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Innovative stream sediment analysis for tungsten exploration: A case study in the Rauris Valley (Salzburg, Austria)

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The European Union has included tungsten (W) in the list of critical raw materials since 2011 and underlined its high importance for technological development in the context of the European green and digital transition by upgrading the metal as an economically strategic raw material in the recently published Critical Raw Materials Act. Although one of the world's largest tungsten deposits is mined at Felbertal in Austria, the European high-tech industry is still dependent on global imports. Therefore, both the development and application of innovative exploration tools play a crucial role in making the quest for critical raw materials in Europe much more effective in terms of time and economics.

The chemical analysis of stream sediments is a globally practiced exploration tool that has been used to locate geochemical anomalies and many deposits of different commodities (e.g., Cu, W, Au etc.) were discovered in this way. Modern analytical methods and new results in the chemical study of certain indicator minerals have significantly increased the contribution of heavy minerals (>4.5 g/cm³) in stream sediments to the understanding of regional geology, exploration for raw materials and an early-stage assessment of the regional economic potential. Scheelite ($CaWO_4$) is not only the most important tungsten mineral in the Eastern Alps, it is also a heavy mineral that provides important constraints for its provenance and petrogenesis. Intensive research on scheelite since 2019 by Montanuniversität Leoben together with GeoSphere Austria using a combination of cathodoluminescence, electron probe microanalysis and in-situ LA-ICP-MS techniques significantly contributed to our understanding of the systematic trace element incorporation in scheelite and its use for mineral exploration.

Mineralogical-chemical signatures of several tungsten deposits/occurrences in the Eastern Alps (including the world-class Felbertal deposit) form the basis for the application of scheelite as an indicator mineral to determine the potential of regional tungsten anomalies. Scheelite is a common minor mineral in orogenic gold deposits and has also been described in the mineral assemblages of the historically mined Tauerngold veins in the valleys of Rauris and Gastein. A genetic connection has always been suspected, though, this has not been satisfactorily proven yet. Scheelite fingerprinting allows different W-dominated mineralization styles to be distinguished. Importantly, the economically most interesting Felbertal deposit has a very unique fingerprint.

In this case study, we present the spectrum of scheelite signatures from a systematic stream sediment survey in the Rauris Valley and evaluate its economic tungsten potential. Watershed delineation supports the comparison of chemical-mineralogical results of scheelite analyses from Tauerngold samples and from heavy mineral concentrates to find out a genetic link between tungsten and gold mineralization. Interestingly, also an independent W mineralization phase without association to the gold-bearing veins is indicated.

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