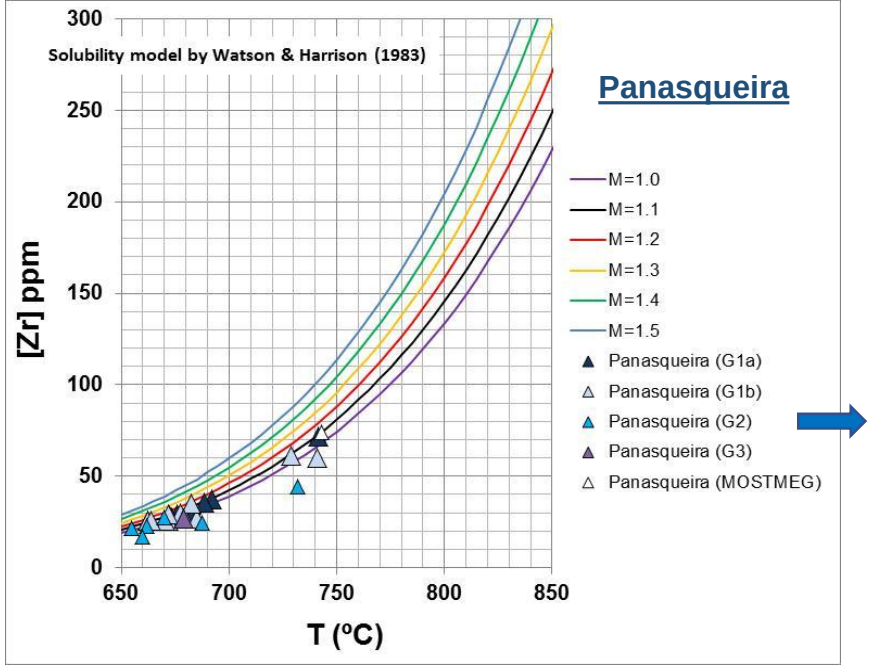
~ 690ºC (M = 1.05)

