GEOCHEMISTRY AND RADIOGENIC ISOTOPE CHARACTERISTICS OF THE FORT HOPE GREENSTONE BELT, NORTHWESTERN ONTARIO: DEVELOPMENT OF A CONTINENTAL ARC ON THE MARGINS OF A SUPERCONTINENT

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Introduction

The Uchi subprovince of the Superior Province (Figure 1) is unusual in that it incorporates over 300 million years of discontinuous volcanic activity. It forms a long, linear domain, well over 600 km, along the southern margin of a Mesoarchean terrane. As such it offers an excellent opportunity to evaluate the nature of continental growth processes in the Archean (Hollings & Kerrich, 1999; Percival et al. 2006), the styles of Archean plate tectonics (e.g. Wyman & Hollings, 2006) and the evolution of these processes over time. In general the older sequences have been interpreted as the result of rifting of passive margins of an older cratonic nucleus (c.f., Davis et al., 1988; Tomlinson et al., 1996), likely related to the impingement of a mantle plume on the continental lithosphere (e.g. Hollings et al., 1999) and are included within the NCT of Thurston et al. (1991). In contrast, the younger assemblages of the Uchi comprise a mix of allochthonous and autochthonous volcanic sequences (Stott & Corfu, 1991; Hollings & Kerrich, 2006).

Regional Geology

The Miminiska-Fort Hope greenstone belt is located towards the eastern end of the Uchi subprovince and has been the subject of relatively little detailed mapping or other geological studies. Detailed geological mapping was undertaken by Wallace (1978, 1981a, b) in the south of the belt and by Prest (1944) in the northern portion. Based primarily on U/Pb zircon age determinations and regional correlations with the central Uchi and the Pickle Lake belt (Young 2006), we tentatively identify one portion of the northern part of the belt that could be correlated with the (~2.89 to 2.86 Ga) Pickle Crow assemblage of the Pickle Lake belt., The older assemblages comprise predominantly tholeiitic pillow basalts with rare felsic pyroclastic flows. In contrast, the

