Thermochronology evidence for Tertiary Inversion of the Continental Margin of Nova Scotia, Canada

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Southern Nova Scotia in Atlantic Canada is underlain by the Meguma Terrane, crystalline basement composed of Cambrian to Devonian marine strata with a likely Moroccan source, which were folded, metamorphosed and intruded (ca. 380 Ma) by granitoid batholiths during the Acadian Orogeny. Considerable erosion followed, and by the Early Carboniferous (ca. 350 Ma) coarse clastics - followed by extensive marine carbonates and evaporites - were deposited non-conformably on exhumed granitoids and metamorphic rocks. The Carboniferous-to-Permian Maritimes Basin developed, accumulating clastic sediments in excess of 12 km in its depocentre further north. Maximum burial of the basin was attained in the Late Carboniferous (ca. 300 Ma), and the youngest sediments preserved in this basin are Lower Permian in age. Our apatite fission track thermochronology studies have shown that basin inversion led to erosion of ca. 5 km of strata in the Late Triassic, coinciding with the Atlantic break-up unconformity, and preceding extensive but short-lived basaltic magmatism (ca. 200 Ma). Offshore Nova Scotia forms part of the present Atlantic passive margin, an active depositional basin from the Late Triassic-Early Jurassic to the present. In such a passive margin it was expected that rocks deep in offshore wells would be at their maximum temperature today. However, our extensive apatite fission track thermochronology study indicates that rocks in offshore wells were tens of degrees hotter (e.g. within the oil window) than at present, and that substantial post-Paleocene cooling has occurred. Although higher paleo-mean annual surface temperatures in the Late Cretaceous may account for some of the thermal anomaly detected, the most probable cause for this cooling is inversion of the margin and erosion of ca. 1 km of post-Albian cover from onland and offshore, probably in the Eocene - Oligocene. The traditional view of gradual exhumation and peneplanation of the Nova Scotia margin since the Triassic- Jurassic is therefore untenable. This Tertiary inversion has important implications for hydrocarbon maturation, the distribution of deep-water sand bodies, overpressures, and post-Paleocene canyons and unconformities.