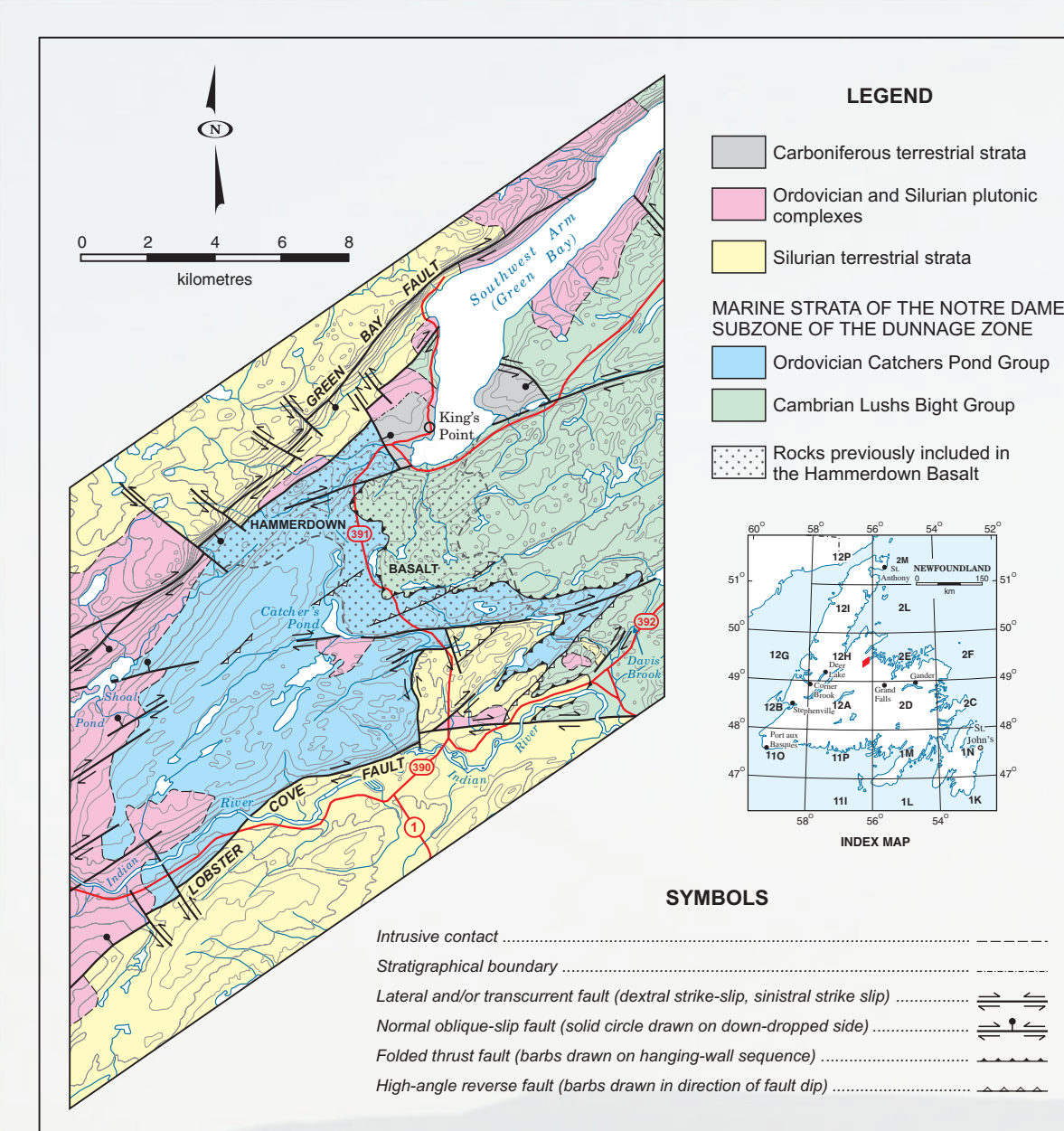


Hammerdown Basalt, Springdale Peninsula, Newfoundland (NTS 12H/09): Lithostratigraphic Unit or Lithotectonic Collage?

