Tracking Sediment Provenance in a River Basin for Mineral Exploration: the Sediment Fingerprinting Technique

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Stream sediment geochemical surveys are a standard exploration tool, but the results can constitute mixing problems that are challenging to solve. Sediment data record water-rock interaction in tributaries followed by fluid mixing in larger downstream catchments, potentially obfuscating the relative trace element contributions of each tributary. We propose a workflow using FingerPro, a state-of-the-art unmixing model implemented as an R package, to quantify the sediment source contribution in order to vector towards the source of anomalous values during exploration.

We present an example workflow from the Ocoña basin, one of the most important drainages in the southern part of Peru. The basin hosts more than 70 recognized Au-Ag and base metal deposits, and exploration is increasing in the region. We applied an unmixing model algorithm to a geochemical database of stream sediment samples from IMGEMMET-Peru. The FingerPro package unmixes the samples after selecting a set of optimal tracers that best fit the reality of our database. This study selects three major subcatchments as potential sediment sources (Upper, Middle and Lower). As a target, we use two mixture samples located in the lower part of the Ocoña basin. The tracers that best fit the model were: Co, As, Cu, Pb, and V based on the consensus and consistency methods. Our preliminary results suggest that the main sediment contributing source is the upper part of the basin, followed by the middle part of the basin, with the least contribution from the lower part of the basin.

Based on these results, we can rule out the lower part of the Ocoña basin as a possible source of noble and base metals. The areas with the greatest potential for mining exploration correspond to the middle and upper part of the catchment, where most small-scale mining and exploration work is currently being carried out.