Quantifier l'altération dans un VMS métamorphisé au grade des amphibolites, l'exemple du dépôt de Coulon

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Consorem projects

2013-04, 2014-01 – Altered rocks metamorphosed to high-grade

2015-06 – Metamorphosed gold deposits

2016-07 – Methods for the quantification of hydrothermal alteration

Publication

The Coulon deposit: quantifying alteration in volcanogenic massive sulphide systems modified by amphibolite-facies metamorphism

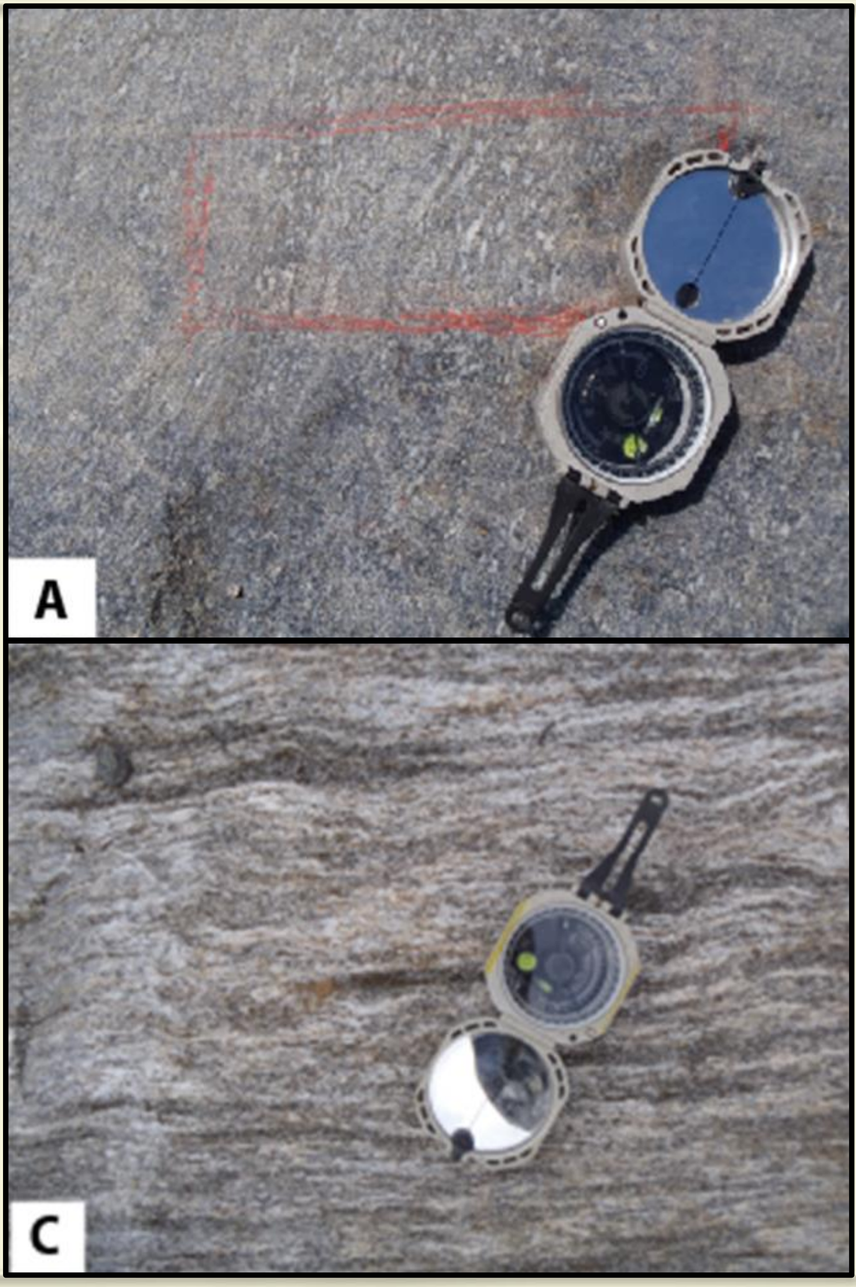
Lucie Mathieu, Rose-Anne Bouchard, Vital Pearson, and Réal Daigneault

(Mathieu et al. 2016b)

