Chronology of fluvial incision in the upper Ganges inferred from *in situ* cosmogenic isotopes

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Although past climatic cycles are well constrained, little is known about their effect on catchment erosion and sediment transport. For instance, what is the role of climate variability on river aggradation/degradation cycles in tectonically active settings? The Alaknanda River, one of the two major tributaries of the Ganges River, constitutes an ideal area for studying this question. From its glacial headwaters sourcing sediment from 7, 000+ meter peaks, fueled by meltwater and the summer monsoon that annually brings the river to sustained flood levels; the Alaknanda River transports a tremendous volume of sediment to the fertile floodplain and the delta of the Ganges River. Sediment transport dynamics has fluctuated in the past with episodes of fluvial aggradation and incision. Recently, Ray and Srivastava (2010) have used OSL dating to provide a chronology of the episodic formation of river terraces, showing that it occurred during two phases: between 45 and 25 ka, and between 18 and 11 ka. A detailed knowledge of fluvial incision chronology is still lacking. Cosmogenic radionuclides (CRN) ^{10}Be and ^{26}Al can be used to determine how long a bedrock surface has been exposed to cosmic rays at the Earth's surface. This can be used to quantify the timing of fluvial incision through bedrock or overlying sediments. With this aim in mind, we have collected bedrock samples along the Alaknanda River at strategic sites. Results will inform on the timing of fluvial incision in this catchment, which when combined to the chronology of river aggradation, will provide a detailed understanding of river dynamics in the lower Himalayas. By comparing these results to regional climatic records, we will be able to identify the role of climate on catchment dynamics in a tectonically active environment.

Ray & Srivastava (2010) *Quaternary Science Reviews* **29**, 2238–2260.

Regulation of atmospheric pCO$_2$ by the North Pacific Ocean since the last interglacial

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The large 80-100 ppmv variations in atmospheric $p\mathrm{CO_2}$ documented in ice-cores from Antarctica over glacial-interglacial cycles provide an essential forcing mechanism in driving the climate system. Existing research on the terrestrial biosphere as well as the low latitude and Southern Oceans are capable of explaining c. 50% of this variability when invoking mechanisms including deep water upwelling, stratification and the biological pump. Evidence is presented here, using new diatom oxygen, silicon and carbon isotope data, that changes in the strength of the North West Pacific Ocean biological pump and the regional halocline also played a key role in acting as both a net sink and source of CO_2 between MIS 5e and MIS 4.

Methods

δ^{18}O and δ^{30}Si were analysed following a combined step-wise fluorination procedure with measurements made on a Finnigan MAT 253 with an analytical reproducibility of 0.4‰ and 0.06 ‰ respectively [1]. Diatom δ^{13}C was analysed using a Costech elemental analyser linked to an Optima mass spectrometer via cold trapping with an analytical reproducibility of 0.3‰.

Results/Discussion

Whereas the regional water column is characterised by an inefficient biological pump and significant ventilation of CO_2 to the atmosphere in MIS 5e, a more efficient siliceous pump during MIS 5b-c led to a reduction in such exchanges. Both intervals culminate with increased meltwater input, establishing a stratification boundary and inhibiting further productivity as well as large scale ventilation of CO_2. Such changes would have helped drive the climate system through the MIS 5 sub-stages and into the last glacial period.

[1] Leng & Sloane (2008) *Journal of Quaternary Science* **23**, 313–319.