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Reconstructing Past Humidity Conditions Using Rice (*Oryza sativa* L.) Archive

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Variation of the Indian Summer Monsoon (ISM) in the perspective of climate change is a subject of concern given its pivotal role in sustaining the food and economic security of the Indian subcontinent. In this context, reconstruction of variation in moisture conditions (relative humidity (RH) and rainfall) associated with ISM has been carried out using tree ring archives located primarily over the Tibetan plateau [1,2]. However, limited studies have documented past variation of monsoonal RH over the main Indian landmass [3].

Here we present the potential of rice, the staple food of many ancient civilisations in Asia, to infer atmospheric moisture conditions prevalent over north-western India during 4,600 - 3500 years BP. Since rainfall associated with ISM is a crucial factor which governs rice productivity over Indian subcontinent, the rice crop is cultivated primarily during the ISM season. The sensitivity of oxygen and carbon isotope composition in the organic matter of rice and other plants ($\delta^{18}O_{OM,}\delta^{13}C_{OM}$) to RH has been studied [4,5]. Thus, the present study uses stable isotope technique to decipher paleo-RH conditions using rice grains retrieved from archaeological sites belonging to the Mature Harappan phase and Chalcolithic period. The archaeo-samples were subjected to SEM/EDAX analysis to identify the morphology and elemental composition, followed by analysis for both $\delta^{18}O_{OM}$gnd $\delta^{13}C_{OM}$after treatment for carbonateremoval.

The results obtained were compared with the observations of $\delta^{18}O_{OM}$ and $\delta^{13}C_{OM}$measured on modern day rice grains sampled across twenty three sites across India which experienced RH ranging from 67% to 89% (Kaushal and Ghosh (under review)). The study showed that decrease in RH was manifested as significant increase in $\delta^{18}O_{OM}$values together with increase in the crop's intrinsic water use efficiency, as calculated from $\delta^{13}C_{OM}$. Based on this comparison; we inferred that the regional climate during the cultivation of the archaeo-rice samples was relatively moist, as compared to the modern day.

[1] Wernicke et al., *Clim. Past* 11, 327-337, (2015); [2] Grießinger et al., *Quat. Int.* 1–8, http://dx.doi.org/10.1016/j.quaint.2016.02.011, (2016); [3] Managave et al., *Geophys. Res. Lett.*, 37, (2010); [4] Kaushal et al., *Ecol. Indic.* 61, 941-951,(2016); [5] Barbour and Farquhar, *Plant cell Environ*. 23, 473-485, (2000).