Quantifying alteration in challenging areas

Coulon VMS

- High-grade metamorphism

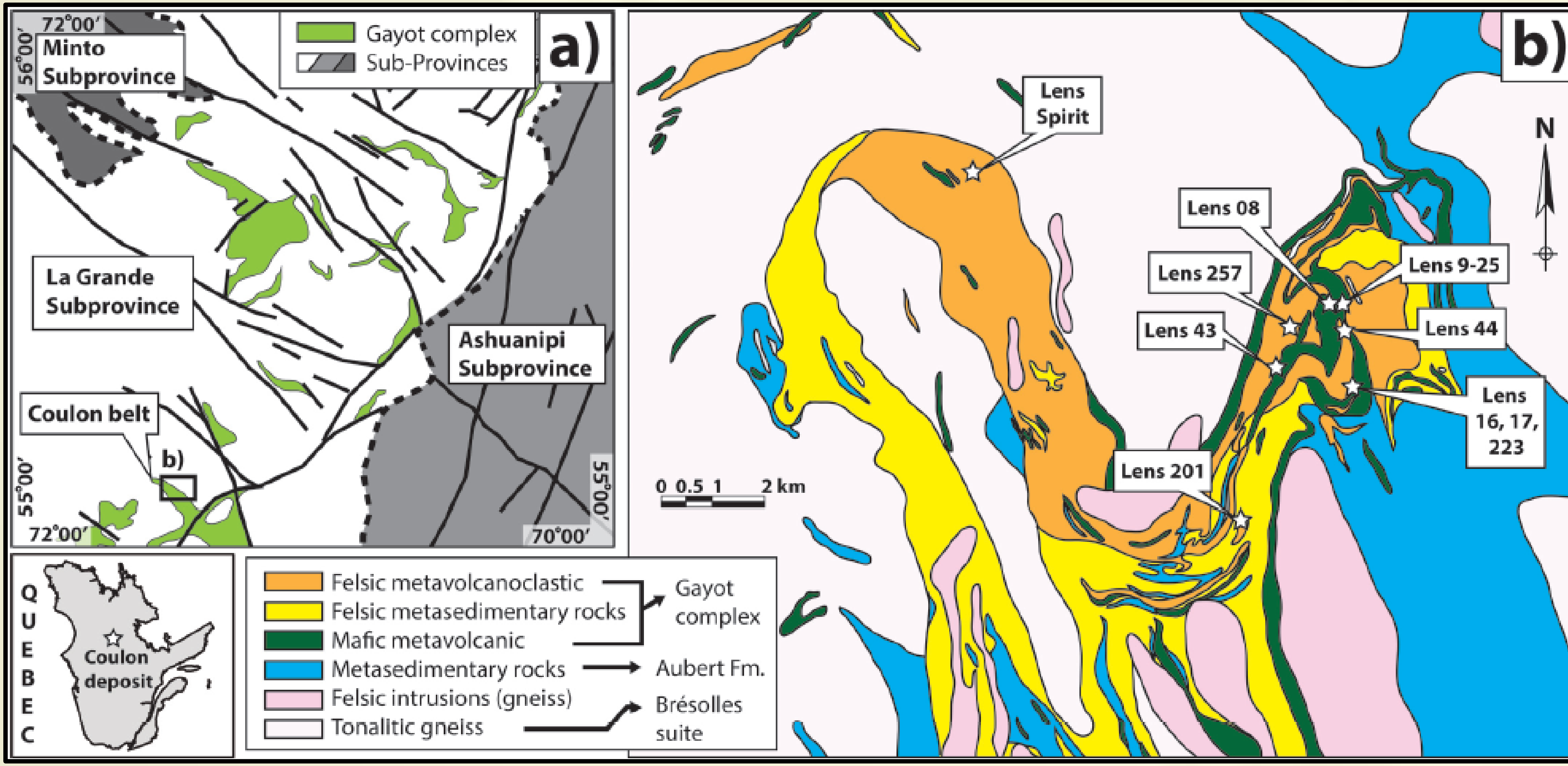


R.A. Bouchard (M.Sc, UQAC)

Coulon VMS

Coulon deposit – La Grande Sub-Province, James Bay area

Upper amphibolite facies



Mathieu et al. 2016b (maps adapted from Gosselin and Simard 2001, Tracy et al. 2009, Savard et al. 2013)

Coulon VMS

OSISKO MINING

Osisko dataset
n = 5583
Five traces analysed

+ 38 thin sections (R.A. Bouchard, M.Sc – UQAC)

Table 1. Averaged chemical analyses of the Osisko database.

