Te and Se systematics in hydrothermal pyrite from precious metal ore deposits

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Pyrite is one of the most common minerals in many hydrothermal ore deposits including Carlin-type, epithermal-porphyry and orogenic Au deposits. Tellurium and Se are enriched in such deposits and pyrite is known to host these, and other semi metals such as As, Sb and Bi. Since pyrite is the dominant sulphide mineral in these deposits it can represent a major repository for these elements. It has been shown that trace elements in pyrite, such as As, Au and Co, can be used to infer ore-forming processes [1, 2]. Hence, Te and Se variatons in pyrite may reflect a number of key ore forming processes such as different source rock compositions and physicochemical changes in the ore-forming fluids.

This study compares the Te and Se contents of pyrite from various deposit-types. Carlin-type and low-sulphidation epithermal pyrite is enriched in Te (and Se) compared to pyrite from high-sulphidation epithermal-porphyry systems. Orogenic Au pyrite shows intermediate Te and Se contents. The solubility limit for Au [3] and Te solid solution as a function of As in pyrite suggests that Au-telluride inclusions occur in some pyrites from alkaline-hosted epithermal systems and orogenic Au deposits, whereas As-rich Carlin-type pyrites mainly host Te in solid solution. Neutral to alkaline fluids can effectively mobilise and transport Te from the source region to the site of metal deposition. Fluid boiling in porphyry-epithermal systems, as well as wall rock sulphidation and oxidation in Carlin-type (and orogenic Au) deposits can effectively precipitate Te in association with pyrite and Au from the ore fluids. In contrast, Se in pyrite varies in response to changes in fluid temperature but irrespective of pH and fO_2. Therefore, Se in pyrite may be used as a new geo-thermometer to estimate the precipitation temperature of pyrite. The combined use of bulk ore and pyrite chemistry indicates that pyrite represents the main host for Te and Se in Carlin-type and some epithermal systems reaching concentrations of potential economic interest.

[1] Keith et al. (2016) *Ore Geol. Rev.* **72**, 728-745. [2] Keith et al. (2016) *Chem. Geol.* **423**, 7-18. [3] Reich et al. (2005) *Geochim. Cosmochim. Acta* **69**, 2781-2796.