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## **Environmental significance of bulk geochemistry and metal anomalies within Hirnantian rocks of the Valongo Anticline, northern Portugal**

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The Sobrido Formation (Hirnantian) of northern Portugal contains a range of glacially-influenced rocks deposited on the north Gondwana platform. These rocks, part of the regional Lower Paleozoic succession, were deformed into the Valongo Anticline during the Variscan orogeny. This structure located near Porto (northern Portugal) is a NW-striking set of folded metasedimentary rocks with intercalated volcanics, surrounded by Variscan granites. In this area there are mineralisations of gold and antimony, forming part of the Dúrico-Beirão mining district, which is part of a wider regional field of mineralisation related to several igneous phases of the Variscan orogeny. The existence of enhanced concentrations of gold, antimony and other metals in some rock layers has been the object of several studies. Mineralisation has taken place mainly in the Cambrian volcano-sedimentary succession, in Lower Ordovician volcano-sedimentary successions with interbedded ironstones, in basal Carboniferous breccias, and likely also throughout in relation to the emplacement of Variscan granites. Mineralisation thus took place in several stages, as evidenced by previous structural, paragenetic and geochemical studies. Farther north, mineralisation associated with Variscan granites also occurred in several stages. The geochemistry of Hirnantian diamictites and related rocks in the Valongo Anticline provides insight into the composition of major elements, and the preconcentration of metals and REE, and thus the geochemical history of the region.

Within the Sobrido Formation, diamictites are interbedded with quartzites, conglomerates and slates. Whole rock geochemistry, metal anomalies and REE within these different rock types were analysed in order to consider the chemical environments of sediment deposition and post-depositional supergene chemical processes. Results show the diamictites are depleted in mobile elements, indicating strong subaerial weathering following deposition. Ferruginous horizons within the diamictite suggest oxidising conditions during deposition, whereas laminated mudstones have high V and low Ni, indicating anoxic conditions. High values of gold, antimony and arsenic are found in particular within the diamictites and associated conglomerates throughout the Valongo Anticline, highlighting the potential of these rocks as guides in prospecting metals. It also highlights their complex post-depositional geochemical histories, related to preconcentrations in older sediment, mainly linked with volcanism, and probably with granitic intrusions around the time of the Variscan orogeny. As such, this study supports previous regional investigations of mineralisation dynamics, and suggests a still more complex syndepositional mineralisation history than has been previously recognised.

