

Geology of the Kisseynew North Flank: a long-lived suture zone?

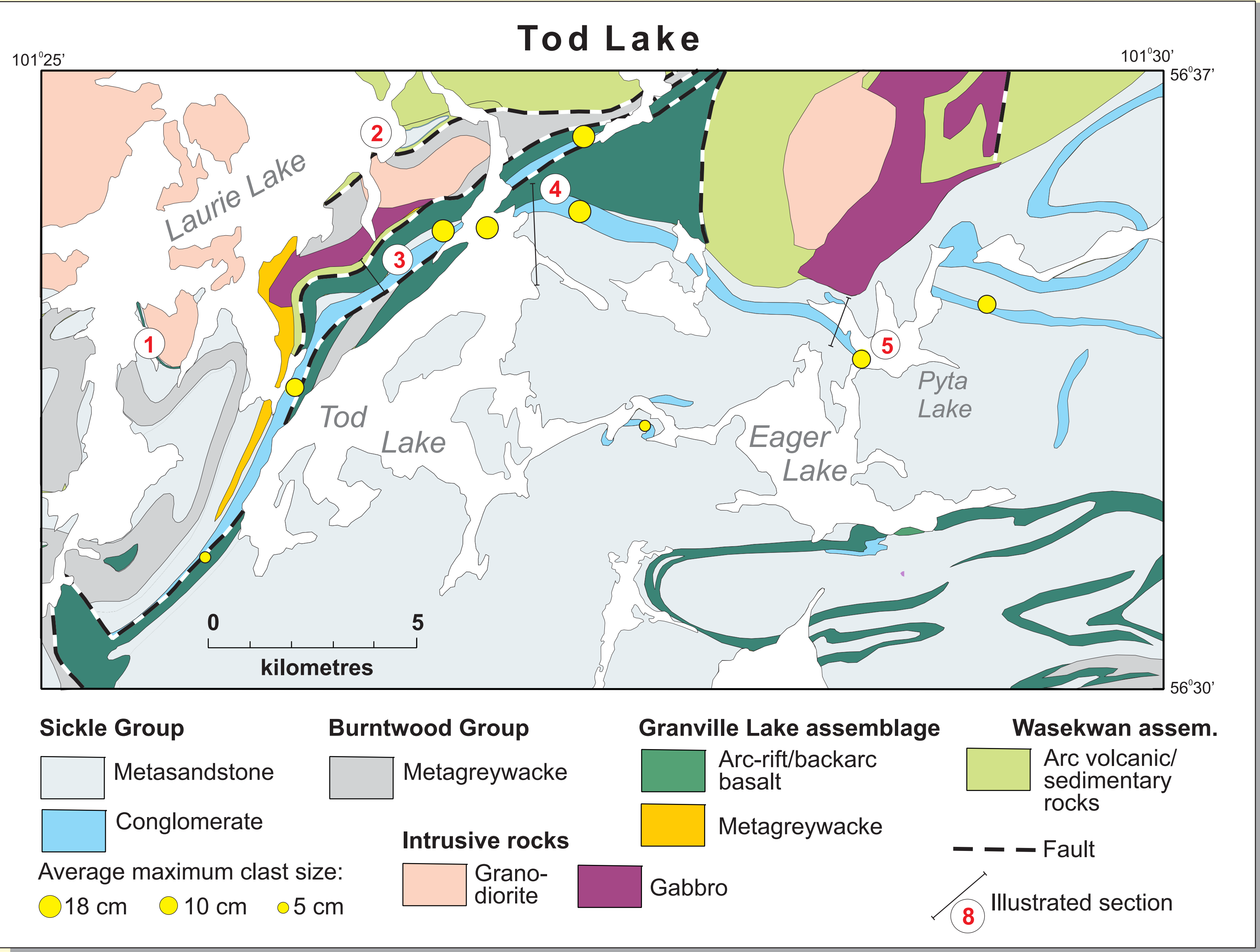
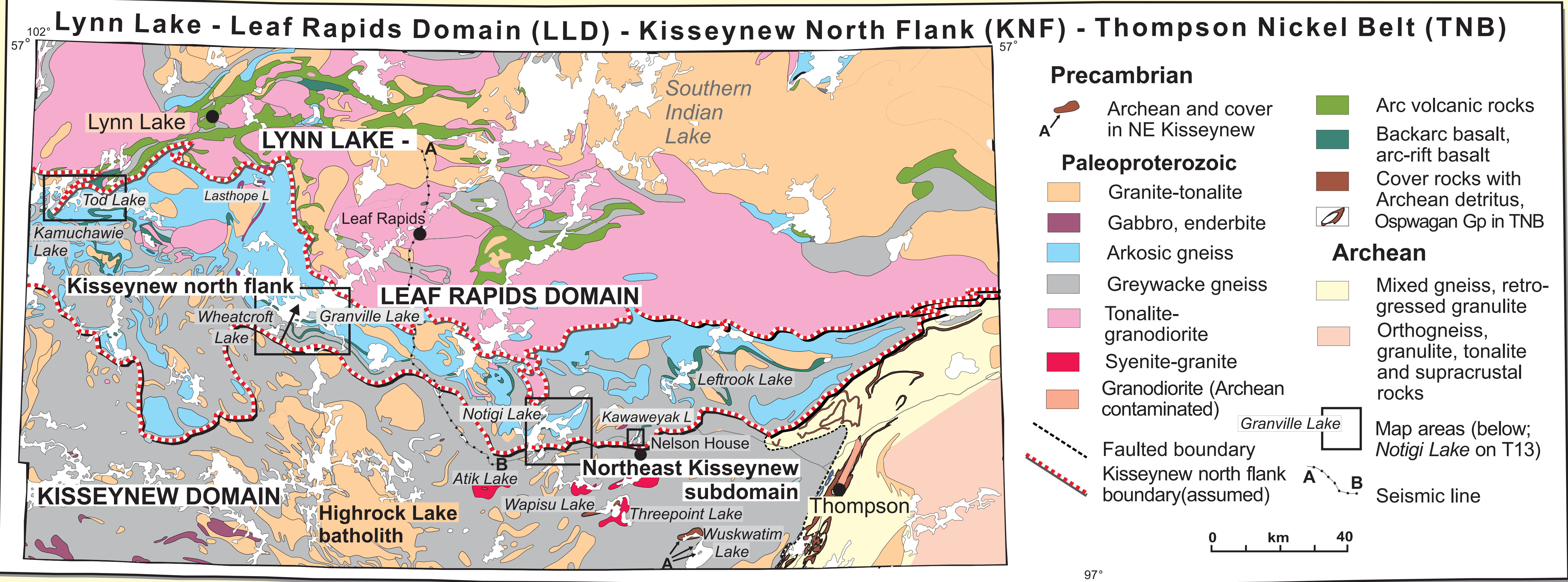
Manitoba by H.V. Zwanzig and L.A. Murphy



