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Geochemical mineral exploration under cover: considerations, challenges and innovative approaches

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Landscapes evolve due to variations in climatic conditions, geological setting and sedimentary dynamics. Understanding landscape types and their development in time is of key importance for mineral exploration in regions with thick weathering profiles and transported cover. Landscape evolution determines how near-surface geochemistry is linked to underlying lithologies. Therefore, it should be used to inform surface geochemical sampling strategy.

Cataloguing landscape domains at regional scales can be challenging. However, satellite derived data such as Digital Elevation Models can describe diverse geomorphological surface patterns. By using machine-learning algorithms and a knowledge-based approach, different landscape types can be mapped and their features quantified at regional and continental scales.

Quantifying geomorphological elements can have a substantial impact for the planning of surface geochemical surveys, since it allows the evaluation of the best sample media for capturing vertical and lateral geochemical dispersion within the cover.

However, due to the complexity of deeply weathered terrains and transported sedimentary packages, further strategies need to be in place to expand the predictive and descriptive geochemical models from the surface at depth. This can be attained at local scale by hydrogeochemical sampling and the integration of stratigraphic and mineral drilling datasets.

Geophysics, and especially airborne electromagnetics, becomes a powerful tool when combined with the previous approaches, since its interpretation may contribute enough information to infer geological features in between drillholes. This helps to determine optimal placement of drill holes and sampling locations for targeting mineral deposits, for which an understanding of the petrophysics of lithological units, and how they relate to geochemical processes is required. The integration of geomorphology, geochemistry and petrophysics would allow better understanding of surface element dispersion processes, and therefore provide a more efficient strategy to target mineral deposits at depth.