

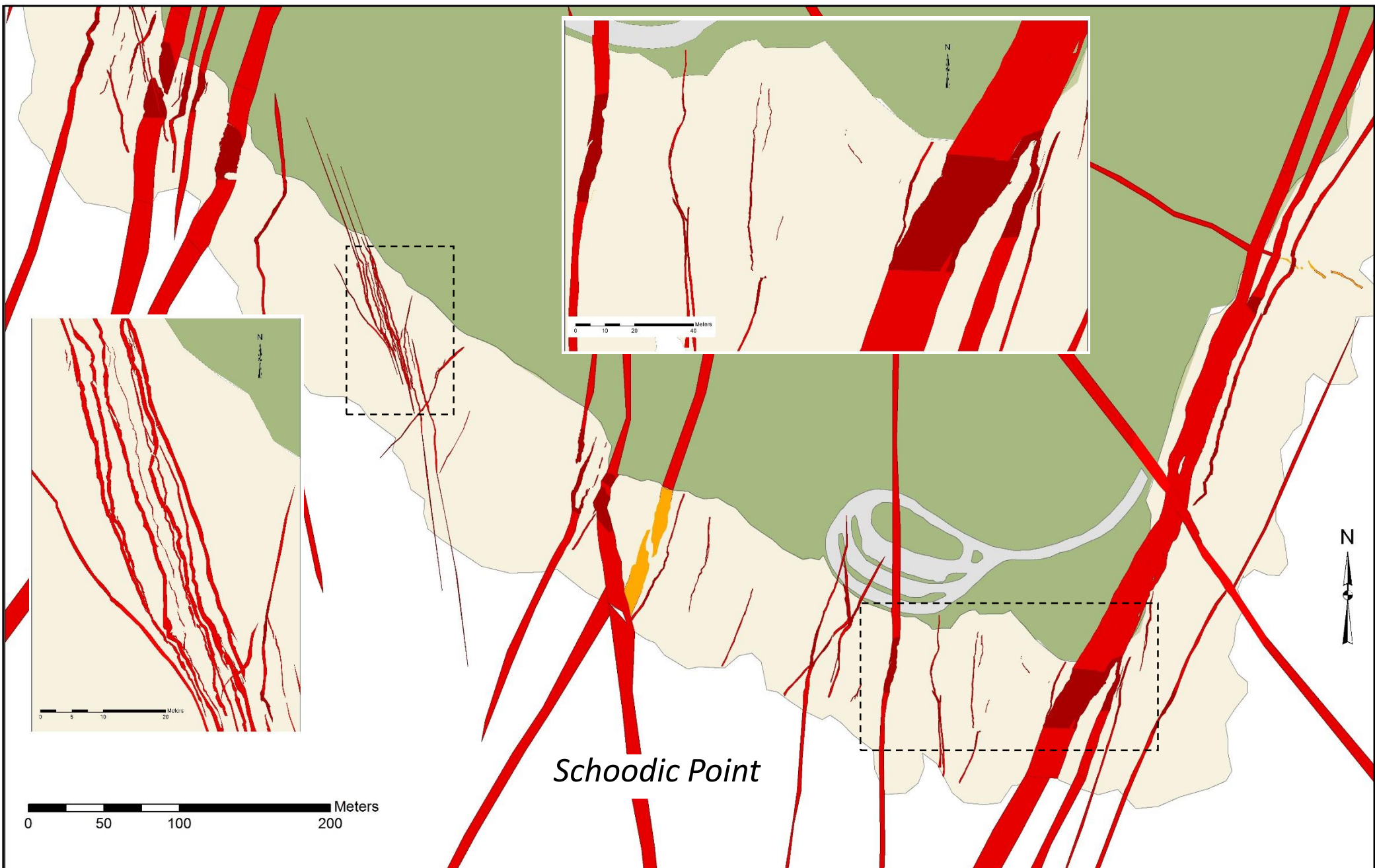
Mapping Dikes and Faults on the Schoodic Peninsula, Acadia National Park

