

New geochronological constraints on the timing of magmatism for the Bull Arm Formation, Musgravetown Group, Avalon terrane, northeastern Newfoundland, and implications for the tectonic evolution of the Bonavista Peninsula, Canada

Andrea Mills¹ and Greg Dunning²

1. Geological Survey, Newfoundland and Labrador Department of Natural Resources, PO Box 8700, St. John's, Newfoundland and Labrador A1B 4J6

2. Department of Earth Sciences, Memorial University of Newfoundland, 300 Prince Philip Drive, St. John's, Newfoundland and Labrador A1B 3X5, Canada

New age constraints are presented for the volcanic-dominated Bull Arm Formation of the Avalon terrane in Newfoundland. Historically, the age has been interpreted from the single previous geochronological constraint, 570 ± 5 - 3 Ma, obtained from a rhyolite flow on Wolf Island where no contact relations are exposed. This rhyolite was later reinterpreted as part of the overlying Rocky Harbour Formation but its initial interpretation as Bull Arm Formation had already become entrenched in the literature. New U-Pb zircon (CA-TIMS) geochronology results for rock samples from the west and east margins of the Bull Arm Formation (Musgravetown Group) on the Bonavista Peninsula (Plate Cove volcanic belt: PCvb) of northeastern Newfoundland yielded ages of 592 ± 2.2 Ma and 591.3 ± 1.6 Ma, respectively. Quartz- and potassium feldspar-phyric, banded rhyolite from the Isthmus of Avalon, nearly 100 km south of the Bonavista sites, yielded an age of 605 ± 1.2 Ma.

The Isthmus rhyolite is overlain by diamictite, possibly correlative to the 579 Ma glaciogenic Trinity facies/Gaskiers Formation, indicating a depositional hiatus, and/or faulting. It is also a possible source of age-equivalent volcanic detritus in upper parts of the 620–605 Ma, arc-adjacent, turbidite-dominated, Connecting Point Group (CPG) at Bonavista Bay. There, north-verging, thrust-stacked CPG rocks are unconformably overlain by ca. 600 Ma glomerocrystic, calc-alkaline basalt of the lower Bull Arm Formation. Aphyric basalts of the PCvb comprise two petrologically distinct, but similar, series of transitional (weakly calc-alkaline) basalts derived from lithosphere-contaminated, enriched shallow mantle source. The earliest is approximately coeval with ca. 592 Ma, east-side-down extension along the PCvb margin that culminated in deposition of a coarse clastic wedge. The younger PCvb series is petrologically similar to dykes that cut Musgravetown Group rocks younger than the 579 Ma Trinity diamictite. These grey siltstones and overlying distal turbidites were deposited during tectonically quiescent times. North-directed thrusting, likely part of Avalonian orogenesis, occurred again post-565 Ma. This terminal Neoproterozoic event preceded deposition of the early Cambrian Random Formation and possibly parts of the Neoproterozoic Crown Hill Formation.