	Altered rhyolite		Altered dacite		Altered andesite		Altered basalt	
	Mean	St.d.	Mean	St.d.	Mean	St.d.	Mean	St.d.
SiO_2	74.11	7.57	63.24	4.39	59.84	3.20	53.43	2.67
TiO_2	0.20	0.09	0.53	0.11	0.94	0.16	1.28	0.28
Al_2O_3	11.98	1.86	14.66	1.24	15.53	1.08	15.79	1.00
FeO_T	3.25	2.68	6.26	2.46	7.70	1.24	10.69	1.28
MgO	2.88	3.69	3.96	2.32	4.55	2.02	5.64	1.88
MnO	0.05	0.05	0.09	0.06	0.11	0.03	0.17	0.04
CaO	1.03	1.54	3.13	1.34	3.52	1.70	6.31	2.28
Na_2O	1.59	1.16	3.04	0.91	3.79	1.13	3.23	0.92
K_2O	2.56	1.26	2.49	0.76	1.57	0.85	0.90	0.71
P_2O_5	0.02	0.02	0.15	0.06	0.19	0.07	0.22	0.07
LOI	1.27	1.64	1.05	0.82	0.87	0.78	0.66	0.68
Cr	43.41	119.00	171.52	195.31	57.75	173.47	84.90	125.36
Ba	395.25	309.71	557.43	246.41	376.26	269.28	233.33	142.66
Zr	251.31	64.09	154.15	41.51	171.74	31.54	136.58	39.43
Sr	41.69	84.60	277.90	200.66	179.21	167.07	172.48	84.35
Y	49.36	19.11	32.89	14.20	28.79	8.47	27.08	9.11

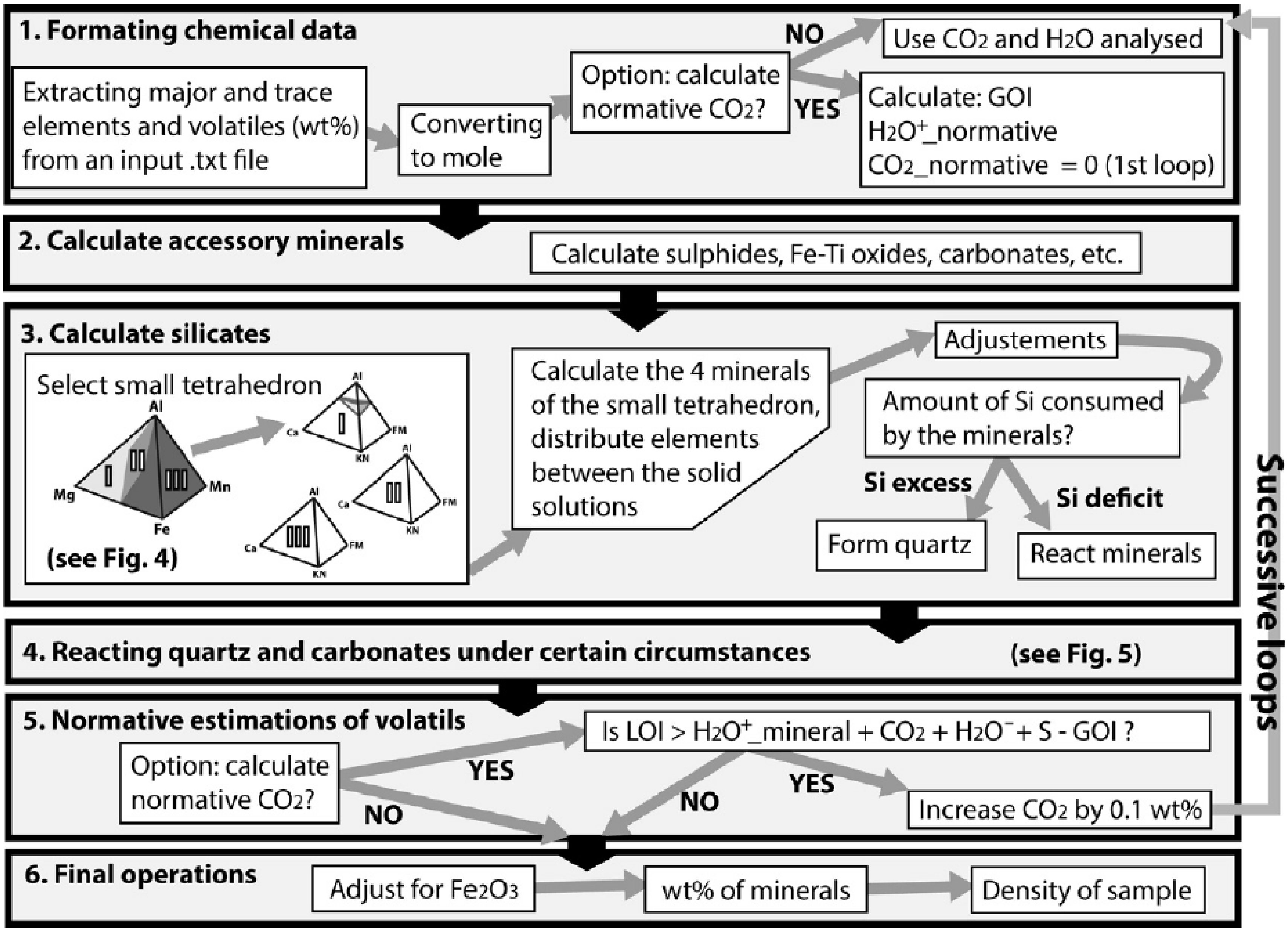
Note: Values for SiO_2 to P_2O_5 in wt.% and for Cr to Y in ppm. St.d., standard deviation.