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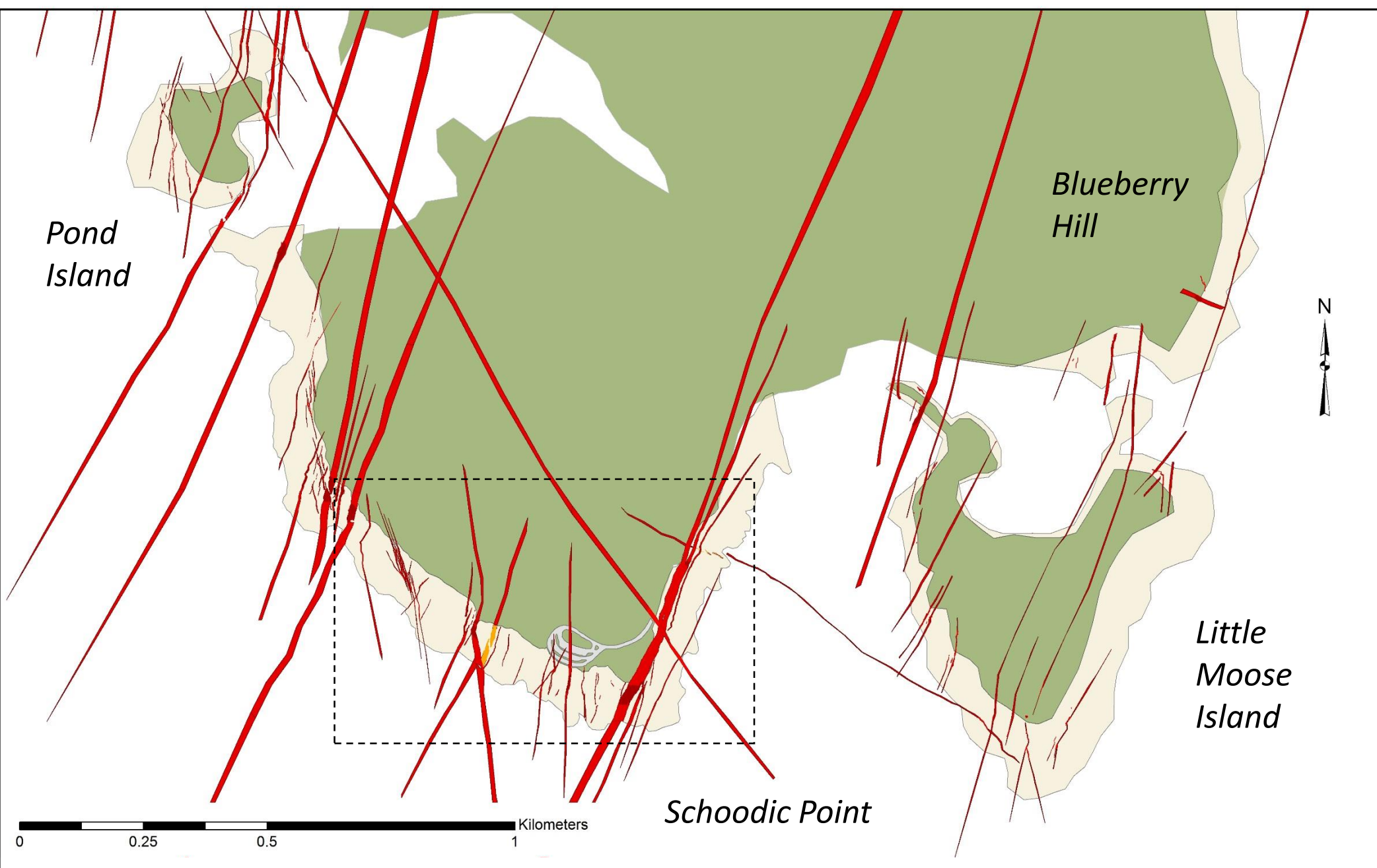
Digital mapping of dikes and faults that cut the Devonian Gouldsboro granite on the Schoodic Peninsula, Acadia National Park was conducted by undergraduate student survey teams from the University of Southern Maine, 2013-2018. Their work provides a unique detailed perspective of the long famous dike intrusions as well as the new Schoodic Point Fault Zone. RTK GPS and total stations were used to delineate the geometry of fracturing and faulting associated with dike intrusion and the early stage fault zone development preserved within these exposures. Mapping has now covered ~150 separate dike intrusions, from less than 1 cm to over 10 meters in width, from Pond Island on the west, across Big Moose Island and Schoodic Point, and Little Moose Island to the Blueberry Hill Pullout on the east. Mapped dikes include early pluton-related felsic aplite and rhyolite porphyry dikes as well as the more common mafic basalt and diabase dikes. The distinction between older pluton-related and younger rift-related mafic dikes is still not clear at this time. Dike orientations are dominantly NE-SW with additional NNE-SSW, and generally younger NW-SE and NNW-SSE oriented dike sets. Lengthening the mapped dikes in their strike directions gives a more realistic view of how these myriad of dikes have sliced across the Schoodic Peninsula.

