
Proterozoic Ultramafic-Mafic Intrusions of the Nipigon Plate, Beardmore, Ontario

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A Proterozoic peridotite overlain by one of the Nipigon diabase sills is located in Eva and Kitto townships, west of the town of Beardmore and about 190 km northeast of Thunder Bay, Ontario. The peridotite intrudes Archean clastic metasedimentary rocks and mafic metavolcanic rocks situated on the southern edge of the Beardmore-Geraldton belt (BGB), along the contact between the eastern Wabigoon and Quetico subprovinces. A swarm of narrow, north-trending diabase dykes cut the supracrustal rocks, and are predominately 2170 Ma Marathon age dykes (Osmani, 1991) with lesser dykes representing branches of the Nipigon sills. The peridotite, mapped during the 2001 field season (Hart et al., 2001), has been interpreted to be time equivalent to the ultramafic (picrite) intrusions of the Leckie and Disreali lakes area (Sutcliffe, 1991) that are currently being explored for platinum group element (PGE) mineralization (East West Resource Corporation, 2001).

The peridotite forms a roughly ring-shaped intrusion that is crudely zoned and dominated by a lherzolite inner zone with a wehrlite outer zone. The lherzolite is composed of massive, medium-grained, cumulus olivine, orthopyroxene, and lesser clinopyroxene. Irregular areas containing approximately 5% coarse-grained, subhedral orthopyroxene phenocrysts and variable amounts of plagioclase are more common towards the inner contact. The wehrlite lacks the irregular areas rich in orthopyroxene phenocrysts, but occasionally contains very coarse-grained poikilitic orthopyroxene. Both units contain 1% fine-grained biotite or hornblende in contrast to the Nipigon diabase. Outcrop exposure is sparse, and the only exposed peridotite contact has fine-grained to chilled diabase overlying the peridotite. A granophyric olivine gabbro located along the inner contact between the peridotite and the supracrustal rocks is interpreted to represent the upper contact of the peridotite. A portion of the gabbro is coarse-grained with pinkish feldspar and small, irregular, possibly mariolitic cavities interpreted to indicate emplacement of the peridotite at a shallow crustal level. A hybrid contact containing pebble to cobble size, angular to subangular xenoliths of

metasediment broken along bedding planes within a biotite-rich gabbro matrix indicates extensive interaction between the peridotite and country rocks. A tremolite rich hornfels zone, composed of magnetite-rich and magnetite-poor lapilli to block sized fragments, is also developed in the mafic metavolcanic rocks and iron formation along the contact with the olivine gabbro. The shape of the intrusion is not known due to the lack of definitive contact relationships, and could range from a steeply dipping cone sheet dyke to a shallow west-dipping sill. Controls on the location of the intrusions may include a fault along the Archean metasedimentary and metavolcanic contact and/or the Wabigoon–Quetico subprovince boundary.

A series of undulating, generally flat-lying to shallow-dipping, massive, medium- to fine-grained diabase sills of the Nipigon Sill Complex intrude all rock units. Sills are generally 100 m thick, and vary by 50 to 60 m in elevation over distances of 400 to 500 m. But a 185 m thick sill was intersected in the workings of two local gold mines. The diabase contains trace to 5% fine-grained olivine in distinct contrast to the Logan sills located closer to Lake Superior (J. Franklin and R. Middleton, personal communication, 2001). Sill stratigraphy is varied and coarse-grained granophyric zones were observed toward the base of the sill, and also near the sill top underlying a magnetite porphyritic phase. Contacts are commonly polygonal jointed, aphanitic chills or xenolith-rich hybrid zone along the contact with adjacent metasedimentary rocks. The hybrid contacts consist of a matrix of fine-grained, black biotite diabase hosting blocks or pebble-size xenoliths of metasediment and subrounded to rounded pebble sized xenoliths of coarse-grained quartz and white to pinkish feldspar. These hybrid contact textures are interpreted to indicate the assimilation of adjacent metasedimentary rocks by the diabase.

The peridotite is compositionally similar to the ultramafic intrusions at Seagull and Disreali lakes, south of Lake Nipigon, recently reclassified as dunites and lherzolites by Middleton (2001). The peridotite is also geochemically similar to the lower suite of the Osler Group volcanic rocks

(Sutcliffe, 1987), with TiO₂: 0.56 to 2.54%, Mg-numbers: 0.71 to 0.80, La/Sm: 2.61 to 4.0, Gd/Yb: 1.76 to 3.73, and Th/Ta: 0.13 to 0.31. The olivine gabbro has similar ratios, but higher elemental abundances, than the peridotite indicating that it is the fractionated and crustal contaminated upper portion of the intrusion. However, this intrusion is older than the diabase sill and could be part of a magmatic event related to earlier rifting in the Nipigon Plate. Nickel depletion within the intrusion is relatively weak, but Cu/Pd ratios fall within the enriched range of Barnes et al. (1993) and overlaps with the Cu/Pd ratios reported for the Disreali and Seagull lakes intrusions (Middleton, 2001). There are a number of interflow chert-magnetite iron formations with minor sulphide mineralization in the adjacent metavolcanic rocks that are potential sulphur sources for the formation of PGE mineralization in the peridotite

The diabase is geochemically similar to the upper suite of the Osler Group (Sutcliffe, 1987), with TiO₂: 0.66 to 2.49%, Mg-numbers: 0.29 to 0.70, La/Sm: 1.59 to 2.93, Gd/Yb: 1.37 to 1.79, and Th/Ta: 0.11 to 0.33. Mineralization within the diabase consists of trace amounts of disseminated pyrrhotite and pyrite and chalcopyrite in joints close to the upper or lower contacts. The assimilation of adjacent metasedimentary rocks increases the potential for contact-style PGE mineralization, with occurrences present near the upper contact of a sill in southeast Kitto Township and the lower contact of a sill in southwestern Eva Township.

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