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Northern Hemisphere Heat Flow Has Been Underestimated

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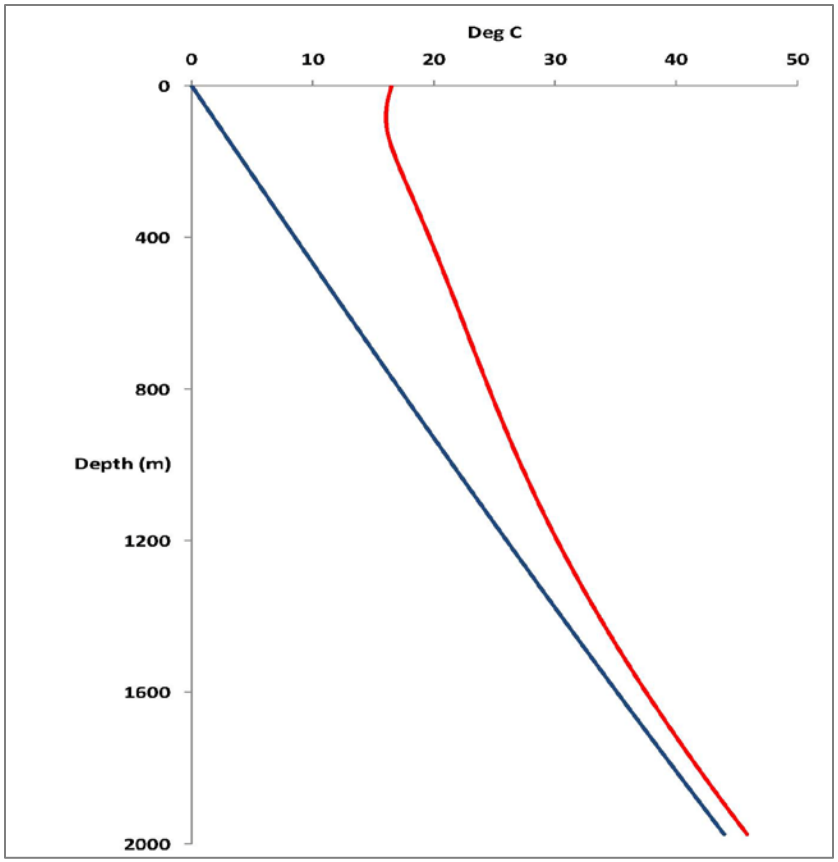

Several observations lead us to suggest that the geothermal gradient in regions near the Pleistocene ice margin may contain a transient signal that causes significant underestimation of present day heat flow. The observations are: (1) heat flow increases with depth in northern hemisphere periglacial regions; (2) surface heat flow in southern hemisphere shields averages 40 percent more than heat flow in northern hemisphere shields; (3) thermal gradients in thick clastic sediments should decrease with depth due to an increase in thermal conductivity due to compaction, but we observe increases in the gradient in all deep equilibrium temperature logs in the Williston Basin; (4) thermally mature Bakken has been reported in regions outside the expected thermally mature zone, (5) pollen analyses in upland lakes in southern Manitoba, CA during the past 12,500 years show that surface temperatures (MJJA) increased by 23°C by 6000 ka and are currently 13°C warmer. Subsurface temperature models based on the time series for the warming in the pollen analyses generate temperature vs. depth plots that match the observed data in the Williston Basin. These observations lead us to advance the hypothesis that post-glacial warming in northern hemisphere continents may have been of the order of 10°C to15°C rather than 3°C to 5°C as is generally accepted in terrestrial heat flow research. If this hypothesis is correct, some northern hemisphere heat flow values will require revision by as much as 30 to 60

percent depending on the depth of the original temperature gradient measurement. The implications for EGS in the northern hemisphere are that the resource may be more accessible.

Temperature vs. depth profiles show the effect of post glacial warming to 2000 m depth. The blue curve is the assumed steady state and the red curve is the present profile. Heat flow determined from the shallow portions of the red curve would lead to significant underestimation of temperature at depths suitable for EGS.