In addition, over 900 short small-scale fault segments have been surveyed in a NW-SE zone over 400 m in length across the western side of Schoodic Point. Faulting was initiated prior to nearly all of the dike intrusions. Faults are marked by patches of coarse breccias, thin zones of cataclasite, sidewall ripout geometries and rare horizontal striations. Most offsets of the earliest aplite dikes and other earlier faults are in the cm to 10's of cm range with possible meter scale displacements for larger zones where smaller fault segments have merged together. Projected connections between mapped fault sections reveal several left-stepping en echelon right-lateral strike-slip segments that are frozen at an early stage in the process of linkage to a through-going fault zone. Lengthening of fault segments that would have occurred with further displacement suggests what a mature through-going fault geometry would look like for a more developed Schoodic Point Fault Zone.



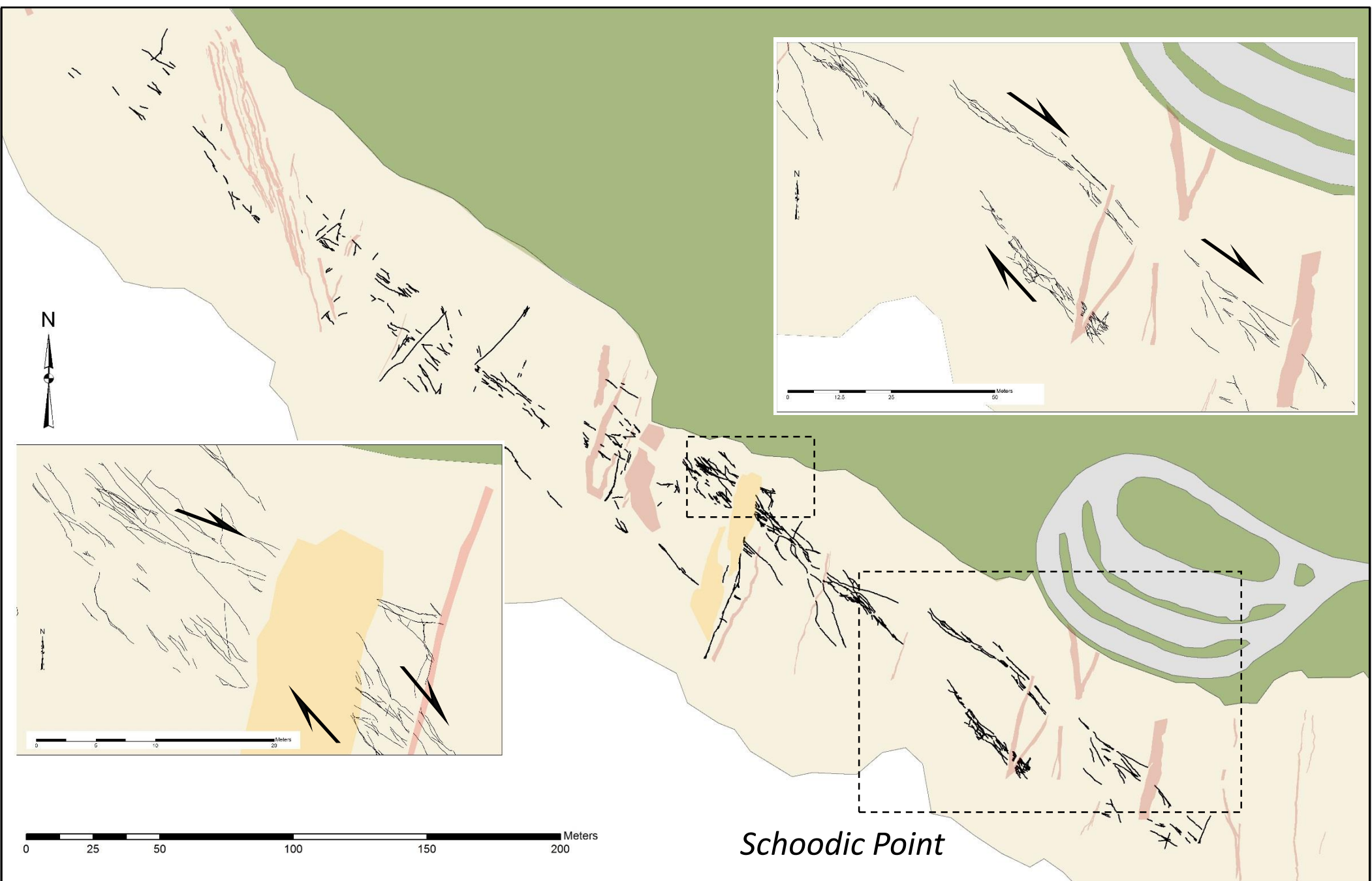
Mafic and Felsic Dikes at Schoodic Point:

