The plutonic map of the Newfoundland Appalachians: a two-sided asymmetrical system

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Newfoundland geology has influenced models for the evolution of the Appalachian- Caledonian Orogenic Belt for many years, and it continues to do so. Our extensive record of magmatism in both ensimatic and ensialic settings demonstrates that the familiar tectonic zones established by Hank Williams in the 1970's each contain distinct sequences of plutonic rocks. Although the orogen in Newfoundland has a broadly symmetrical pattern, its plutonic map pattern is asymmetrical, in that there is both temporal and compositional polarity.

"Early sequence" plutonism (essentially Cambro–Ordovician) is largely restricted to the Dunnage Zone. In the west, there are both trondhjemites (intraoceanic arcs?), and

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calc-alkaline suites (mature or continental arcs?). In contrast, equivalent Ordovician suites in the east record anatexis of the Gander Zone metasediments following juxtaposition of the Gander and Dunnage zones, likely by obduction of the latter. There is a prominent gap in the plutonic record in the latter part of the Ordovician (460–440 Ma), the significance of which remains unclear.

"Middle sequence" plutonism (mostly Silurian) expanded well beyond the Dunnage Zone, notably to the east, and affected all areas except the Avalon Zone (sensu stricto). Its onset in the Humber and Gander zones most likely indicates the closure of the main Iapetus basin. The Dunnage Zone plutonic suites are bimodal, and have an alkali-calcic, "A-type" geochemistry, in sharp contrast to spatially associated Ordovician suites. This compositional shift may record a transition from compressional to extensional tectonic environments. Compositional commonality amongst these suites across the Dunnage Zone does not support wide separation of the western and eastern parts during most of the Silurian. The Humber and Gander zones, on opposite sides of the orogen, are both dominated by peraluminous, "I-type" granite suites (commonly K-feldspar megacrystic), with subordinate "S-type" muscovite-biotite granites. In the east, these form a continuum, and were derived from diverse supracrustal, infracrustal, and subcrustal sources. The Gander Zone Middle Sequence suites could represent distal arc-related magmas, generated via subduction of oceanic crust originally located between the Gander and Avalon zones, but the primitive arc-type rocks expected in such settings are absent. The granitoid rocks could equally represent a late-orogenic, post-closure assemblage, within which spatial compositional and temporal variations reflect the nature of lower crustal blocks, coupled with the eastward propagation of some mysterious "lithospheric delamination" process.

During "late Sequence" plutonism (mostly Devonian), magmatic activity shifted eastward once more, because younger post-orogenic granites appear to be most abundant in the Gander-Avalon boundary boundary region. These suites are typically more compositionally evolved than their Middle Sequence counterparts, and their highly variable isotopic compositions indicate that the Gander-Avalon zonal boundary is a crustal-scale structure separating discrete basement terranes. They are also the group of plutonic rocks with the greatest potential for economic deposits of fluorite, molybdenum, tungsten, uranium and other commodities.