Introduction: The distribution of the various lithotectonic assemblages with different mineral potential along the Kisseynew Domain margins provides a basic guide for the first step in mineral exploration. The Kisseynew North Flank (KNF) subdomain comprises interleaved metasedimentary rocks of the Burntwood and Missi groups and narrow packages of the Granville Lake assemblage, which include older metavolcanic rocks. These units are interpreted to have formed on a long-lived boundary between the Lynn Lake-Leaf Rapids Domain (LLD) arc volcanic and plutonic rocks with significant VMS and Au potential, and the Kisseynew marginal basin, which is apparently barren. The Granville Lake assemblage, features arc-rift and other ocean-floor volcanic units that have a potential for Au deposits and possibly VMS deposit. Semi-continuous

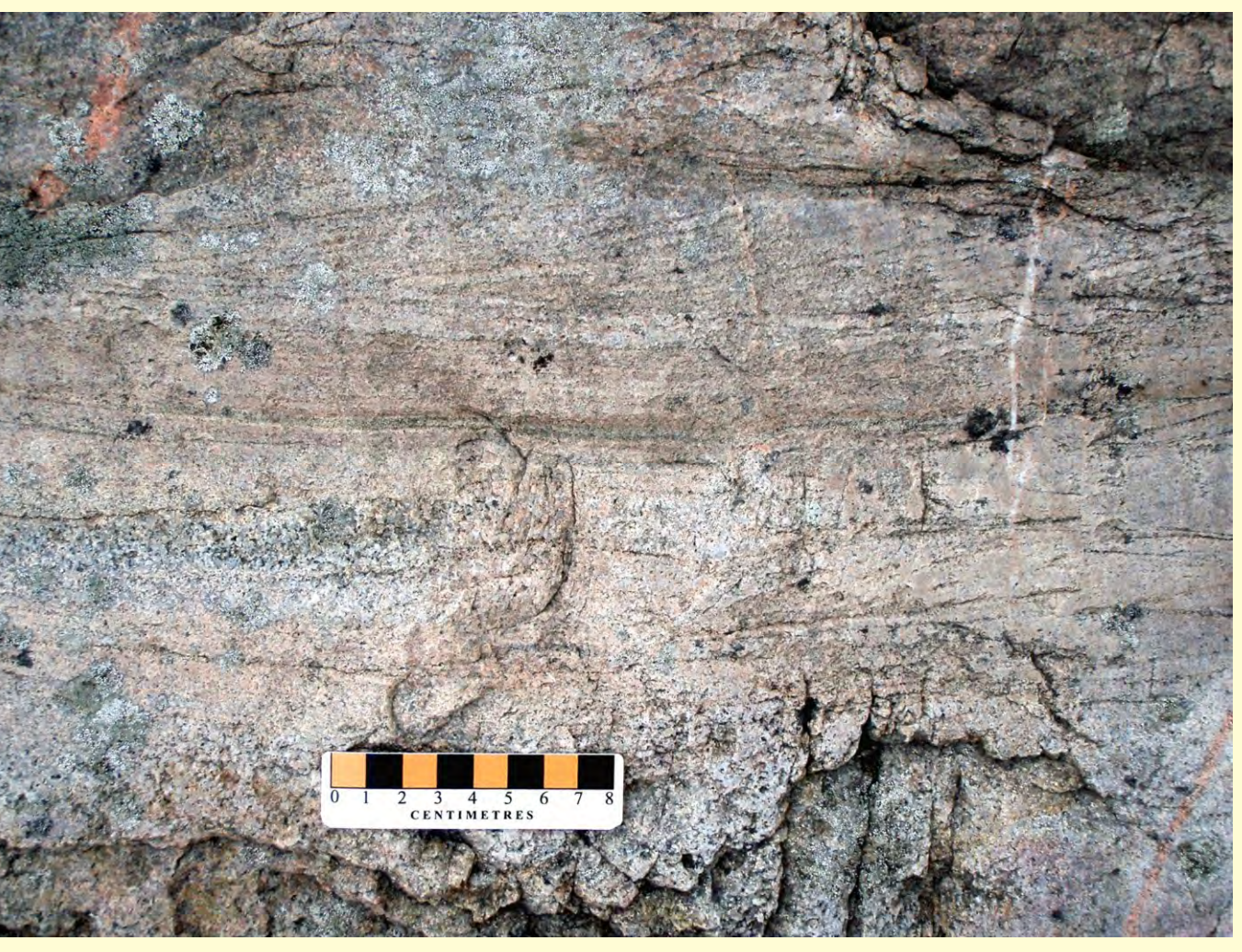
stratigraphy and persistent geochemistry indicate >250 km strike-length of the assemblage from Tod Lake toward the east.