The Devonian Gouldsboro Granite at Schoodic Point is crosscut by numerous igneous dike intrusions that range from early tan aplite and gray porphyritic rhyolite dikes directly linked to the granite to dark basalt dikes in porphyritic, aphyric and diabasic textures, some attributed to late syn-plutonic magmas while others to fractures related to Triassic rifting. Approximately 150 separate dike intrusions have been surveyed across the southern end of the Schoodic Peninsula from Pond Island on the west to Blueberry Hill on the east. Dikes range in thickness with the largest at over 10 meters. Dike orientations are dominantly NE-SW with additional NNE-SSW, and generally younger NW-SE and NNW-SSE oriented dike sets. One early rhyolite dike can be traced from the south end of Little Moose Island to the Schoodic shoreline. A younger NW-trending dike on the SE Schoodic shoreline may connect with a similarly oriented dike in the Pond Cove area.



Dike Extensions:

With typical W/L aspect ratios for dikes at 0.01 - 0.001, dikes are known to extend significantly along their length parallel to their strike directions. A 1 meter wide dike could be several 100 meters to 1 kilometer in length. Short surveyed dike segments along the narrow coastal outcrops can then be extended significantly along strike into the forested interior of the peninsula and out to sea. Thicker dikes can be extended greater distances than thinner dikes. When combined together these dike extensions provide a unique perspective on what the Schoodic Dike Swarm looks like.



