Texture, cathodoluminescence and trace elements composition of scheelite, indicator of orogenic gold deposits

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Macraes, New Zealand
Variation in trace elements between two generations

Macraes, New Zealand
Crusader, Agnew district, Australia
Variation in trace elements between two zones

Crusader
Agnew district, Australia

<table>
<thead>
<tr>
<th>CRUS01B-L1</th>
<th>ppm</th>
<th>Zone 1</th>
<th>Zone 2</th>
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<tbody>
<tr>
<td>Mo</td>
<td>58300</td>
<td>70200</td>
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</tr>
<tr>
<td>Na</td>
<td>166.10</td>
<td>15.60</td>
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</tr>
<tr>
<td>V</td>
<td>4.25</td>
<td>0.17</td>
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<tr>
<td>As</td>
<td>172.00</td>
<td>6.18</td>
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<tr>
<td>Nb</td>
<td>48.80</td>
<td>1.50</td>
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</tr>
<tr>
<td>Ta</td>
<td>0.33</td>
<td>0.02</td>
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</tr>
<tr>
<td>Y</td>
<td>860.00</td>
<td>15.50</td>
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<tr>
<td>ΣREE</td>
<td>559.77</td>
<td>18.10</td>
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REE Patterns

Bell-shape with positive Eu anomaly
REE Patterns

Bell-shape with negative Eu anomaly

Deposits
* Malartic (n=2)  ■ Buzwagi (n=1)
○ Val-d’Or (n=13) + Mount Pleasant (n=4)
× Meliadine (n=5) ● Norseman (n=3)
**REE Patterns**

**Flat with positive Eu anomaly**
REE Patterns

Positive slope with HREE enrichment
REE Patterns

- Negative slope with positive Eu anomaly and LREE enrichment.
REE Patterns

Orogenic Gold deposits
REE Patterns

Chinese skarn deposits

- Baizhangyan W-Mo skarn (n=35)
- Jitoushan W-Mo skarn (n=26)
- Xuebaoding W-Sn-Be skarn (n=7)
- Zhazixi W-Sb skarn (n=55)
Quantification of the REE patterns

(a) 

(b) 

REE pattern
- Bell +
- Bell -
- Flat
- Decreasing
- Increasing
- Nevoria
- Bell Ho +
- Bell Ho -

Deposit type
- Orogenic
  - This study
  - Literature
- Crusader
  - Skarn
    - Kumbel (Poulin et al., accepted)
    - Jitoushan and Baizhangyan (Song et al., 2014)
    - Zhazixi (Peng et al., 2008)
    - Xueboading (Yan et al., 2007)
Substitution in scheelite

\[ 2\text{Ca}^{2+} = \text{REE}^{3+} + \text{Na}^+ \]
Influence of the hostrock composition
Influence of the metamorphism

![Graph showing the relationship between various geological factors and metamorphic facies.](image)

<table>
<thead>
<tr>
<th>Metamorphic facies</th>
<th>Mineralization age</th>
<th>Host rock composition</th>
<th>Legend per orogenic-gold deposits</th>
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<tbody>
<tr>
<td>Low</td>
<td>Archean</td>
<td>Sediments</td>
<td>Meliadine</td>
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<tr>
<td>Moderate</td>
<td>Proterozoic</td>
<td>Black shales</td>
<td>Cuiaba</td>
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<td>Phanerozoic</td>
<td>Intermediate</td>
<td>Nevoria</td>
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<td>Contact mafic/felsic</td>
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</tr>
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<td>Beaufor</td>
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<td>Macraes</td>
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</table>

Gold deposit not orogenic in origin: Crusader
PCA on orogenic gold deposits

Influence of the hostrock composition and the metamorphism

Legend per orogenic-gold deposits (One symbol is not exclusive to one deposit):
- Melleadine
- Dome
- Young Davidson
- Beaufor
- Kochkar
- Malartic
- Lameque
- Essakane
- Huti
- Tarmoosa
- Paddington
- Norseman-01
- Norseman-02
- Norseman-03
- Mt Pleasant
- Mt Charlotte
- Macraes
Strontium variation in scheelite

Orogenic gold deposits
- EPMA
- LA-ICP-MS
- Literature

Crusader
- EPMA
- LA-ICP-MS

Skarn
Greisen
VMS
Molybdenum variation in scheelite

Orogenic gold deposits
- EPMA
- LA-ICP-MS
- Literature

Crusader
- EPMA
- LA-ICP-MS

Skarn
Greisen
VMS
PCA on various deposit types

Deposit types:
- Orogenic gold:
- W-Mo skarn:
- Other gold-deposit:

Score contributions:
- Orogenic
- Nevoria
- Crusader
- Skarn
Conclusion

Scheelite from orogenic gold deposits:

• homogeneous in CL & trace element composition
• CL zonation correlates with variation in trace element composition
• 4 REE patterns with a bell-flat serie
• Trace element variation after hostrock composition, metamorphic facies
• Not conclusive features: ultramafic and mafic hosted deposits, mineralization age

• REE, Mo & Sr: discriminant for orogenic vs. others
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Thank you for your attention

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References


Poulin, R. S., McDonald, A. M., Kontak, D. J., and McClennenagh, M. B., accepted. Crystal-chemical influences on the cathodoluminescence of scheelite, Canadian Mineralogist.


Richard Sillitoe présentera un cours sur

“Porphyry Copper Deposits: from their Roots to the Paleosurface”