Applications

Henderson Creek, Dawson Range, Yukon

Casino Cu-Mo-Au porphyry, Yukon

Why study gold particles?

Exploration scenarios: refinement of classic ‘panning back to the source’

Does gold from a placer match that of known lodes?

Are there undiscovered sources?

Is the gold from different drainages in a region the same or different?

Do we have more than one deposit type/different occurrences of a similar type?

Can we identify the source deposit type for a placer signature?

Deposit studies: what can placer gold tell us about and ore deposit model?

Study of gold from in situ localities – linking composition to quartz generations revealed by Cl

Study of placer gold in the environs of a deposit

Both use gold compositions as a (new) source of information

Exploration: example study: Dawson Range, Yukon

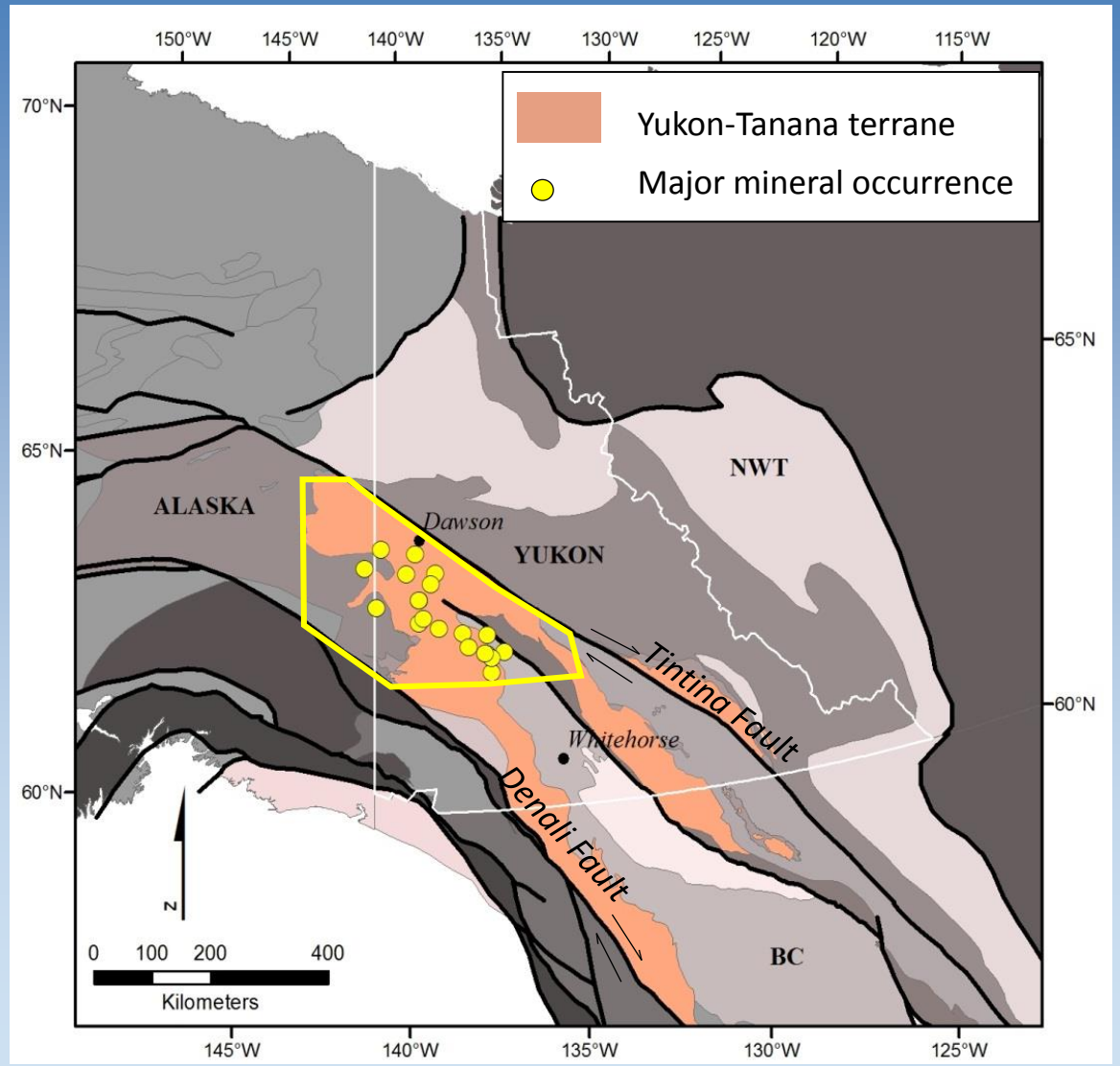
Illustrates various aspects of gold particle studies –

Exhibits generic applications

Yukon Tanana Terrane:

Complex assemblage of metamorphic and
Intrusive rocks

Several episodes of magmatism



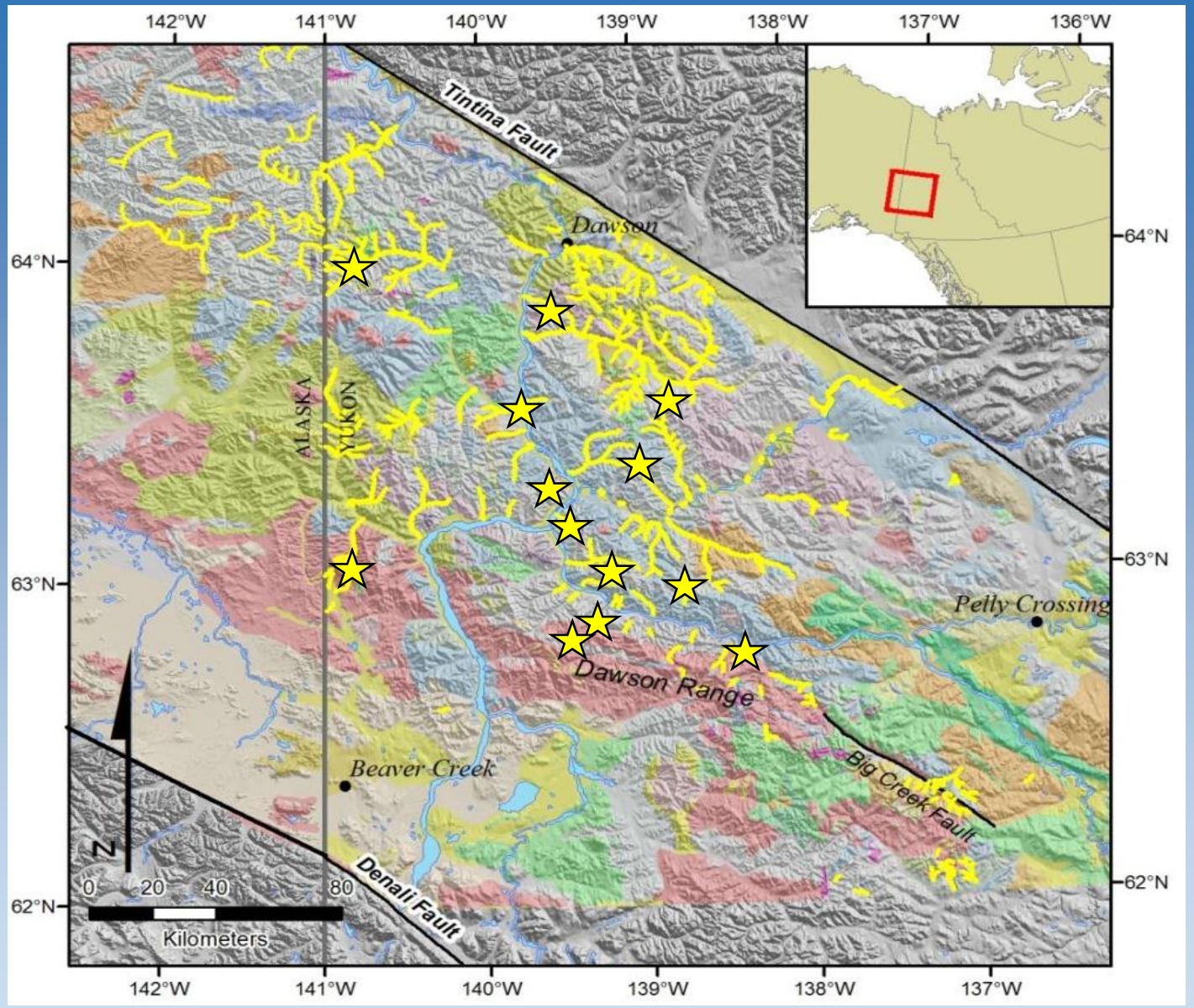
Total gold: 12-20 m oz. Still producing, 2012: 80,000 oz