The KNF was assembled by southeast-directed folding and thrusting, partly during the ca. 1850–1830 Ma sedimentation of the Sickle Group (fluvial-alluvial facies) and the Burntwood Group (marine turbidite facies). This marked the end of the 1890–1840 Ma arc magmatism in the LLD to the north. The Granville Lake assemblage is interpreted to include early (?1.9 Ga but undated) arc-rift and MORB-like basalts conformably overlain by hotspot-related picrite and unconformably overlain by the Sickle Group. The early volcanics may be part of a supra-subduction-zone ophiolite and forearc sediments. These were thrust over the Burntwood Group following northwest-dipping subduction.

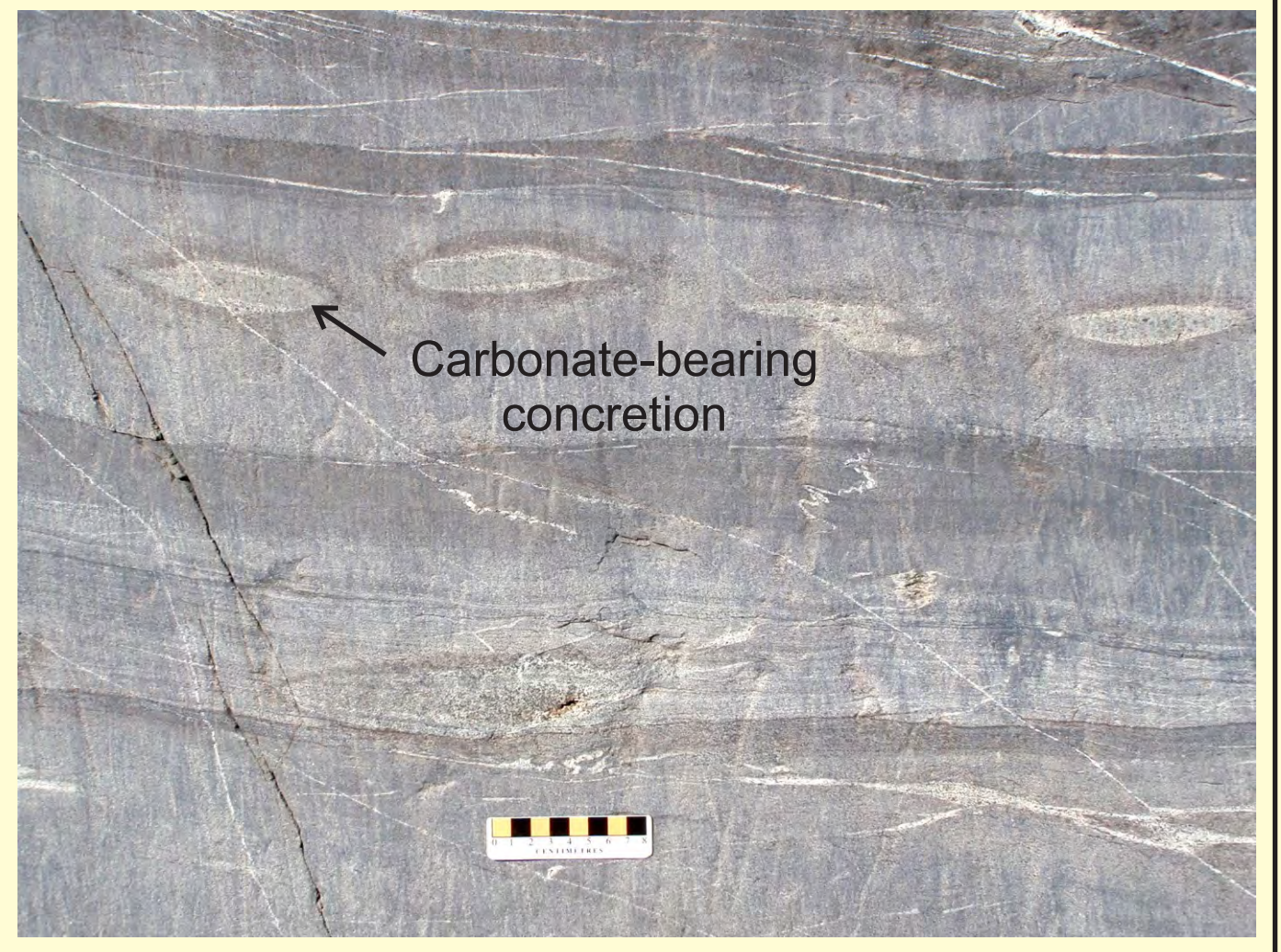


Isotopic ages of all the Kisseynew sediments include U-Pb detrital zircon ages and Nd model ages that peak respectively at 1855 Ma and 2.35 Ga, similar to the successor arc granite bloom