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‘T’-type mineralisation – a pseudo-epithermal style of VHMS associated gold mineralisation, Cyprus

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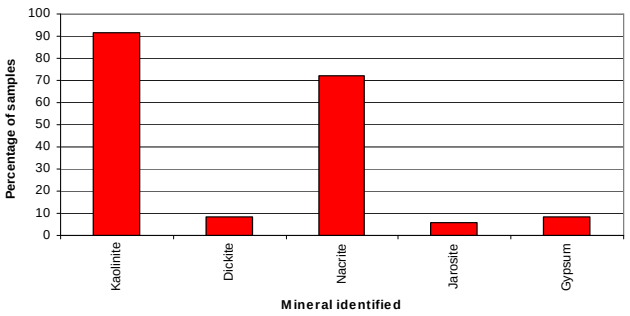
PIMA and XRD Results

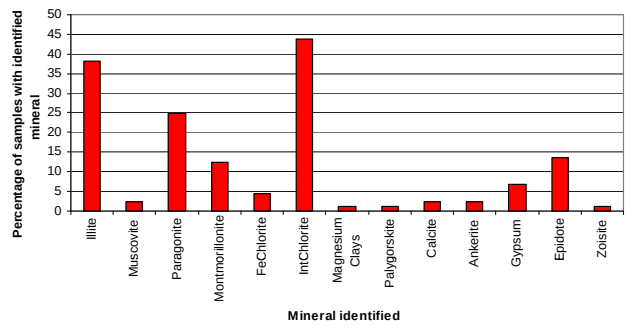
Short wavelength infrared (SWIR) analysis of core and chippings from each of the deposits studied using a Portable Infrared Mineral Analyser (PIMA) shows two distinct styles of alteration:

(i) P- and M-type alteration (Richards 1989), typical of Troodos VHMS deposits

(ii) A third type – here named ‘T-type’ after Tourounjia – with the presence of the acidic alteration minerals dickite and nacrite

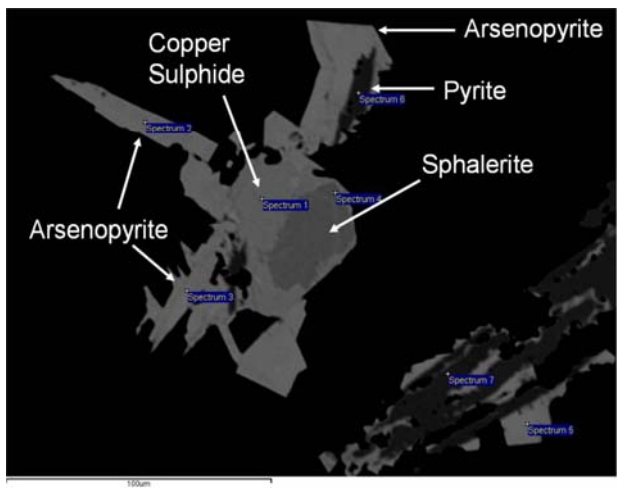


Alteration minerals from the Tourounjia prospect identified by PIMA analysis. Note the prevalence of kaolinite and nacrite and the presence of dickite compared to typical VHMS analyses.



Alteration minerals from the Agrokipia ‘B’ deposit – a typical Troodos VHMS deposit – identified by PIMA analysis. Note the complete absence of high temperature polytypes of kaolin group minerals.

X-ray Diffraction (XRD) analyses confirmed the presence of high temperature polytypes of the kaolin group, nacrite and dickite (Marumo 1989) at the Tourounjia prospect, as identified using a PIMA. The positive identification of nacrite, the highest temperature polytype of the kaolin group, confirming that high temperature acidic alteration has occurred, a feature not previously observed in association with Cyprus-type VHMS deposits.



Scanning Electron Microscope (SEM) image of mineralisation from Tourounjia, showing arsenopyrite with pyrite, sphalerite, and copper sulphide. Cinnabar was also identified in one sample from Tourounjia.