Dawson Range: Background: 1

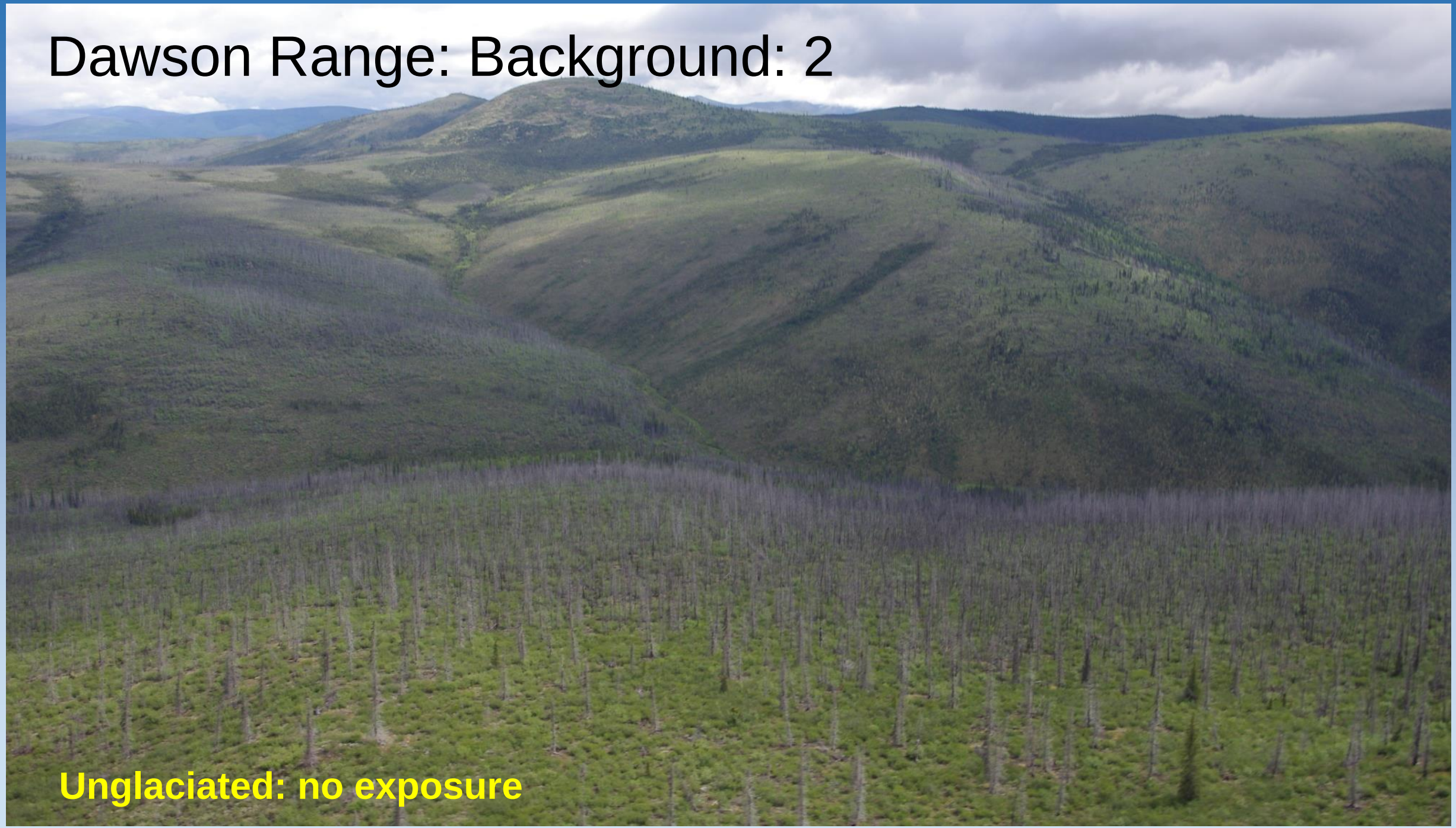
Placer creeks give indication of the geographic distribution of (coarse) lode gold

In general,

Source of placer gold
1. Unclear
2. Distal to major magmatic domains



Dawson Range: Background: 2



Research questions

How are we going to do this ?

What deposit type(s) are the source of the placers?

Can we enhance targeting around significant placer localities?

Much better understanding of regional metallogeny

Project methodology

Regional geochronology established potential relationships between in situ mineralization and magmatism

