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Seismic Imaging of the Geological Framework and Structures Related to Volcanogenic Massive Sulfide Deposits in the Archean Rouyn-Noranda District, Québec, Canada

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Two seismic reflection profiles acquired by Noranda Inc. (now Xstrata) in the Noranda mining camp (Canada) were re-processed and interpreted with the objective of providing key information on the geological contacts and structures associated with volcanogenic massive sulfide (VMS) deposits at depth. The Amulet and Ribago seismic profiles run approximately from east to west and cross the volcanic rocks of the Noranda formation which host most of the ore deposits in this camp. The seismic data interpretation relies strongly on a detailed 3D geological model built from an extensive number of exploration boreholes available in this area and is further supported by physical rock property measurements from in-situ borehole logging data. Some reflections observed on the Amulet and Ribago seismic profiles correlate with rhyolite/andesite or silicified-andesite/andesite contacts that host the prospective exhalite horizons of the Noranda formation. In particular, the silicified-andesite/andesite contact hosting the C-contact is imaged clearly down to a vertical depth of 1100 m along the Ribago profile. The processing sequence included dip move out (DMO) corrections and poststack migration. The seismic data re-processing allowed the identification of two diffractions that correlate with known sulfide bodies intersected in boreholes located close to the Ribago profile. One of these diffractions, at approximately 1200 m depth, coincides with the main massive sulfide intersection of the sub-economical Ribago orebody. Diorites cause several reflections observed within the Flavrian pluton. Some diorite units also have sufficient acoustic impedance contrast to produce strong reflections when juxtaposed against volcanic rocks. However, such reflections do not predominate on the Amulet and Ribago profiles, possibly because reflective diorite units are not so significant or have limited lateral continuity in this part of the Noranda formation. The reconciliation of the detailed 3D geological model and 2D seismic data was not necessarily a straightforward task. A significant complication results from the inherent limitations of 2D seismic imaging techniques in a complex 3D geologic environment. Nevertheless, results indicate that seismic methods can image prospective contacts and deep-seated massive sulfide mineralization and can be a valuable exploration tool in the Noranda mining camp.