Geophysical Research Abstracts, Vol. 8, 07210, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07210

Evidence for linked geodynamic evolution of the Phanerozoic Canadian Shield and intracratonic basin from thermochronological analysis

S. Feinstein (1), B. Kohn (2), K. Osadetz (3), R. Everitt (4) and P. O'Sullivan (5)

(1) Department of Geological and Environmental Sciences, Ben Gurion University of the Negev, Beer Sheva, Israel, (2) School of Earth Sciences, University of Melbourne, Victoria, Australia, (3) Natural Resources Canada, Earth Sciences Sector, Geological Survey of Canada - Calgary, Calgary, Alberta, Canada, (4) Atomic Energy of Canada Limited, Pinawa, Manitoba, Canada, (5) Apatite to Zircon Inc., Viola, ID., USA (shimon@bgu.ac.il / Fax: +972 8-6472997 / +972 8-6472622)

Intracratonic basin formation and persistence remains an outstanding problem in continental geodynamics. Here we report a seemingly common apatite fission track (AFT) thermochronology history linking the Phanerozoic tectonic and sedimentation history of the Precambrian Canadian Shield to basement underlying the adjacent intracratonic Williston Basin. Thermal history models based on a new AFT profile ($\sim$1.15 km deep) from the Canadian Shield at the Underground Research Laboratory (URL), Pinawa, Manitoba, records two Phanerozoic thermal events. The maximum Phanerozoic temperatures occurred in the late Paleozoic when the URL site was buried below a $\sim$1 km Paleozoic succession under an estimated geothermal gradient of $\sim 44^{o}$C/km. A later thermal peak, interpreted to record subsequent burial of the URL profile under a $\sim$1.5 km thick Mesozoic-Paleogene succession, occurred under an estimated geothermal gradient of $\sim 28^{o}$C/km. The URL late Paleozoic thermal anomaly matches in both time and magnitude thermal and lithospheric anomalies previously reported below the Williston Basin by thermal history modelling and independently constrained by robust stratigraphic reconstructions. Below Williston Basin the late Paleozoic heat flow anomaly became manifest at the top of the basement $\sim$75 Ma, or about one lithospheric thermal time constant, after accelerated subsidence resumed in the Emsian ($\sim$400 Ma). Our data suggest that the URL records a similar late Paleozoic heat flow anomaly, indicating a much wider extent (at least 1000 km) than inferred previously.

Furthermore our results suggest that the difference between the intracratonic Williston Basin, where a thick Phanerozoic succession is preserved, and the Precambrian Shield stems from a variable lithospheric thermomechanical response in the former to the geodynamic event, specifically the viscous flexure. We suggest that the intracratonic Williston Basin was probably initiated by thermal contraction in the early Paleozoic, but later rejuvenated by late Paleozoic dynamic topography, which thermally affected the basement underlying the Williston Basin and the Precambrian Shield, but with differing mechanical results.