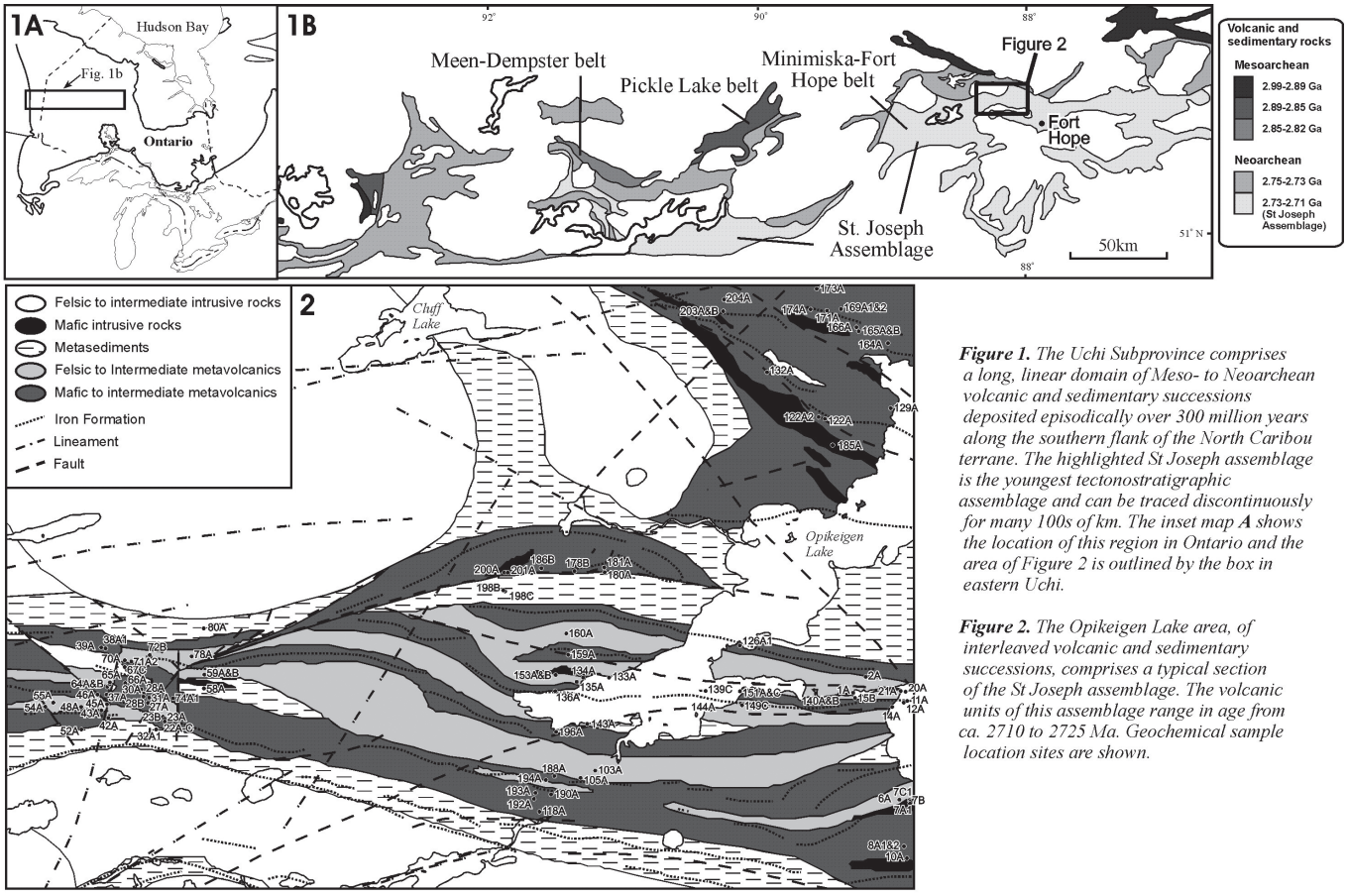

Figure 1. *The Uchi Subprovince comprises a long, linear domain of Meso- to Neoarchean volcanic and sedimentary successions deposited episodically over 300 million years along the southern flank of the North Caribou terrane. The highlighted St Joseph assemblage is the youngest tectonostratigraphic assemblage and can be traced discontinuously for many 100s of km. The inset map* ***A*** *shows the location of this region in Ontario and the area of Figure 2 is outlined by the box in eastern Uchi.*

Figure 2. *The Opikeigen Lake area, of interleaved volcanic and sedimentary successions, comprises a typical section of the St Joseph assemblage. The volcanic units of this assemblage range in age from ca. 2710 to 2725 Ma. Geochemical sample location sites are shown.*

southern portion of the Fort Hope belt includes felsic pyroclastic rocks with ages of 2723-2716 Ma (Corfu & Stott 1993) and younger clastic sediments. Based on the reported ages and the presence of tholeiitic and calc-alkaline basalt flows overlain by intermediate to felsic pyroclastic units (Wallace, 1981a) Stott & Corfu (1991) proposed that this assemblage was an extension of the St Joseph assemblage of the Lake St Joseph greenstone belt. Wallace (1978) conducted the first detailed mapping of the Opikeigen Lake area (Figure 2). He reported the presence of abundant massive and pillowed lavas and flow breccias in east-trending belts throughout the area. Algoma-type iron formation occurs as minor bands intercalated with the mafic volcanics (Wallace, 1978). Mafic tuffs between 0.3 and 1.5 m thick are intercalated throughout the volcanic pile as are felsic to intermediate pyroclastic tuffs, massive flows and autobreccias (Wallace, 1978). More recently the Norton Lake area was subject to detailed mapping as part of a Master's thesis by Johnson (2005) whereas the Opikeigen Lake area was mapped in detail by Hall (2005) with more recent compilation by Madon et al. 2009.

Results

The volcanic rocks of the Fort Hope belt range in composition from basalts to rhyolites. Some mafic volcanic rocks of the St Joseph assemblage are characterised by pronounced LREE depletion (La/Sm_n = 0.54-0.95) comparable to modern Mid-Ocean Ridge basalts, with $\varepsilon_{Nd(T=2700Ma)}$ ranging from 0.83-3.03; whereas other mafic volcanic rocks of this assemblage are characterised by depleted to weakly LREE enriched primitive mantle normalized patterns and negative Nb anomalies (La/Sm_n = 0.56-3.63; Nb/Nb* = 0.21-0.69) with $\varepsilon_{Nd(T=2700Ma)}$ ranging from 0.29-2.09. The intermediate to felsic volcanic rocks are characterised by LREE enrichment and negative Nb anomalies similar to modern supra-subduction sequences. The complexity of the mafic rock chemistry of the St Joseph assemblage is consistent with a backarc origin, upon which was constructed the largely pyroclastic calc-alkalic volcanic successions observed along the length of the southern edge of the Uchi domain.

Implications

Previous Hf isotopic work (Corfu & Stott, 1996), field relations (Stott & Corfu, 1991) and geochemistry (Hollings & Kerrich, 2006) in the central Uchi complement the available geochemical data for the St Joseph assemblage in the Fort Hope area. The evidence suggests that the Uchi domain was constructed largely as an episodic, parautochthonous succession of intra-oceanic arcs and backarc basins, initially composed of relatively juvenile, mantle-derived material, with evidence of progressive crustal contamination from older basement on the southern margin of the Mesoarchean North Caribou terrane. During the circa 2700 Ma Uchian orogeny, these assemblages were telescoped and interleaved, with especially notable interleaving of the St Joseph assemblage volcanics and younger clastic sedimentary panels that form the southernmost margin of the North Caribou terrane. This collisional orogenesis was concurrent with the intrusion of large, continental arc plutons most prominently inboard from the southern margin and suggests plate tectonic processes were similar to those occurring today.

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