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Rift flank uplift and thermal evolution of an intracratonic rift basin (eastern Canada) determined by combined apatite and zircon (U-Th)/He thermochronology

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As a significant portion of the world's oil reserves are retrieved from rift systems, a better understanding of the timing of thermal evolution and burial history of these systems will increase the potential for the discovery of hydrocarbon-bearing rifts. The Ottawa Embayment of the St. Lawrence Platform of eastern Canada is a reactivated intracratonic rift basin related to the opening of the Iapetus Ocean at ca. 620-570 Ma, followed by the formation of the well-developed continental passive margin. Siliciclastic sediments derived from the adjacent uplifted Neoproterozoic Grenville basement provide the basin fill material. Apatite and zircon (U-Th)/He thermochronology allows for low-temperature analysis across the exposed crystalline rift flank into the synrift sedimentary sequence to resolve the unroofing, burial and subsidence history of the region. Samples were collected along a ∼250 km NE-SW transect, oblique to the axis of the rift, from Mont-Tremblant, Québec (∼900 m) to the central axis of the Paleozoic rift in the Southern Ontario Lowlands (∼300 m). Targets included Neoproterozoic metamorphic rocks of the Grenville Province along the rift flank and basinal Cambro-Ordovician Potsdam Group. Samples from the rift flank yield zircon ages from ca. 650 Ma to ca. 560 Ma and apatite ages from ca. 290 Ma to ca. 190 Ma, with a weak positive correlation between age and grain size. Zircon ages demonstrate a strong negative correlation with radiation damage: as eU increases, age decreases. By incorporating (U-Th)/He ages with regional constraints in the thermal modelling program HeFTy, viable temperature time paths for the region can be determined. Through inverse and forward modeling, preliminary rift flank (U-Th)/He ages correspond to post-Grenville cooling with <4 km of post-Carboniferous burial. The data define slow and long episodes of syn- to post-rift cooling with rates between 0.4 and 0.1 °C/Ma. (U-Th)/He dating of samples along the full-length of the transect will resolve thermal changes in the basin-orogen system and improve our understanding of the rift related history of the region.