EVIDENCE FOR SPREADING IN THE LOWER KAM GROUP OF THE YELLOWKNIFE GREENSTONE BELT: IMPLICATIONS FOR ARCHEAN BASIN EVOLUTION IN THE SLAVE PROVINCE. H. Helmstaedt and W.A. Padgham, Dept. of Geological Sciences, Queen's University, Kingston, Canada K7L 3N6, and Geology Division, Northern Affairs Program, P.O. Box 1500, Yellowknife, N.W.T., Canada X1A 2R3

The Yellowknife greenstone belt is located in the southwestern part of the Slave Structural Province, a Late Archean (2.7-2.5 Ga) granite-greenstone terrane in the northwestern part of the Canadian Shield. Supracrustal rocks within this province, collectively referred to as Yellowknife Supergroup (Henderson, 1970), differ from the supracrustal successions of the Superior Province and other older Archean terranes by the absence of komatiites and the high proportion of metasedimentary to metavolcanic rocks. The Yellowknife belt was first mapped by Jolliffe (1942, 1946) on the scale of one inch to one mile, and the gold-producing area around Yellowknife was remapped on a more detailed scale (1:12 000) by Henderson and Brown (1966). As the belt became the best-known example of the basalt-dominated supracrustal belts in the western Slave Province (Padgham, 1985), the stratigraphic framework established here (Henderson, 1970), formed the basis for the development of models for Archean basin evolution (McGlynn and Henderson, 1972; Henderson, 1981). Under a recent mapping program of the Geology Division of the Northern Affairs Department in Yellowknife, detailed mapping was extended, and a 1:10 000 map series for the entire belt is currently under preparation. This work resulted in a number of revisions and refinements in the established stratigraphy (Helmstaedt and Padgham, 1986) and provides the basis for a reassessment of current models of greenstone belt evolution in the Slave Province.

The major portion of the Yellowknife greenstone belt is underlain by the predominantly mafic rocks of the Kam Group which consists of a northeasterly-striking, homoclinal sequence of flows and tuffs that dip steeply and face uniformly to the southeast (Fig. 1). Numerous dikes, sills and irregular bodies of gabbro and locally anorthosite appear to form an integral part of the volcanic sequence. The Kam Group has been subdivided into four formations (Fig. 2) with a combined thickness of approximately 11km. The lower contact is obscured by the intrusion of a composite batholith (Western Granodiorite, Fig. 1) that cuts across the strike of the flows. At the base of the exposed section, near the northern end of the belt, a narrow band of felsic volcanic rocks and banded iron- formation is in conformable contact with overlying pillowed flows above which a mafic extrusive- intrusive complex is developed (Fig. 2) whose pseudostratigraphy resembles that of certain Phanerozoic ophiolites. Near the southwestern end of the belt, the upper part of the Kam Group (Yellowknife Bay Formation) overlaps a sequence of older volcanic and sedimentary rocks belonging to the Octopus Formation (Fig. 1). In the northern part of the belt, the upper formations of the Kam Group are truncated by an unconformity beneath conglomerates and sandstones of the Jackson Lake Formation. Farther to the south, where the top of the Kam is preserved locally, it is overlain by calc-alkaline rocks of the Banting Group that, in turn, are overlain by turbidites of the Walsh and Burwash Formations. All rocks of the Yellowknife Supergroup are deformed and metamorphosed, with metamorphic grade increasing from greenschist to amphibolite facies towards the granitoid intrusions. Inspite of the metamorphic overprint, however, primary structures and intrusive relationships are well preserved.

