

Sm-Nd and detrital zircon provenance study of the Upper Devonian Sassenach Formation in the Jasper Basin

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Summary

The Upper Devonian (Famennian) Sassenach Formation is a distinctive unit in the Front Ranges of the Canadian Cordillera, comprising a mixture of carbonates and calcareous shales, along with a significant component of siltstone and subordinate fine-grained quartz sandstone. The presence of sandstone within the Sassenach Formation renders it unique within a Devonian Cordilleran stratigraphic succession that otherwise comprises carbonate reefs and their associated fine-grained off-reef sediments. We present new Sm-Nd and detrital zircon U-Pb data from the Sassenach Formation in the Jasper Basin of the Alberta front ranges. Our Sm-Nd results are similar to previous Sm-Nd studies that record a subtle negative deviation in ϵ_{Nd} upward from the underlying basinal Mount Hawk Formation into the Sassenach Formation from an overall increasingly positive post-Ordovician ϵ_{Nd} trend within Paleozoic strata of the Western Canada Sedimentary Basin (WCSB). Along with sedimentological characteristics, such as an eastward fining and thinning of Sassenach equivalent strata (Graminia Silt), the Sm-Nd isotopic evidence has been interpreted as representing a new western source of siliciclastics from a newly uplifted highland at Canadian latitudes. Given the potential overlap in timing of Sassenach sedimentation with the Antler Orogeny in the southwestern United States, Antler-related convergence or transpression has frequently been invoked along the WCSB starting with Sassenach deposition in the Famennian. However, our new detrital zircon provenance data show remarkable similarity with Eifelian–Famennian strata of the Canadian Arctic region, suggesting a common provenance. Notably, our data includes a 500–700 Ma zircon population shared with the Devonian Arctic strata but which has no known Laurentian affinity. Newly developed discordance modelling of the 548 Sassenach zircons (6 locations) points to a potential common tectonothermal overprinting at ca. 390 Ma, which corresponds to the first major tectonic episode in the Ellesmerian orogenic belt. The new detrital zircon U-Pb data thus suggests an Arctic Canada provenance for the bulk of Sassenach sediments in the Jasper Basin, which would have been transported along the western margin of Laurentia by southward-directed currents.