GeoUtrecht 2020
24–26 August 2020 | Utrecht | The Netherlands

EARTH!
Treasures
Threats
Transitions

FRAME
FORECASTING AND ASSESSING EUROPE'S STRATEGIC RAW MATERIALS NEEDS

The W Alps Project: Casting new light on scheelite tungsten deposits from the Eastern Alps

Florian Altenberger, Julia Weilbold, Johann G. Raith, Albert Schedl, Christian Auer, Tanja Knoll, Holger Paulick, Hassan Neinavaie

florian.altenberger@unileoben.ac.at

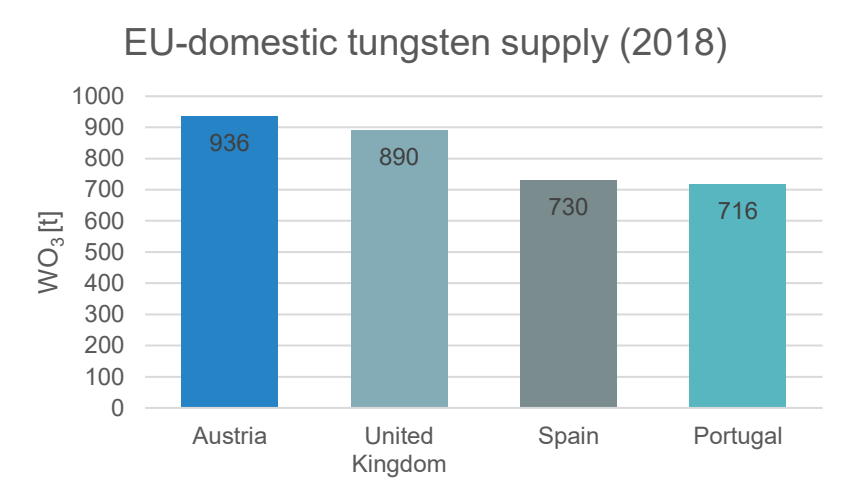
Geologische Bundesanstalt

MONTAN UNIVERSITÄT LEOBEN

mining | refining | recycling wolfram

Scheelite mineralization from the Mühlbach valley
© Karsten Aupers

What is it about?

- Critical raw materials (CRM) = economic supply + potential challenges to supply security
- 

World Mining Data 2020
- 80 % of global tungsten supply covered by China (65.300 t)

- Mineralrohstoff-Initative (MRI) project
  - Geological Survey of Austria (GBA)
  - Montanuniversität Leoben (MUL)
  - Wolfram Bergbau- u. Hütten AG (WBH)
- GeoERA project FRAME
  - Critical and Strategic Raw Materials Map of Europe
  - http://www.frame.lneg.pt

- Objectives
  - Developing assessment criteria for the evaluation of regional tungsten potential
  - Collecting in-situ chemical data (trace elemens) on scheelite from different types of tungsten deposits
  - Evaluating tungsten mineralization in context of the new geological-tectonic concept of the Eastern Alps

florian.altenberger@unileoben.ac.at

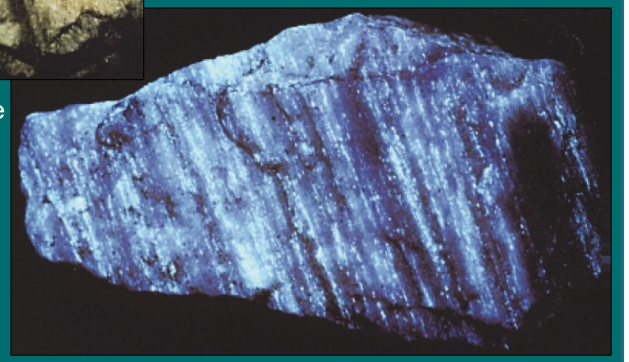
W-mining in Austria

- Earliest known tungsten mineralization at the Au(-W) deposit Schellgaden (Salzburg) and in Alpine veins (Hohe Tauern)
- **1950s to 1976**: Tungsten mining as by-product from the magnesite-scheelite deposit Tux-Lanersbach (Tyrol)
- **1967**: Discovery of the Felbertal deposit
- **1975 to 1986**: Open pit mining at the Eastern Ore Zone at Felbertal, in total 2.5 Mt of ore @ 0.6 wt.% WO_3 (strip ratio < 1:1.5)
- **1977 to recent**: Development of underground mining at Western Ore Zone
- **1980s**: Felbertal discovery triggered various exploration campains (VOEST-Alpine, MINEREX) in the Eastern Alps

