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The Eurekan Orogeny: convergent intraplate deformation through accretionary tectonics?

Philip Heron (1), Russell Pysklywec (1), and Randell Stephenson (2)

(1) Department of Earth Sciences, University of Toronto, Toronto, Canada (philip.heron@utoronto.ca), (2) School of Geosciences, University of Aberdeen, Aberdeen, Scotland (r.stephenson@abdn.ac.uk)

The Eurekan Orogeny, which created much of the high topography (∼1-2km) of Ellesmere Island and adjacent Greenland, exhibits a crustal architecture linked to intraplate orogenesis in the Cenozoic. These features occurred as a result of mountain-building processes the dynamics of which are not well understood. It is generally considered that the rotation of Greenland in the Eocene (related to sedimentary basin formation in Baffin Bay) produced compressional tectonics between Greenland and Ellesmere Island. As part of this process, the Eurekan Orogeny formed away from a traditional convergent ocean-closure plate boundary, and may represent a style of intraplate deformation. One hypothesis is the amalgamation of continental material (i.e. micro-plates) leave deformational 'scars' in the crust and mantle lithosphere (specifically in the Ellesmere Island case through accretionary orogenesis in the Palaeozoic). This weakening of the lithosphere may produce episodic reactivation of faults within continental interiors. For example, lithospheric shortening at a time after continental collision could cause the previously deformed crust and mantle lithosphere to produce intraplate deformation. In this work, the geodynamic evolution of the Eurekan Orogeny and its relationship to the tectonics of the Canadian polar margin and northern Baffin Basin is explored using high-resolution thermal-mechanical numerical experiments with the modelling code SOPALE. The modelling of the High Arctic is constrained by the first-order crustal structure of the region (deduced by local gravity field and passive seismological data). Presented are suites of numerical experiments that investigate how the pre-existing lithospheric structures (both crustal and sub-crustal) control the evolution of the resulting intraplate orogen. The influence of other primary modelling parameters, such as crustal thickness and assumed rheology, is also explored. To highlight the role of surface processes on plate and lithosphere deformation, the importance of climate-controlled erosion and deposition in influencing the tectonics of High Arctic orogenesis is considered. With these studies we present some of the first interpretations of the development of Ellesmerian and northern Baffin lithosphere from the Earth's surface down to the base of the lithosphere. The numerical experiments also evaluate and refine the geodynamical interpretations for enigmatic intraplate tectonics, applicable to this Arctic region and other instances globally.