1500 yr cyclicity during mid- Holocene in the Eastern Mediterranean

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High-resolution (~3 to 20 years) speleothems records from the Eastern Mediterranean (EM) during mid-Holocene (7.0 to 4.0 ka) reveals 4 important patterens: a) ~1500 years cyclicity; b) correlation between half a cycle and archeological time framework; c) "dogtooth" pattren representing fast ~50-100 years increase in rainfall followed by gradual drying over a longer period of ~100-500 years. The structure of these changes resembles the structure the D-O events d) rapid climate changes (RCC) lasting 20-50 years [Fig. 1]. It is not clear what controls the 1500 years cycle (Bond cycles) and the so called "D-O events" that are clearly recognized during mid-Holocene speleothems in mid latitudes, the EM.

Interestingly each half cycle is associated with cultural-technological tranzitions, suggesting that these tranzitions follow long term climate trends (~400-800 years) rather than a response to RCC. Two of the tranzitions occur at the peak of the wettest period: the tranzitions from Mid- to Late Chalcolithic and from the Early Bronze II to III at 6.55-6.45ka and 4.8-4.7ka respectively, when annual precipitation increased by up to ~30% relative to present. The end of the Chalcolithic period and the transition from Early Bronze IV to the end of the Mid Bronze age occurred after of a long drying trend at 5.7-5.6ka and at 4.2-4.05ka respectively when precipitation dropped by ~30% relative to present.

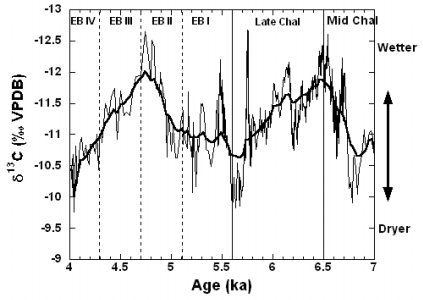

Figure 1: carbon isotopic composition showing the 1500 y cyclicity, D-O type events, RCC and the archeological time framework.

Li isotope compositions of Hawaiian post-shield lavas

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Hawaiian post-shield lavas show more depleted geochemical signatures than their shield equivalents and the difference is attributed to material in the plume source, where the very enriched trace element concentrations in post-shield lavas clearly indicate that the source material is not MORB. We investigated Li isotope compositions in a series of well-characterized post-shield samples [1] to explain the origin of these geochemical characteristics and assess the potential contribution of recycled oceanic crust in post-shield lava.

Hualalai volcano δ^7Li values range between 1.91±1.00 (2SD) and 3.53±0.53‰, Mauna Kea samples show the smallest range, 3.39±0.89 to 4.93±1.92‰, contrasting with δ^7Li from the oldest sampled volcano, Kohala, which shows the broadest range, 1.97±0.35 to 4.04±0.44‰. For comparison, a 1993 tholeiitic sample from Kilauea volcano has δ^7Li of 3.72±1.29‰, while a Koolau Makapuu sample shows a relatively heavy δ^7Li value at about 4.5‰. In contrast to other isotopic ratios (e.g., ^{208}Pb/^{204}Pb), Kilauea and Koolau do not appear to represent compositional end-members of Hawaiian compositions in the Li isotope system.

Li isotope signatures of the studied post-shield lavas tend to be 'light' relative to shield lavas (δ^7Li 3.45 to 5.7‰; Mauna Loa and Mauna Kea)[2] and correlate positively with Nd, Hf and Pb isotope signatures, and negatively with Sr isotopes, possibly defining the history of the source material.

Our results indicate that the youngest post-shield lava sampled (Hualalai) has some of the 'lightest' δ^7Li values. Hualalai Volcano also has some of the lowest radiogenic Pb ratios that may derive from ancient recycled oceanic lithosphere and sediments that have geochemically evolved in the presence of low U/Pb during subduction dehydration processes in the upper mantle. We suggest that these dehydration processes may have driven ^{7}Li off in the fluid from the residual slab resulting in an isotopically 'light' Li signature in the plume source material [3].

[1] Hanano *et al*. (2010) *Geochem. Geophys. Geosyst.* **11**, doi:10.1029/2009GC002782. [2] Chan & Frey (2003) *Geochem. Geophys. Geosyst.* **4**, doi:10.1029/2002GC000365. [3] Elliott *et al*. (2006) *Nature* **443**, 565-568.