Establish templates of gold composition from in situ occurrences

Establish signatures of gold from placer localities where source is unknown

Gold associated with early late-Cretaceous calc- alkaline magmatism

Orogenic gold emplacement Jurassic

Two principle signature types identified by As/Te content of inclusions

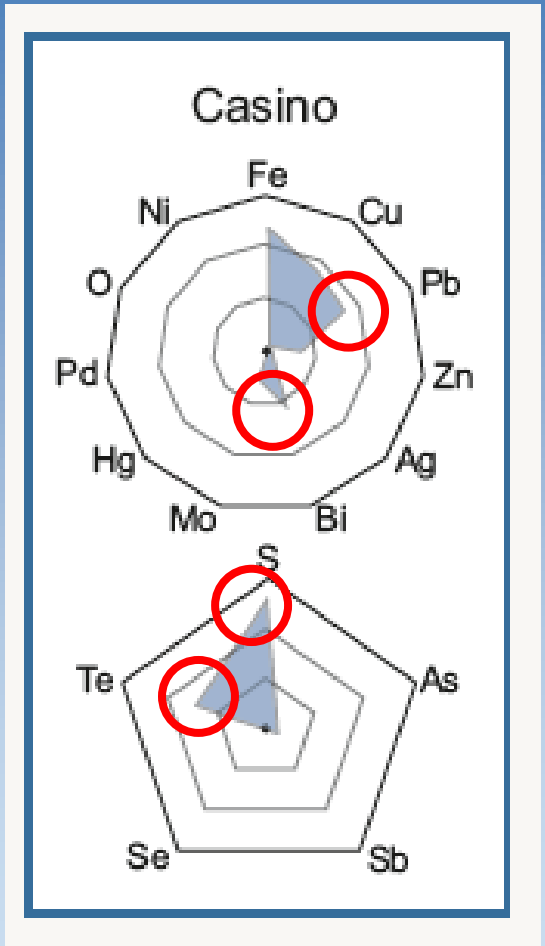
Orogenic gold emplacement Cretaceous

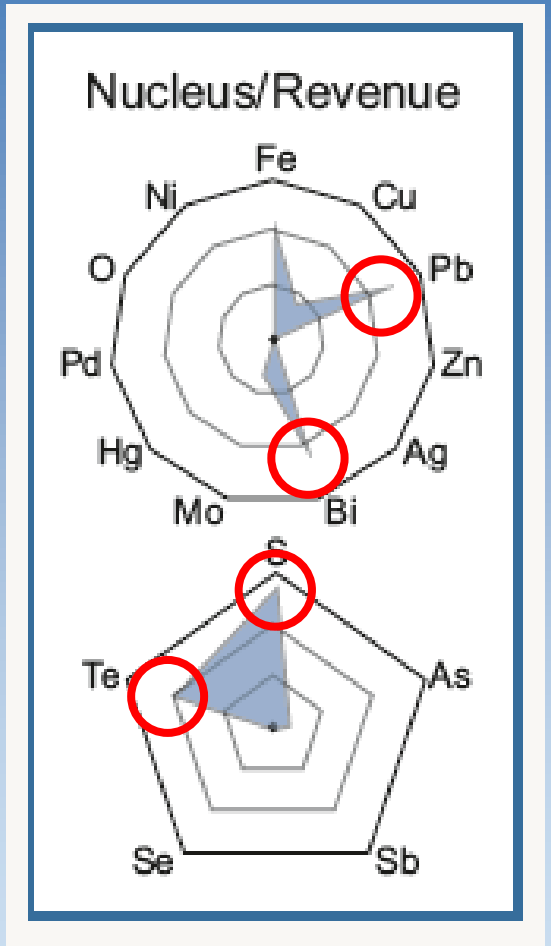
Big result:

- Porphyry and associated epithermal is closely spatially associated with one episode of magmatism
- Most placer deposits have a source genetically un- related to magmatism

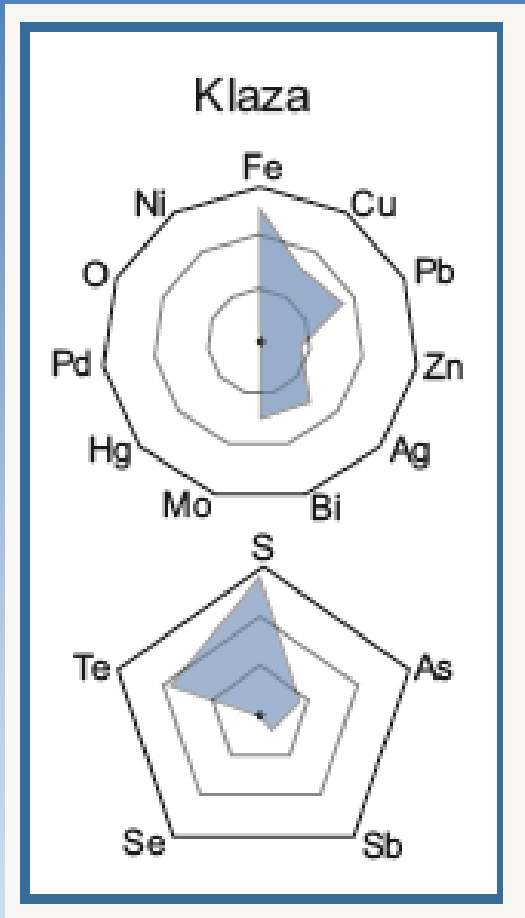
What did the gold studies contribute ?

Showed importance of inclusion suites as the primary discriminant





Addition of Ag



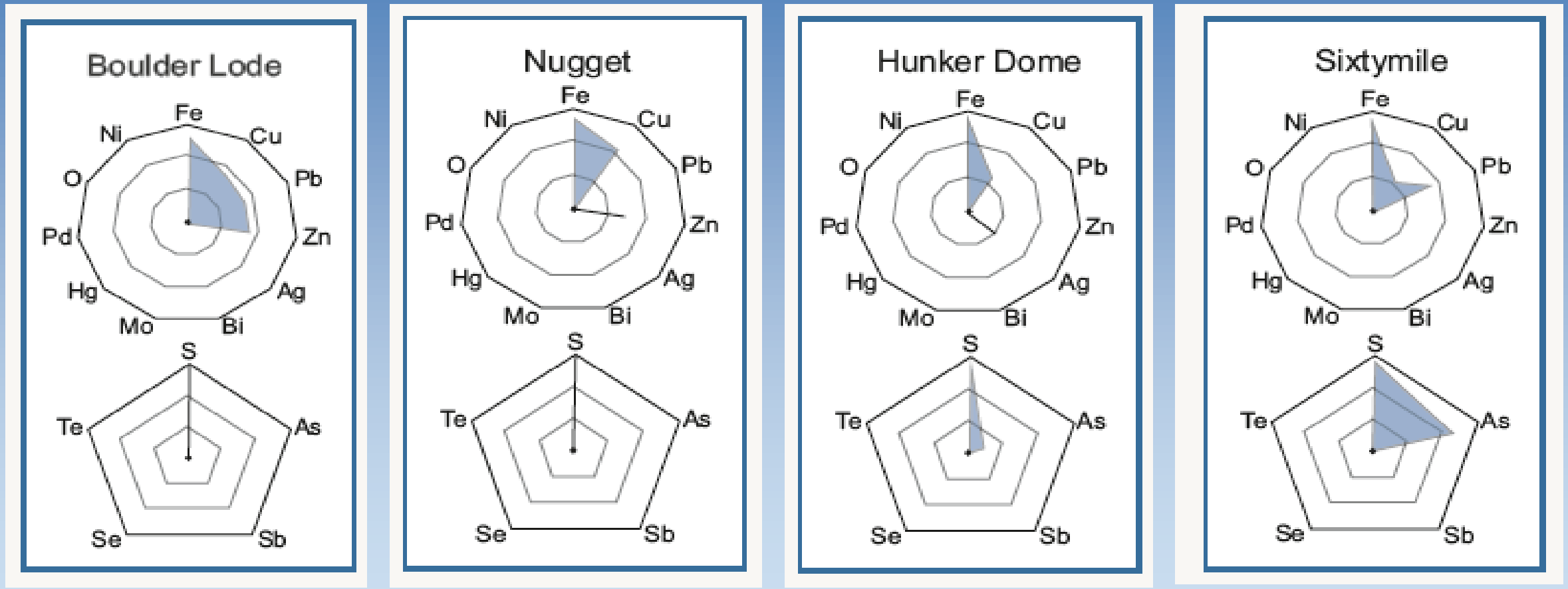
Calc – alkalic porphyry

Chapman et al. 2017

Associated epithermal

What did the gold studies contribute ?