Mathieu et al. (2016b)

Alteration quantified with:

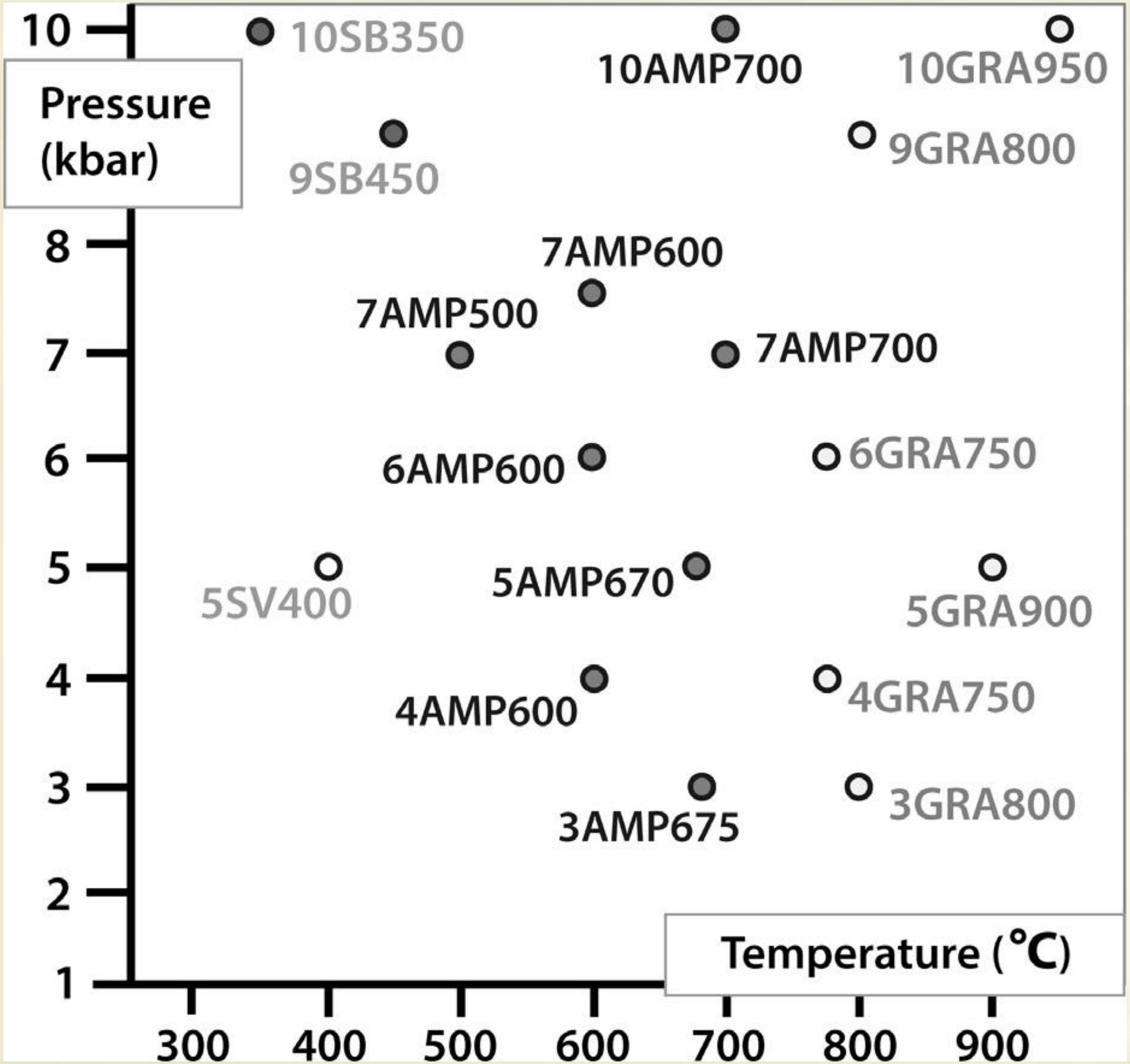
- CONSONORM_HG (Mathieu et al. 2016a)
- Mass balance (Gresens 1967) with modelled precursor (Trépanier et al. 2016)

Coulon - #1. CONSONORM_HG



Mathieu et al. (2016a)