in the hinterland to the northwest. Minor peaks at 2540 Ma in the Sickle Group and 2700 Ma in the Grass River Group correspond respectively to sources at the margins of the Hearne and Superior cratons. These and local Archean Nd model ages in the east indicate that continental collision had started during the ca. 1850-1830 Ma sedimentation.

The older Granville Lake assemblage extends into the 1.9 Ga volcanic rocks in the LLD, this age being equivalent in correlated basalt in Saskatchewan (D. Corrigan, pers. comm.). About 1874 Ma felsic tuff or reworked tuff in the mainly sedimentary southern group of the Granville Lake assemblage (D. Corrigan, pers. comm.) suggest that the proposed thrust slices become progressively older toward the base of the original hanging walls.



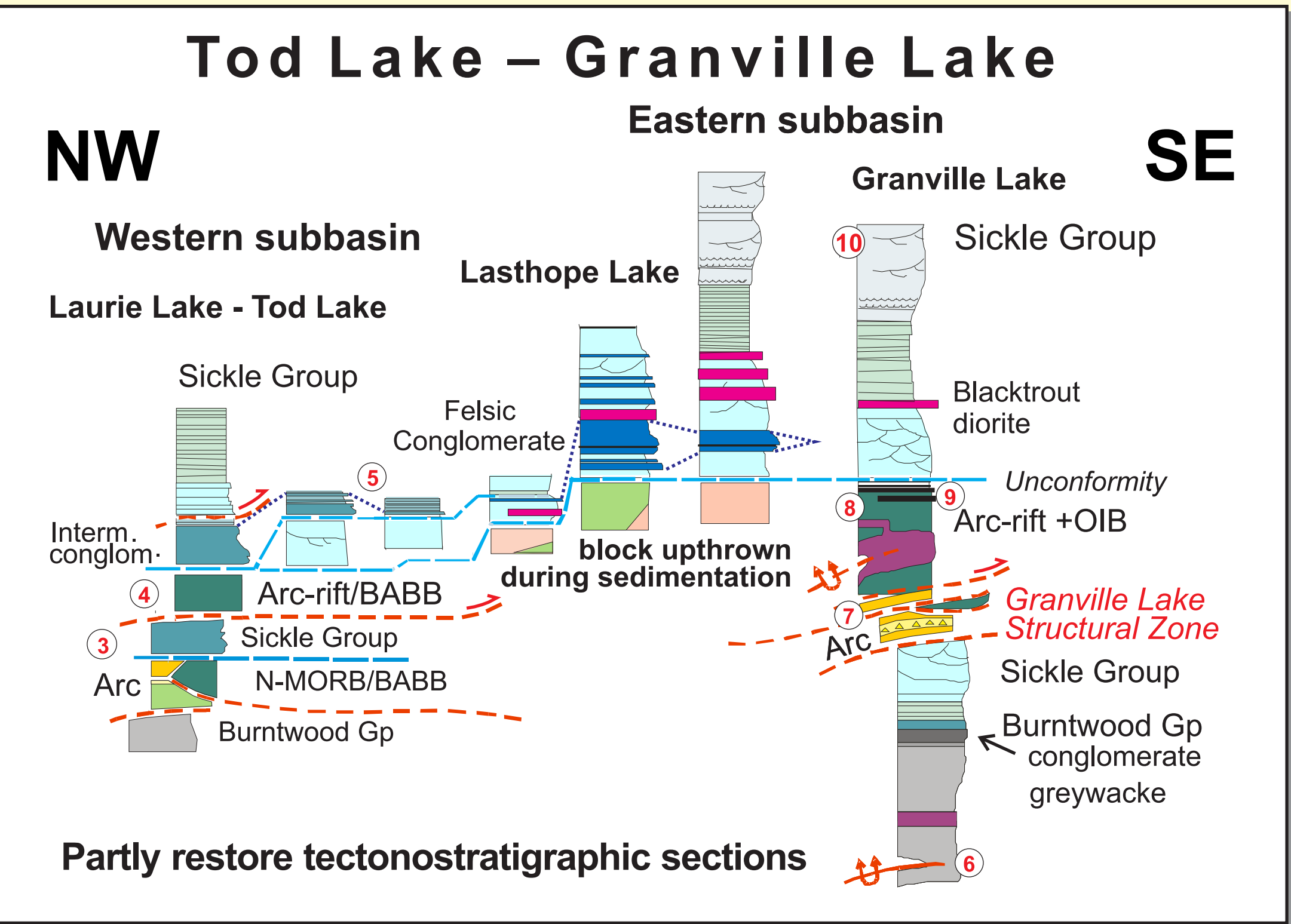
Sickle Group crossbedded meta-arkose overlying Tod Lake basalt on Granville Lake.



