THE PORPHYRY TO EPITHERMAL LINK: PRELIMINARY FLUID CHEMICAL RESULTS FROM THE APUSENI MOUNTAINS, ROMANIA, AND FAMATINA, ARGENTINIAN ANDES T. Pettke, W. E. Halter, T. Driesner, A. von Quadt and C. A. Heinrich, ETH Zürich, Isotope Geochemistry and Mineral Resources, Department of Earth Sciences, 8092 Zürich, Switzerland (pettke@erdw.ethz.ch).

Introduction: A spatial association of porphyry-style and epithermal ore deposits is common, yet possible genetic links between the two are not well understood to date. Laser-ablation (LA-) ICP-MS microanalysis of liquid and vapour inclusions from boiling assemblages in porphyry systems have revealed that, compared to most metals dissolved in the brine (e.g., Na, K, Ca, Fe, Mn) elements such as Cu, Au, As and other volatile metals selectively partition into the vapour phase[1]. The characteristic element suite of low-to high-sulfidation epithermal ores broadly corresponds to that of the vapor phase of boiling fluids in porphyry-type deposits. If rising vapour condensates at higher crustal levels, it could, thus, form an epithermal aqueous liquid enriched chiefly in Au, and gold could precipitate in response to fluid mixing or low-pressure boiling. This hypothetic genetic link is tested by LA-ICP-MS analyses of fluid inclusion assemblages from two porphyry-type Cu±Au mineralisations and associated low-sulfidation epithermal veins in Argentina and Romania, the latter being an important gold producer during Roman times.

Field relations and sample description: Rosia Poieni in the northern sector of the Apuseni Mountains, Romania, is the locality investigated in detail. Here, a late Miocene volcanic centre contains numerous andesitic subvolcanic intrusions. Some of these such as the Fundoaia andesitic to microdioritic stock show economic porphyry-type Cu±Au mineralizations associated with a series of hydrothermal alteration types. Porphyry-stage ore minerals are dominated by chalcopyrite, pyrite, bornite, magnetite, hematite and molybdenite. This multi-stage mineralization is cut by steep epithermal structures associated with acid sulfate alteration dominated by quartz, pyrite and alunite. Fluids of the early porphyry stage were trapped in the two-phase field characterized by co-existing vapour (5 wt-% NaCl equiv) and brines (67 wt-% NaCl equiv) that contain halite, sylvite, chalcopyrite and hematite daughter crystals. Epithermal fluid inclusion assemblages consists of tiny low-salinity aqueous two-phase inclusions within <2 mm sized quartz crystals.

LA-ICP-MS analyses of fluid inclusions: To test the hypothesis that a small fraction of Cu-As-Au-rich magmatic vapour may provide an essential contribution in ore-metals to epithermal Au-rich veins, the early porphyry-stage boiling assemblage was analysed for a set of 22 elements. Results show a clear relative enrichment of As and Sb, and Cu to a lesser extent, in the vapour phase relative to other elements such as Na, K, Rb, Cs, Pb, Zn and Fe (Fig. 1). Concentrations of Cu in the vapour are high and variable, while those of As and Sb are of the order of several hundreds of µg g⁻¹ of fluid. Concentrations of Au in the brine were below the limit of detection of 0.76 µg g⁻¹.

Conclusions: Reconnaissance data of fluid inclusions from early porphyry stage boiling fluid assemblages in Rosia Poieni confirm that Cu together with As and Sb tend to become relatively enriched in the vapour upon phase separation. These low-density magmatic fluids thus are a promising source candidate for overlying epithermal deposits for which results will be presented at the conference.

A similar study was conducted on spatially related porphyry and epithermal deposits in Famatina. Analysis from porphyry and epithermal fluids yielded very similar element ratios in the vapour phase of the porphyry stage and the aqueous phase of the epithermal stage, respectively, further supporting a direct genetic link between these two types of deposits.

Thus, our results provide strong evidence that rising vapour from porphyry-style intrusions is indeed a potentially important source of components for epithermal mineralizations.