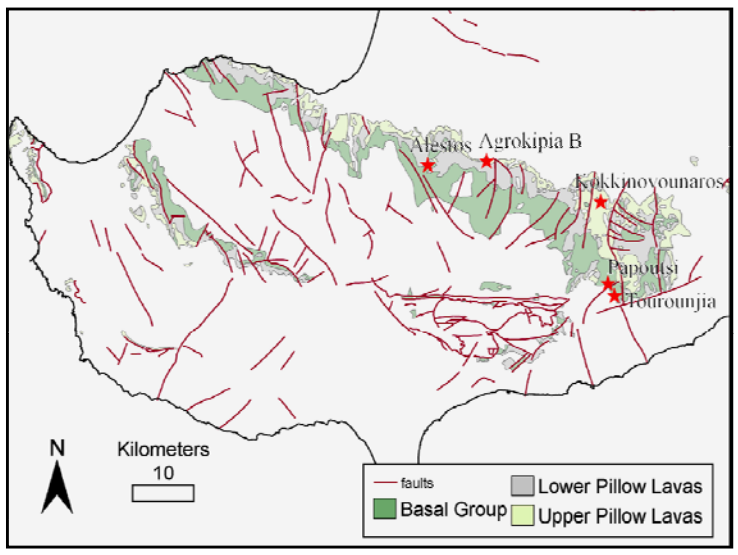
Introduction

Investigation of five VHMS prospects located in the Troodos ophiolite, Cyprus (Tourounjia, Alestos, Papoutsi, Kokkinovounaros and Agrokipia B), has indicated the possible presence of a pseudo-epithermal style of mineralisation. Three distinct styles of alteration are present:

• Two represent typical Cyprus-type VHMS alteration (Richards et al. 1989)

• Acidic alteration, not previously documented in Cyprus-type VHMS deposits

A process of sub-seafloor boiling, as inferred to be occurring presently in the Lau basin, most easily explains the formation and spatial link between acidic alteration and the zones of explosive hydrothermal brecciation present in the Tourounjia prospect.



Geological map of the Troodos ophiolite showing prospective lithologies and the location of the deposits studied in this project

Formation of T-type mineralisation

Kaolin minerals present at Tourounjia may have been formed by three hypogene processes:

(i) Genesis of acidic fluids through oxidation of H_2S;

(ii) Magmatic input (~terrestrial high sulphidation)

(iii) Boiling (~terrestrial low sulphidation)

Acidic fluid generation requires a sulphur content higher than the S_2:Fe ratio and more oxidising conditions than those in which the other Cyprus VHMS deposits formed. Acidic alteration could have formed through magmatic input, as proposed by Sillitoe et al (1996) to explain alteration within shallow Kuroko-type VHMS deposits and the presently active Hine Hina hydrothermal field of the Lau Basin. However, it is doubtful whether the magmas that formed the Troodos ophiolite are sufficiently rich in magmatic volatiles to provide the necessary input to form the Au-rich zones seen in the Tourounjia deposit.

Our preferred process for acidic fluid generation at Tourounjia is one of sub-seafloor boiling, as inferred to be occurring in the Lau basin (Herzig et al. 1993). Decreasing pressure or increasing the temperature of the hydrothermal fluids could cause subcritical phase separation and boiling. Typical temperatures encountered within Troodos VHMS deposits inhibit the precipitation of Au (from Au(HS)) – boiling processes allow the deposition of Au and the precipitation of Au, Ag and As seen in the Tourounjia prospect.

Further Work

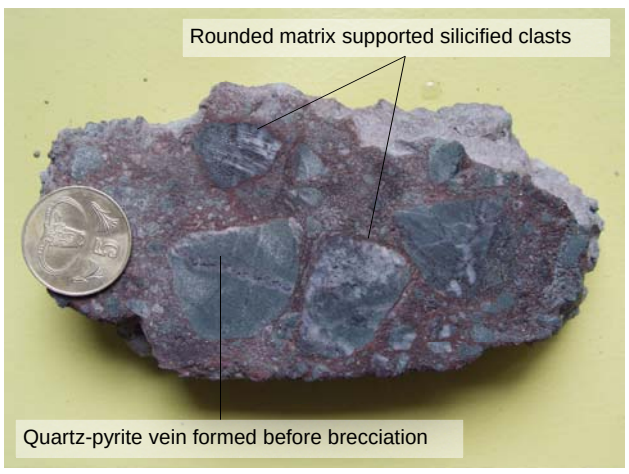
• Fluid inclusion work to further determine the composition of fluids and setting of mineralisation at Tourounjia

• Stable isotope studies to determine the source of hydrothermal fluids involved in mineralisation at Tourounjia

• Combination of data from Tourounjia with ongoing research to examine the hydrothermal mineralisation of the Troodos ophiolite

Photograph of hydrothermal breccia from Tourounjia. The clasts are sub-angular to rounded and supported in an entirely silicic matrix.

Photograph of the hydrothermal breccia at Alestos showing the sub-angular to rounded clasts supported by an Fe-rich silicic matrix.



Photograph of the pebble breccia zone from Alestos. Sub-angular to rounded clasts and the silicic matrix implies that brecciation was caused by explosive release of hydrothermal fluids.

References

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