Burntwood Gp metaturbidite with graded, laminated and shaly Bouma divisions, Wheatcroft Lake.



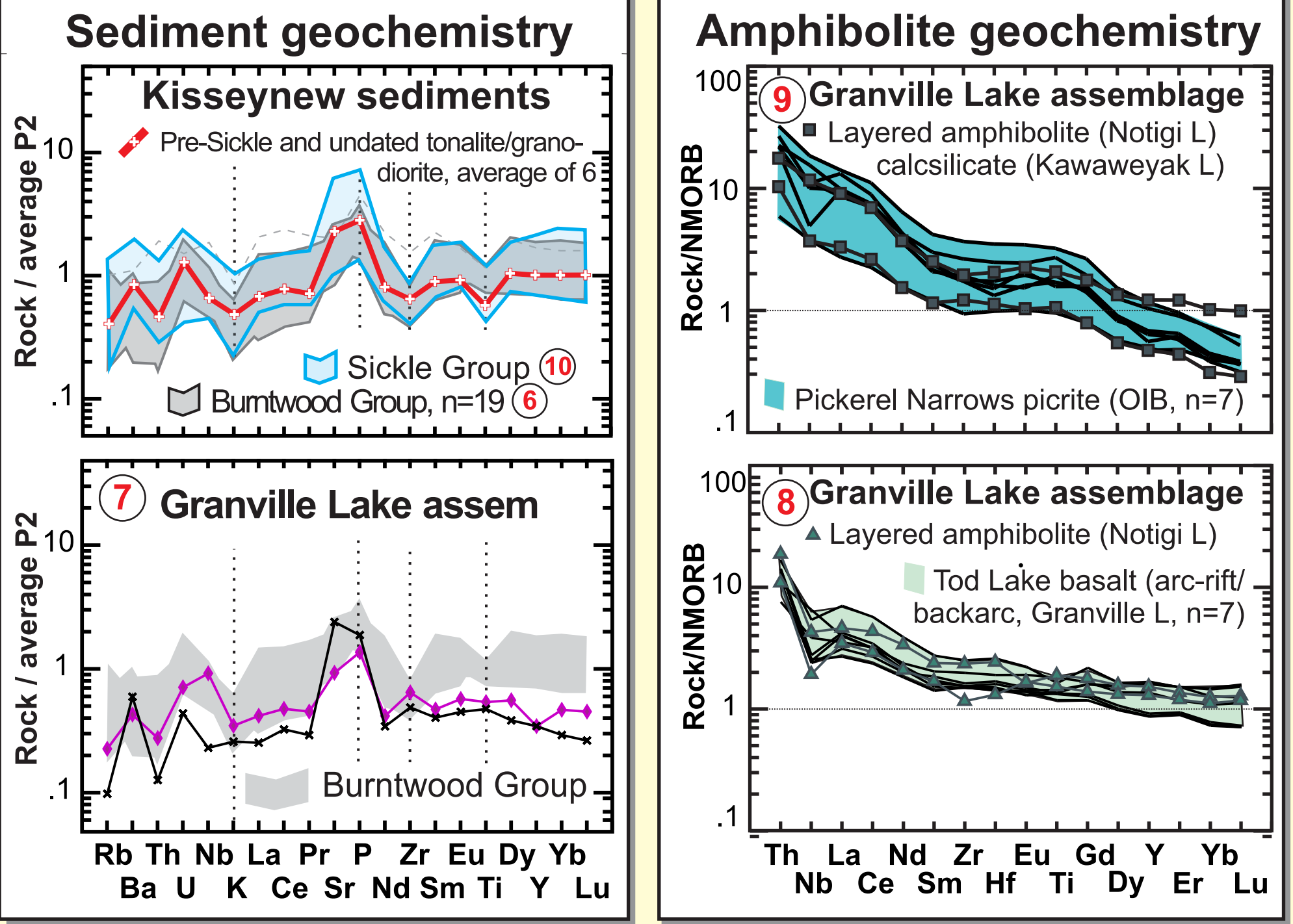
Granville Lake assemblage: pillowed Tod Lake basalt on Granville Lake.



Tectonostratigraphy was restored to an early stage of thrusting and folding using the basal Sickle unconformity as datum. Sediment transport, determined from conglomerate thinning and fining, was to the southeast, like the thrusting. Facies changes from intermediate to arkosic compositions at the base define the subbasin stratigraphies. Southwestern facies prograded over the upward-coarsening top of the Burntwood Group turbidite at a fault-basin margin or inner trench slope.