Coulon - #1. CONSONORM_HG

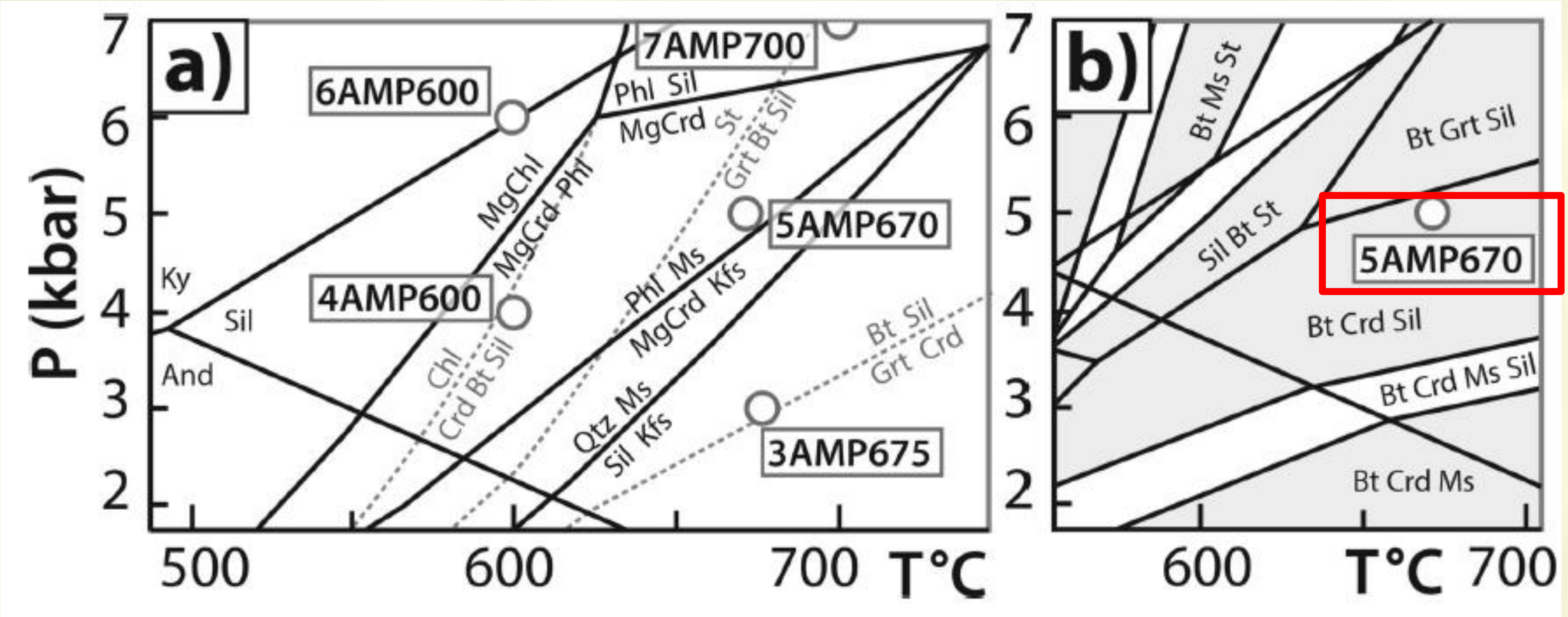


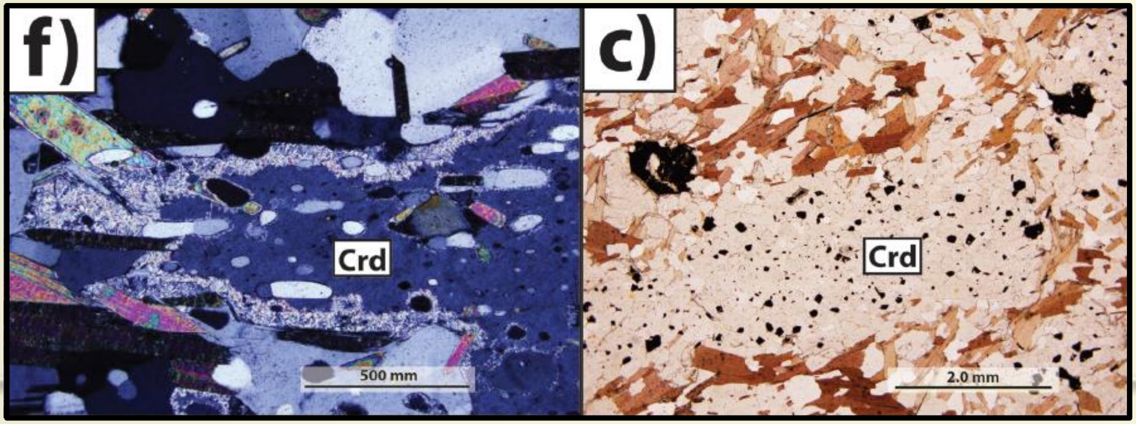
Mathieu et al. (2016a)