Zircon saturation geothermometry

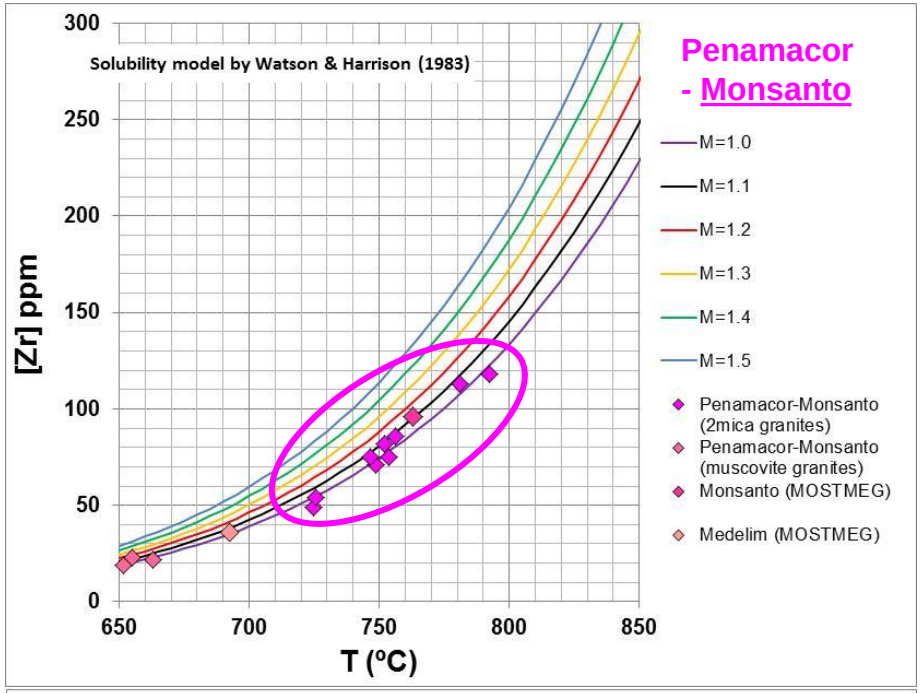


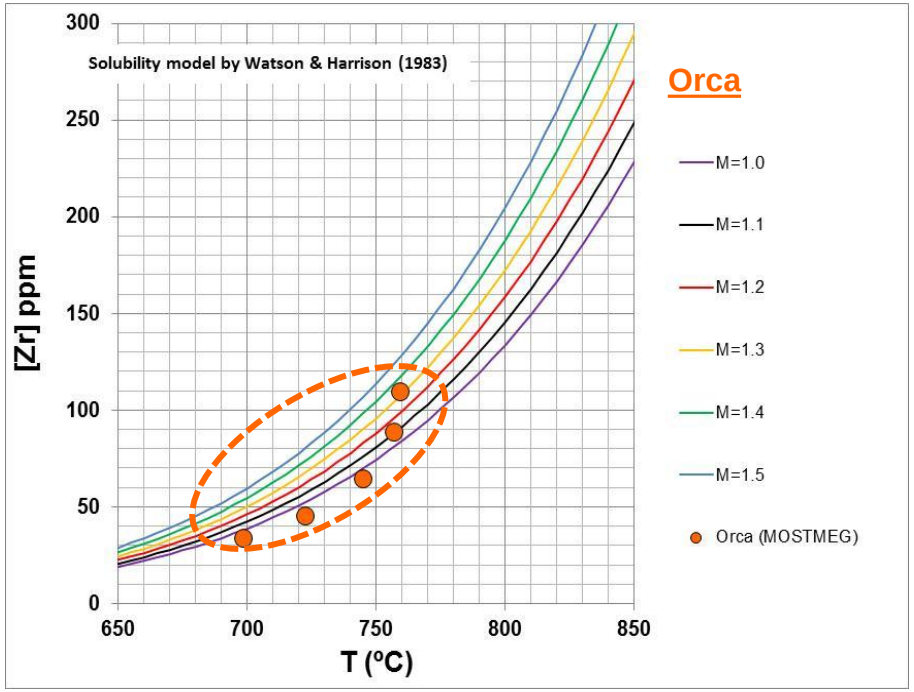