  → findings of dozens of scheelite occurrences

RAITH ET AL., 2018

Eastern (EOZ) and Western (WOZ) Ore Zone of the Felbertal deposit (left) and open pit mining at the EOZ in the early days (right), WBH archive

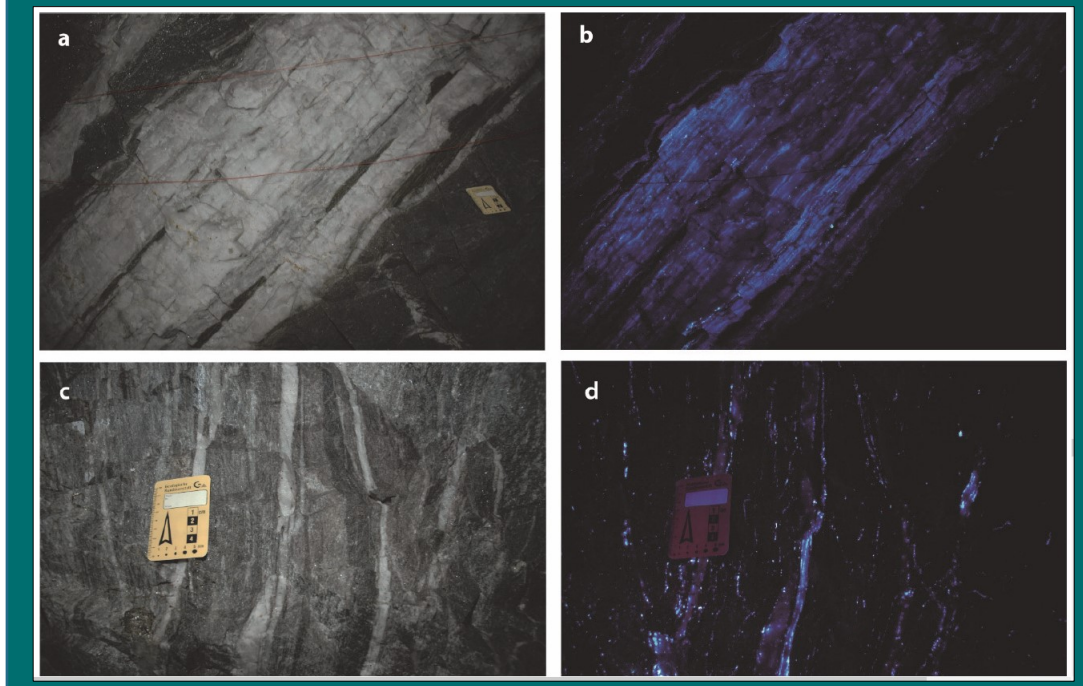


Foliated high-grade scheelite ore from the Eastern Ore Zone, WBH archive

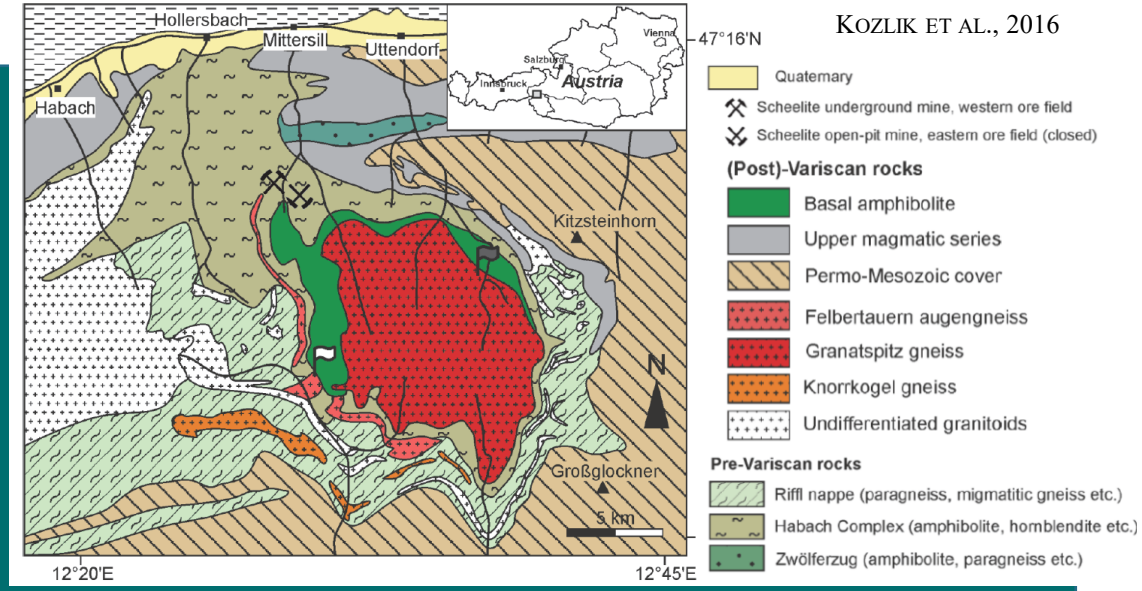
florian.altenberger@unileoben.ac.at

Tungsten deposit Felbertal

- Located at boundary to Nationalpark Hohe Tauern
- Scheelite only mined in active underground mine (WOZ)
- Production: ca. 500.000 t/a of ore @ 0.3 wt.% WO_3
- In total about 16 Mt ore mined so far

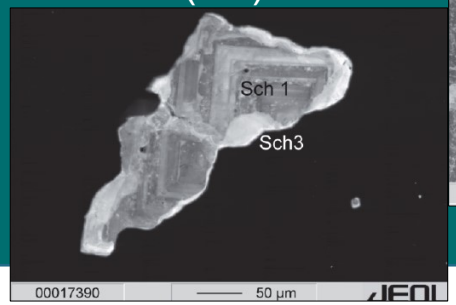


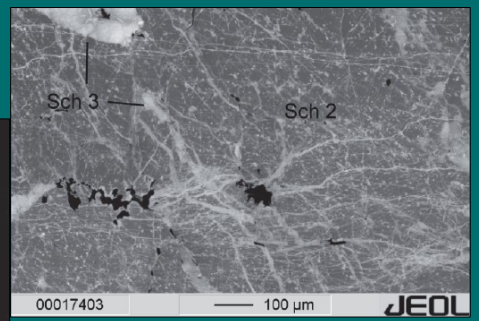
a) About 1 m thick, foliated scheelite-quartz vein; b) same under UV-light; c) scheelite-quartz veins subparallel to the foliation in gneiss – metabasite; d) same under UV-light (Foto: Schmidt, S., February 2009)



KOZLIK ET AL., 2016

- Magmatic-hydrothermal origin of scheelite mineralization (Variscan) and significant metamorphic (Alpine) overprint
- Early Paleozoic host rocks intruded by highly differentiated leucocratic metagranitoid (E.Carb. 336-341 Ma; KOZLIK, 2016)
- Stockwork-like quartz veins and disseminated
- 4 generations of scheelite distinguished
  - Fluorescence (white-blue to yellow)
  - Mo-contents (0.1 to 1.8 wt.% Mo)
  - Cathodoluminescence (CL)



