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Akimiski Island, Nunavut, Canada: The Use of Cree Oral History and Sea-Level Retrodiction to Resolve Aboriginal Title

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SUPPLEMENT: SENSITIVITY STUDY

We have performed a study that explores the sensitivity of the estimate of the emergence time of Akimiski Island to uncertainties in various aspects of the ice history and Earth model described in the main text. We will refer to the simulation within the main text as simulation number one (henceforth Sim1). We have run nine additional simulations of GIA based on 3-D viscoelastic Earth models. Simulations 2 and 3 are identical to Sim1, with the exception that our scaling of lateral viscosity variations (e.g., Fig. 5B–D) is increased by a factor of 2.7 and 7.4, respectively. These viscosity fields are all ultimately based on heterogeneity inferred from the seismic tomography model S40RTS (Ritsema et al., 2011). Simulations 4 and 5 are identical to Sim 1 with the exception that the underlying seismic tomography fields are given by the Savani model of Auer et al. (2014) and the SEMUM2 model of French et al. (2013), respectively. Both models have lateral viscosity variations that are tuned to be comparable to the variations in Sim1 (Fig. 5B–D). Simulation 6 replaces the lithospheric thickness and mantle viscosity variations in Sim1 by the Earth model derived by Hoggard et al. (2020) and Richards et al. (2020). Simulation 7 replaces the lithospheric thickness model used in Sim1 (Conrad and Lithgow-Bertelloni, 2006) with the model of Watts (2001). Simulation 8 is identical to Sim3, with the exception that the spherically averaged viscosity model adopted in the latter (VM5) is replaced by a model with upper and lower mantle viscosities of 5×10^{20} Pa s and 5×10^{21} Pa s, respectively. All the above simulations use the ICE-6G history (Peltier et al., 2015). Simulation 9, in contrast, adopts the ICE-5G ice history and assumes the spherically averaged Earth structure of VM2 (Peltier, 2004). Simulation 10 adopts the ANU ice history, spherically averaged viscosity structure characterized by upper and lower mantle viscosities of 1.5×10^{20} Pa s and 5×10^{22} Pa s, respectively, and a global average lithospheric thickness of 48 km (Lambeck et al., 2014). Simulations 9 and 10 have lateral viscosity variations that are tuned to be comparable to the variations in Sim1

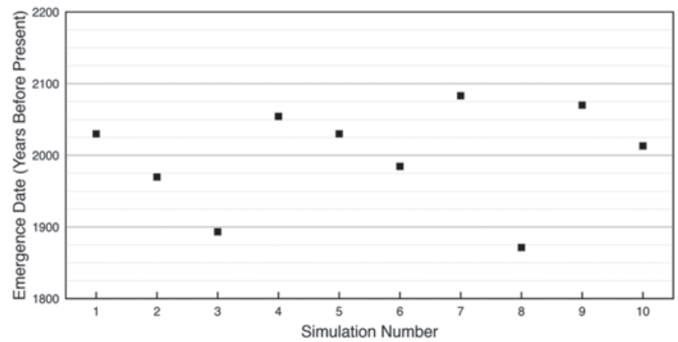

FIG. S1. Estimates of the emergence date of Akimiski Island from the 10 GIA simulations based on 3-D Earth models described in the Appendix.

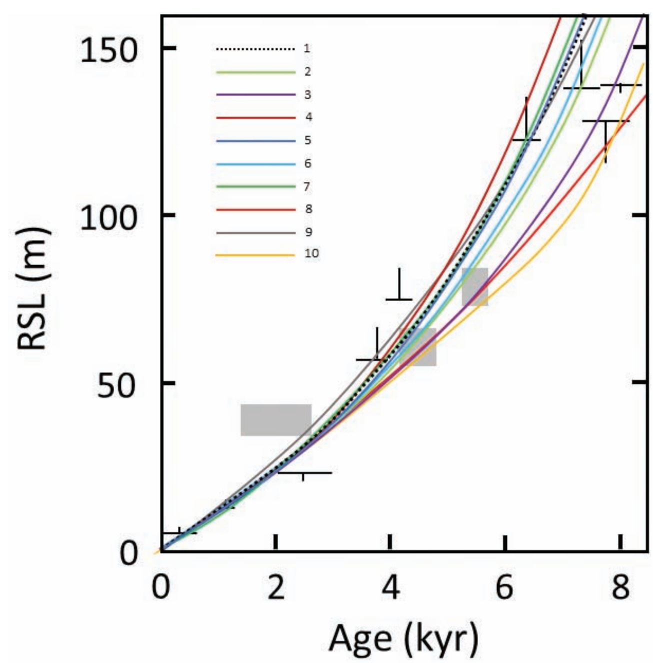

FIG. S2. Predictions of RSL change in western James Bay over the past 8 kyr generated using all 10 GIA simulations described in the main text and appendix, superimposed on observational constraints compiled by Vacchi et al. (2018) in their (western James Bay) Region #3. The predictions are generated at a site located at the mean position of all sites in Region #3.

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(Fig. 5B – D). In all 10 cases, the Laurentide ice history is scaled to match the GPS-derived uplift rate at Moosonee (9.3 ± 0.3 mm/yr; NRC, 2003; Tsuji et al., 2016).

Figure S1 provides estimates of the emergence time of Akimiski Island (in years before present) for all 10 simulations. These estimates show reasonable consistency and range from 1870 – 2083 yrs. Their mean value, with one standard deviation uncertainty, is 1985 ± 78 yrs. In the main text, we cite an uncertainty of 2000 ± 100 yrs.

Figure S2 shows predictions of relative sea level (RSL) change over the past 8 kyr in western James Bay for all 10 simulations superimposed on a composite RSL history compiled by Vacchi et al. (2018; Region 3). The predictions are consistent with the observations and they capture the extent of uncertainty explicit in the RSL record.

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