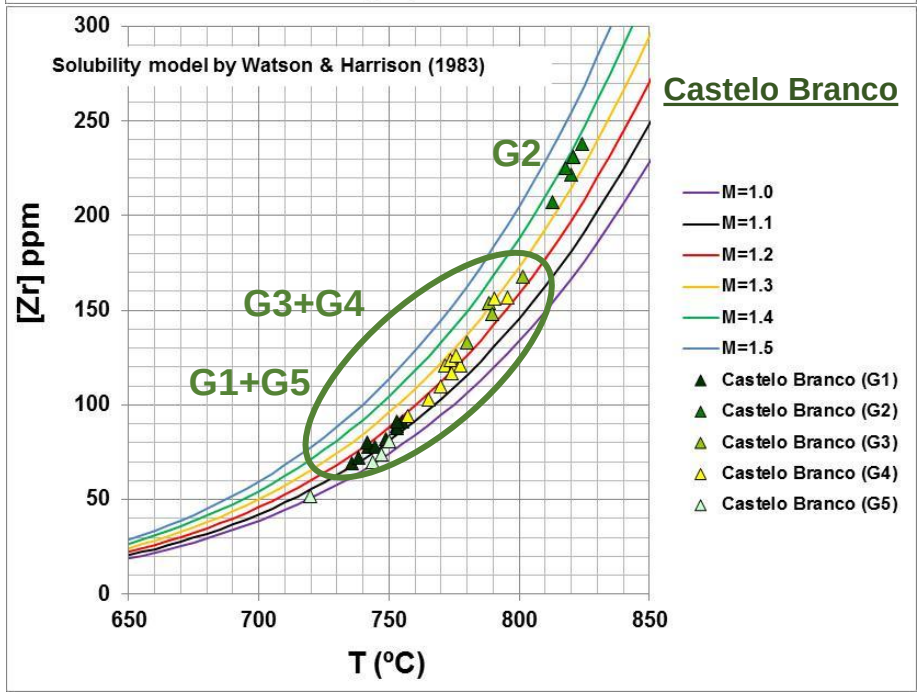


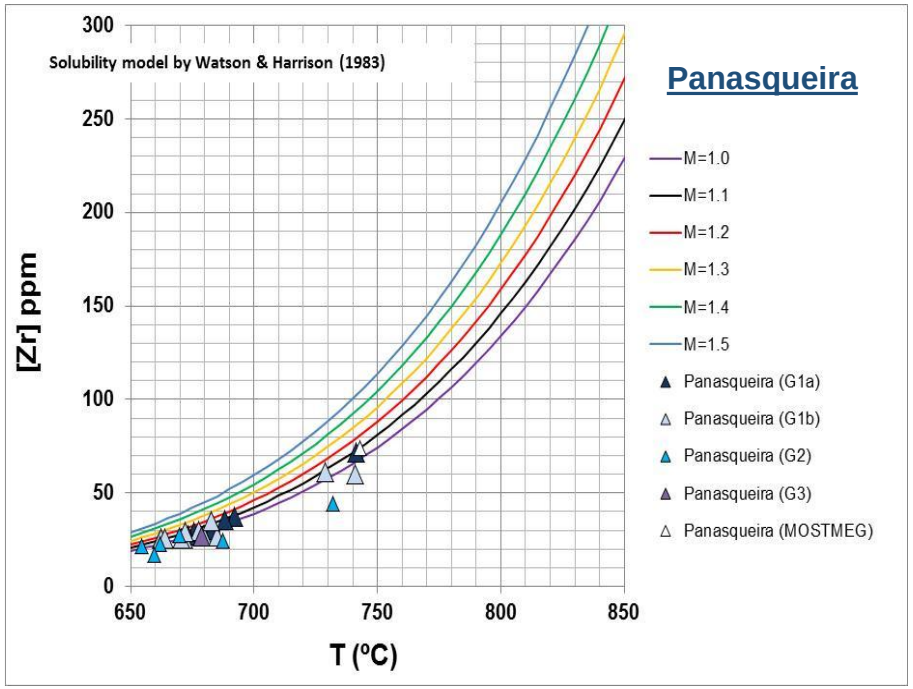


Zircon saturation geothermometry