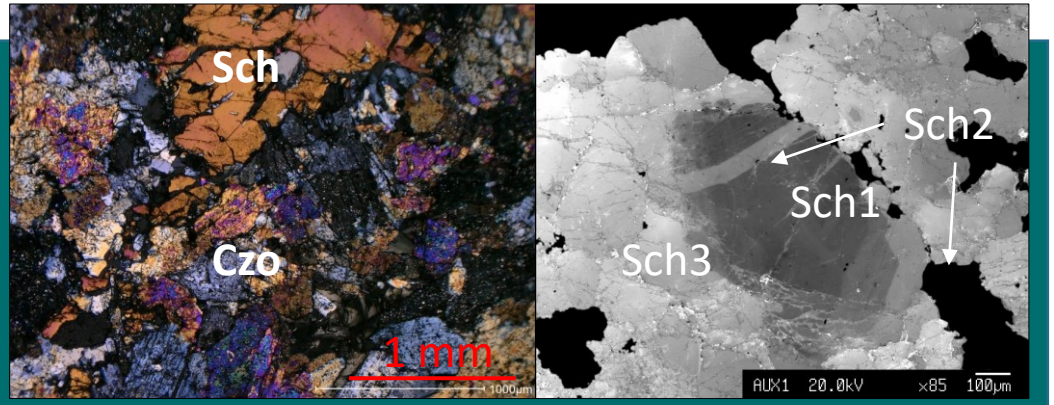


CL-images of scheelite

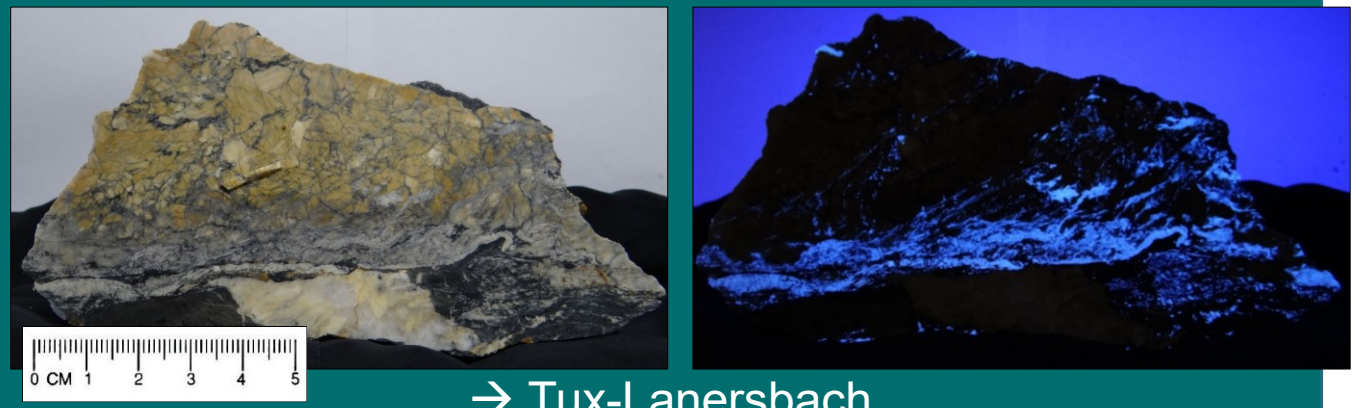
florian.altenberger@unileoben.ac.at

Other tungsten occurrences

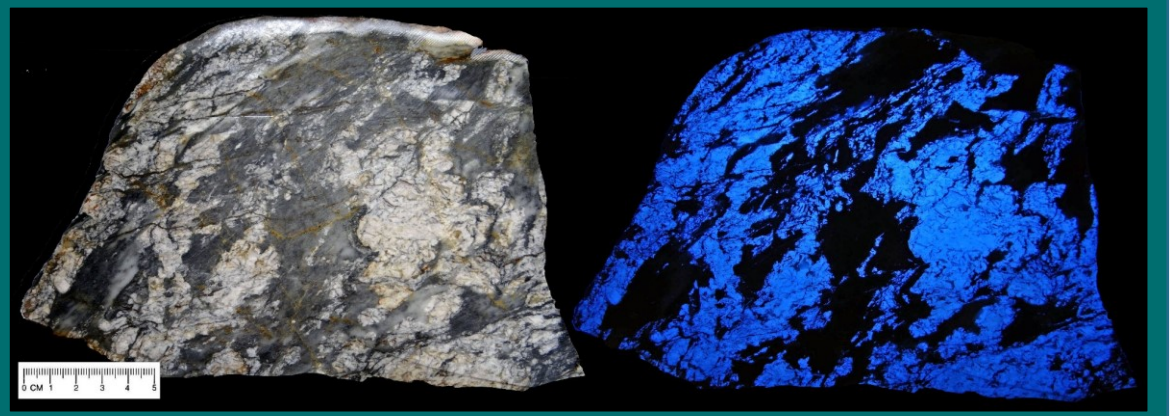
- Stratabound carbonate-hosted
  - Tux-Lanersbach (W+magnesite)
  - Mühlbach/Neukirchen (W)
  - Mallnock (W+magnesite)
- Skarn-like (calc-silicate rocks)
  - Messelingscharte (W±Sn)
  - Lienzer Schlossberg (Fe-Cu±W)
- Orogenic gold
