

# Reconciling marine influences in the Eastern Siwaliks through the use of biomarkers and reconstructing the Miocene-Pliocene closure of Himalayan Foreland Basin

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The Siwalik group of rocks archives an essential part of the Himalayan foreland basin evolution. These east-west laterally extended foreland sedimentary packages were previously thought to have been deposited by fluvial alluvial fan settings. However, recent studies on ichnofossils, leaf macrofossils, pollens, and sedimentary architectures provided contradicting evidence from the Miocene-Pliocene Eastern Siwalik suggesting a depositional exclusively of marine dominated environment setting. The marine signatures suggest openness of the foreland basin to marine influences that were supposed to have closed after the retreating of Eocene sea. However, most of these signatures are qualitatively known from the Eastern Siwalik. To validate the marine influences more quantitatively, an alternate perspective, molecular-level characterization of these Eastern Siwalik sedimentary sequences has been attempted to re-evaluate the organic matter (OM) origin and paleo-depositional conditions. The *n*-alkane profiles show a bimodal distribution, with a relatively higher abundance of long-chain *n*-alkanes, Pristane/*n*-C<sub>17</sub> and Phytane/*n*-C<sub>18</sub> cross-plot, and relative abundance of C<sub>27</sub>-C<sub>28</sub>-C<sub>29</sub> steranes suggesting major OM contributions from the terrigenous source. The temporal increase in the oleanane index also demarcates an increase in contribution from higher-plants with age. Redox-sensitive parameters like Pristane/Phytane and C<sub>30</sub>-norhopane/C<sub>30</sub>-hopane ratios indicate fluctuations between highly oxic to suboxic conditions typical for the terrestrial dominated environment. Interestingly, an increased abundance of gammacerane, high regular sterane/17 $\alpha$ -hopane ratios, and high  $\delta^{13}\text{C}$  values of bulk OM during the suboxic phases suggests water-column stratification and deposition in hyper-saline/brackish water or marine conditions. Our data, therefore, indicate a mixture of the terrestrial, lacustrine and open bay/estuarine type, suggesting a fluctuating near-shore depositional condition during Siwalik deposition. Throughout the depositional period of the Eastern Siwaliks, marine influences (high C<sub>31</sub>R/C<sub>30</sub> hopane and Gammacerane index) were observed mostly during the deposition of the older deposits, which then subsided and allowed the domination of the fluvial signatures (higher Oleanane and long-chain *n*-alkane abundance) with minor marine influx during forced transgression stage. However, Late Miocene-Pliocene tectonics in the hinterland areas subsequently uplifted the foreland basin and drove back the paleo-Bay of Bengal Sea leading to complete closure of the Himalayan foreland basin and allowed the deposition of fluvial sedimentary packages.

Keywords: Hopane and Sterane, Siwaliks, Foreland Basin

