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A Framework for 3D Multiparameter Mapping of VMS Ore Systems illustrated with a Case Study from the Flin Flon Mining District, Trans-Hudson Orogen, Canada

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It is widely acknowledged in the hydrocarbon and mineral industries that the development of more effective exploration methods benefits from a system approach that establishes the link between critical mass and energy transfer processes and mappable targeting elements. Accordingly, 3D geologic modelling in support of deeper mineral exploration, should not only focus on modelling the ore deposit and its hosting rock units, but also on the 3D spatial characterization of targeting elements that reflect mineralizing fluid transport and mineral deposition mechanisms. We present a framework for deposit to camp scale 3D modelling of strata-conformable VMS ore systems in which this process-oriented targeting objective is addressed and illustrate its application to the Flin Flon-Callinan-777 VMS ore system hosted in accreted juvenile volcanic arc terranes of the Paleoproterozoic Trans-Hudson orogen, Canada. A grid of the envelope of the VMS-hosting mine horizon has been modelled from lithostratigraphic and fault surfaces by the systematic reconciliation of drill hole and geologic map data. This 3D strata-conformable grid serves as a multi-parameter container for geostatistical modelling of volcanic and volcaniclastic lithofacies, hydrothermal alteration indices, Cu/(Cu+Zn) ore metal zoning and physical properties supporting forward modelling and inversion of geophysical data. Although fault displacements due to early layer-parallel thrust imbrication of the mine horizon can not be restored, the integrated interpretation of the lithofacies and geochemical parameters provides valuable insight in the Palaeo-submarine setting of the VMS ore system that directly benefits deep targeting strategies in the mine camp.