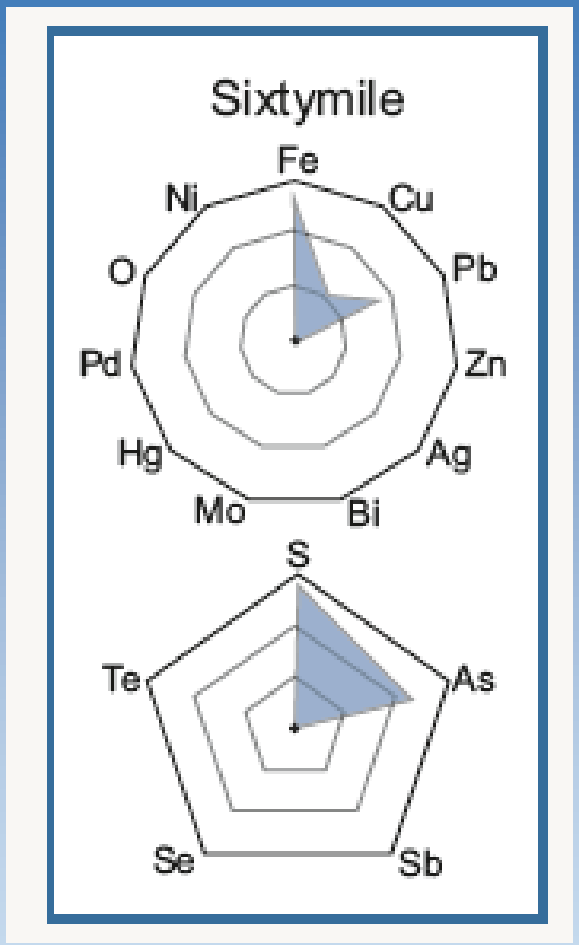
Orogenic Gold: S- only signature and S-As signature



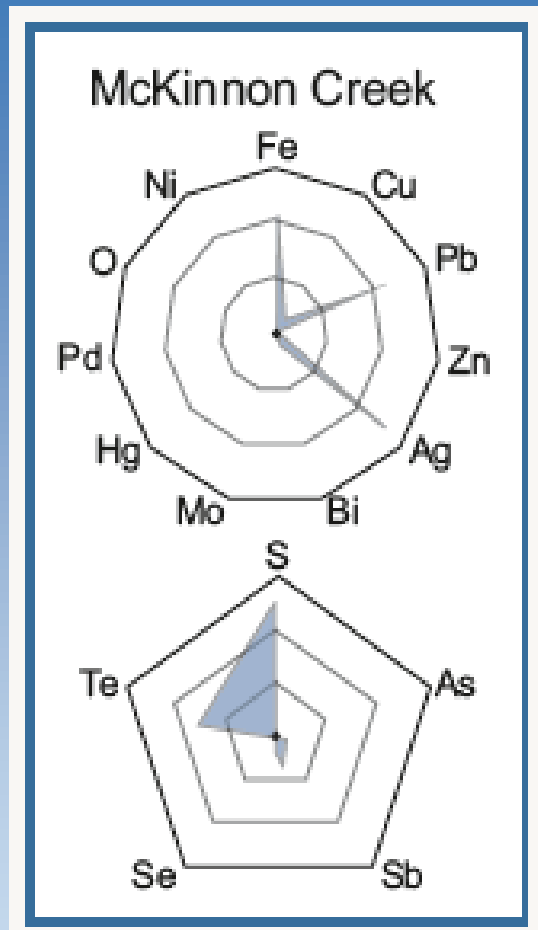
S only

S and As only

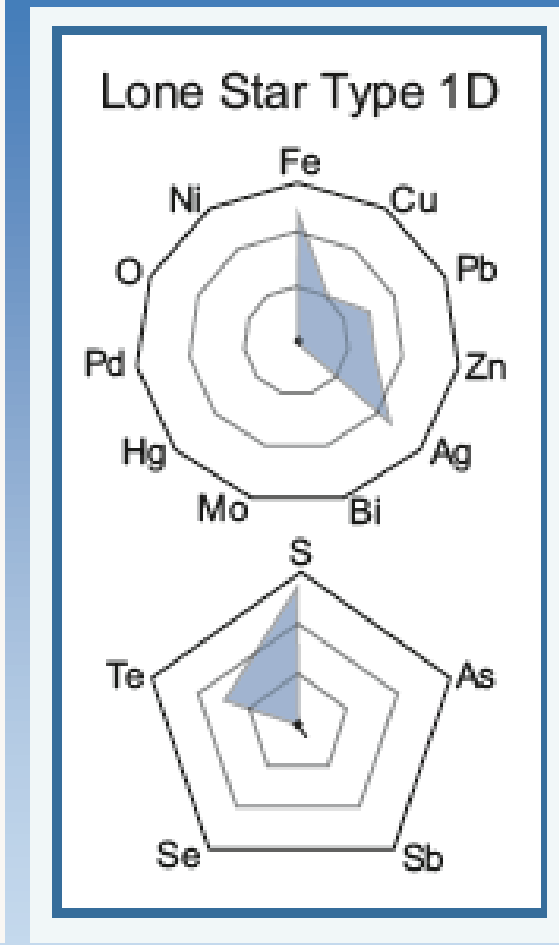
Other generic orogenic gold signatures

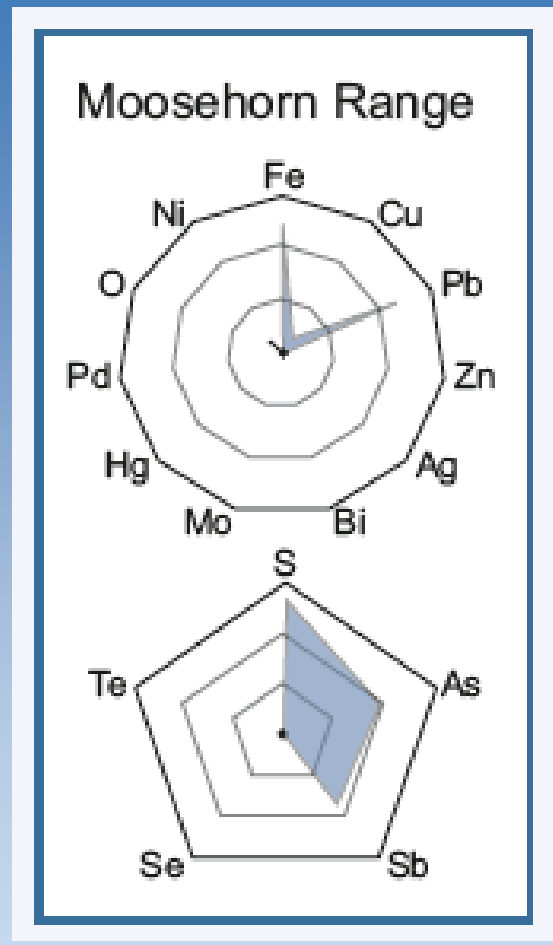


S-As



S-Te





Cretaceous orogenic gold
: Pb-Sb-As

Where did alloy compositions fit in to the study?