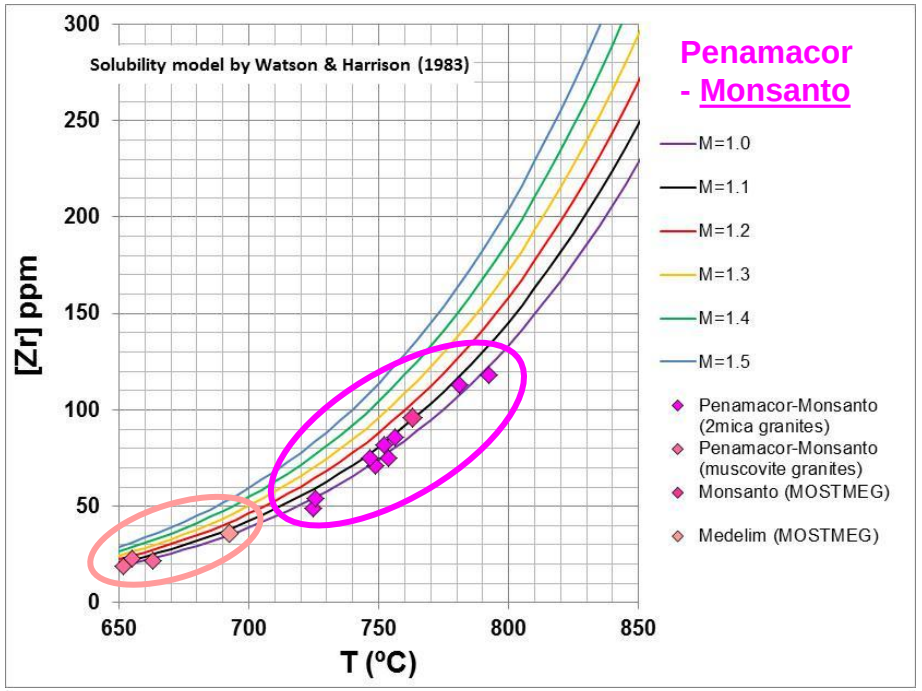


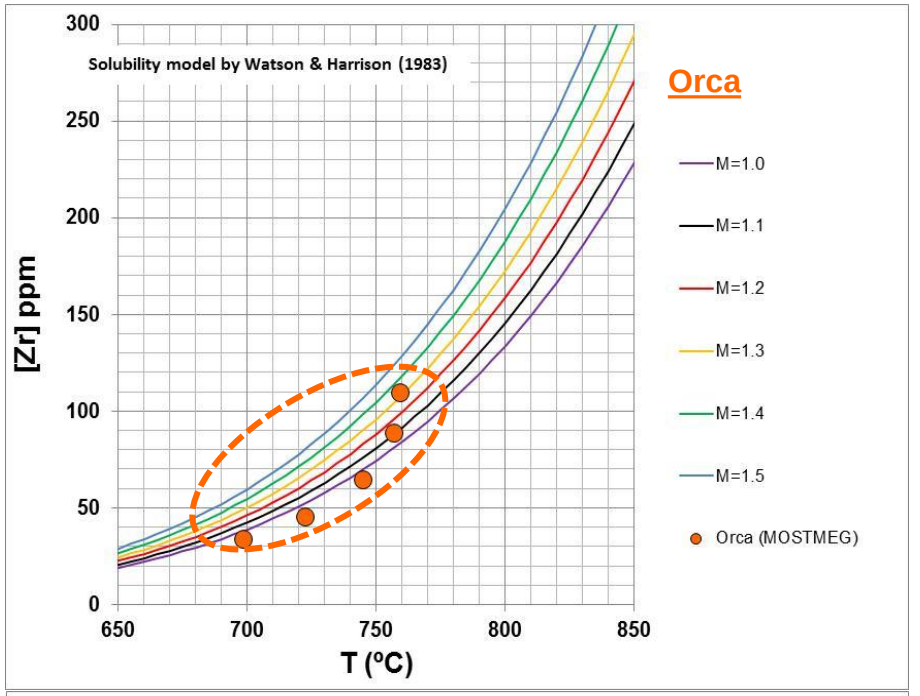


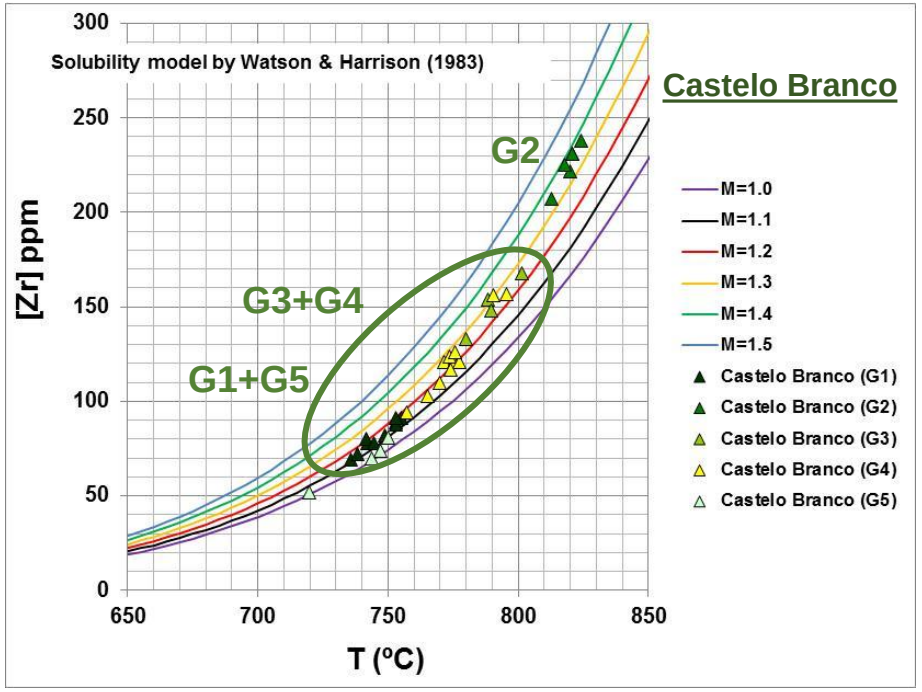


