Kilometre-scale cross-folding in the Ottawa River Gneiss Complex, western Grenville Province – signal of transtensional collapse of overthickened hot crust

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Recent 2D and 3D analogue and numerical experiments have shown that transtensional folds form in constrictional regimes in which extension (stretching) of the fold hinge is coeval with buckling (shortening and rotation) of the fold limbs. In ductile extension-dominated regimes, transtensional folds are characterised by the presence of L>>S mineral elongation lineations parallel to the fold hinges, and can exhibit a range of axial surface orientations from upright to recumbent depending on the original orientation of the folded surface. We have used these criteria to identify a system of transtensional cross-folds (also known as transverse folds) with NW- to NNW-trending hinge lines at high angle to the NE-SW orogenic grain of the Grenville Province within the Ottawa River Gneiss Complex (ORGC), a giant metamorphic core complex in the western Grenville Province. The amplitudes of individual cross-folds range from metre- to 10s-of-kmscales and the hinge lines of the larger examples can be traced along strike for more than 50 km.

The highest structural level of the ORGC is known as the Muskoka domain, a ductile amphibolite-facies detachment surface with abundant leucosome that is up to 7 km thick and separates the underlying granulite-facies core (the Algonquin—Lac Dumoine domain) from the overlying greenschist- to amphibolite-facies carapace (Composite Arc Belt). The transtensional folds are especially well developed in the Muskoka domain, and on the basis of petrological evidence they formed after the peak of metamorphism during amphibolite-facies retrogression of granulite-facies precursors in a tectonic setting of orogenic collapse. To our knowledge, this is the first record of transtensional, as opposed to extensional, gravitationally-driven collapse of a large hot orogen.

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