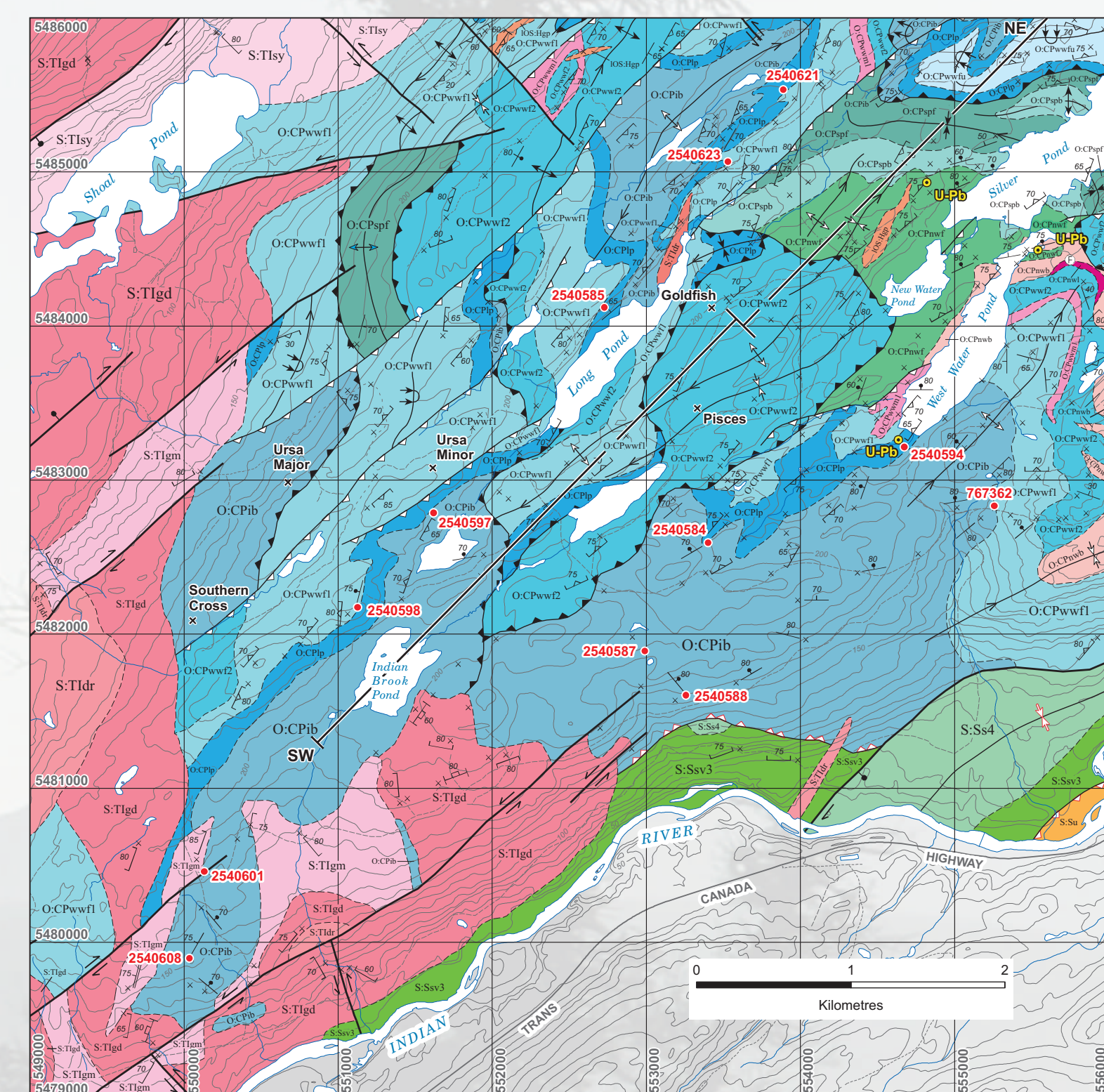
Brian O'Brien (Regional Geology, GSNL) and Greg Dunning (Earth Sciences, MUN)

REGIONAL GEOLOGICAL SETTING



Located southwest of the Springdale peninsula in Green Bay, the Hammerdown Basalt separates two of the oldest tectonic constituents of the peri-Laurentian Western Notre Dame Bay volcanic belt (Notre Dame Subzone of the Dunnage Zone). It forms a narrow map unit situated near the regional boundary between the Ordovician Catchers Pond Group and the Cambrian Lushs Bight Group.

