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Post-collisional delamination of the late Ediacaran Large Igneous Province as a metal source for the world-class Imiter Ag-Hg deposit, Morocco: Constraints from field geology, mineralogy, and Pb isotopes

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The Imiter silver district, a world-class concentration of silver-rich base metal mineralization in the Anti-Atlas belt on the northwestern edge of the West African Craton, comprises several sectors including Imiter I, II, South, and Igoudrane. Mineralization occurs as sub-horizontal ore bodies, steeply dipping north-trending veins controlled by the major Imiter fault, and low-angle south-dipping veins associated with crustal-scale fault zones. The formation of this extensive district is attributed to a sustained magmatic source and significant tectonic structures linked to asthenospheric mantle reservoirs. This study integrates new field observations, electron probe microanalysis, and lead (Pb) isotopic data with a review of existing geochemical, isotopic, and geochronological data. The Pb isotopic data define three distinct signatures corresponding to discrete geological episodes: Pb1, related to Late Ediacaran magmatism; Pb2, linked to Hercynian orogenic hydrothermal activity; and Pb3, attributed to Alpine magmatism. The primary mineralization (Pb1) is associated with the Late Ediacaran high Sr/Y Bou Fliou (582 Ma) and Igoudrane (538 Ma) intrusions, as well as dykes controlled by the crustal-scale Imiter Fault. Subsequent remobilization of precious metals (Au, Ag) is linked to magmas derived from delaminated lower crust and a former subducted slab during post-collisional processes, which introduced a significant mantle-derived component. In this context, dykes served as critical conduits for mineralizing fluids. The formation of these magmatic-related deposits in the Imiter region is part of a broader regional metallogenic event during the Late Ediacaran Large Igneous Province (590–540 Ma), a period of extensive magmatism that was fundamental to the development of intrusion-related mineral systems in the Anti-Atlas belt.