1. Ag provides an indication of ‘same or different’ for spatially proximal samples
2. Elevated Hg associated with ‘S-Te’ orogenic signature
3. Measurable but low Cu provides a potential discriminant between porphyry and intermediate/low sulphidation Au

Outcomes

On the basis of gold composition potential lithological targets in a licence area may be targeted/ignored

Established a methodology to provide generate far more complete understanding of gold metallogeny than previously possible

Provided a platform for further deposit style- specific studies (e.g alkalic porphyries, BC)

Underpins a current GBC project applying similar methodology throughout BC and the USGS gold study in E Alaska

Generic potential

N American Cordilleran studies yielded ‘gold signatures’ applicable throughout the cordillera

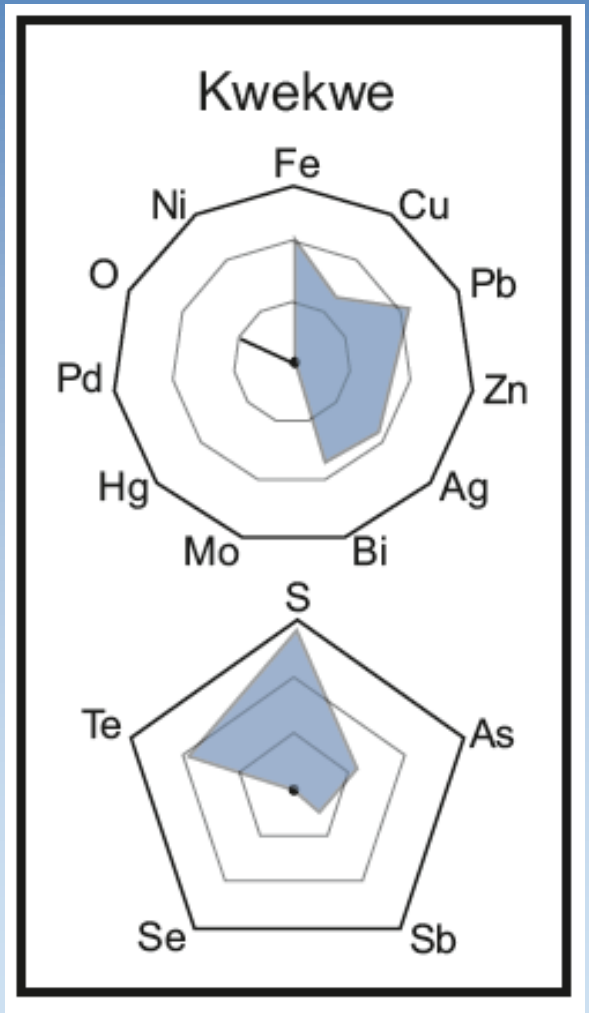
Comparison with data sets from Europe/elsewhere show transferability of compositional templates for Palaeozoic orogenic gold

Pd-Hg signature of gold from alkalic porphyries recorded
in gold from Tethyian Belt

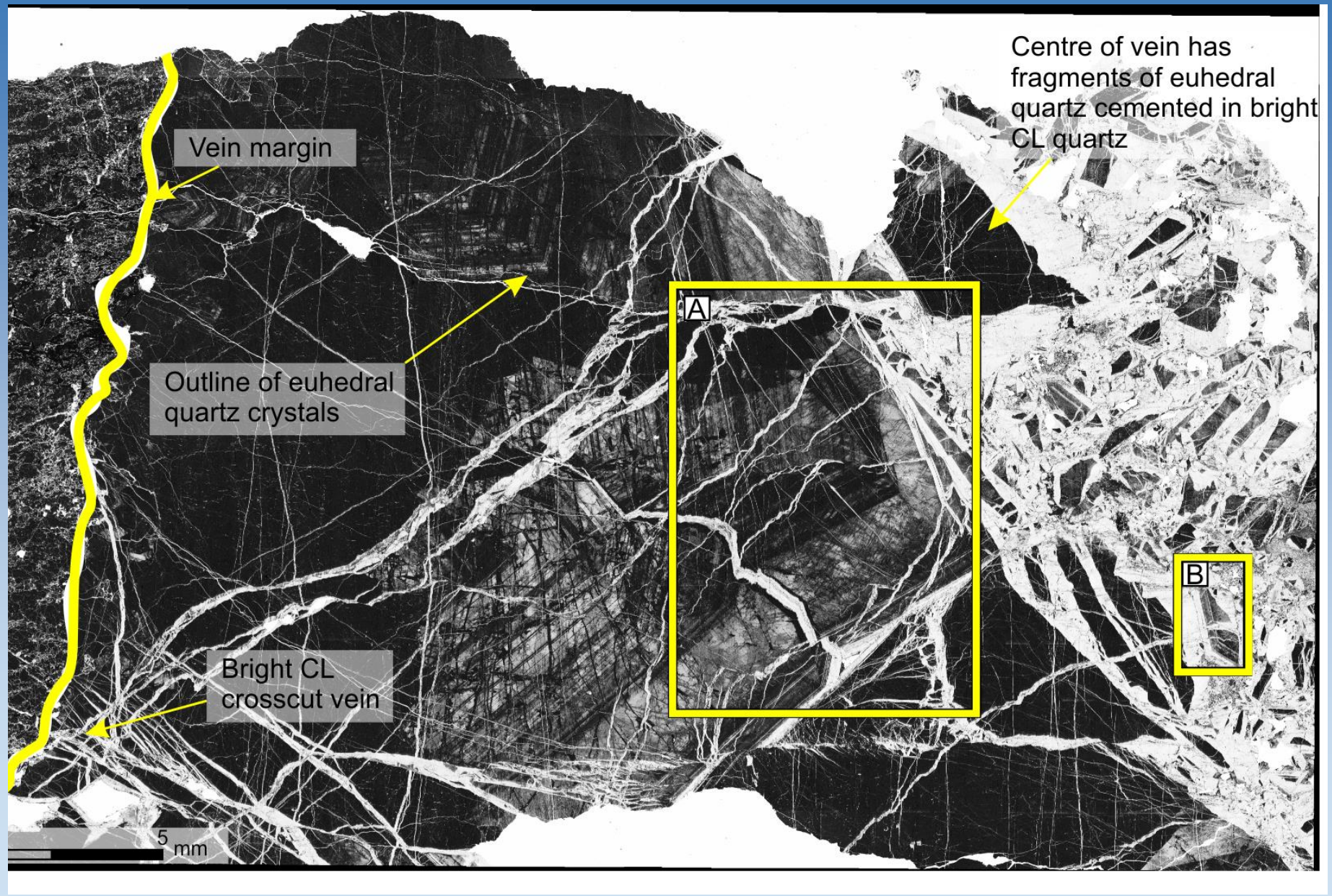
Big question remaining : signatures of gold from Pre Cambrian Settings.