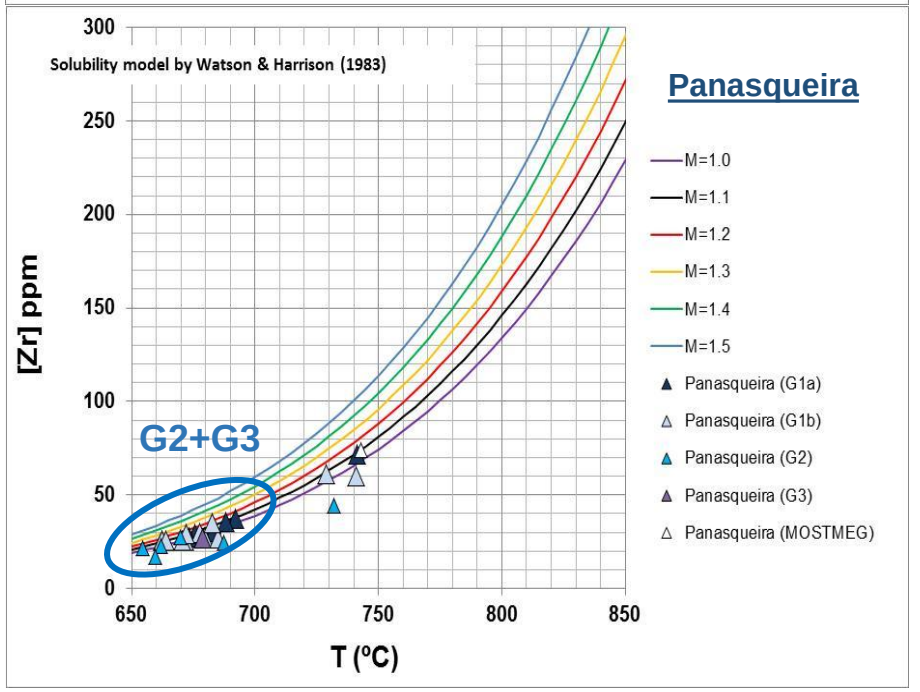


Zircon saturation geothermometry



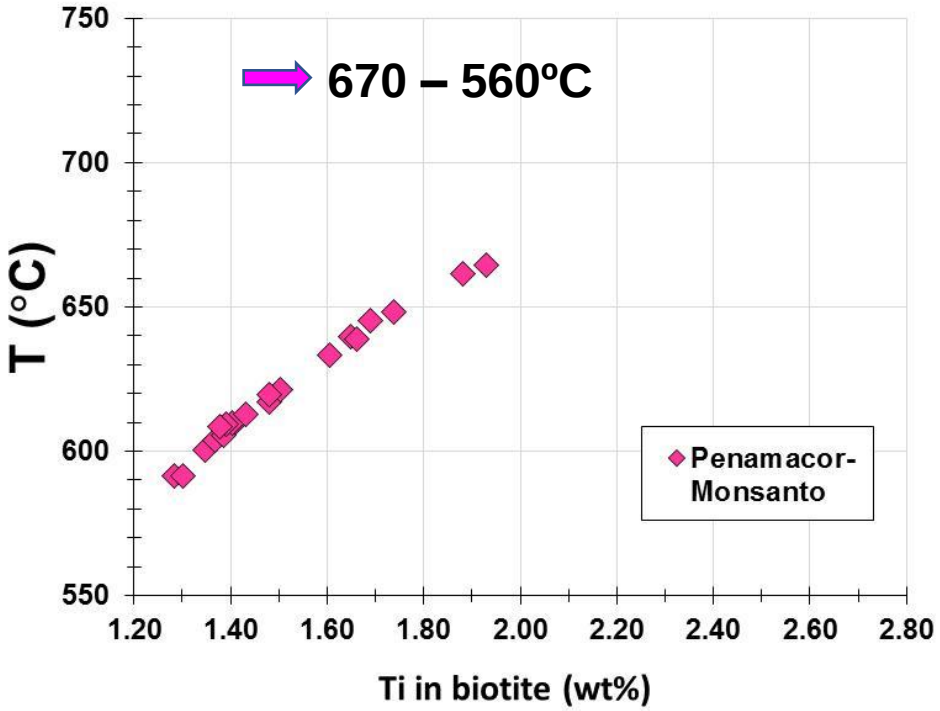