Coulon - #1. CONSONORM_HG

KFASH (dashed) and KMASH (solid) reactions (after Spear and Cheney 1989)

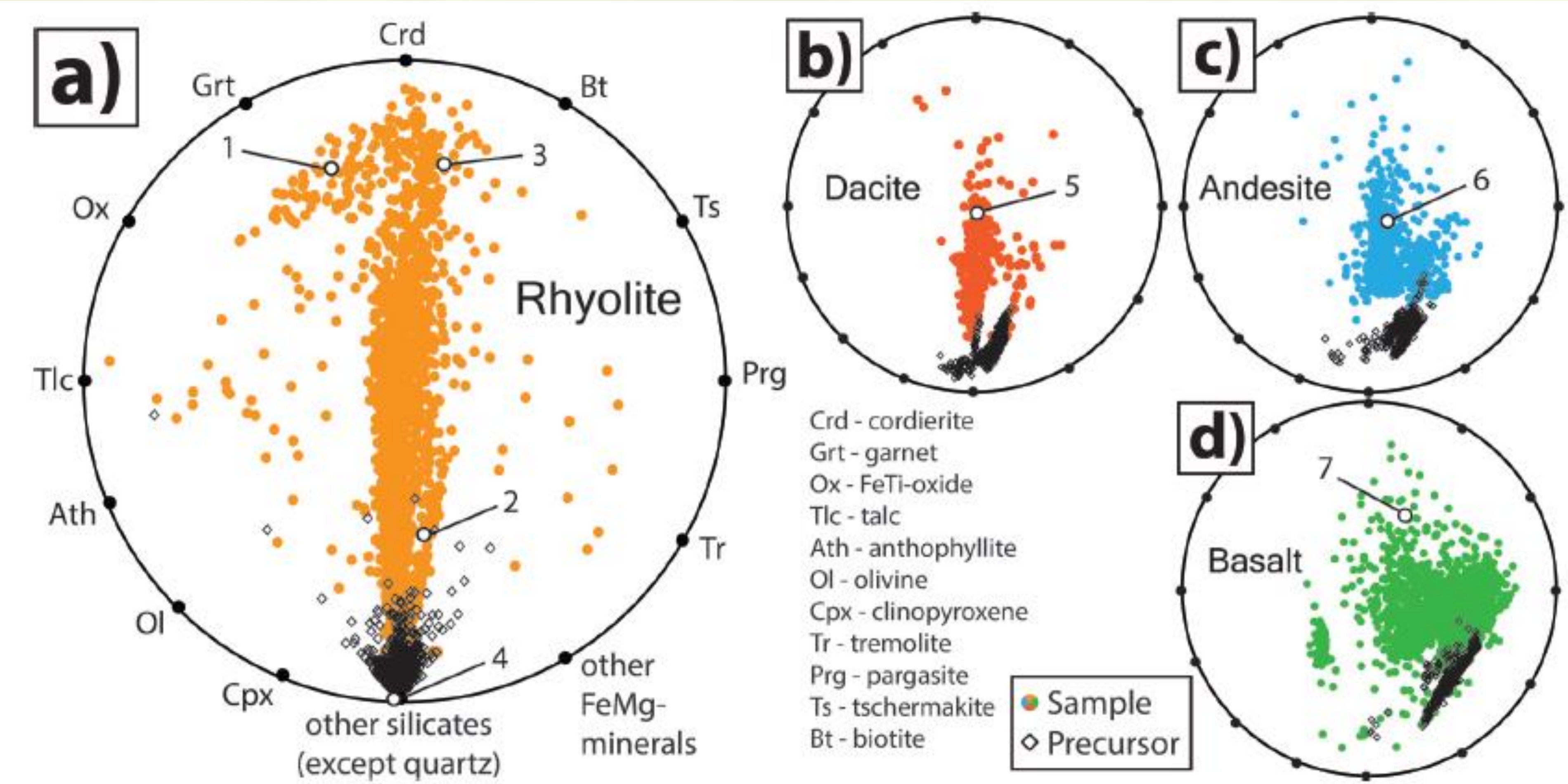
KFMASH pseudosection (Mesger and Régnier 2016)





Pictures: Cordierite-enriched rocks of Coulon

Coulon - #1. CONSONORM_HG



$$\text{Index\_FeMg} = 100(\text{cordierite} + \text{biotite} + \text{olivine} + \text{talc} + \text{anthophyllite})/(\text{sum of all silicates} - \text{quartz})$$

