

## ISOTOPIC EVIDENCE FOR CLIMATIC, ECOLOGIC, AND FAUNAL CHANGE IN THE SIWALIKS OF PAKISTAN

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The biggest replacement of fauna in the Siwaliks of Pakistan takes place between 7.5 and 7.0 million years (Ma) ago. By 5 Ma, almost the entire fauna that existed at 8 Ma had been replaced by a different fauna. Although other important faunal changes occurred at about 13.5, 12, and 9.5 Ma those changes are small compared to that between 7.5 and 7.0 Ma. What event caused the wholesale local extinction of fauna which was replaced by another?

The stable isotopic composition of paleosol carbonate shows two important "events" in the Siwalik sequence. First, at 8 Ma a big shift in the  $\delta^{18}\text{O}$  of soil carbonate indicates that a major shift in climate occurred. We have found a similar change in Europe and East Africa in soil carbonates on those continents, suggesting a major change in global circulation patterns. The second event is a change in the isotopic composition of carbon-bearing phases which shows that the pre-7.5 Ma vegetation was dominated by  $\text{C}_3$  plants which were completely replaced by  $\text{C}_4$  plants between 7 and 6 Ma. This is most likely a replacement of woody plants by tropical ( $\text{C}_4$ ) grasses.

The carbon isotopic composition of tooth enamel from Siwalik mammals shows that prior to 7.5 Ma they consumed  $\text{C}_3$  plants, and by 5 Ma consumed only  $\text{C}_4$  plants. While it comes as no surprise that animals eat local vegetation, this study shows that isotopic reconstruction of paleo-diets can be traced back into the Tertiary.

Global climatic change in the late Miocene resulted in the invasion of tropical grasslands into the Indian subcontinent. The resulting change in habitat and diet caused the migration of many species of mammals, which is manifested as an almost complete turnover in the fauna for the Siwaliks.

