Crustal-scale transport of NANOPARTICLE EMULSION forms ore deposits

Centre for EXPLORATION TARGETING

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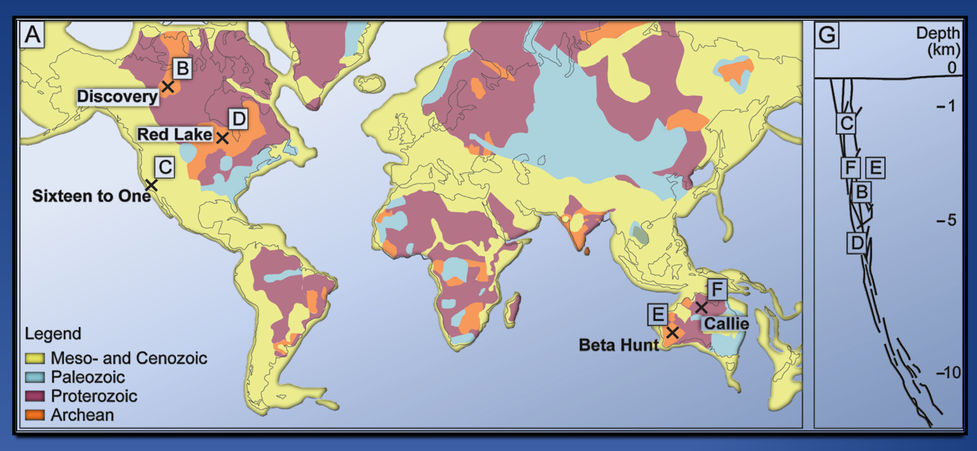
Background

High-grade gold deposits are formed through the accumulation of metals transported in hydrothermal fluids from their source to the deposit. The contribution of gold nanoparticle suspensions in fluids is required to form such grades[1,2].

However, as the source of gold is spatially disconnected from the deposit location[3], **it is not known how the transport of gold nanoparticles is achieved.**

Samples location

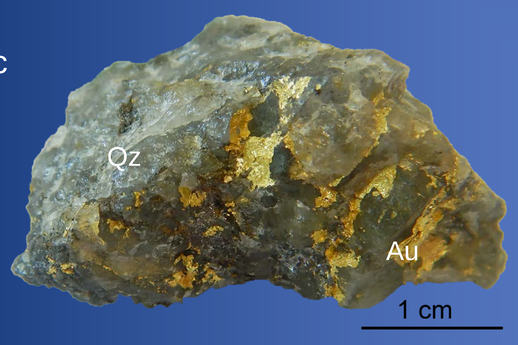


Observations

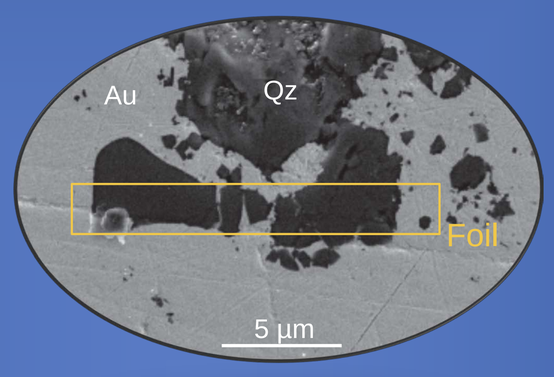
We document systematic occurrence of metals nanoparticles (Au, AgO, AuAg Cu) in five orogenic gold deposits formed in different geological settings and show a systematic and previously unrecognized close association with **amorphous silica and carbon.**

Nanoscale petrographic investigation done by Transmission Electron Microscopy (TEM).

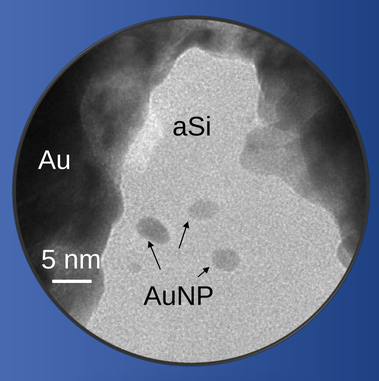
Example from the Discovery sample to the right.



BSE image taken within a coarse gold grain and showing the location of the foil extracted for TEM analysis.

