^{15}N-Enrichment of amino acids for studying trophic structure and energy flow in food webs

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To better understand the trophic linkages and energy flow in complex networks of ecosystems, we recently have employed compound-specific stable isotope analyis (CSIA) of amino acids as a relatively new tool. In particular, the CSIA has been used to estimate trophic position (TP) among animal species, using a following equation:

$$TP = [(\delta^{15}N_{Glu} - \delta^{15}N_{Phe} + \beta)/TEF] + 1$$

where β epresents the isotopic difference between glutamic acid and phenylalanine in aquatic algae (–3.4‰), and C3 (+8.4‰) and C4 higher plants (–0.4‰), and TEF represents trophic enrichment factor (7.6‰ = $\Delta\delta^{15}N_{Glu} - \Delta\delta^{15}N_{Phe}$) at each shift of trophic level (Chikaraishi *et al*., 2010). By using this CSIA, the estimation error on the TP has been suggested to be 0.12 unit as 1σ for aquatic (Chikaraishi *et al*., 2009) and 0.17 for terrestrial environments (Chikaraishi *et al*., 2011). Thus the CSIA of amino acids potentially reduces the uncertainty on the TP estimates compared to the traditional bulk isotope method by approximately 1/10 or more.

However, the validity of such estimates is dependent on the consistency of both β and TEF values. In the presentation, we will discuss whether the β value is universal among different producers and also whether the TEF value scales with trophic level, based on the experimental results for a number of organisms in our study and previously published literatures.

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CO_2 and advective heat fluxes in central Apennine, Italy

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Carbon dioxide Earth degassing process affecting the Apennine belt was quantified on the base of the carbon mass balance of the regional aquifers. The deeply derived CO_2 resulted in ~ 2-2.5×10^{11} mol/a that represents ~10% of the estimated present-day total CO_2 discharge from the sub aerial volcanoes of the Earth. The groundwaters enriched in CO_2 systematically display a slight temperature anomaly, which becomes significant when the differences between the water temperatures at the springs and the temperature of corresponding recharging meteoric waters are compared. These temperature differences, together with the hydrogeologic parameters of the different aquifers, have been used to compute the total amount of heat by geothermal warming which results of ~ 2.1 × 10^{9} J/s. This geothermal warming implies heat fluxes higher than 300 mW/m^2 in a large sector of the Apennines, i.e. values in average higher than those affecting the famous geothermal provinces of Tuscany and Latium. This finding is in some way surprising because so far the central Apennines is though to be a cold area. This high heat and CO2 flux opens a new vision of the Apennines belt and requires the existence, at depth, of a thermal and fluid source such as a large magmatic intrusion. Recent tomographic images of the area confirm the presence of such intrusion visible as a broad negative velocity of seismic waves. This study reveals how the investigations based on large groundwaters systems are important for a more reliable estimation of both deep CO_2 and heat fluxes in orogenes.

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