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Facets of Proterozoic Sedimentation against the backdrop of a carbonate-siliciclastic transition: Examples from parts of the Vindhyan Supergroup, Central India

Abstract

The present thesis delves into sedimentalogical characteristics, both physical and chemical, of some parts of the Mesoproterozoic Rohtas Formation and lower part of the Kaimur Formation of the Vindhyan Supergroup in central India. Detailed state-of-art facies analysis of the aforementioned formations creates the broad frame for the present deliberation. A special emphasis has been laid on shallow water glauconitization in the epeiric sea in which the said formations were deposited. The process of chertification of the Rohtas Limestone and calculation of the then earth's surface temperature are the other two major issues that have been brought under focus. In the light of the latter a modified model of the Precambrian paleoclimate has been presented. The Rohtas Limestone Member of the Rohtas Formation is constituted by two distinct facies associations (I and II) and detail sedimentological analysis infers a restricted (Association I) to open marine (Association II) paleogeography for the limestone deposition. The basal ~12 m thick sandstone of the Kaimur Formation overlies an unconformity present above the Rohtas Limestone. The sandstone was also deposited in a tide dominated marine setting with frequent storm intervention. The Lower Quartzite (LQ) above the unconformity is claimed earlier to have been deposited in a localized area in the eastern sector of the basin. However, the present investigation carried out over a 120 km strike-parallel stretch reveals that the formation maintains the same lithological similarity refuting its local occurrences. Numerous soft-sediment deformation features present within Rohtas limestone have been analysed for their respective genesis. Adjudging their genetic implications in their respective facies (depositional) background helped to unravel their respective triggering mechanisms and to identify the triggering agents involved.

The discontinuous, but significant chert horizon present above the uppermost portion of the Rohtas limestone, just beneath the unconformity, has been studied in depth and its origin has been inferred. The then earth's surface temperature has been calculated with the help of recently developed triple oxygen isotopic studies. The present study suggests that earth's surface temperature during the Mesoproterozoic time was no different from that of the modern times (around ~25^{0}c). The result contradicts the existing claim for considerably higher contemporary earth temperature and attributes to overestimation of ancient ocean. In another way of mass balance calculation proposes a new window to estimate the paleo-temperature in

relation with chertification process and replacement model during the present endeavour. Chert form by replacement of dolostone (Rohtas Limestone) by mass change of (Tmass) of 2.12 at constant volume. Mass balance calculation of studied chert infer that initially carbonate was deposited in a marine setting at 10^0c temperature in equilibrium of modern sea where chert form at 0.8 F/R (Fluid/Rock) interaction. The triple oxygen isotope recorded within chert may be a transformation of later diagenesis of 25^0c to 300^0c fluid at F/R of 1 to 0.

An integrated sedimentological, petrographical and geochemical investigation of the LQ and the Lower Bhander Sandstone (LBS) of the Vindhyan Supergroup reveals a shallow marine sub-oxic depositional setting for the glauconite formation. The mineralogical and chemical analyses indicate enrichment of the glauconite in K_2O, MgO and Al_2O_3, and depletion in Fe_2O_3(total), compared to the Phanerozoic variety. Detailed sequence stratigraphic analysis suggests their association within transgressive systems tract (TST) deposit, which is capped by the maximum flooding zone (MFZ). The occurrence of glauconite within the LBS and LQ has been discussed at length to throw light on the glauconitization process within the overall shallow epeiric marine depositional setting. Intermittent subsidence and/or marine transgression of the depositional basin, associated with an event of major marine flooding eventually created a condition conducive for glauconitization of sediment.

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