Reconstructing palaeo-hydroclimate using rice (*Oryza sativa* L.*)* grains

RITIKA KAUSHAL[1*], PROSENJIT GHOSH[1,2], ANIL K POKHARIA[3]

[1] Centre for Earth Sciences, Indian Institute of Science, Bangalore, India (*correspondence: kaushal.ritika@ymail.com; pghosh@ceas.iisc.ernet.in)
[2] Divecha Centre for Climate Change, IISc, Bangalore, India
[3] Birbal Sahni Institute of Palaeosciences, Lucknow, India Pokharia.anil@gmail.com

Variation of the Indian Summer Monsoon (ISM) in the perspective of climate change is a subject of utmost concern. In this context, it is pertinent to study the variation in palaeo-moisture conditions (rainfall and relative humidity (RH)) during ISM, over the main Indian landmass.

Rice is a water-intensive crop whose very presence in archaeological sites indicates prevalence of adequate water in the environment. It has been in cultivation over India for nearly 4600 years now, with archaeological evidences documenting its cultivation during the ISM season [1,2].

An earlier study has demonstrated the potential of isotopic ratios in rice grain organic matter (OM) to record RH levels [3]. In view of limited paleo-RH records during ISM, the present study uses stable isotopic ratios of carbon and oxygen measured in the bulk OM as well as in cellulose of well preserved rice grains, recovered from seven sites belonging to the Harappan civilisation and contemporary cultures, to provide estimates of RH and intrinsic water use efficiency (WUE_i) of the rice crop during seven time windows between 4575 and 3200 yr BP. This time frame spans the Mature and Late Harappan phase [4]. The average WUE_i of rice plants : indicator of water availability in the environment, estimated from carbon isotope ratios in bulk OM ranges between 54 to 70 μmole.mole^{-1} and the RH varies from 65% to 80%, considering samples from the entire time span. Isotopic signature in stalagmite from northeastern India [5] indicates moist condition during Mature Harappan phase, an abrupt episode of drier condition around 4200 yr BP and subsequent amelioration in two to three centuries. Our results conform with this stalagmite based climatological record. The consistency of our argument on water availability will be further verified using isotope-ratios of cellulose preserved in the archaeo-samples.

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