LITHOSTRATIGRAPHY



On the basis of new CA-TIMS U/Pb geochronology (chemical abrasion thermal ionization mass spectrometry method), and its integration with previously published biostratigraphic studies, the Early Ordovician volcanosedimentary strata of the Catchers Pond Group are thought to have been deposited between the late Tremadocian and mid-Floian stages (ca. 480 Ma - 475 Ma). Extrusive rocks include microbasalt, basalt, basaltic andesite, andesite, dacite, rhyodacite and rhyolite. They are typical of the shallow marine volcanic rocks observed in extensional island arc-back arc sequences that developed on convergent peri-cratonic continental margins.

AGE CONTROLS ON EARLY ORDOVICIAN LITHOSTRATIGRAPHY IN THE CATCHERS POND GROUP

Silver Pond Formation

O:CPspf *Upper felsic volcanic member:* rhyolite mega-breccia and size-graded tuff having blocks derived from underlying rock formations; **pre-474.7 +/- 1.6 Ma; early Mid Floian?**

O:CPspb *Lower mafic volcanic and chert member:* pillowed IAT-type basalt, basaltic andesite, andesite sheet flows and laminated chert; **early Mid Floian?**

New Waters Pond Formation

O:CPnwf *Argillite and felsic volcanic member:* banded argillite, iron formation and waterlain rhyodacite tuff having limestone blocks; **earliest Mid-Floian [475.0 +/- 1.4 Ma; earliest Middle Arenigian; basal O. eve conodont biozone]**

O:CPnwl *Limestone member:* in the east, bedded bioclastic carbonate; **early-mid Floian or Early-Middle Arenigian [P. elegans Zone to O. eve Zone]**

O:CPnwb *Lower mafic volcanic member:* basaltic andesite breccia, tholeiitic andesite and pillowed IAT-type basalt; limestone lenses; **early Floian or Early Arenigian [P. elegans Zone]**

West Waters Pond Formation

O:CPwwf2 *Upper rhyolite and mudstone member:* calc-alkaline rhyolite, ignimbrite, rhyolite-derived tuffaceous wacke, and laminated mudstone; quartz-sericite schist; **age unknown**

O:CPwwm2 *Upper pillowed basalt member:* in the east, pillowed IAT-type basalt, pillowed MORB-type basalt, and chlorite schist; **age unknown**

O:CPwwm1 *Lower mafic volcanic member:* carbonatized basaltic andesite, jasperitized andesite and IAT-type pillow lavas; **age unknown**

O:CPwwf1 *Lower felsic volcanic member:* in the east, dacitic ash tuff rich in limonite and ferroan carbonate, and high-Si rhyolite of transitional tholeiitic type; **age unknown**

Long Pond Formation

O:CPlp *Upper part:* vitric chlorite-altered dacite tuff, lithophysae-bearing low-Si rhyolite, pillowed IAT-type lava, and silicified andesite breccia; **early Floian or earliest Arenigian [477.3 +/- 1.3 Ma]**

