Noise in Heat Flow Data

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Temperature disturbances due to a variety of heat transport phenomena in the upper few km of the crust and the inclusion of unconventional heat flow determinations, i.e., use of bottom hole temperatures from petroleum exploration, alter the geothermal gradient and lead to inaccurate heat flow determinations. These data can be problematic in assessing the geoneutrinos flux due to radiogenic heat production because they have been included in the global heat flow database without correction. Careful analysis of heat flow data is particularly important on a local scale where inaccurate determination of surface heat flow can lead to miscalculation of radiogenic and mantle heat flow components and thus to erroneous estimation of the local background geoneutrino flux at sites where observatories could be installed. For example, high and low heat flow anomalies within a 140,000 km^2 area close to the Black Hills are due to gravity-driven regional groundwater flow in confined aquifers. Heat flow determined by conventional methods in Minnesota, Manitoba and Ontario has a long-period transient from ground warming after retreat of the Pleistocene ice sheet that causes under estimation of heat flow by 25 to 40 percent. We present a range of heat flow and heat production models to explore the end members of these conditions.

Nitrogen isotopic fractionation during enzymatic transamination of glutamic acid to form aspartic acid

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The trophic enrichment of ^{15}N on amino acids from diets to consumers has recently been employed as a potential useful tool for characterizing the trophic position of organisms in ecological food webs (Popp *et al*., 2007; Chikaraishi *et al*., 2009). Amino acids are the basic subunit of biomass protein and major pool of nitrogen in organisms. These facts enhance our motivation to understand nitrogen flux and associated change in the isotopic composition of amino acids in animal metabolisms.

Glutamic acid generally has a significant ^{15}N-enrichment with increase of trophic position (~8‰/each), probably due to the isotopic fractionation associated with its enzymatic deamination or transamination. To evaluate this hypothesis, we estimated the isotopic fractionation factor (α) associated with an *in vitro* enzymatic transamination of glutamic acid to oxaloacetic acid (i.e., to form aspartic acid).

The α value is estimated to be 0.9958 based on change in the observed $\delta^{15}N$ value and abundance data of glutamic acid between before and after transamination. These results are almost consistent with the α estimation in the previous study (Macko *et al*. 1986: α=0.9923) within an analytical error. Also, the α value roughly account for that 86% of glutamic acid (which derived from diets) is deaminated and the remaining only 14% is used to configure biomass protein, when the 8‰ trophic enrichment occurs on glutamic acid from diets to consumers. These values may correspond closely to the "Ten percent law" for the transfer of energy from one trophic level to the next. Thus, we conclude that the transamination is a likely process to explain the observed trophic enrichment of ^{15}N on amino acids.

[1] *Popp et al*. (2007) Stable isotopes as indicators of ecological change, pp. 173-190. [2] Chikaraishi *et al*. (2009) *Limnol. Oceanogr. Methods*. **7**, 740-750. [3] Macko *et al*. (1986) *Geochim. Cosmochim Acta* **50**, 2143-2146.

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