The mafic intrusive-extrusive complex of the Chan Formation (Fig. 2) grades from a lower part, dominated by gabbro, through a multiple dike complex into massive and pillowed flows with thin beds of interflow sediments. At the base of the section is a sheet-like body of massive, medium- to coarse-grained, locally layered gabbro that was intruded into a sequence of pillowed flows, remnants of which are preserved at three levels. The upper boundary of this body is a relatively sharp transition into the dike complex which consists of numerous, fine- to medium-grained metadiabase dikes and septa and irregular bodies of relatively coarse gabbro between which screens of pillowed flows can be recognized. The dikes, which are locally sheeted, show symmetric and asymmetric chilled margins and range in width from less than one to over 10m. Some dikes grade into pillows, suggesting that they were intruded close to the seafloor and may have acted as feeder system to the growing volcanic pile (de Wit and Stern, 1978). Most of the irregular gabbros are multiple intrusions with abundant chilled margins and extremely complex contact relationships. Igneous layering is generally absent at this level, but an up to 100m thick, sheet-like body of gabbroic anorthosite was recognized (Fig. 2). It is surrounded entirely by gabbro that has chilled margins against the anorthosite. Though massive and pillowed flows predominate above the dike complex, sills and irregular bodies of gabbro, many of them multiple intrusions, are common in the upper parts of the Chan Formation. The top half of the Kam Group continues to be dominated by pillowed and massive mafic flows, but contains numerous intercalations of felsic tuffs and tuffaceous sediments. Some of the flows and many of the interflow tuffs and sediments are continuous along strike for more than 10 km and allow stratigraphic correlation across Proterozoic transcurrent faults (Fig. 1). Synvolcanic mafic intrusions in this part of the section consist of numerous sills some of which are connected to dike swarms. The entire section was intruded also by several post-volcanic dike swarms.

The Yellowknife greenstone belt has been interpreted as the western margin of an Archean turbidite-filled basin bordered in the east by the Cameron River and Beaulieu River volcanic belts (Henderson, 1981; Lambert, 1982). This model implies that rifting was entirely ensialic and did not proceed beyond the graben stage. Volcanism is assumed to have been restricted to the boundary faults, and the basin was floored by a down-faulted granitic basement. On the other hand, the enormous thickness of submarine volcanic rocks and the presence of a spreading complex at the base of the Kam Group suggest that volcanic rocks were much more widespread than indicated by their present distribution. Rather than resembling volcanic sequences in intracratonic graben structures, the Kam Group and its tectonic setting within the Yellowknife greenstone belt have greater affinities to the Rocas Verdes of southern Chile (deWit and Stern, 1981), Mesozoic ophiolites, that were formed in an arc-related marginal basin setting. The similarities of these ophiolites with some Archean volcanic sequences was previously recognized by Tarney et al. (1976) and served as basis for their marginal-basin model of greenstone belts. The discovery of a multiple and sheeted dike complex in the Kam Group confirms that features typical of Phanerozoic ophiolites are indeed preserved in some greenstone belts and provides further field evidence in support of such a model.

FIGURE CAPTIONS: (1). Geological map of the Yellowknife greenstone belt. Modified from published maps of the Geological Survey of Canada and Northern Affairs Program, Yellowknife. (2). Generalized section of the Kam Group.