Gold samples from granite- greenstone terrains in W and E Africa
Contain very few inclusions (but Cu is high in alloy)

Gold from Kwekwe (Zimbabwe) shows a more complex elemental inclusion signature than gold from L Palaeozoic mineralization

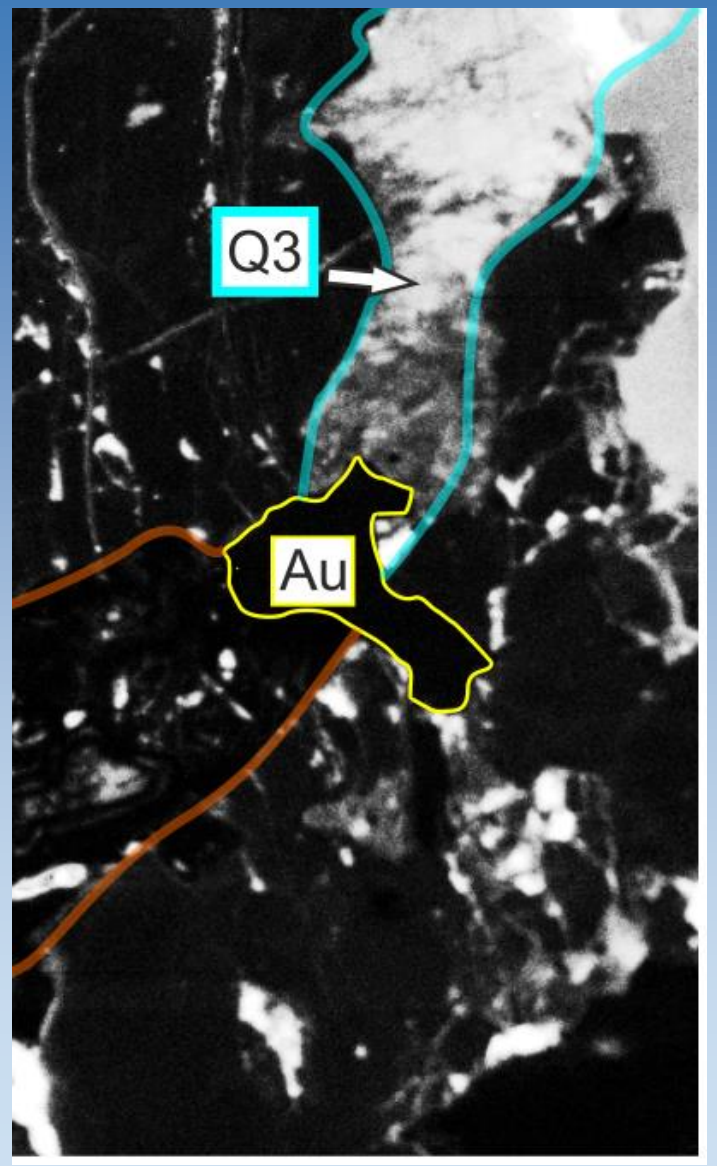


Deposit scale studies

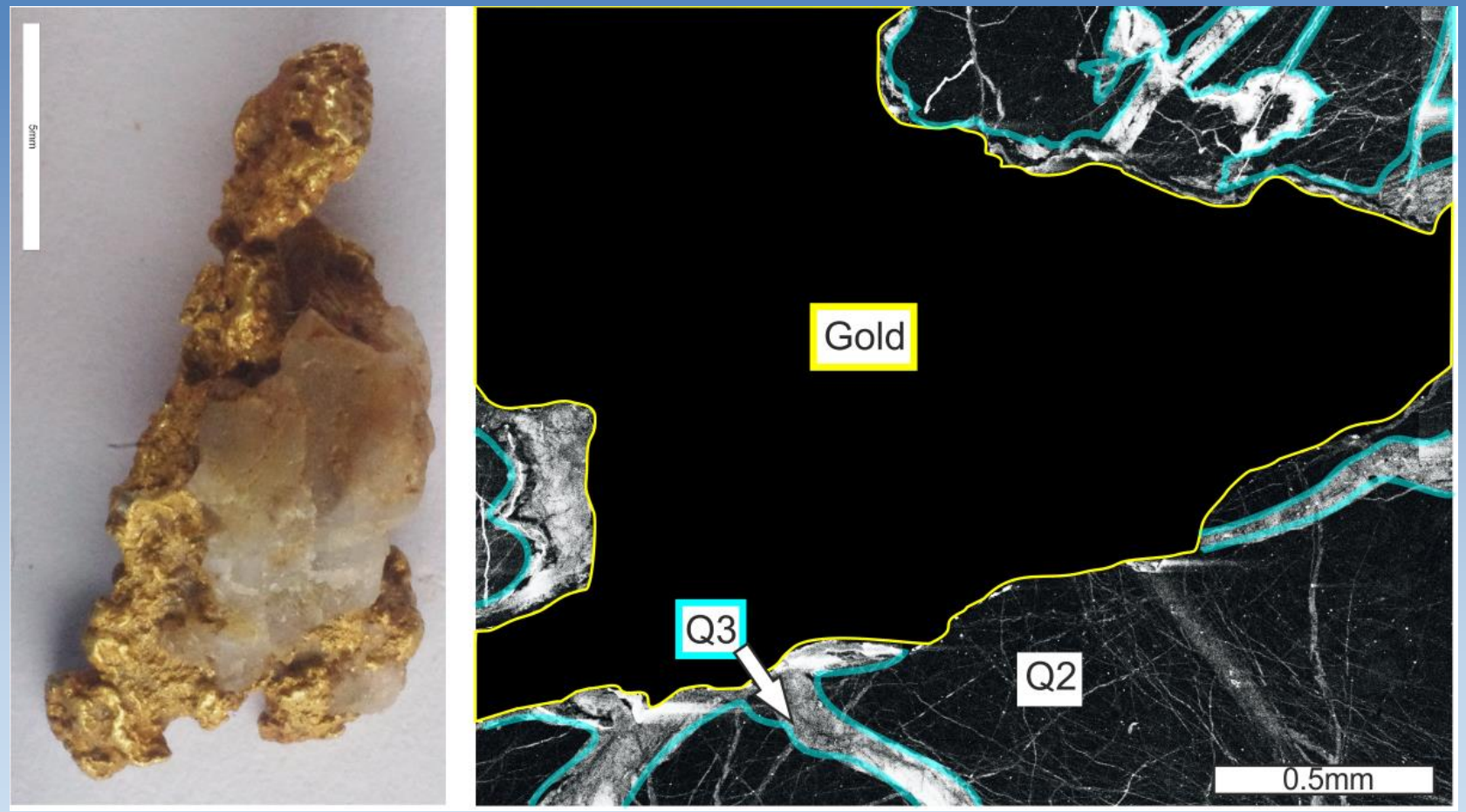


CL studies of vein to identify Qtz generations

Deposit scale studies



