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

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(Mathieu et al. 2016b)
Quantifying alteration in challenging areas

Coulon VMS

- High-grade metamorphism

R.A. Bouchard (M.Sc, UQAC)
Coulon deposit – La Grande Sub-Province, James Bay area
Upper amphibolite facies

Osisko dataset
n = 5583
Five traces analysed

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

Mathieu et al. (2016b)
1. Formatting chemical data
   - Extracting major and trace elements and volatiles (wt%) from an input .txt file

2. Calculate accessory minerals
   - Calculate sulphides, Fe-Ti oxides, carbonates, etc.

3. Calculate silicates
   - Select small tetrahedron
   - Calculate the 4 minerals of the small tetrahedron, distribute elements between the solid solutions
   - Adjustments
     - Amount of Si consumed by the minerals?
     - Si excess
     - Si deficit
     - Form quartz
     - React minerals

4. Reacting quartz and carbonates under certain circumstances
   - (see Fig. 5)

5. Normative estimations of volatils
   - Is LOI > H₂O⁺_mineral + CO₂ + H₂O⁻ + S - GOI?
     - YES
     - NO

6. Final operations
   - Adjust for Fe₂O₃
   - wt% of minerals
   - Density of sample

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Mathieu et al. (2016a)
KFASH (dashed) and KMASH (solid) reactions (after Spear and Cheney 1989)

KFMASH pseudosection (Mesger and Régnier 2016)

Pictures: Cordierite-enriched rocks of Coulon
Index_{FeMg} = 100(cordierite + biotite + olivine + talc + anthophyllite)/(sum of all silicates - quartz)
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
Coulon - #2. Mass balance

Box plot

Modelled precursors on the TAS diagram

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