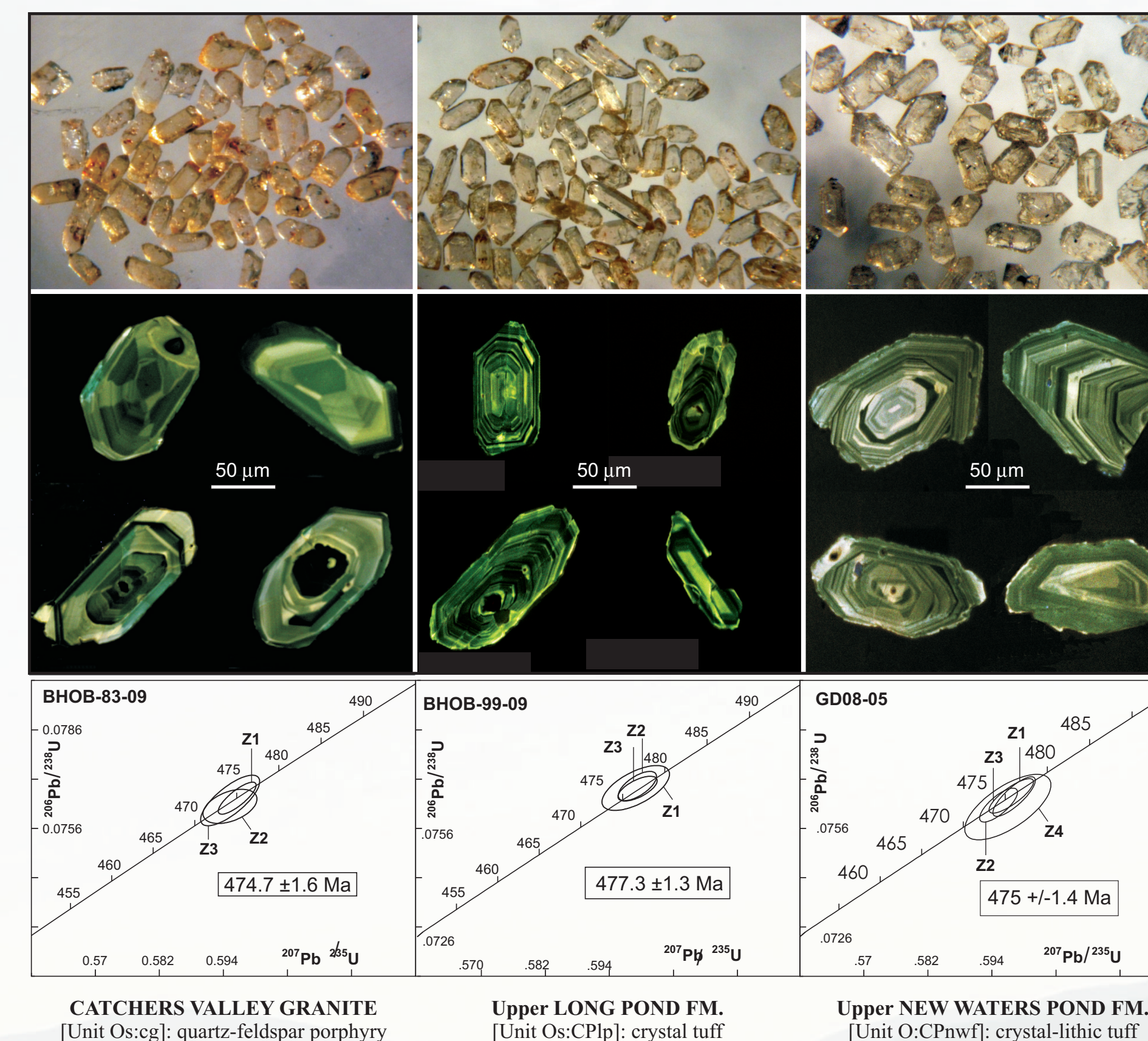
O:CPlp *Lower part:* carbonate-altered BAB-type basalt, MORB-type basalt, basaltic andesite, dacite tuff, and rhyodacite breccia; **Tremadocian-Floian [479 +/- 2 Ma]**

Indian Brook Formation

O:CPib *Upper part:* basaltic andesite, hematitic chert and microbasalt, including BAB-type basalt; **latest Tremadocian?**

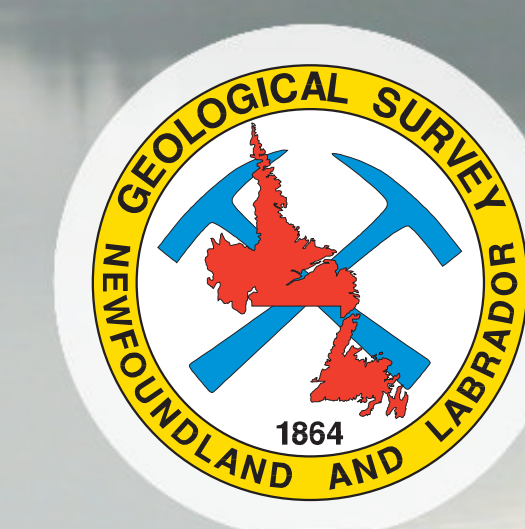
O:CPib *Lower part:* high-Fe tholeiitic basalt and aquagene tuff, including variolitic MORB-type pillow lava; **age unknown**

U-Pb AGES BY CHEMICAL ABRASION - THERMAL IONIZATION MASS SPECTROMETRY (CA-TIMS)