  - Schellgaden (polymet. Au±W)
- Alpine-type veins
  - Karchau b. St. Blasen (As-Pb-Zn±W)



→ Messelingscharte



→ Tux-Lanersbach



→ Mühlbach/Neukirchen

florian.altenberger@unileoben.ac.at

Trace element studies on scheelite

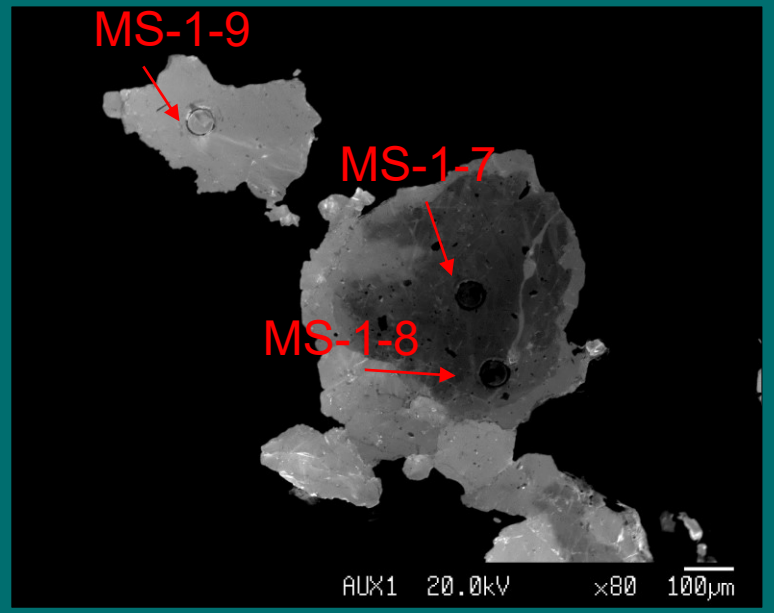
- Previous studies by
  - Raimbault et al., 1993
  - Uspensky et al., 1998
  - Ghaderi et al., 1999
  - Brugger et al., 2000, 2002, 2008
  - Poulin et al., 2016, 2018
  - Sciuba et al., 2019

