Late-stage propagation of the Grenville orogen: implications of U-Pb ages from Sudbury metadiabase, Georgian Bay, Ontario, Canada

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Did the final (Rigolet) phase of the Grenvillian orogeny result from renewed convergence or post-convergent ductile flow? This question remains unresolved, in part because of limited data on the timing of late Grenvillian tectonism in the parautochthonous Britt Domain in central Ontario, which occupies the critical region between the Grenville Front and the orogenic core. U-Pb data is reported from Sudbury metadiabase, part of a ca. 1235 Ma dyke swarm that intruded Laurentian crust after pre-Grenvillian tectonism, but before the onset of Grenvillian orogenesis (ca. 1100 Ma), and which therefore records exclusively Grenvillian metamorphism.

Representative samples were collected from the southern, central, and northern Britt Domain along Georgian Bay, spanning a 40-km transect across the parautochthon. All samples preserve relict igneous textures overprinted by granulite-facies corona assemblages recording metamorphic conditions of ca. 720–790°C at 13–15 kbar. Fine-grained (10–20 µm) metamorphic zircon decorates grain boundaries of relict Fe-Ti oxides within biotite coronas, forming "string-of-beads", overgrowths, and replacement textures. Zircon was analyzed in situ by LA-ICP-MS at the University of New Brunswick. Metadiabase from H.A. Gray Island in the southernmost Britt Domain yielded a weighted mean ₂₀₆Pb/₂₃₈U age of 1031 ± 14 Ma, with ages of 1020 ± 9 Ma and 1011 ± 11 Ma obtained from metadiabase bodies at Byng Inlet and Key Harbour in the central and northern Britt Domain, respectively.

The ca. 1030 Ma metamorphic age of the southern sample overlaps with ages of synkinematic pegmatite dykes within the nearby Shawanaga Shear Zone (ca. 1042–1021 Ma), which record normal-sense ductile reactivation of the precursor Allochthon Boundary Thrust. The ca. 1010 Ma age from the northern Britt Domain sample is similar to other metamorphic ages from the Grenville Front Tectonic Zone (1010–990 Ma), interpreted to mark the final stage of thrusting at the orogenic front. Collectively, the new ages from Sudbury metadiabase are interpreted to reflect ca. 2 mm/y propagation of Grenvillian metamorphism and deformation from SE to NW across the parautochthon. This is compatible with model predictions for post-convergent ductile flow involving thinning and extension in the orogenic core, coeval with thrusting at the orogenic front, although assumed model viscosities may be somewhat too low.

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