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Mercury vapour haloes in near-surface air above ore deposits and faults on Vancouver Island, British Columbia, Canada

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Volatile geogenic components, such as CO_2, He, Rn, and Hg^0, form haloes in soil gas and near-surface air directly above mineral deposits. This contrasts with lithochemical, hydrochemical, and biochemical dispersion haloes that can be laterally displaced or obscured by transported overburden. Mercury vapour surveys have been used in exploration, because Hg occurs in most types of enogenic ore deposit types and is highly mobile. Low background concentrations in the atmosphere (1.2 to 1.5 ng/m^3) enable detecting even weak Hg emissions directly above buried ore deposits. In this study, we measured Hg vapour in air 1-50 cm above ground at 15 sites on Vancouver Island, British Columbia, Canada. To evaluate the effectiveness of the method across a range of settings, these sites include different types of known mineralized zones, barren rocks, and faults, both buried and exposed. The direct and continuous analysis via a portable RA-915M mercury analyzer reveals Hg vapour concentrations ranging from 0.5 to 54.4 ng/m^3. The highest Hg concentration was observed above tailings at the Bentley Au occurrence, possibly due to the amalgamation technique used for fine gold extraction between late 1800s and early 1900s. Prominent Hg vapour haloes mark shear-hosted Cu-Ag-Au sulphides at Mount Skirt (13.4x background Hg), epithermal Au-Ag-Cu at Mount Washington (8.9x background Hg), and sediment-covered polymetallic volcanogenic massive sulphides at the Lara-Coronation occurrence (4.2 to 6.6x background Hg). Basalt-hosted Cu-Ag-Au sulphide zones at the Sunro past producer are marked by weak Hg vapour anomalies relative to local background. Faults, including the Leech River fault, which was active in the Quaternary, are also marked by weak Hg vapour anomalies. The study confirms that, although the Hg level is influenced by weather, the real-time Hg vapour measurement of near-surface air can instantly delineate mineralized zones and fault structures that are buried under overburden 10s of m thick. In contrast to soil gas sampling, this simple and rapid technique can be applied to mineral exploration and geological mapping under overburden above any type of surface, including outcrops, talus, bogs, water bodies, snow, and permafrost.