A new calibration site for cosmogenic ^{3}He production rate in the Central Altiplano

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It is critical to refine the accuracy and precision of the *in situ* cosmogenic dating tool, especially for establishing reliable glacial chronologies that can be compared to other paleoclimatic records. Indeed, the fiability of this chronometer is highly dependent on the accuracy of the spatial and time dependent correcting factors. Potential bias are particulary important for the high altitude tropical area. There is thus a crucial need of well-dated calibration sites allowing to establish robust regional production rates.

We present here a new calibration site for cosmogenic ^{3}He that is located in the tropical Altiplano (20°S, 68°W), on the southern flank of the Tunupa volcano, in the vicinity of the Salar de Uyuni at ~3800 m. The calibration site consists in a fluvio-glacial outwash that has the remarkable characteristic to be stratigraphically bracketed by two successive lacustrine shorelines. These shorelines are well-dated by ^{14}C and U-series dating [1,2], allowing to define an absolute age of 15.1±0.3 ka for the outwash deposition. We sampled 10 andesitic boulders on this site and analyzed the cosmogenic ^{3}He contents in the pyroxenes phenocrysts. The measured ^{3}He concentrations are characterized by a very low scatter: 9 samples agree within analytical uncertainties, suggesting that pre-deposition or post-deposition processes dit not produce any detectable bias. If the nucleogenic contribution from ^{6}Li capture is lower than 2% (as measured in similar samples on the same volcano [3]), these clustered data will allow defining a new reference value for the local production rates of ^{3}He with a precision better than 5% (1σ).

[1] Sylvestre *et al*., 1999, *Quat. Res*., **51**, 54:66. [2] Placzek *et al*., 2006, *G.S.A. Bull*., **118**, 515:532. [3] Blard *et al*., 2009, *Quat. Sci. Rev*., **28**, 3414:3427.

Changes in global weathering indicated by the Ca-isotope record of Oceanic Anoxic Events 1a and 2

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Oceanic Anoxic Events (OAEs) are huge perturbations to climate that offer an opportunity to observe the response of the Earth system to large and abrupt changes in the carbon cycle. Calcium-isotope ratios ($\delta^{44/42}$Ca) were measured by MC-ICPMS in carbonate-rich sedimentary sections deposited during OAE1a (Early Aptian) and OAE2 (Cenomanian–Turonian). A negative excursion in $\delta^{44/42}$Ca of ~0.20‰ is observed in two sections spanning OAE1a from Resolution Guyot (Mid-Pacific Mountains) and Coppitella (Gargano, Italy); a negative excursion of ~0.10‰ is observed in two sections spanning OAE2 from the English Chalk (at Eastbourne and South Ferriby, UK).

These Ca-isotope excursions occur at the same stratigraphic level as the C-isotope excursions that define the anoxic events, but they do not correlate with lithological changes or evidence for carbonate dissolution in the sections. Diagenetic and temperature effects on the Ca-isotope trends are discounted, leaving changes in global seawater composition as the most probable explanation for the change in $\delta^{44/42}$Ca in the carbonate records.

An oceanic box model with coupled Sr- and Ca-isotope systems indicates that a global weathering increase is likely the dominant driver of transient excursions in Ca-isotope ratios. Contributions from hydrothermal activity and carbonate dissolution are likely to be too small and short-lived to generate the observed changes in the oceanic Ca-isotope composition. A modelled increase in weathering flux, on the order of three times the modern flux, combined with increased hydrothermal activity due to formation of the Ontong-Java Plateau (OAE1a) and Caribbean Plateau (OAE2), can produce trends in both Ca- and Sr-isotope ratios that match the signals recorded in the carbonate sections. These data are the first major-element records of a weathering response to Oceanic Anoxic Events.