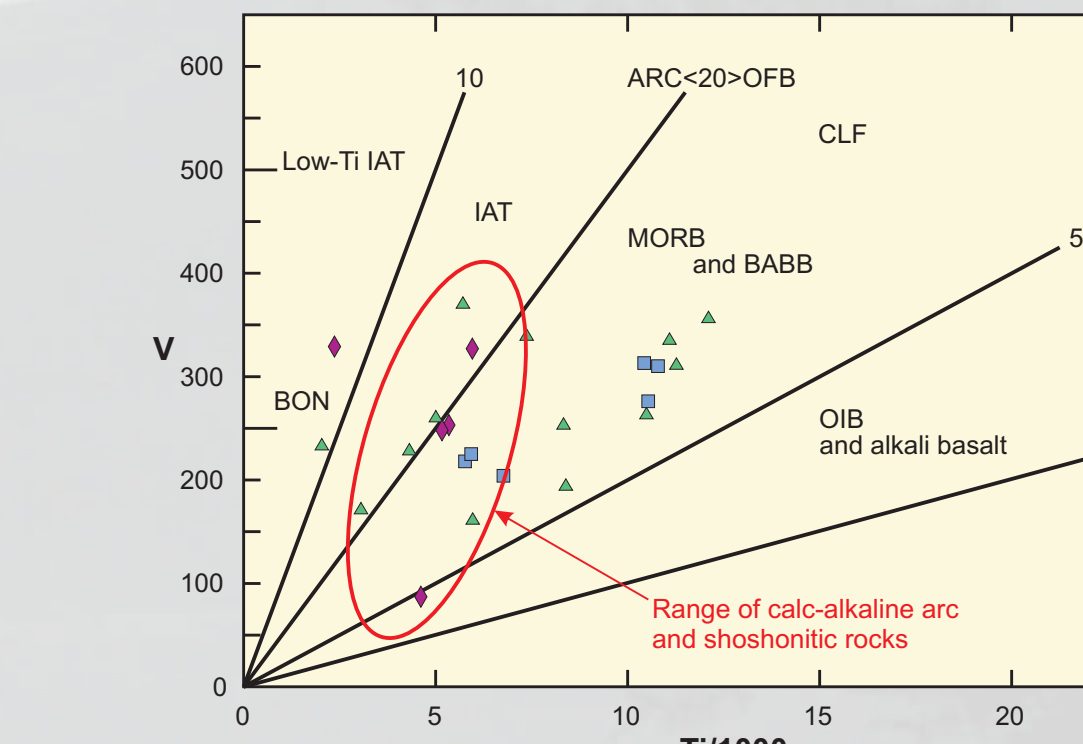
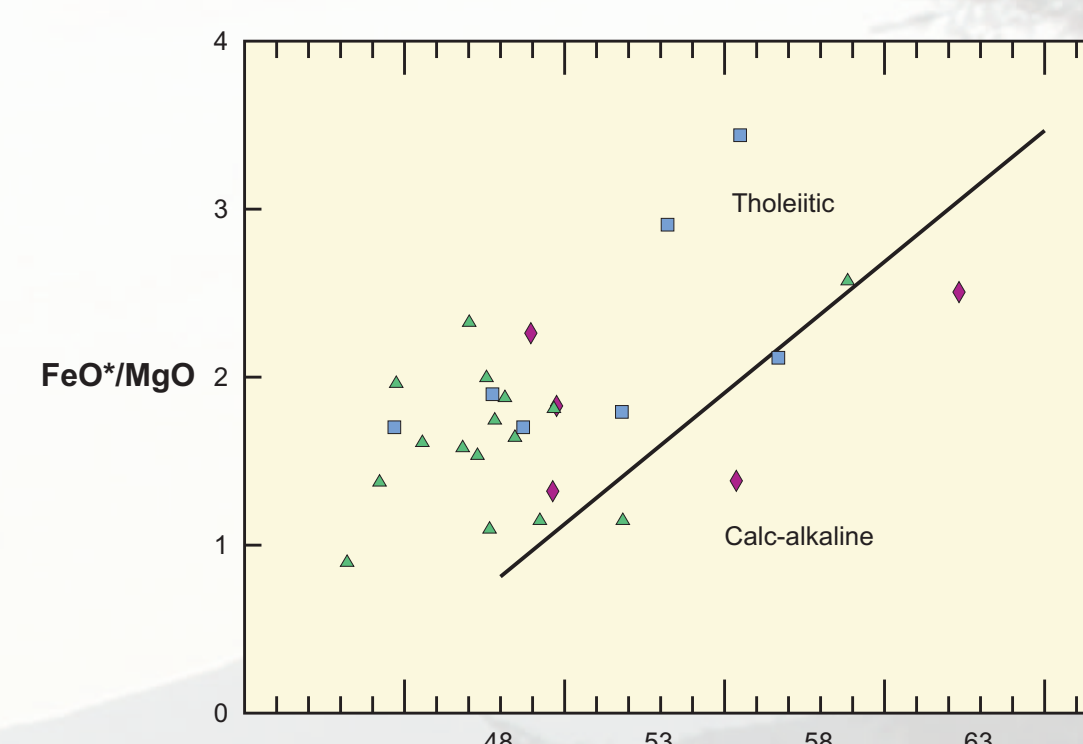