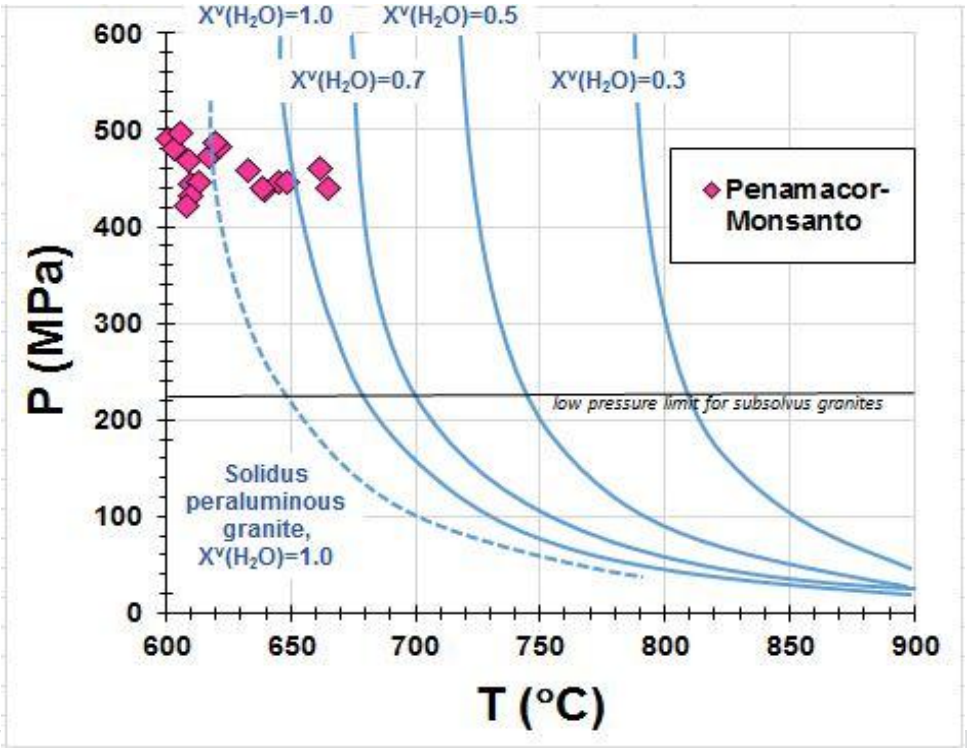




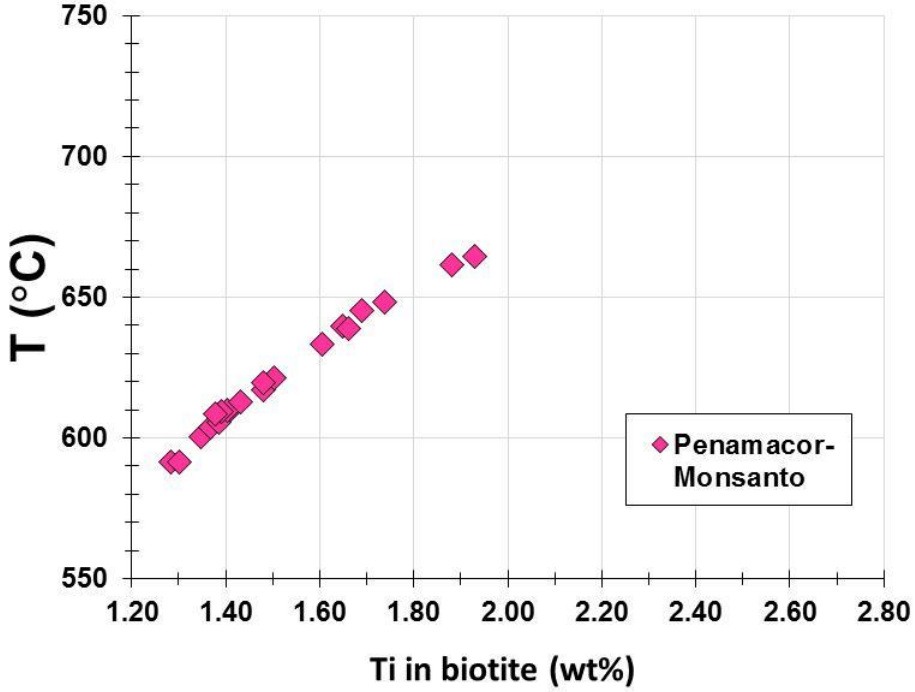
Biotite in two-mica monzogranites: