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Impact of dissolution and sedimentation rate changes on the phase estimates of the Asian summer monsoon on Milankovitch timescales

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In depth understanding of the basic forcing mechanisms of the Asian monsoon system is urgently needed in view of its potential sensitivity to global warming. One of the longstanding open questions within the study of Asian monsoon variability on Milankovitch timescales is the unusual long phase lag between reconstructed summer monsoon intensity and precession induced summer insolation maxima. This phase lag contradicts not only numerical modelling results but also straightforward physical considerations. Even more puzzling is the observation that the lag between the Asian summer monsoon and global ice-volume over the Milankovitch frequency bands is not constant through time. Such a non-stationary of either the monsoon or global ice volume would have a major impact on some widely accepted theories about Quaternary climate.

IMAGES cores from the Murray Ridge in the Northern Arabian Sea are investigated to improve constraints on phase relations for the last 800,000 years. The benthic oxygen isotope based age model reveils large changes in sedimentation rate, which ranges from less than 1cm/kyr up to 15 cm/kyr. Although the sediment core was retrieved from a water depth (2000 meters) well above the modern lysocline, interglacial periods are often affected by intense dissolution events. These events are characterized by distinct glauconite horizons and high foraminiferal fragmentation. The observed sedimentation rate changes and accompanied age model uncertainties clearly complicate interpretation of summer monsoon indicators and the accurate determination of phase lags. Earlier reconstructions of phase lags were possibly affected by those problems as well. Although spectral analysis of the organic carbon record shows a

strong 23 kyr periodicity, maxima are antiphased with precession minima in northern hemisphere summer insolation. Earlier explanations suggested that the phase of the organic carbon signal resides halfway between strong Monsoons (high biogenic productivity) and high sedimentation rates (enhanced preservation). This would imply that the organic carbon record is not a reliable proxy for changes in monsoon related upwelling. In order to find a proxy that is independent of accumulation rates and solely upwelling controlled we use differences in oxygen isotope ratios between different planktic foraminiferal species and benthic foraminifera.