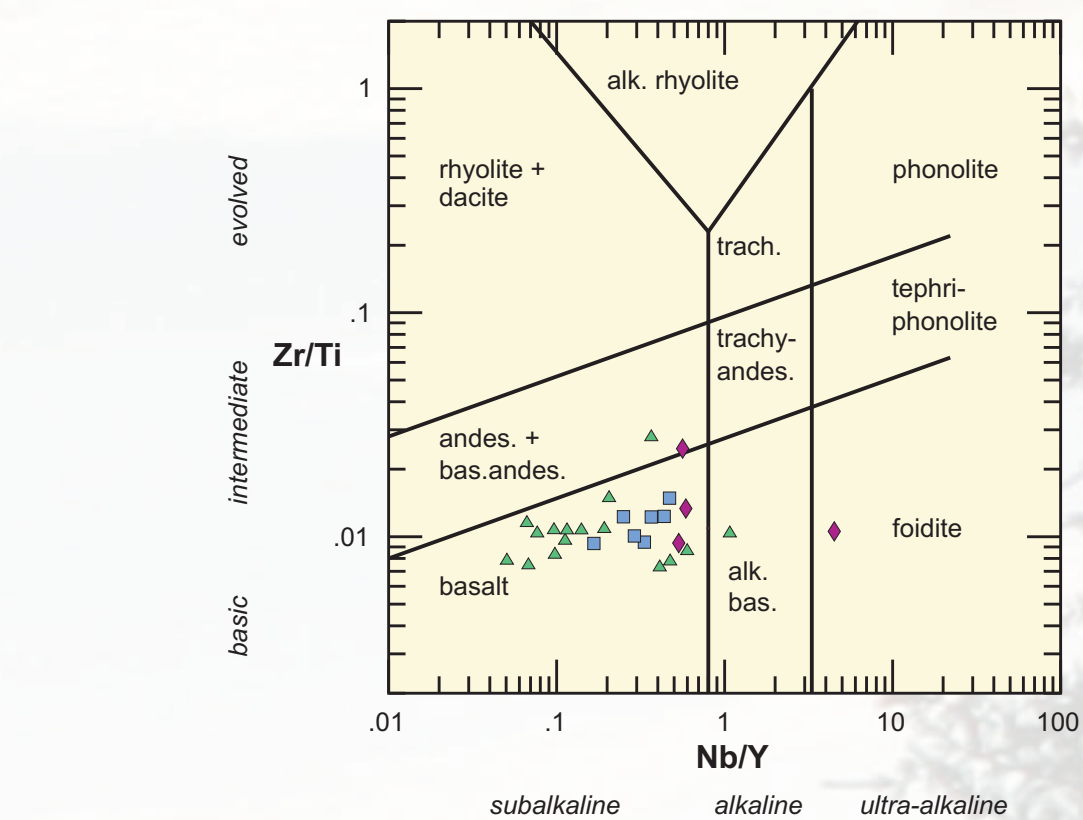