Link gold to specific quartz phase



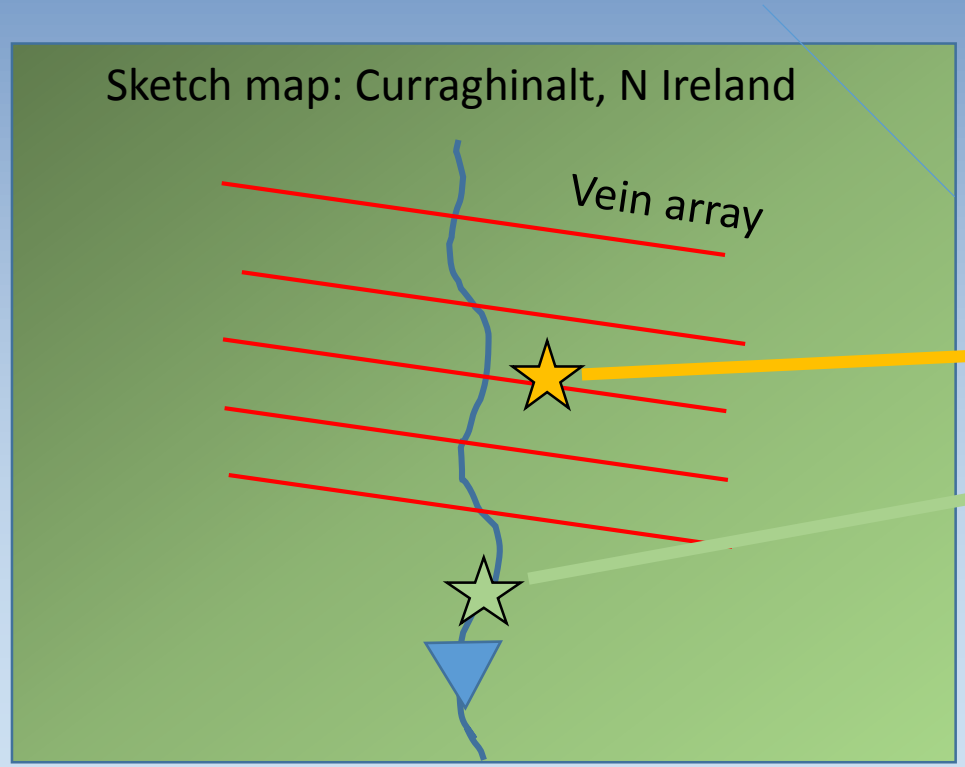
Apply to detrital nuggets with vein quartz attached

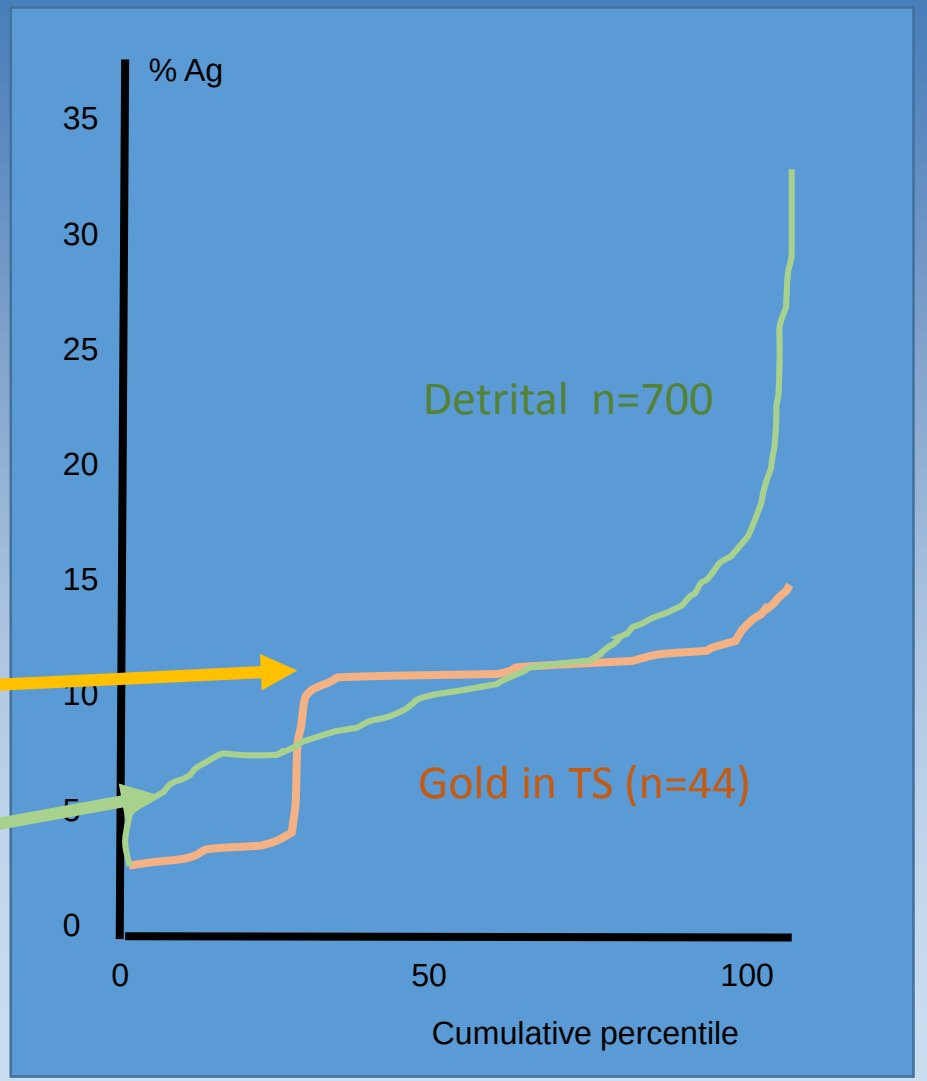
Grimshaw PhD 2019

Deposit scale studies

Information form detrital populations

Early stage paragenetic studies of in situ mineralization normally confined To thin/polished sections.





Could ascribe a clear bimodal Au emplacement on basis of TS data alone.

