

Catalytic Structure of the Hammerhead Ribozyme in a Clay Mineral Environment

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The hammerhead ribozyme is an RNA molecule that performs self cleavage as part of a replicative cycle [1]. We use the enhanced sampling of replica exchange molecular dynamics (REMD) performed on petascale computers to study the folding pathway and the catalytically active structure of the full-length hammerhead ribozyme in both aqueous solution and a clay mineral environment. We simulated 100 replicas of each system producing a total of 10 μ s of fully atomistic molecular dynamics simulation. Our aim was to understand the solution structure, dynamics and mechanism of the ribozyme in order to resolve hitherto open questions related to the catalytic activity of the ribozyme including the role of metal ions in mediating the reaction and to assess the effect the mineral environment has on the catalytic activity.

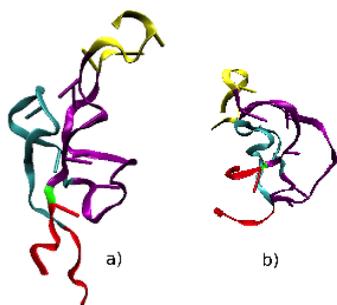


Figure 1. The dominant principal component (PC1) projected

The dominant mode of motion is a junction-bend Figure 1, which alters the availability of the catalytically competent conformations of the active site. We have characterized a set of highly populated structures that reveal a pathway to the native catalytically active site. We show how the montmorillonite clay environment significantly alters the structure and kinetics of the hammerhead ribozyme and discuss the implications this has on the RNA world [2].

[1] W. Scott *et al.* (1995) *Cell* **81**,991-1002. [2] E. Bondi *et al.* (2006) *Gene* **389**,10-18.

¹⁰Be derived catchment denudation rates from the Garhwal Himalaya

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Despite numerous Quaternary paleoclimatic reconstructions based on stable isotope records from ice core, speleothems, etc., relatively little is known about the climatic influence on terrestrial landscape processes beyond the Last Glacial Maximum (LGM). Specifically, how will changes in temperature and precipitation affect erosion rates on orbital and sub-orbital timescales? To address this question, we are measuring the concentration of *in situ* ¹⁰Be, in 15 independently dated Himalayan alluvial terrace samples[1], to quantify paleo denudation rates over the past 50ka.

Within the montane landscape of the Garhwal Himalaya, the Alaknanda River endures extreme monsoon precipitation that totals greater than 2,000mm·a⁻¹ at orographic foci. The intensity of such extreme hydrologic conditions have varied spatially and through time, which should exhibit a quantifiable effect on integrated catchment erosion rates.

This research follows in the fundamental footsteps of Bierman & Steig[2] and Schaller *et al.*[3] who first utilized ¹⁰Be in deciphering paleo-erosion rates from European terrace alluvium. Erosion rates are derived from the inherited TCR concentration integrated over the upstream catchment area and the, which incorporates time spent within the weathering profile, during transit and all other time before compete shielding. When measuring ¹⁰Be within shielded alluvium, subsequent erosion rates may be inferred from the time of burial.

By studying how catchment wide average denudation rates have varied across the LGM transition and correlating this to regional paleoclimatic records; we will be able to quantitatively assess how erosion in the the Himalayan respond to climatic variability. Thus providing geochemically derived evidence linking climatic variability with the geomorphic evolution of Himalayan landscapes.

[1] Ray & Srivastava (2010) *QSR* **29**: 1-24. [1]Bierman & Steig (1996) *ESPL* **21**, 125-139. [2]Schaller *et al.* (2004) *Geology* **112**: 127-144.