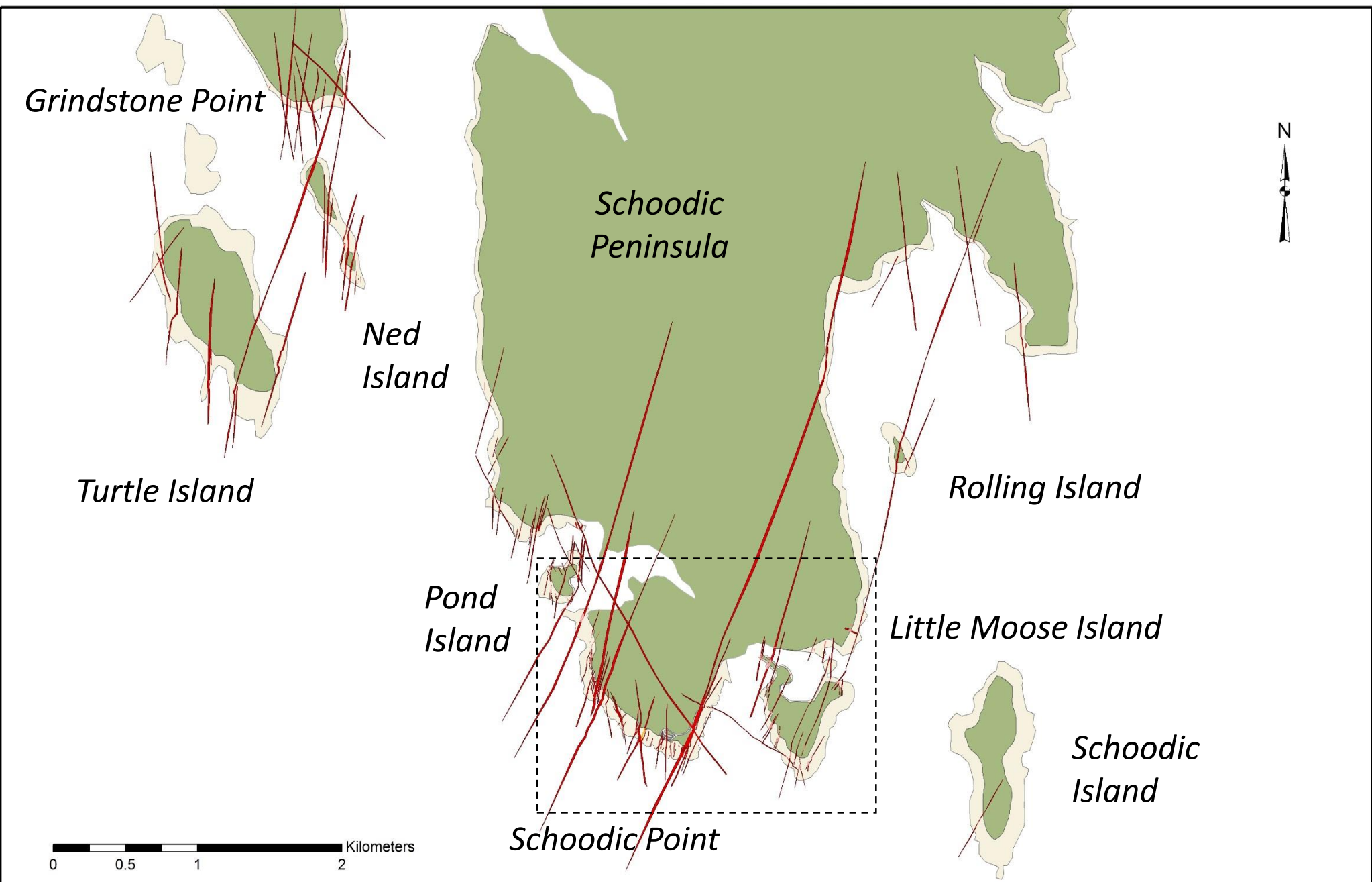
Brittle Faults at Schoodic Point:

The granite host rock at Schoodic Point is also cut by small strike-slip faults as mm-cm wide zones of breccia in a darker cataclastic matrix. Fault zones cut early syn-plutonic aplite dikes with cm-scale offsets. Over 900 small discontinuous fault segments have now been surveyed in a 400 m-long NW-SE zone across Schoodic Point. Having both right and left lateral strike-slip faults suggests a Riedel shear model of fault zone development.



