High-resolution imaging and quantification of Au in sulphide minerals using NanoSIMS

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With its high lateral resolution and high sensitivity, NanoSIMS is the ideal tool for mapping the distribution of trace elements within sulphide minerals. In Carlin-type deposits, Au is typically present as narrow rims along the edges or within the matrix of the sulphide grains. The low concentrations of Au in solid solution with the sulphide are notoriously difficult to detect by most in situ techniques, such as EPMA, and is thus commonly referred to as 'invisible gold'. As SIMS is very sensitive to Au, and other commonly associated trace elements such as Te and Sb, NanoSIMS provides the ability to image these elements with sub-micron resolution. At such scales it is possible to investigate the intricate relationships between the Au and associated elements to help determine the nature and evolution of the Au-bearing fluids [1]. Furthermore, through the development of ion-implanted standards, it is possible to quantify the concentration of Au directly from the NanoSIMS secondary ion images. Preliminary data also show the potential to obtain S isotope measurements from the same regions of interest.

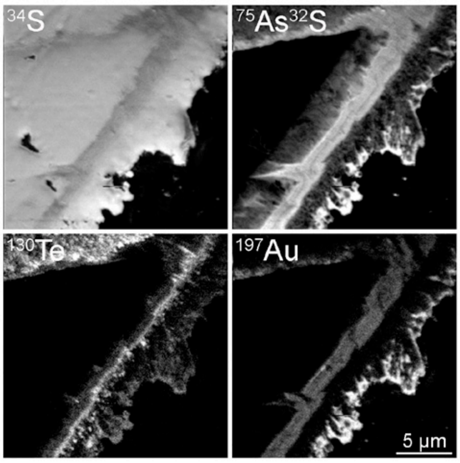

Figure 1: Secondary ion images showing the distribution of S, As, Te and Au in a pyrite grain from a Carlin-type deposit.

[1] Barker *et al*. (2009) *Econ. Geol*. **104**, 897-904.

Investigating the role of noble gases as tracers for CO_2 storage

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The capture and long term storage of carbon dioxide (CO_2) in the subsurface is one of the most promising ways of mitigating the current level of anthropogenic CO_2 being released to the atmosphere. A major issue surrounding long term storage is the risk of failure of CO_2 containment. Developing a monitoring strategy which would allow early detection of CO_2 leakage would enable measures to be implemented to mitigate and remediate the impact of containment failure. Experiments and modelling results have shown that noble gases have the potential to act as early warning tracers for CO_2 arrival [1]. Previous studies highlight the importance of understanding the transport processes involved for calculating tracer arrival times [2].

This study uses specially constructed equipment for experiments to determine factors affecting the transport of noble gases relative to CO_2. Initial pipeline experiments using argon and CO_2 have determined the parameters required for complete mixing of the gases.

We intend to examine conservative transport processes such as the advection, dispersion and diffusion of noble gases relative to CO_2 in porous media. The existence of any non-conservative transport processes such as sorption and dissolution are also considered. These data are compared to results from core flow experiments in order to determine the relationship between CO_2 and noble gases on rock core samples. The choice of sample used for experiments are low permeability porous sandstones.

Preliminary data will establish how noble gases and CO_2 behave in porous media during migration. Upscaling of the initial results will determine how effective different noble gases could be at acting as early warning tracers in a real world storage site.

[1] Cohen *et al*. (2013) *International Journal of Greenhouse Gas Control* **14**, 18-140. [2] Carrigan *et al*. (1996) *Nature* **382**, 528 – 531.

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