CATCHERS VALLEY GRANITE [Unit Os:cg]: quartz-feldspar porphyry; Upper LONG POND FM. [Unit Os:Clp]: crystal tuff; Upper NEW WATERS POND FM. [Unit O:CPnwf]: crystal-lithic tuff

In all three samples the coarse-grained zircon contains well developed igneous growth zoning, with layers of high and low luminescence. Zircon grains were selected for analysis according to criteria of mineral clarity, euhedral form and lack of inclusions, and then were annealed at 950° C. Finally the grains were etched in concentrated HF acid at 200° C to remove radiation-damaged domains. Each age is calculated as the weighted average ²⁰⁶Pb/²³⁸U age of the overlapping concordant points, which have excellent fits (low MSWD) and uncertainties are reported at the 95% Confidence Interval.



VOLCANIC GEOCHEMISTRY

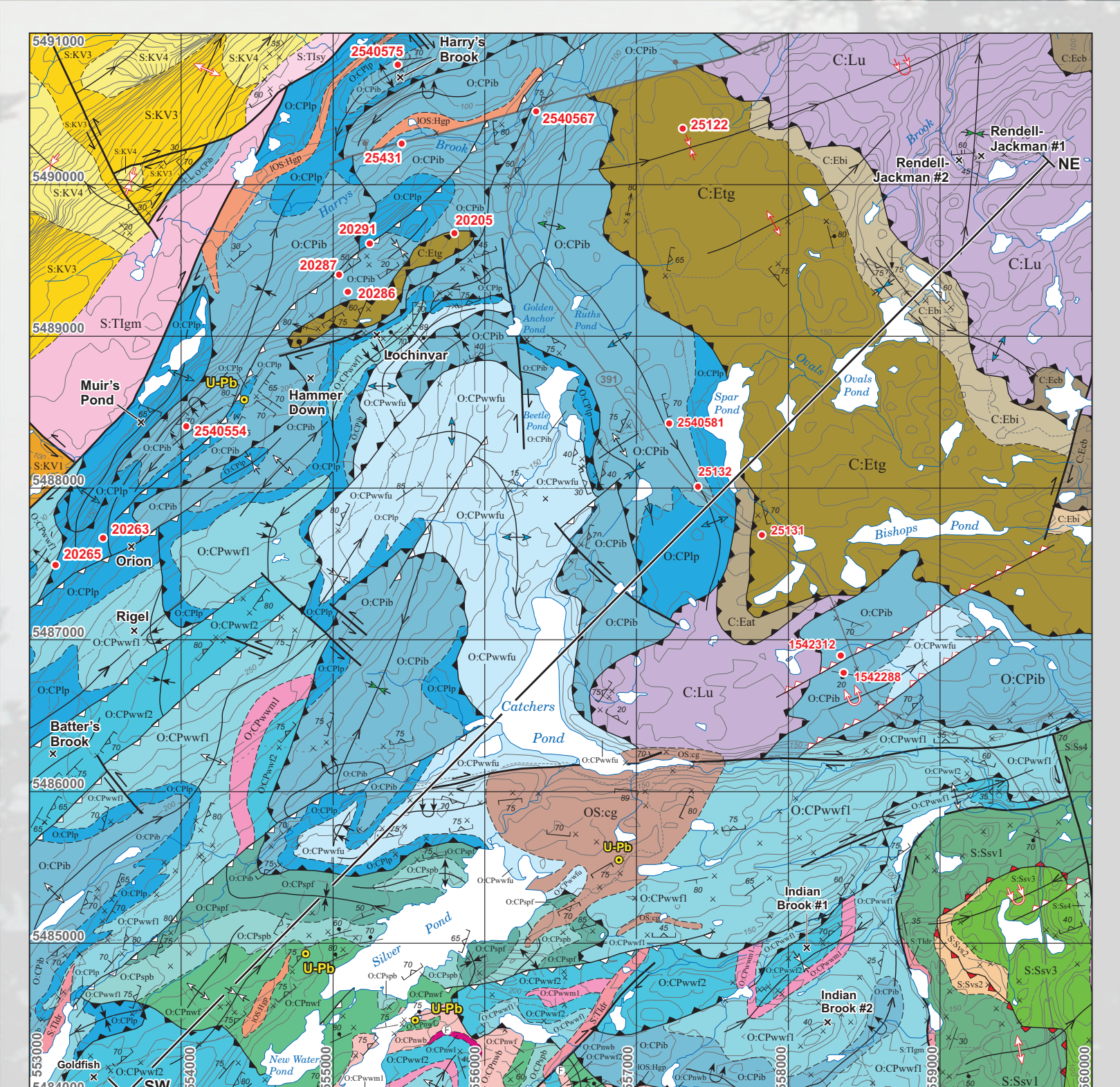


TYPE AREA OF HAMMERDOWN BASALT ▲
TYPE AREA OF INDIAN BROOK FORMATION ●
TYPE AREA OF LONG POND FORMATION ◆

Pillowed lavas in the southwestern part of the Hammerdown Basalt comprise locally mineralized suites of tholeiitic and transitional calc-alkalic rocks. They are predominantly subalkaline basalts, although basaltic andesite is also present.