Coulon - #2. Mass balance

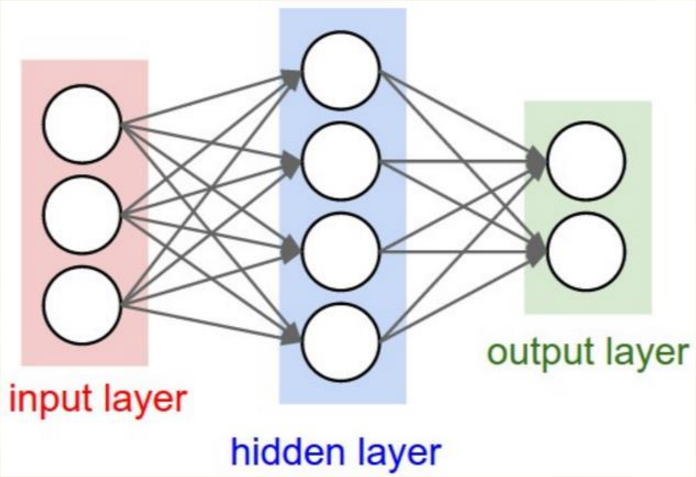
Calculated using mass transfer equations (Gresens 1967)

Requires: 1. Precursor (fresh rock)

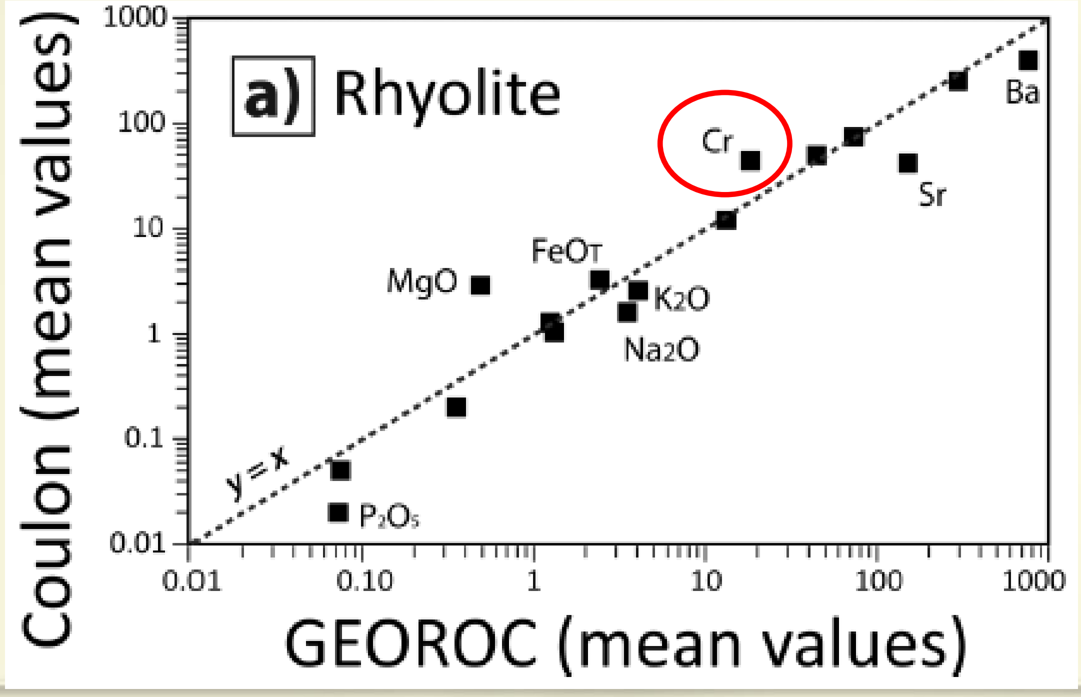
- Model (Trépanier et al. 2016)