Geochemistry indicates that distinctive units occur widely throughout the KNF. A correlation between metabasalt at the southwest end of the Lynn Lake belt (Tod Lake basalt, 4) and the metabasalt and layered amphibolite at Granville Lake 8 is supported by their similar moderate to weak arc signature, suggesting an origin as arc-rift basalt or backarc-basin basalt. The same volcanic origin of layered amphibolite that extends east beyond Nelson House is supported by recent chemical analyses at Notigi Lake and Kawawayak Lake. Stratigraphically intercalated Ti-enriched, picritic to mafic amphibolite 9 has been interpreted to have a hotspot affinity. As at Granville Lake, the amphibolite in other parts of the KNF contains massive units derived from gabbro. Gabbro and quartz diorite 6 chemically similar to Tod Lake basalt apparently intrude the Burntwood Group. This indicates that similar magmatism occurred along the KNF possibly from 1.89 to 1.84 Ga, marking the suture zone of a long-lived plate margin.

Kisseynew metasediments have a distinctive pattern 6, 10 when normalized by Paleoproterozoic continental pelite (Pipe Formation in the TNB). This is identical to Pre-Sickle plutons, which acted as the main source of detritus. The older sediments (in the Granville Lake assemblage) 7 are more depleted in HREE than the Burntwood Group.



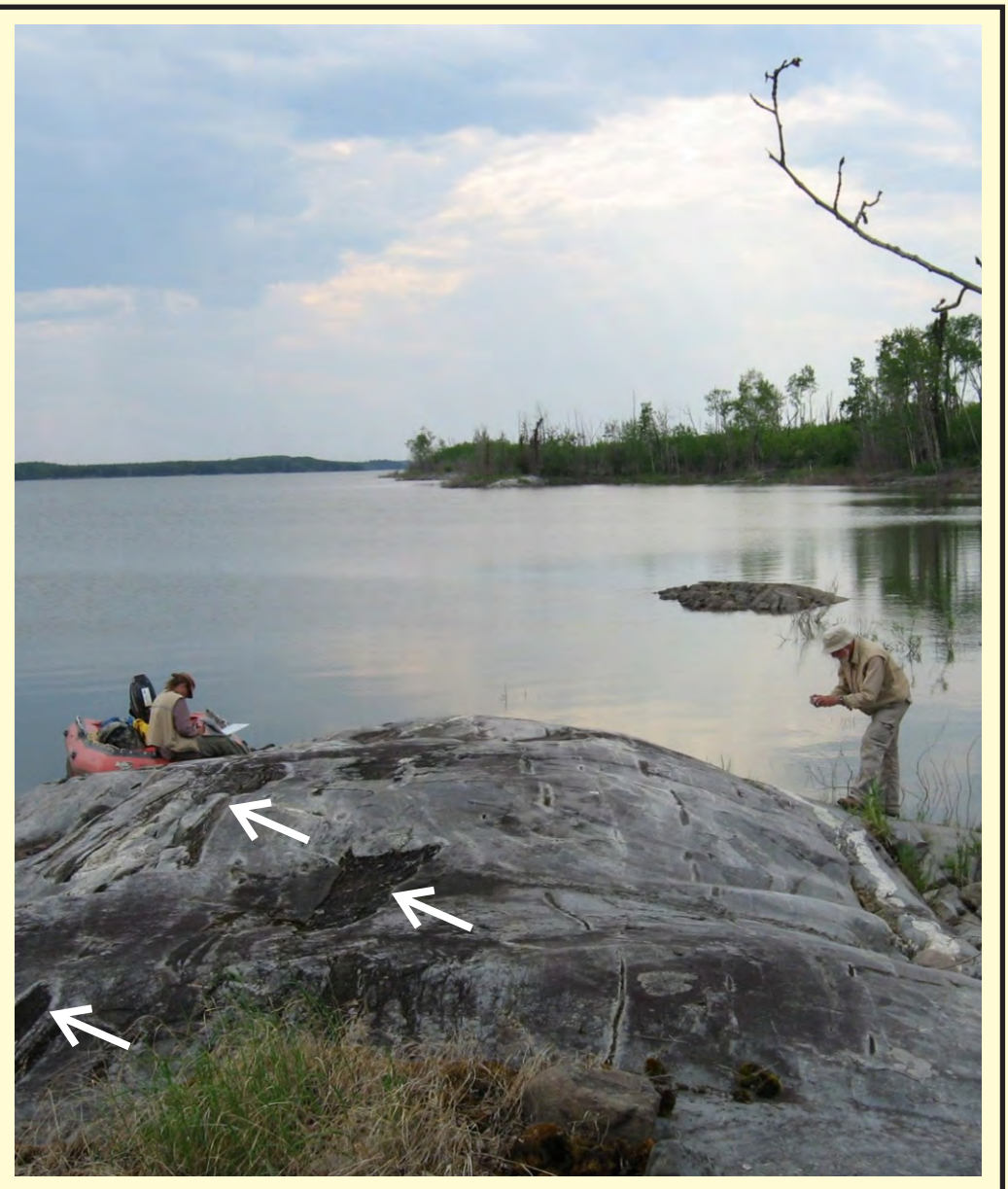
Granville Lake assemblage: Pickeral Narrows picritic to basaltic fragmental rock with hotspot-related geochemistry, overlying and interlayered with Tod Lake basalt on Granville Lake.



Granville Lake assemblage: deformed recrystallized Tod Lake basalt, probably originally pillowed, but transposed into amphibolite with pale diopside- and dark hornblende-rich layers from altered and unaltered domains.