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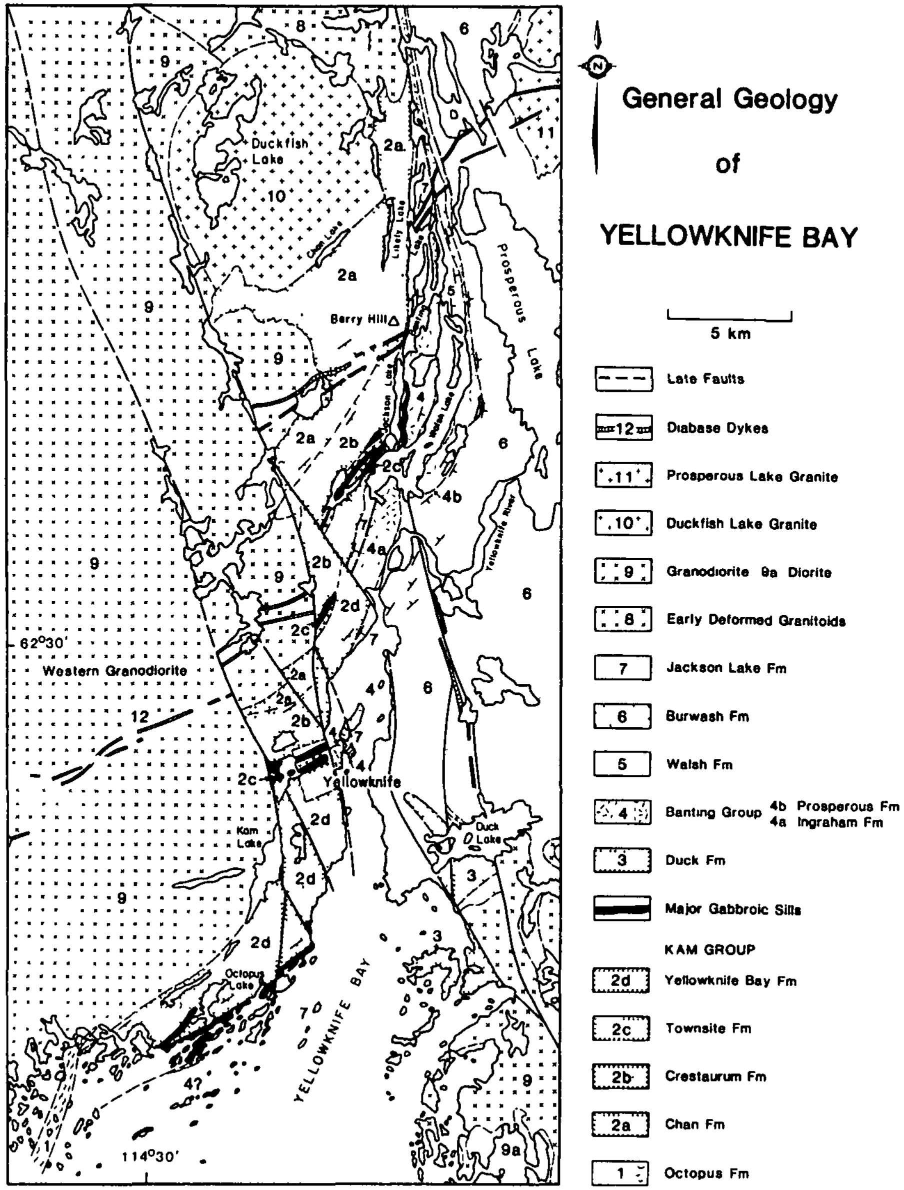

FIGURE 1

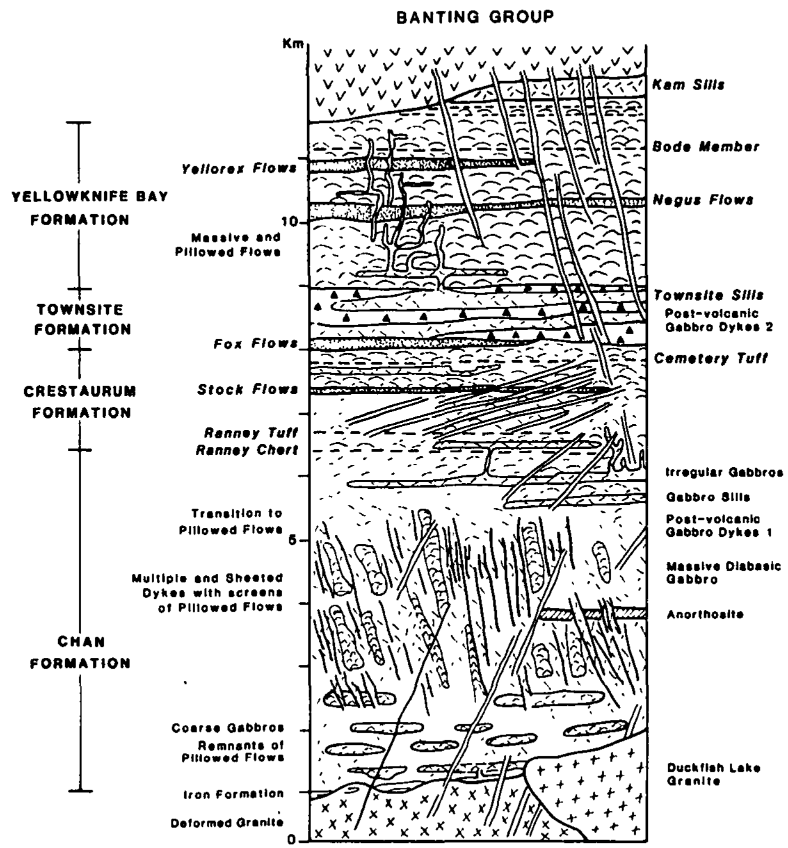

FIGURE 2

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