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## Automated Multi-Sensor Core Logging and Analysis for the Assessment of Sn-W Mineralization Pattern and Distribution – Hemerdon Deposit, Devon, UK

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The Hemerdon deposit, located in Devon, southwest England, is the world's third largest tin-tungsten deposit, boasting an estimated resource of 347.7 Mt at 0.12% $WO_3$ and 0.03% Sn. The deposit is hosted in a sub-vertical granite dike that strikes NNE-SSW and consists of a series of steeply dipping veins that contain cassiterite and wolframite. The deposit displays complex geology and metallurgical characteristics due to its multi-phase alteration overprinting, ore-texture variations, and gangue mineral contamination. This study aims to re-evaluate the mineralization and alteration patterns and their relationship to the geological structures by using an integrated non-destructive core analysis. This approach includes a portable XRF, an ASD spectrometer, magnetic susceptibility meters, high-resolution linescan imaging, and a 3D laser profiler. The data from these analyses are then fed into machine learning algorithms that use K-Means clustering to generate litho-geochemical and alteration clusters. We also utilized a U-Net Convolutional Neural Network (CNN) algorithm to map the structural patterns and distribution of key ore minerals, using the linescan and 3D laser images as inputs. To test our methods, we examined three main drill holes with a total length of 760 m. Our analysis revealed a distinct pattern of alteration and mineralization, beginning with partly oxidized granite with low-moderate arsenopyrite alteration (low Ca, P, and Ni) at the top of the holes, followed by highly kaolinized granite with high arsenopyrite, and then the greisen with intense muscovite alteration (high P, Ca, Ni, Zn) at the bottom of the holes. We identified three primary structural trends, including the NNE-SSW steep-angle sub-parallel tourmaline veins, the NE-SW steeply dipping quartz and feldspar veins, and the shallow-angled E-W fractures. This study represents a significant step forward in our understanding of the deposit's characteristics and provides insights for future exploration and development efforts.