Granville Lake assemblage: fault-slice of greywacke, sulphidic pelite (brown) and chert (white) between south-facing (arrows) panels of pillow-basalt in the south limb of an early anticline.



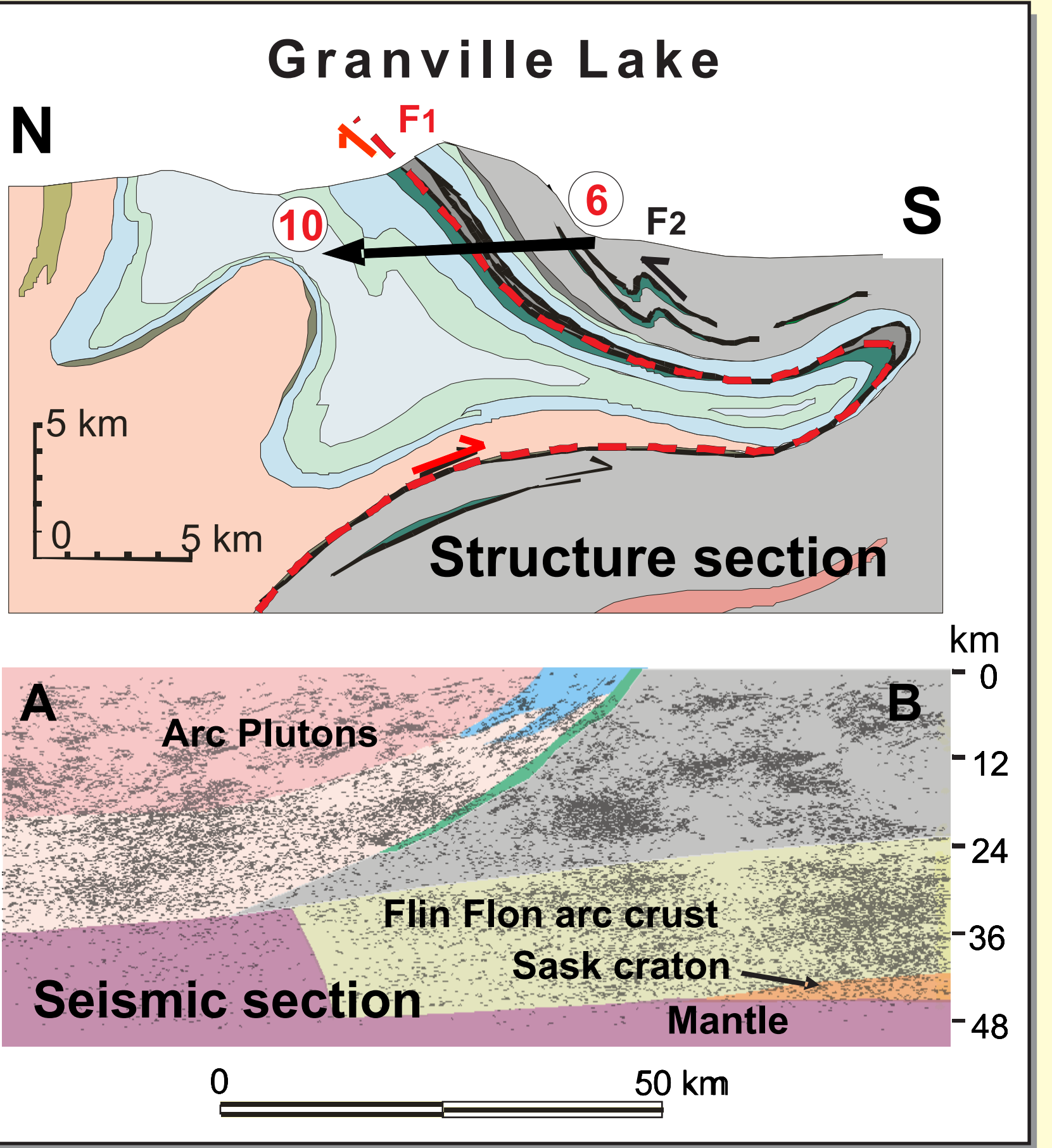
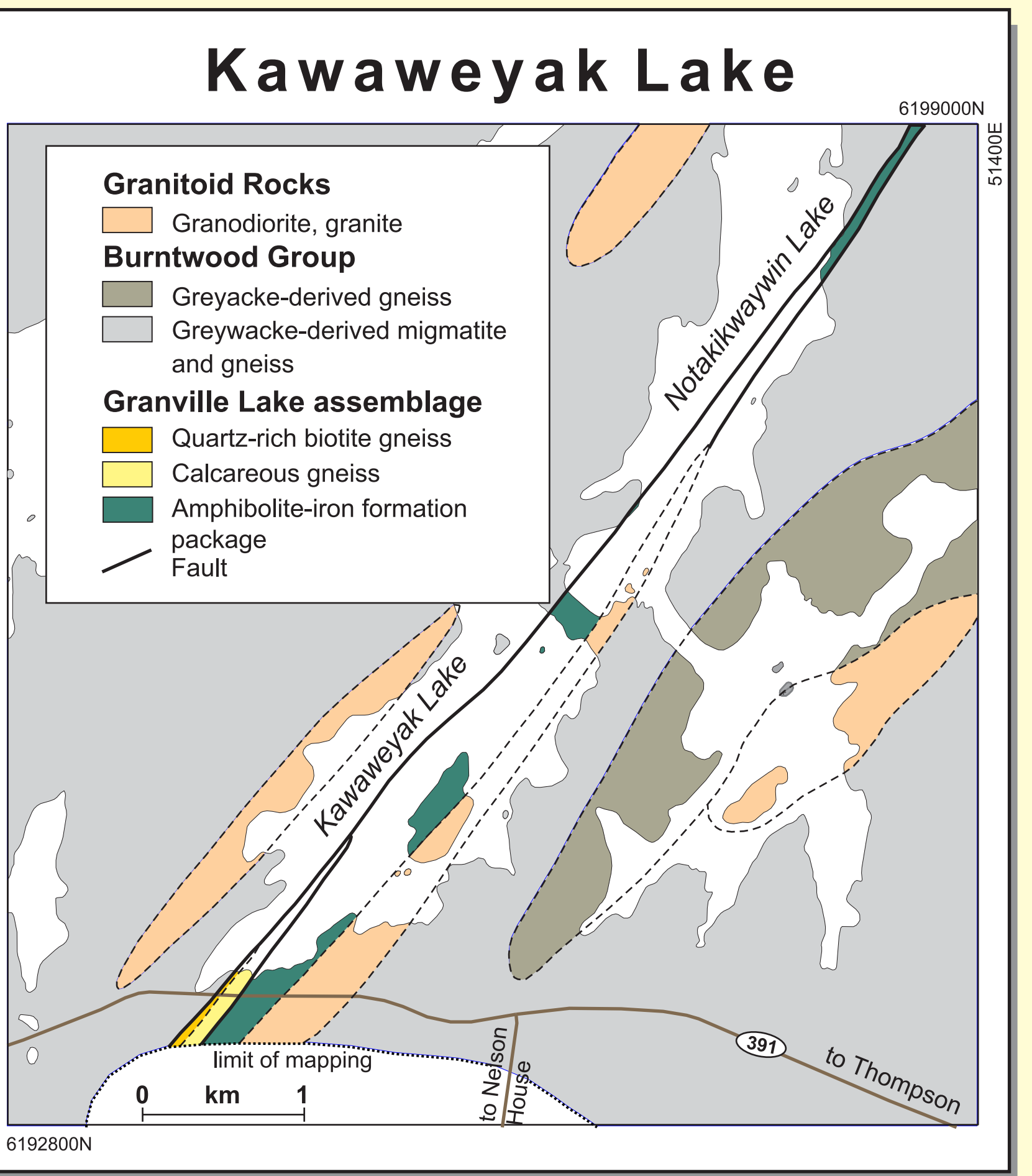
Ultra-thick bed of feldspathic greywacke containing exotic blocks (e.g. white arrows) at the base (at boat with assistant) grading through greywacke into siltstone (at author on the right).