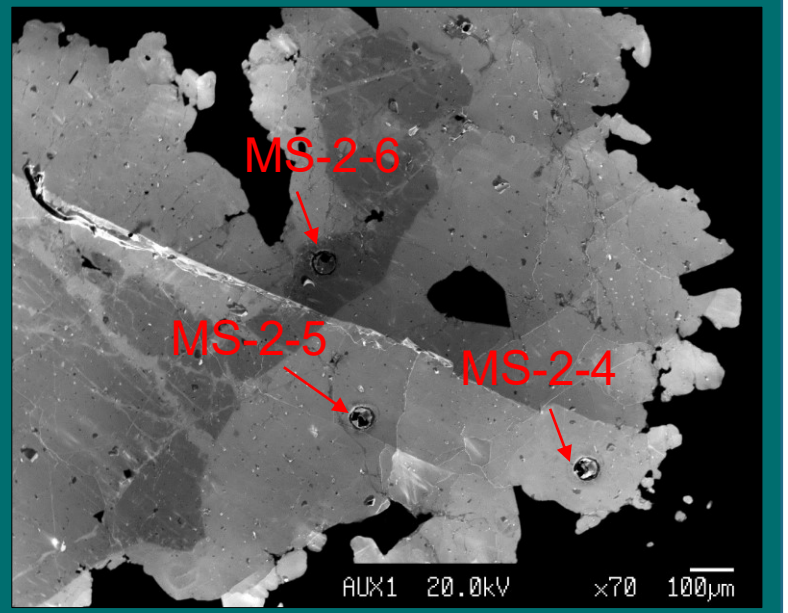
- Methodology
  - Ore petrography
  - SEM/CL imaging
  - EPMA
  - Laser Ablation-ICPMS

- Trace elements

^{7}Li ^{9}Be ^{23}Na ^{24}Mg ^{29}Si ^{34}S ^{39}K
^{47}Ti ^{51}V ^{52}Cr ^{55}Mn ^{56}Fe ^{59}Co
^{63}Cu ^{66}Zn ^{75}As ^{85}Rb ^{87}Sr ^{88}Sr
^{89}Y ^{93}Nb ^{95}Mo ^{107}Ag ^{118}Sn ^{133}Cs
^{137}Ba ^{139}La ^{140}Ce ^{141}Pr ^{146}Nd
^{147}Sm ^{153}Eu ^{157}Gd ^{159}Tb ^{163}Dy
^{165}Ho ^{166}Er ^{169}Tm ^{172}Yb ^{175}Lu
^{178}Hf ^{181}Ta ^{182}W ^{208}Pb ^{232}Th ^{238}U