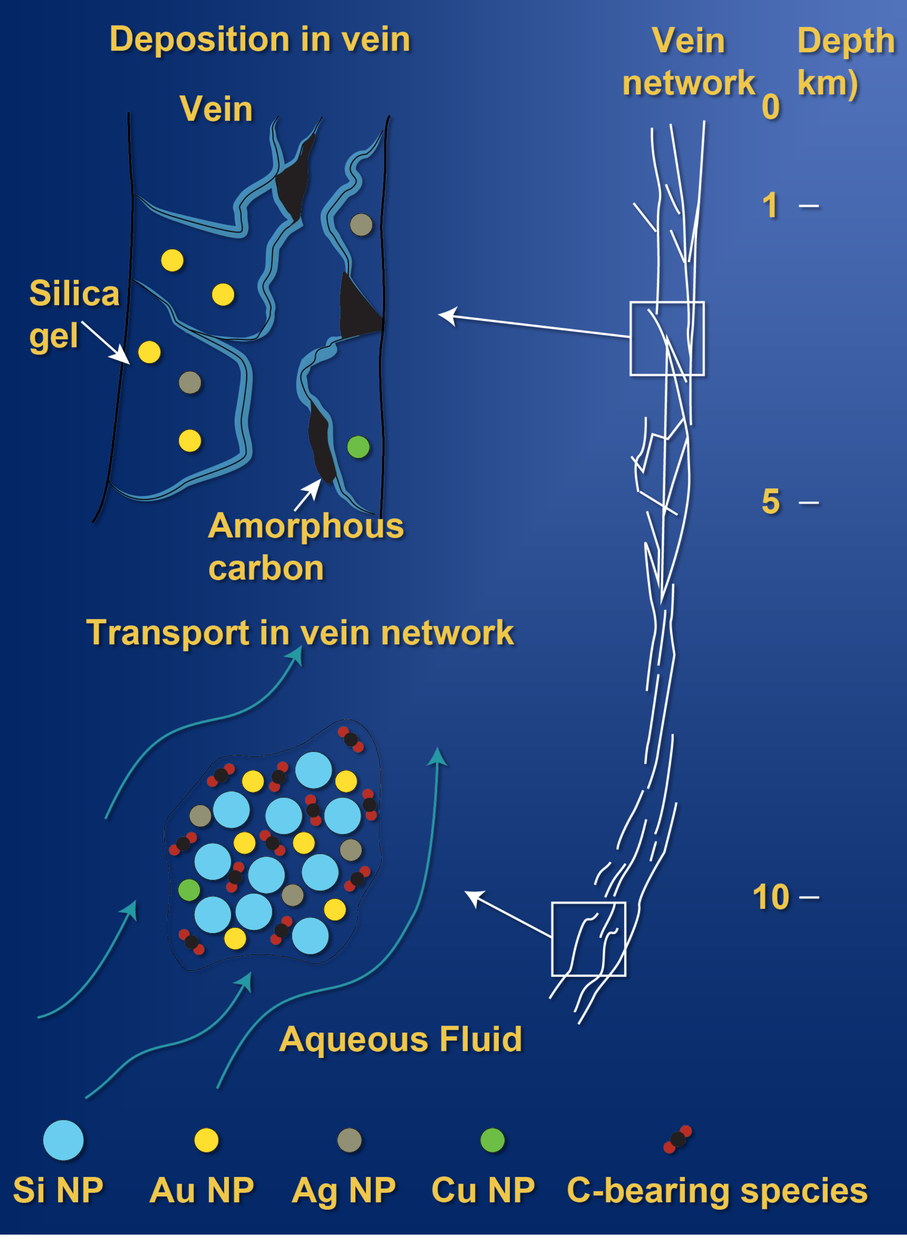


TEM image that shows an amorphous silica (aSi) phase filling an inclusion in gold hosting Au NP.



Model for the transport of metal NPs in the Earth's upper crust

Metal NPs transport of may have occurred (10 to 1 km deep) by the combined contributions of silica and gaseous/supercritical phases such as CO_2, CH_4 and N_2 under the form of nanoparticle emulsion.



Colloidal silica prevents the aggregation of the metal NP and the carbonic phase provides buoyancy to the emulsion.

Upon destabilisation, the carbonic phase precipitates as amorphous carbon and the colloidal silica as amorphous silica in veins.

What's next

New collaborative **ARC linkage project** has just started at CET

MAHGI Multiscale Analysis of High-Grade Gold Intercepts

The project will investigate the Multi-scale Analysis of High-grade Gold Intercepts.

To improve our understanding of high-grade gold formation. The project is in collaboration with Monash, Curtin and CSIRO and sponsored by Karora Resources, Northern Star and Kirkland Lake.

Acknowledgments

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References

1. Pearce, M. A., White, A. J., Fisher, L. A., Hough, R. M. & Cleverley, J. S. Gold deposition caused by carbonation of biotite during late-stage fluid flow. Lithos 239, 114-127 (2015).
2. Petrella, L. *et al.* Colloidal gold transport: a key to high-grade gold mineralization? *Mineralium Deposita*, 1-8 (2020).
3. Goldfarb, R. J. & Groves, D. I. Orogenic gold: common or evolving fluid and metal sources through time. Lithos 233, 2-26 (2015).

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