Structural and tectonic evolution of the Kisseynew North Flank (KNF) apparently started with backarc rifting and development of normal (Hatchet Lake) to enriched (Tod Lake) MORB and arc-rift basalt, and picrite (Pickeral Narrows) influenced by a mantle plume or hotspot. An age of ca. 1.9 Ga is suggested by the close relation to dated arc volcanics southwest of Lynn Lake and by a tonalite dike cutting the correlative Levesque Bay assemblage in Saskatchewan. Mafic-intermediate intrusions into the 1840-1850 Ma Burntwood Group suggest a protracted history of Tod Lake-type magmatism in the KNF. Correlation over 250 km shows its wide extent.

The basalt and related mafic-ultramafic intrusions, siliciclastic rocks and sulphide iron-formation are interpreted to have been thrust over ca. 1.87 Ga, mainly sedimentary, successor-arc deposits. Block-bearing high-density turbidite (shore photo, below) may have formed on the steep inner slope of an active trench above a northwest-dipping slab. The amalgamated volcano-sedimentary package (Granville Lake assemblage) was unconformably overlain by the shallow-water sediments of the Sickle Group and thrust over the marine turbidite facies, the Burntwood Group. Folding and thrusting seem to have started with the sediment-filling of the Kisseynew basin (lower right photo).

The Sickle Group filled syncollisional basins with high-taper conglomerate wedges, (see columns) cross-bedded arkose (photo lower left) and thinly layered calcareous siltstone. These non-marine sediments prograded southeast over over the Burntwood Group.

The fold-and-thrust belt was back-folded (structure section below) and highly metamorphosed after deep burial during terminal collision between the LLD and the Superior craton to the southeast. A seismic section (below) illustrates the overall northerly dipping crustal structure and supports the existence of a suture extending into the mantle.



Burntwood Group: turbidite, with an early isoclinal fold and a thrust; bedding tops as at white arrows; bedding disruption (bracket) probably occurred before complete lithification; shale injection (black arrow) occurred from shale detachment layer (at red arrows); truncations are seen beyond 15 cm scale card; apparent thrust displacement of the northern limb (originally upright) is to the east. North is toward the lower left.

