Constrains on the enhanced burial of authigenic uranium in the glacial age sediments of Arabian Sea

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Enhanced burial of authigenic U in sediments requires favorable conditions that are commonly related to increase in biological productivity and/or bottom water anoxia. Sediments laid down at two sites in the southeastern Arabian Sea during the last glacial periods ($\delta^{18}O$ stages 2, 3 &4) have recorded enhanced U burial concomitant with organic carbon, which has been implicated to either mechanisms of bottom water anoxia or increase in primary productivity. Based on the detailed study of a box core recovered from the eastern flank of Carlsberg Ridge, southern Arabian Sea (4°N, 65°E, 3869 m water depth), we report here that the bottom water anoxia envisaged falls well short of its goal and is least powerful to enhance U burial in the glacial Arabian Sea.

Our results reveal a statistically significant correlation between the sedimentary records of authigenic U and $^{230}Th_{xs}$ normalized burial flux of biogenic calcite. The in phase correlation observed during the glacial periods, implies that U burial is syngenetic with the increased settling flux of planktonic detritus and thus tied to a pronounced increase in productivity. Such an increase in productivity during glacial times is implicit in the strengthening of the NE monsoon in the weak to moderate upwelling regions of the Arabian Sea. Regional comparative analysis based on the evidence of similarities suggests that by far authigenic U burial remains as a localized event confining much to the weak to moderate upwelling regions of southern and its eastward-extended Arabian Sea. The synchronicity between U burial and the strengthened NE monsoon during glacial times suggests strong biological linkage for localized U burial and argues its widespread occurrence in other sites of similar upwelling regions.

Grand Canonical Monte Carlo simulations of high T-p binary H_2-H_2O fluids

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The hydrogen-water system at high temperatures and pressures is of considerable importance for geochemistry. However, because it is difficult to measure the thermophysical properties of mixed-volatile fluids at elevated pressures and temperatures, experimental investigations of H_2-H_2O mixtures are limited in scope leading to gaps in important p-V-T-x regions [1,2]. Calculations of thermophysical properties using various equations of state depend on the reliable experimental data in complete p-V-T-x space, and consequently have limited extrapolation capabilities to the p-V-T-x regions not covered experimentally. On the contrary, molecule-based simulations can give fundamental insight into understanding the properties of the systems at a molecular level and can be used to correlate and extend the range of experimental data. For the particular system, histogram-reweighting grand canonical Monte Carlo simulations were performed in order to calculate thermophysical properties. The water molecule was represented by fixed point charge model with the Buckingham exponential-6 site on oxygen. Hydrogen was represented by one site Buckingham exponential-6 model. Lorentz-Berthelot and Kong combining rules were used to calculate phase envelope at experimentally known conditions. Kong combining rules for the unlike pair interactions were found to result in much better agreement with experimental data than Lorentz-Berthelot combining rules. p-V-T-x properties calculated at supercritical conditions agree well with the available experimental data which makes solid basis for the calculation of thermophysical properties of hydrogen-water fluids at extreme conditions.

References

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