

The Quetico Intrusions of Western Superior Province: Neo-Archean examples of Alaskan/Ural-type mafic–ultramafic intrusions

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Abstract

The Quetico Intrusions are a series of ultramafic–mafic igneous rocks that occur along the northern Quetico subprovince boundary. These intrusions show lithological zoning from cores of olivine-bearing ultramafic rocks to margins of hornblende and gabbroic rocks, and they are commonly accompanied by Cu–Ni–platinum group element (PGE) sulphide mineralization. We identified three additional Quetico Intrusions in the centre and southern part of the Quetico subprovince, bringing the entire Quetico Intrusion array to be over 125 km in length across the subprovince. The Samuels Lake intrusion in the centre of the subprovince has an U–Pb age of $2688 \pm 6/-5$ Ma, which is similar to the age of ~ 2690 Ma for the Quetico Intrusions along the northern subprovince boundary, suggesting that all the Quetico Intrusions are likely to be contemporaneous. The parental magmas of the intrusions were Mg-rich based on the high Mg of olivine and clinopyroxene, and they were hydrous as evidenced by abundant hornblende, early crystallization of clinopyroxene, and the common occurrence of mafic pegmatite. The bulk rocks show arc geochemical signatures, including a high concentration of large ion-lithophile elements combined with a low concentration of high field-strength elements. The mineral compositions of pyroxene and hornblende also plot in the field of arc igneous rocks. The data suggest the derivation of the parental magmas from a mantle wedge or a refractory mantle that was previously metasomatized in a subduction setting.

The Quetico Intrusions display many similarities with Alaskan/Ural-type zoned mafic–ultramafic intrusions along major sutures of Phanerozoic orogenic belts. Common features include their geodynamic settings, internal lithological zoning, mineralogy and mineral chemistry, and common association with PGE mineralization. The striking similarities between the two indicate that the late Archean Quetico Intrusions likely formed in a tectonic setting similar to that of the Alaskan/Ural-type intrusions. We propose that the parental magmas for the Quetico Intrusions formed during the very early stage of accretion of the Wawa arc to the Wabigoon subprovince. Oblique accretion of the Wawa arc likely steepened the subduction angle, which allowed upwelling of hot asthenospheric mantle. This resulted in high degrees of partial melting in the mantle wedge to produce the Quetico Intrusions.

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1. Introduction

Several mafic–ultramafic intrusions, collectively known as the Quetico Intrusions, occur along the northern boundary of the Quetico metasedimentary subprovince (Figs. 1 and 2). These late Archean intrusions are important in understanding the evolution of this Archean craton because they represent the final mantle-

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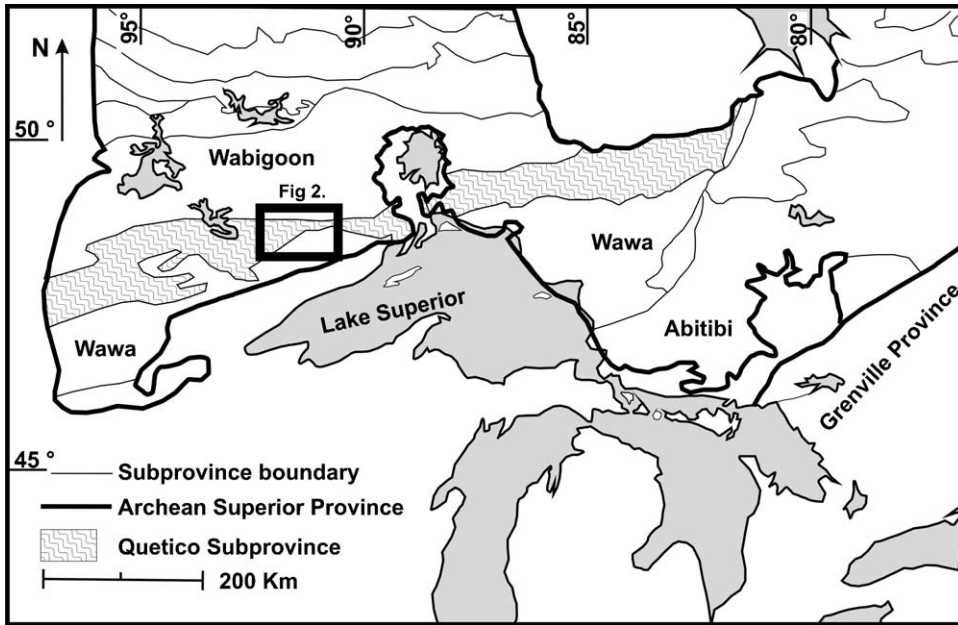