Ti- based geothermometry and Al-based geobarometry

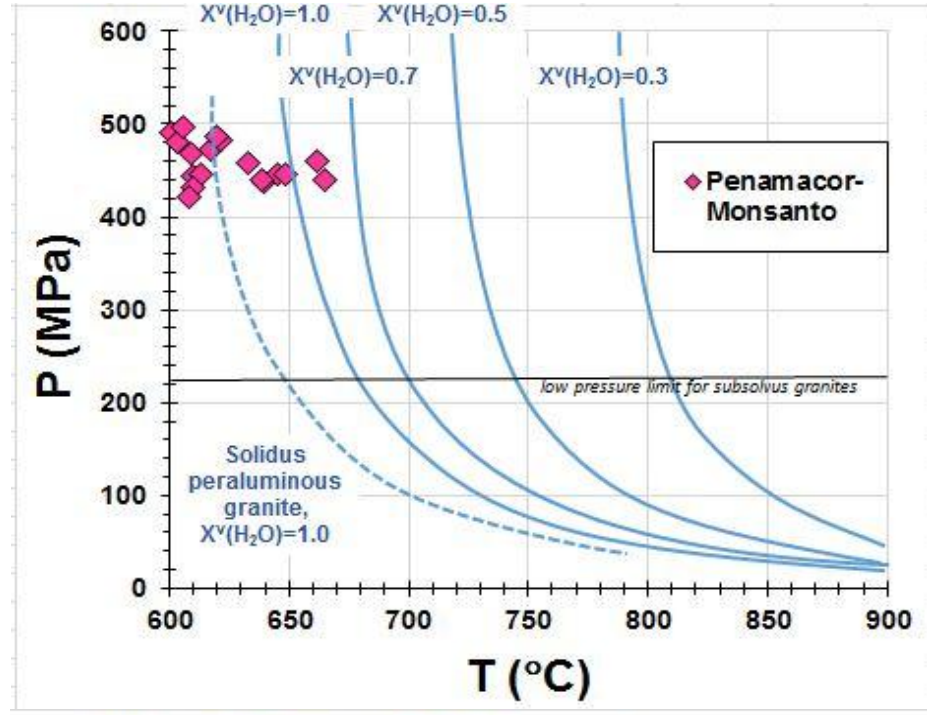
(Henry *et al.*, 2005)