→ Messelingscharte

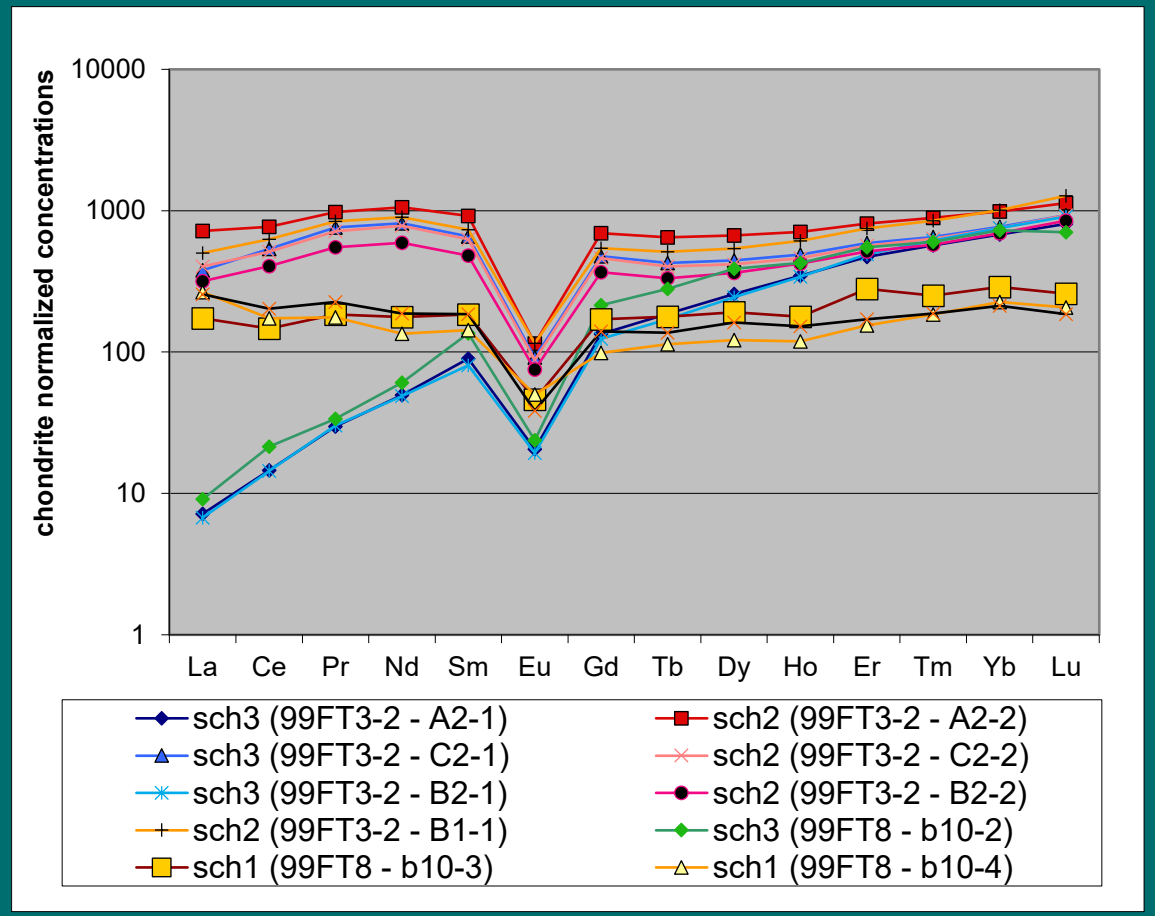


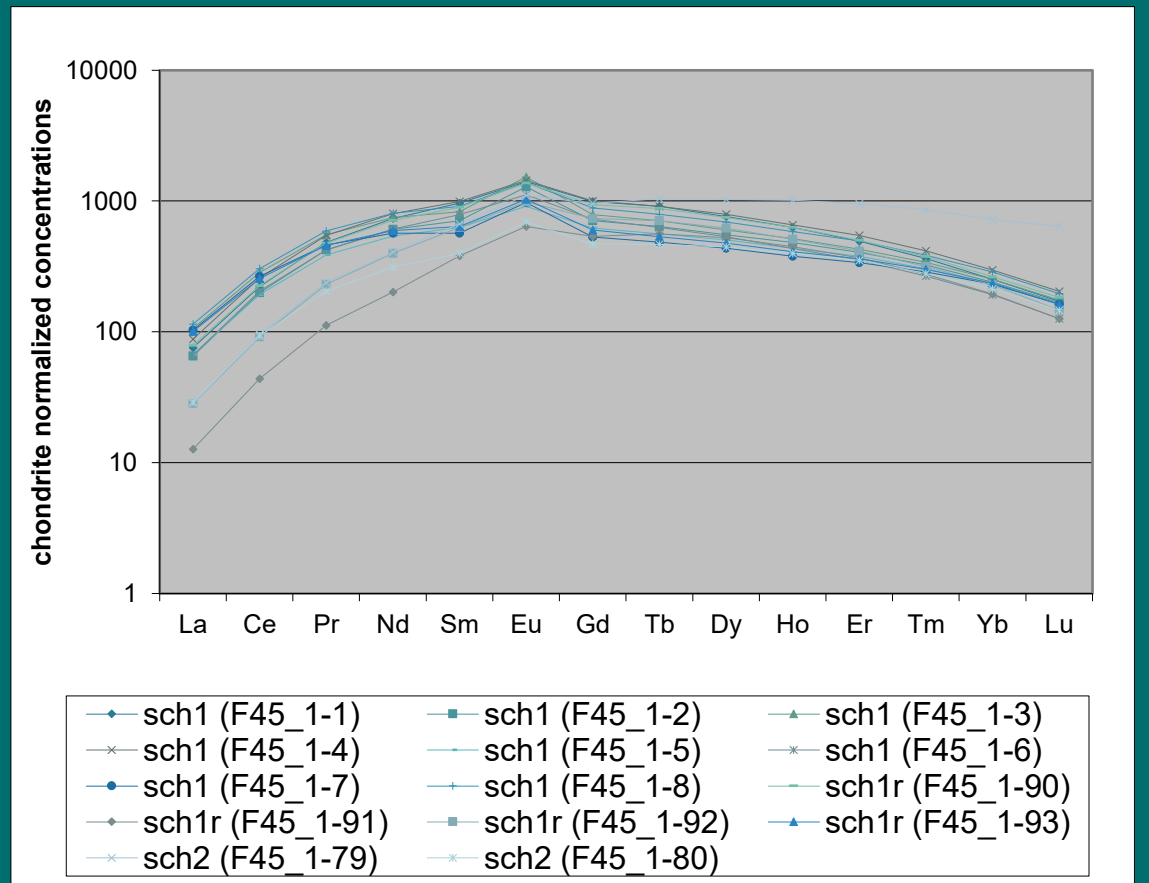


florian.altenberger@unileoben.ac.at

Evaluation of existing data

- Felbertal (RAITH, UNPUBL.)
- Schellgaden (WIESER, 2010)