Fig. 1. Location map of the Quetico subprovince.

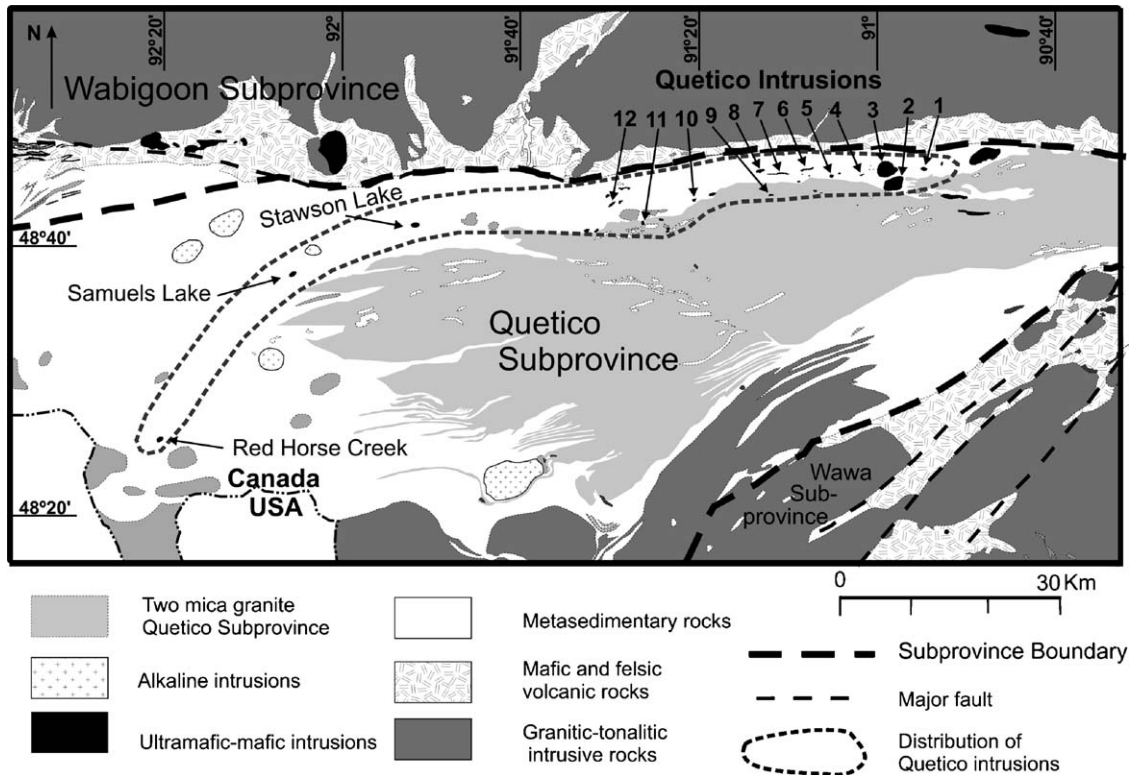


Fig. 2. Location map of the Quetico Intrusions. Several intrusions are less than 0.5 km in size and not appear on the map; relatively large classical Quetico Intrusions include: (1) Chief Peter, (2) South Elbow, (3) North Elbow, (4) Mud Lake, (5) Abiwin, (6) Heward Lake, (7) East Kawene, (8) Kawene Lake, (9) Eva Lake, (10) Nickelbe, (11) Nym Lake, (12) Plateau Lake. The distribution of the Quetico Intrusions is outlined with the thick dashed line.

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