Requires: 2. Immobile elements

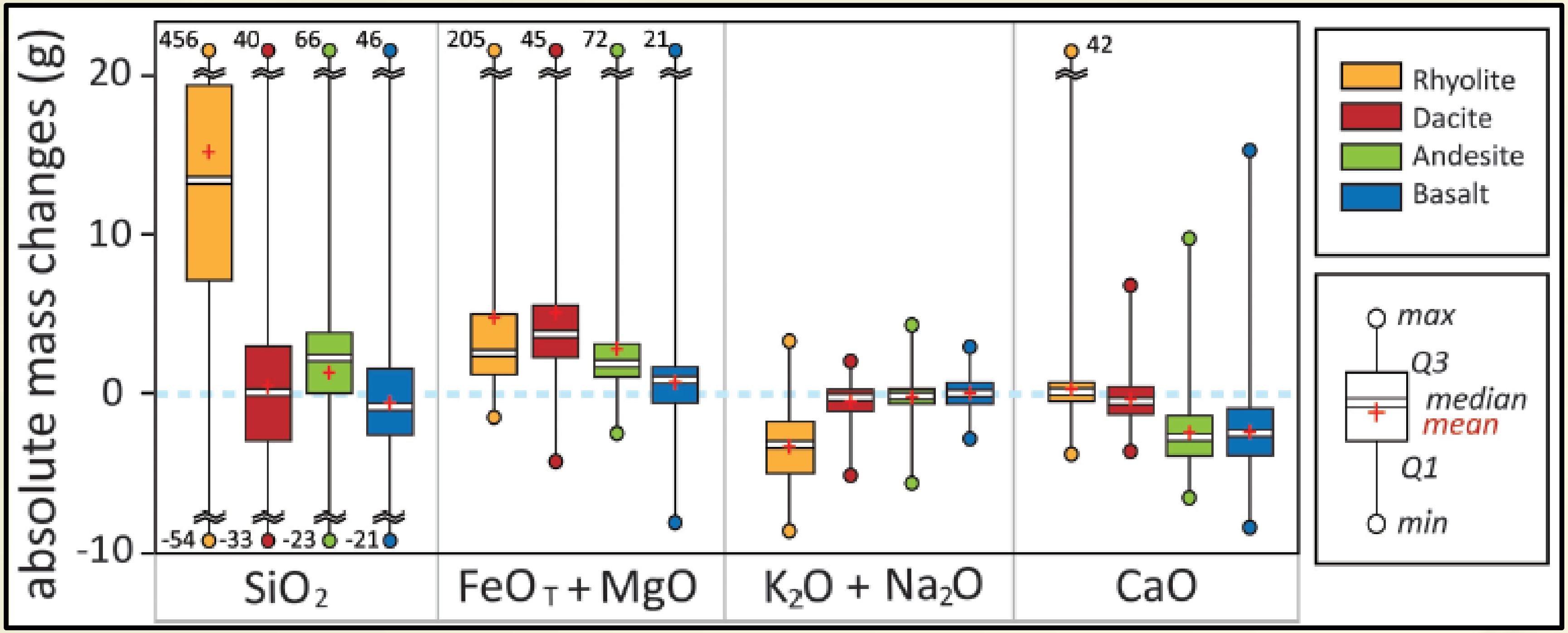
- Ti, Al, Zr, Y, Cr available
- Cr removed



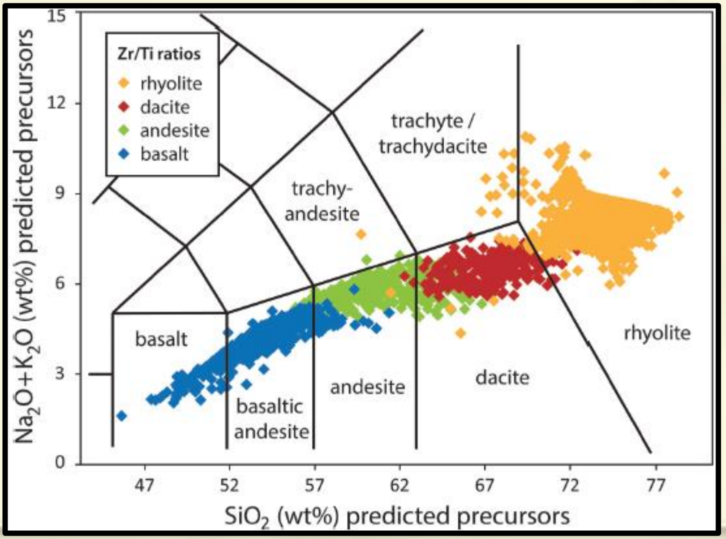
Neural network



Coulon - #2. Mass balance



Box plot



Modelled precursors on the TAS diagram

Rhyolite, dacite, andesite, basalt classification – made using Zr/Ti

Coulon - conclusions

OSISKO MINING

VMS deposit, Baie-James area

Upper amphibolite facies

Cordierite-enriched hostrocks

- « Prograde hydrothermal remobilisation » ? (Tomkins 2007)

Alteration

- Chloritisation mostly, and sericitisation (proximal samples)
- In the most felsic unit (maximum porosity?, sub-surface VMS?)

Recommendations

- Sericitisation = Sillimanite-bearing schists (Qz-Bt-Sill)
- Chloritisation:
  - Moderate: Bt+Cord < 20-30 vol% and **Bt**>Cord
  - Intense: Bt+Cord > 20-30 vol% and Bt<**Cord**

Mathieu et al. (2016b)

Merci de votre attention

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