Detrital Au provides better understanding on a deposit scale

Ongoing PhD : Spence-Jones

Deposit scale studies

Regional targeting: Cononish, Scotland

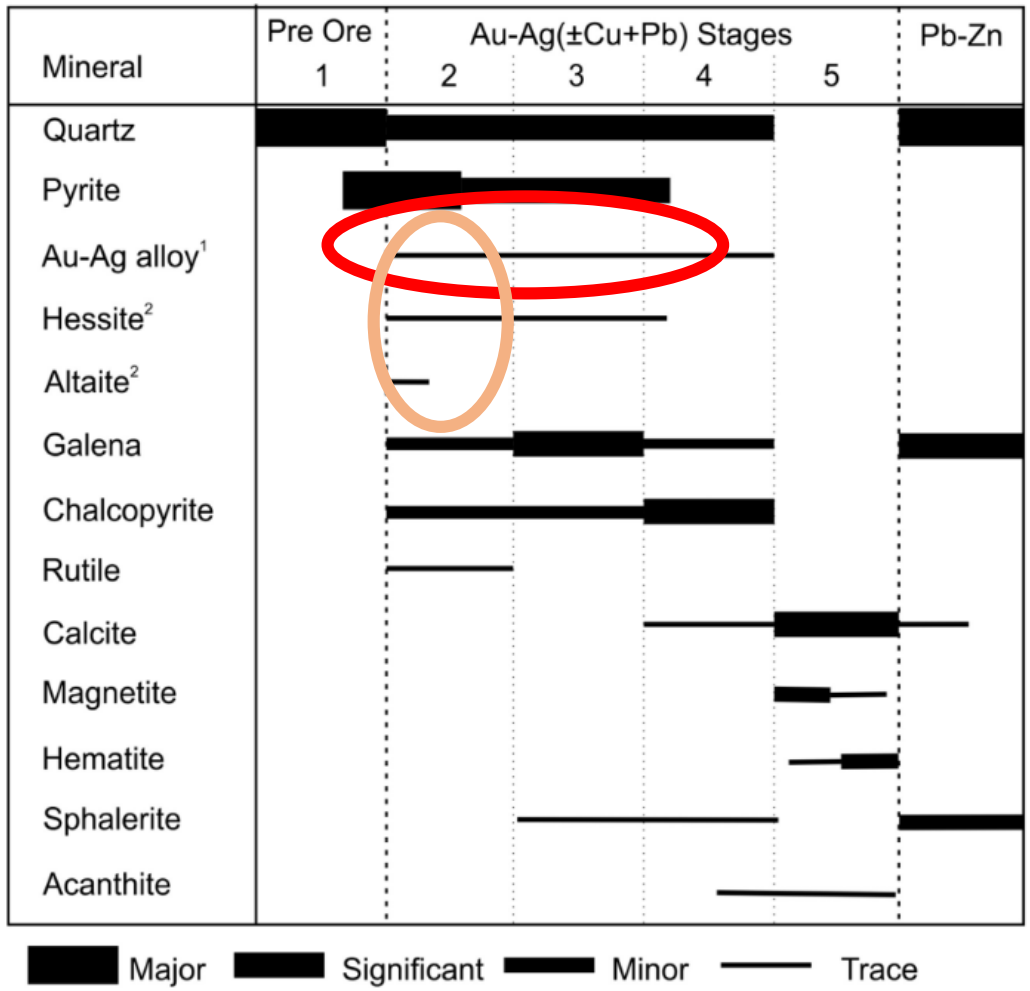


Fig. 4. Paragenesis for the Cononish Au-Ag (± Cu, Pb) vein and later cross-cutting Pb-Zn vein. Estimated relative mineral proportions are shown by width of the bar. [1]Au content of the alloy is observed to decrease over time. [2]Abundance of tellurides decreases from stage 2 with very few tellurides observed in stage 3 mineralisation.

Standard paragenetic diagram- no acknowledgement of Au/Ag ratio.

Stage 2 is the most economically important: i.e., the Au-Te association.

Stage 3 and 4: Au associated with cpy and ga

Stage 2: alloy contains ≈ 15-25 wt% Ag,
Stage 3-4 alloy contains 20-50 wt% Ag

Spence-Jones et al. 2018

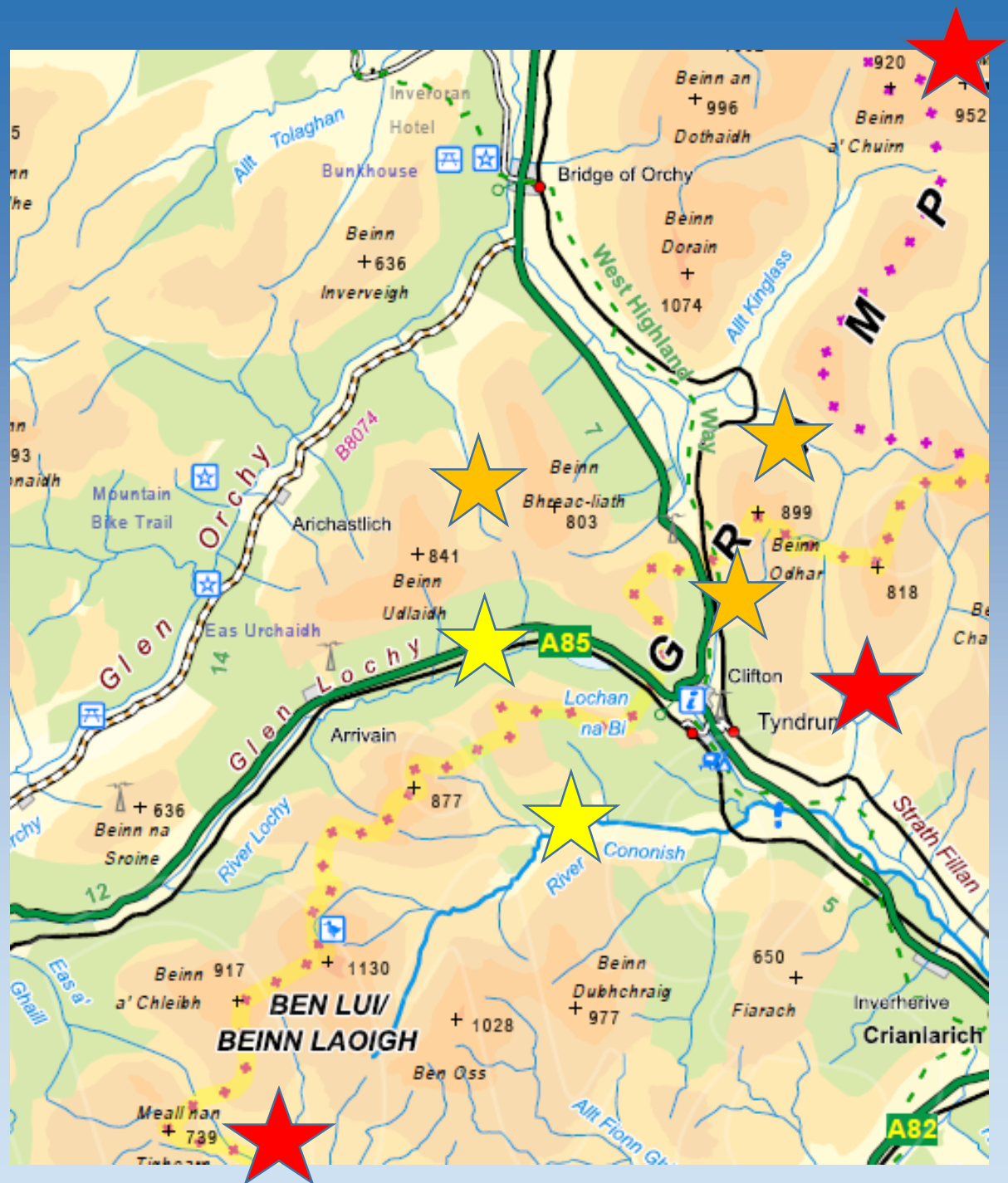
Deposit scale studies

Cononish signature replicated in Glen Lochy

Similar signature but with reduced Te (inclusions of Ag_4TeS not Ag_2Te)

Apparently unrelated signatures

Even though regional stream seds show widespread Au can target most economically attractive signature



Recap

We can apply gold composition studies to illuminate various relationships:

1. Local placer- lode
2. Regional metallogeny
3. Vein scale paragenesis

Very useful in areas where we don’t have a complete picture of bedrock geology
poor exposure
Under- explored/mapped

In terms of overall exploration costs they are low budget

Next Time

1. The practicalities of collecting gold
2. How gold studies can be integrated with other standard exploration approaches
3. What could possibly go wrong?
4. Future directions