Causes of Late Pleistocene Lake Victoria water level change, derived from clumped isotopes in land snails and fresh water mollusks

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Carbonate clumped isotopes thermometry is based on the dependence of 13C-18O bond abundance (D47) on carbonate formation temperature. Most marine and fresh water biogenic carbonates agree with the D47-T calibration. The clumped isotope thermometry is particularly useful in terrestrial environments where the interpretation of carbonate d18O is limited by difficulty in estimating paleo-water composition.

Clumped isotopes - derived temperatures of land snails are generally higher than the ambient environmental temperatures, but show no evidence for disequilibrium. We attribute these higher body temperatures to eco-physiological snail adaptations. Combined with shell $\delta^{18}O$, we use these temperatures to calculate snail body water composition, that serves as a paleo-hydrological indicator.

We combine Δ_{47} and $\delta^{18}O$ in modern and fossil fresh water mollusks and land snails from Rusinga and Mfangano Islands in Lake Victoria to examine lake paleo-hydrology, testing hypotheses about the mechanism of a significant rise in lake level in Lake Victoria ~35-40 ka BP.

Outcrops of paleo-beach deposits ~18 m above the modern day lake levels indicate high water stands at ~35-40 ka BP. Such increase in lake level could be driven by local mean annual precipitation that is significantly greater than modern. However, this is inconsistent with regional climate reconstructions, suggesting that either lake level was controlled by non-climatic factors, or that local climate in the Lake Victoria basin was different than regional patterns of climate across eastern Africa. We analyze modern and fossil shells from this 18 m beach outcrop on Mfangano Island to compare with modern lake water $\delta^{18}O$ values and to calculate paleo-water compositions. We combine these results with calculated land snail body water $\delta^{18}O$ from Rusinga and Mfangano Islands, to study hydrological changes of Lake Victoria and to evaluate the relative importance of climate change and tectonics as mechanisms for the Late Pleistocene expansion of Lake Victoria.

A cold slab-mantle interface: Constraints from exceptionally well preserved lawsonite eclogites

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The area around Halilbagı in the Tavşanlı Zone, Turkey exhibits the largest known continuous unit (>5 km^2) at which lawsonite eclogite facies conditions (circa 460- 520°C and 2.2- 2.4 GPa, [1,2]) were attained and peak metamorphic assemblages preserved. Within this area, a wide range of rock types can be found, of which metamafic (lws-gla-omp-grt bearing), Mn-rich metachert (piedmontite-phe-qtz bearing), marble (with aragonite pseudomorphs) and serpentinites (with antigorite) are of particular relevance. Critical is the recent finding of rare lws-epi-chl assemblages at the direct contact between serpentinite lenses and metamafic rocks, interpreted as metasomatic blackwalls formed close to peak metamorphic conditions. This argues for an intimate mixing of mantle-derived and crust-derived components at great depths (in contrast to incorporation of nearby low pressure serpentinites during exhumation).

The exceptional preservation of those mineral assemblages (especially with lawsonite) has been a matter of discussion. Cetinkaplan et al (2008) [1] calls for cooling through continued underplating of crustal material during exhumation. The discovery of a second generation of lawsonite and glaucophane in a chlorite matrix that replaces garnet supports that model, as it confirms the assumption that on the cooling path at temperature below 400°C, lawsonite was still stable. I would like to add that the underplating of very H_2O-poor lithologies (especially cherty limestone of the Afyon Zone) [3] helped to minimize the availability of retrogressing fluids.

These findings imply that the formation of lawsonite eclogite is not only possible in the interior of a downgoing slab, but also in direct contact to the overlying mantle wedge. Therefore it can be concluded that rather low temperatures (460-520°C) are achieved at a depth of ca 70 km at the slab-mantle boundary, and this at moderate to low convergence rates (ca 2 cm/a) after less than 20 Ma of convergence [4]. This places tight constraints on any thermal model of subduction zones, ruling out several recent models predicting much higher slab-mantle temperatures at such depths.

[1] Cetinkaplan *et al*. (2008) *Lithos* **104**: 12-32. [2] Davis & Whitney (2008) *Contr Min Petrol* **156**: 217-241. [3] Candan *et al*. (2005) *Lithos* **84**: 102-124. [4] Okay *et al*. (1998) *Tectonophysics* **285**: 275-299.

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