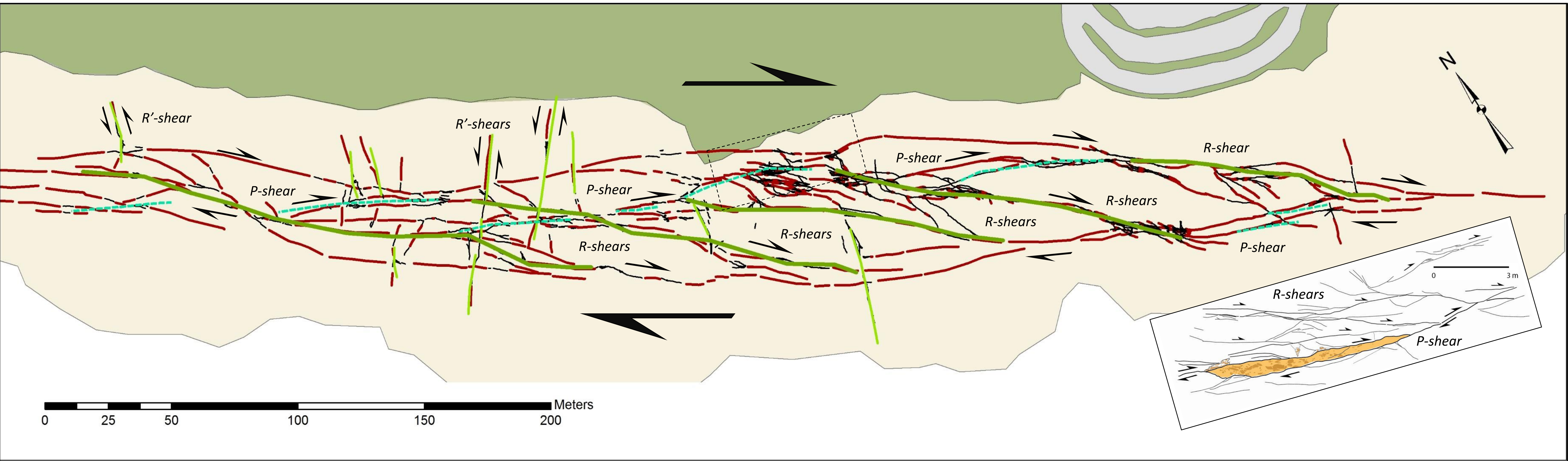
Dikes across the Schoodic Peninsulas:

Dikes from along the flanks of the Schoodic Peninsula and on nearby islands were added to the compilation by using Google imagery. Dikes were identified on Google imagery and then mapped by on-screen digitizing to an aerial base map in GIS. This proved to be an effective technique for incorporating dikes from outlying areas into the Schoodic mapping project.



Schoodic Point Strike Slip Fault Zone:

Right-lateral strike-slip fault zone development in a Riedel shear model starts with a conjugate set of right-lateral R-shears at low angles to the shear zone and left-lateral R'-shears at high angles to the overall zone. Continued displacement develops a series of right lateral R-shears in a left-stepping en echelon geometry that link through ramping P-shear connectors to a through-going fault zone. Projected connections between mapped fault sections reveal several left-stepping en echelon right-lateral strike-slip segments (as R-shears) at low angles to the overall zone of shear as well as linking P-shears that are frozen at an early stage in the process of linkage to a through-going fault zone. Although rather discontinuous at this level of displacement the lengthening of fault segments that would have occurred with further displacement suggests what a more mature through-going fault geometry would look like for a more developed Schoodic Point Fault Zone.



References:

Burk, S.R., Gibson, D. & Koteas, C.G., 2012, Field relations, petrography and geochemistry of mafic dikes, Schoodic Peninsula, Coastal Maine, Geol. Soc. Amer., Abstr. w Prog. V. 44, # 2 p. 80.

Button, L.J., Gibson, D. & Dalrymple, L., 1997, The Schoodic Point Dike Swarm: A petrographic and structural study of dike emplacement, Geol. Soc. Amer., Abstr. w Prog. V. 29, # 1, p. 34.

Koteas, G.C., 2010, Analysis of the Gouldsboro Pluton and the Fehr Granite: Understanding the scales of magmatic processes and partial melt generation from the deep to shallow crust, Open Access Dissertation, Paper 284, U. Mass. Amherst, 203 p.

Swanson, M.T., 2015, Mapping mafic/felsic dikes and strike-slip faults at Schoodic Point, Acadia National Park, Geol. Soc. Amer., Abstr. W Prog., V. 47, # 3, p. 90.

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