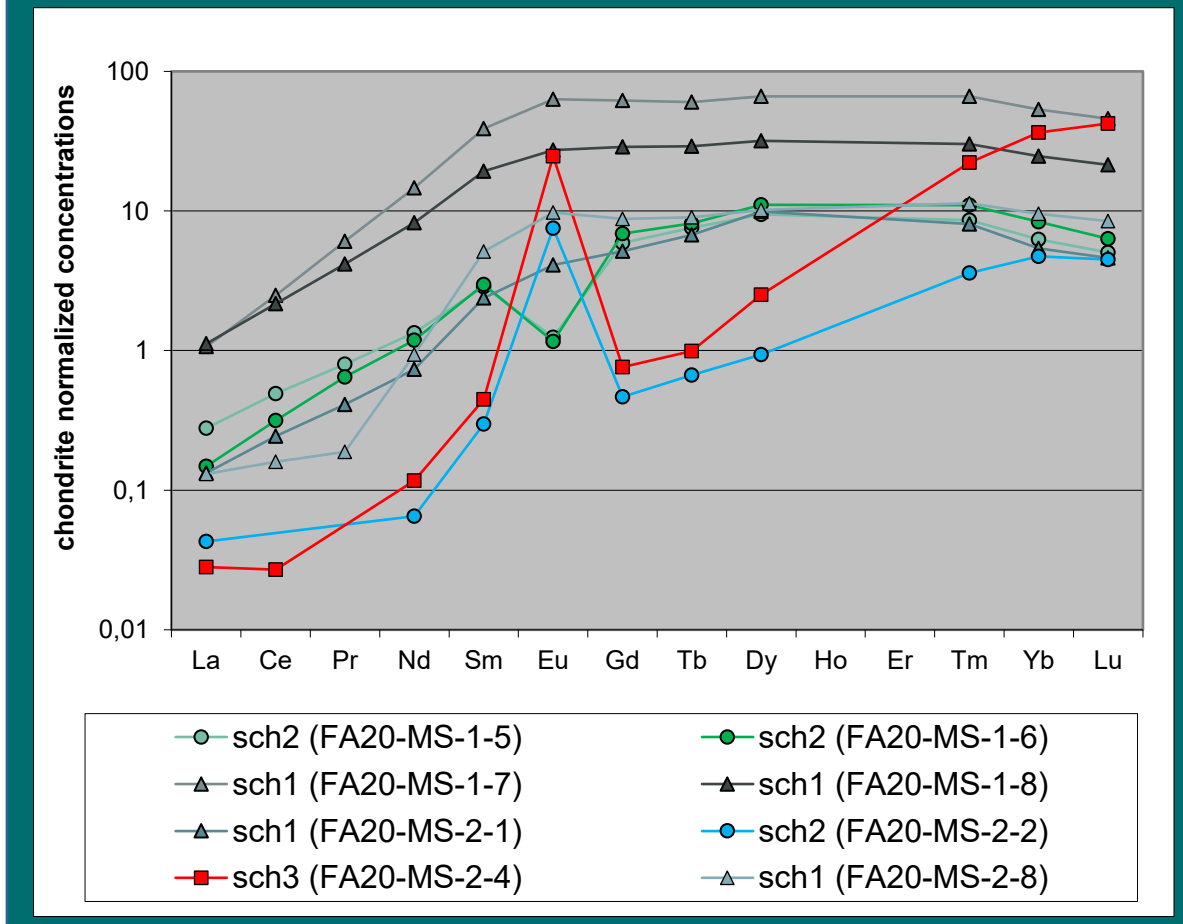




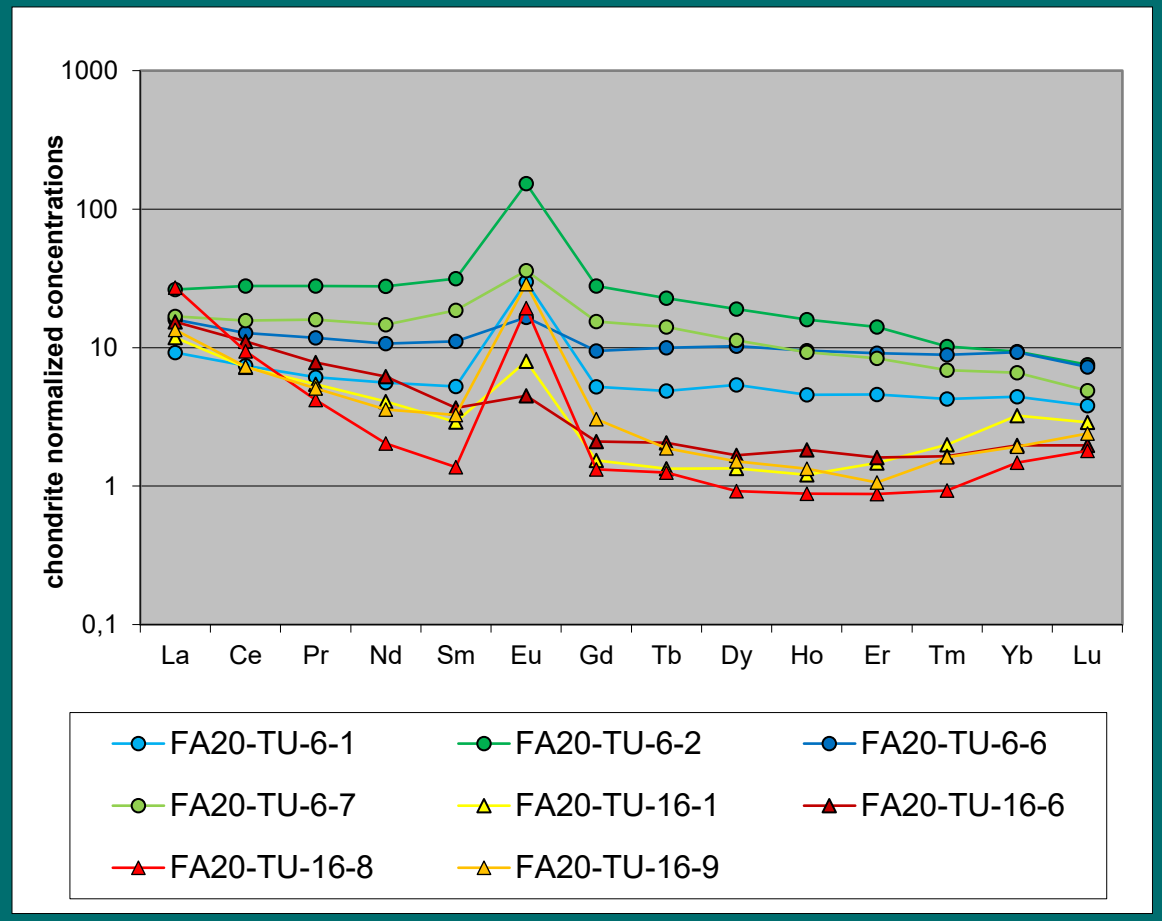
florian.altenberger@unileoben.ac.at

Preliminary results

- Messelingscharte



- Tux-Lanersbach



florian.altenberger@unileoben.ac.at

Next steps and future goals…

- Collecting more trace element data from scheelites of different deposits
- Creating a database, fingerprints of scheelite
- Geostatistical evaluation
- Testing the approach on stream sediment anomalies for exploration
- Better understanding of trace elements distribution in scheelites and ore forming processes
- Establishing a modified metallogenic model for W-mineralization in the Eastern Alps

florian.altenberger@[illegible]

Summary

- Tungsten mainly as **scheelite** in different types of ore deposits and paragenesis in the Eastern Alps
- Different **generations** of scheelite within one deposit
- **Trace element** compositions vary between different types of deposits/scheelites
- Scheelite „**fingerprinting**“ has potential for understanding ore formation as well as exploration tool

florian.altenberger@unileoben.ac.at