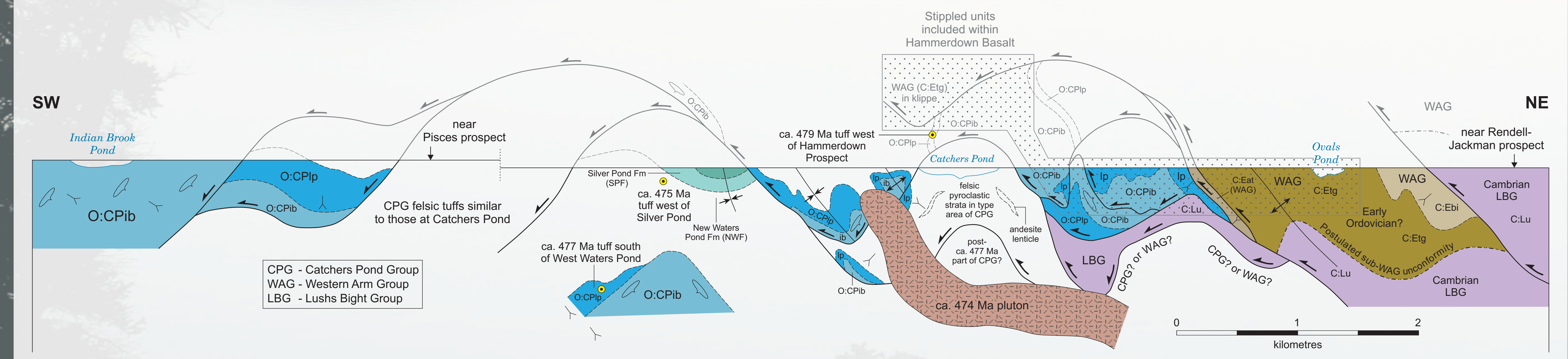
Such Hammerdown volcanic strata can be correlated with the Fe-rich mid oceanic ridge basalt typical of the lower part of the Indian Brook Formation of the Catchers Pond Group as well as the back-arc basin basalt, volcanic arc basalt and Mg-rich microbasalt seen in the upper part of this formation. They are also probably the equivalent of some of the (low-Ti) island arc tholeiite, (normal) island arc tholeiite, mid ocean ridge tholeiite and tholeiitic basaltic andesite that typify the Long Pond Formation of the Catchers Pond Group.

LINE OF CROSS SECTION



A line of cross section is illustrated from the vicinity of Silver Pond to Ovals Pond passing through the type area of the Catchers Pond Group and including thrust sheets carrying volcanic rocks from the Western Arm Group and the Lushs Bight Group. Also shown are the geochemical sample locations (red font) from the so-called Hammerdown Basalt.

REGIONAL CROSS SECTION



The youngest preserved strata in the Catchers Pond Group [475 +/- 1.4 Ma] are exposed in a northwest-trending tectonic window lying structurally below several overriding thrust sheets that carry the older rocks of the Catchers Pond Group. Rocks assigned to the lower Catchers Pond Group [479 +/- 2 Ma] were thrust toward the southwest, structurally imbricated to form a tectonic collage of right-side-up and inverted strata, and emplaced above the rocks of the upper Catchers Pond Group. On the southwest flank of the tectonic window (secondary antiform) at Silver Pond, the folded thrust surface changes from its original northeastward dip to being southwesterly inclined.

CONCLUSIONS

The Hammerdown Basalt represents a tectonic collage of several Cambrian and Early Ordovician lithostratigraphic units; however, it is mainly composed of strata belonging to parts of the two lowest formations of the Catchers Pond Group. Such marine lavas originally formed the depositional substrate of the Floian felsic pyroclastic strata that dominate the middle and upper part of the Catchers Pond Group.

The Tremadocian-Floian mafic volcanic strata preserved within the Hammerdown Basalt are observed to structurally overlie these same Floian felsic volcanic rocks. Orogen-parallel Taconian II displacement occurred along an arcuate thrust zone during partial inversion of the Catchers Pond depositional basin prior to the intrusion of a 474 +/- 1.6 Ma sheet of quartz-feldspar porphyry.