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Seismic Exploration for VMS Deposits within the Paleoproterozoic Flin Flon Belt, Trans-Hudson Orogen, Canada

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The Trans-Hudson Orogen forms the largest Paleoproterozoic orogenic belt of Laurentia. It is particularly known for its world-class volcanogenic massive sulphide (VMS) deposits. The Flin Flon-Glennie complex, which represents remnants of ca. 1.92 to 1.88 Ga juvenile island arc, ocean floor, ocean plateaus, evolved arc, and associated sedimentary and plutonic rocks, hosts the largest Paleoproterozoic VMS district in the world, with 24 deposits with aggregate tonnage of 143 Mt of sulphide in past and presently producing mines, and 64.3 Mt contained in a number of subeconomic or preproduction deposits.

The main deposits of the Flin Flon camp have mineral compositions of predominantly pyrite, pyrrhotite, sphalerite, and chalcopyrite. All of these minerals are characterised by high acoustic impedances relative to typical host rocks, thus making them excellent candidates for seismic exploration using high-resolution techniques. In a concerted effort to support exploration for new ore deposits in the vicinity of Flin Flon and surrounding region, a program of seismic investigations has been implemented as part of the Targetted Geoscience Initiative-3 (TGI-3) Saskatchewan-Manitoba project. This project is a joint Federal-Provincial effort led by the Geological Survey of Canada with active participation by Hudson Bay Mining and Smelting Ltd. The seismic program is designed to provide a basis for constructing a 3D geological model for the mining camp, to scrutinize and refine the current conceptual exploration model for the camp,

and ultimately to provide new drill targets.

Rock property measurements, downhole geophysical logging and vertical seismic profiles acquired in advance of the main seismic survey demonstrated the expected reflectivity of the mining camp geology. The principle seismic survey was conducted during May-September, 2007 and comprised a total of 75 km of high-resolution 2D seismic profiles and a 3D survey covering approximately 10 km2. Seismic imaging in the Flin Flon area poses significant challenges due to the complex crystalline geology, the location of the imaging targets beneath an active town and operational mine site, and the highly variable terrain. Data were recoreded using IO System IV digital vector (3-component) accelerometers, spaced at 5 m intervals (for 2D survey) with recording times of 4 s. Seismic sources spaced at 20 m intervals included Vibroseis and dynamite sources on land, and an airgun for lake areas. The results of processing the vertical-component data for P-wave reflections reveal subhorizontal reflectivity associated mainly with the Missi metasedimentary complex and steeply dipping reflectivity associated with the polydeformed volcanic rocks, including the main rhyolite horizon which hosts the VMS deposits. Some important fault zones are also imaged.