The topography of the Eurekan Orogen of Ellesmere Island and the Canadian-Greenland polar continental margin

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Ellesmere Island, in Canada's Arctic, comprises a series of ~SW-NE trending tectonic provinces, the crustal structure and geological expression of which represent a combination of interplate, accretionary orogenesis in the Palaeozoic (Caledonian equivalent and Ellesmerian orogenies) and intraplate orogenesis in the Paleogene (Eurekan Orogeny). The present-day topography of Ellesmere Island is closely related to the crustal architecture of these tectonic provinces, which includes the adjacent polar continental margin. The first-order crustal structure of the area has been deduced from the regional gravity field: the high topography of northwest Ellesmere Island is isostatically compensated by a thick crust; the Hazen Trough (Hazen Foldbelt) running most of the length of central Ellesmere Island is underlain by a shallow Moho; and the central Ellesmere fold-and-thrust belt loads (Greenland-Laurentian) cratonic basement that flexes to the northwest beneath it. The first-order geological and crustal structure can be explained by a model, supported by the preliminary analogue modelling results, that depends on lithosphere-scale structures imposed during Palaeozoic orogenesis being reactivated during Eurekan (Paleogene) intraplate shortening ("mega-basin inversion"). In order to test this model – and to complement the scarce seismological data that are available in the area (only two receiver function estimates of Moho depth) – a passive seismology campaign is underway. Eight temporary seismic observatories were installed, using instruments and equipment provided by SEIS-UK, across Ellesmere Island in June and July of this year and will be removed in 2012. The objectives are to collect sufficient high quality seismological data for (i) receiver function analyses (Moho depth and other first-order crustal and upper mantle discontinuities) for the structurally diverse tectonic provinces of the Eurekan Orogen, (ii) shear-wave splitting analyses to determine the presence, geometry, and character of possible lithosphere anisotropy within the Ellesmere Island lithosphere and (iii) surface wave studies to determine lithosphere thickness and for joint inversion studies in this frontier region. The results will comprise a key element of a Canada-Greenland polar margin lithospheric transect within the CALE (Circum-Arctic lithosphere evolution) task force of ILP.