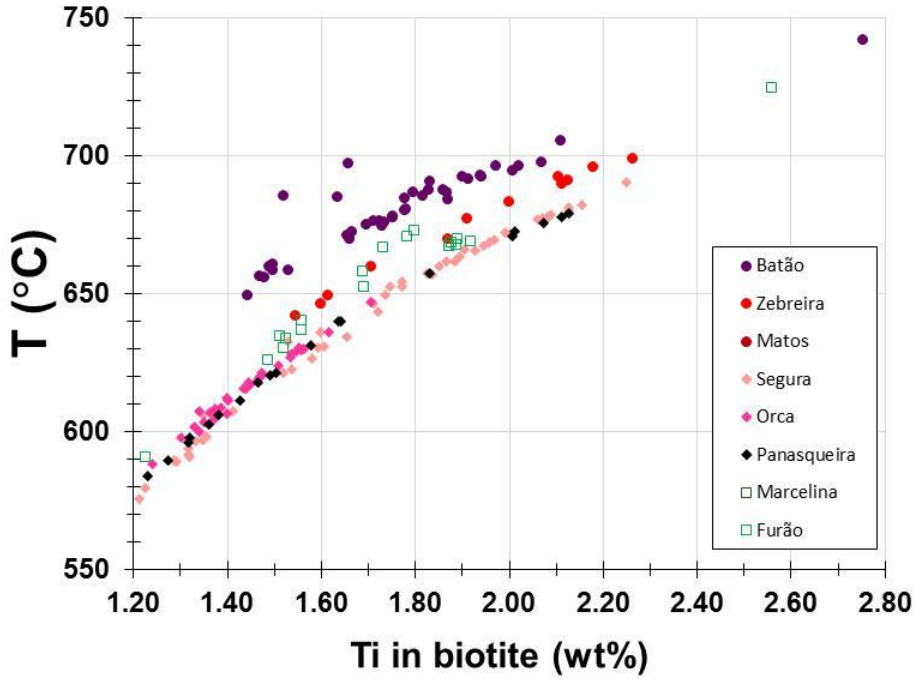


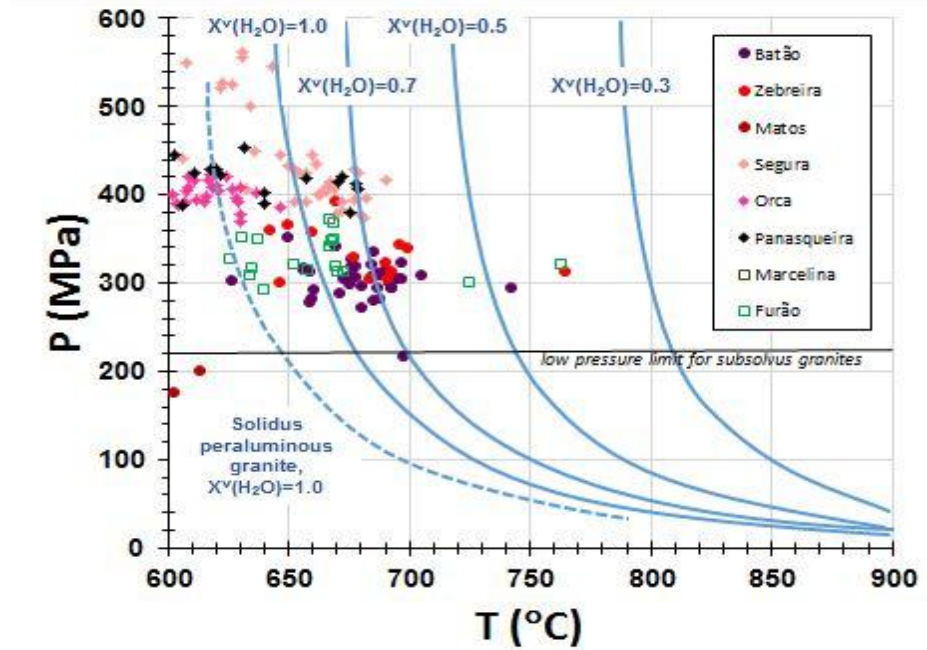


Sample	No. An.	TiO2	Al2O3	F/(F+OH)	Cl/(Cl+F)	Mg/(Mg+Fe)	T (ºC)	sol H_2O wt%	P (MPa)
P-8	10	2.14 - 2.75	19.4 - 20.9	0.019 - 0.022	0.001 - 0.025	0.14 - 0.16	***592 - 640***	8.46 - 8.95	***437 - 495***
P-9	8	1.84 - 3.22	19.4 - 21.0	0.010 - 0.019	< 0.009	0.20 - 0.24	***565 - 665***	8.32 - 9.16	***421 - 526***
P - 32	3	2.47 - 2.77	19.9 - 20.6	0.000	1.000	0.19 - 0.20	***619 - 639***	8.48 - 8.86	***440 - 487***
P-27	2	0.005 - 0.054	19.9 - 20.2	0.020	0.000	0.17 - 0.22	-	894 - 8.98	***496 - 502***
P-28	4	0.01 - 0.11	19.2 - 20.3	0.025 - 0.029	0.000	0.14 - 0.18	-	8.58 - 9.00	***452 - 505***
P-30	1	0.044	19.3	0.022	0.000	0.21	-	8.86	***487***
P-35	3	< 0.075	19.8 - 20.4	0.020 - 0.022	0.000	0.31 - 0.32	-	8.76 - 8.95	***474 - 498***
P-39	4	0.0237 - 0.0548	19.2 - 20.2	0.025 - 0.033	0.000	0.29 - 0.32	-	8.59 - 8.84	***453 - 484***


T (°C)
Ti in biotite (wt%)
Penamacor-Monsanto


$X^v(H_2O)=1.0$
$X^v(H_2O)=0.5$
$X^v(H_2O)=0.7$
$X^v(H_2O)=0.3$
Penamacor-Monsanto
low pressure limit for subsolvus granites
Solidus peraluminous granite, $X^v(H_2O)=1.0$
P (MPa)
T (°C)


T (°C)
Ti in biotite (wt%)
Batão
Zebreira
Matos
Segura
Orca
Panasqueira
Marcelina
Furão


$X^v(H_2O)=1.0$
$X^v(H_2O)=0.5$
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Batão
Zebreira
Matos
Segura
Orca
Panasqueira
Marcelina
Furão
low pressure limit for subsolvus granites
Solidus peraluminous granite, $X^v(H_2O)=1.0$
P (MPa)
T (°C)

The Penamacor-Monsanto granites: main conclusions

- The Penamacor-Monsanto pluton includes tourmaline-bearing two-mica monzogranites and muscovite granites and aplites, as well as some quartz-tourmaline breccias and pegmatite facies in the outer margin.

- Recently-acquired geochronological data indicate the following ages (late- to post-D3):

  - Monsanto: 311±2.8 – 299±1.6 Ma (core facies), 308±2.8 – 295±1.5 Ma (metasomatized facies), 306±1.5 Ma (pegmatite) and 297±1.6 Ma (quartz-tourmaline vein)
  - Medelim: 302±0.4 - 299±0.4 Ma (evolved facies) and 299±0.2 Ma (aplite).

- Geothermometric estimations based on Zr-saturation yield temperatures in the order of 800-720ºC for the two-mica monzogranites and 670-650ºC for the muscovite granites.

- Geothermometric estimations based on Ti contents in biotite yield rather lower temperatures, 670-560ºC, for the temperature of crystallization of biotite in two-mica monzogranites.

- Geobarometric estimations based on the Al contents in biotite suggest pressures of 530 – 420 MPa.

- The same geothermobarometric estimates indicate the amount of water dissolved in these granitic rocks is rather high, 8.3 – 9.2 wt.%.


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Thank you!