Geophysical Research Abstracts
Vol. 21, EGU2019-605, 2019
EGU General Assembly 2019

Evidence of early human induced paleofire events in Belan valley, north-central India

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Fire plays a crucial role in shaping the Earth's dynamic ecosystem and climate. Natural phenomena and human interference can equally contribute to fire events in the past, present, and future. Disentangling climate and human induced fire events can help to better understand the paleoenvironmental conditions. However, identification and reconstruction of past fire remain a major challenge before unraveling its causal factors and consequences on the landscape. Therefore, Hominin sites provide a unique platform to study the natural and human induced paleofire events to resolve the cause and impacts of fire on the landscape. Accordingly, the present study is carried out in six archaeological sites preserved in fluvial deposits with an age span of ∼100 (middle Paleolithic) to ∼3 ka BP (late Neolithic) in the Belan valley, north-central India.

To unravel the fire history, 48 paleosol samples were collected from archaeological sites of Belan River. We analyzed n-alkane and micro-charcoal of paleosol as a paleofire proxy. The carbon preference index (CPI_{25-33}) and average chain length (ACL_{15-33}) vary from 7.3 to 1.0, average at 3.3 and 29.3 to 23.0, average at 26.7 respectively. The C_{27}+C_{29}/C_{31}+C_{33} vary from 1.9 to 0.6 with an average of 0.9 which indicate the prevalence of woodlands during ∼64 to 57 ka BP in a mixed vegetation ecosystem. The distribution pattern, CPI_{25-33} and ACL_{15-33} of n-alkanes indicate the organic matter contribution mostly from terrestrial plants. However, three samples of lower CPI_{25-33} (∼1.0) and ACL_{15-33} (∼23.0) belong to the oldest archaeological site (Main Belan) suggest enhanced degradation of organic matter. Therefore, the paleosol samples with lower CPI_{25-33} were critically analyzed for $n-$alkane distribution which showed a particular predominance of mid to short-chain even-numbered carbon (maximum at n-C_{16} or n-C_{18}). Previous studies from archaeological sites with known paleofire evidence showed a similar distribution of n-alkane in paleosols (Eckmeier and Wiesenberg, 2009). Hence, to further support, micro-charcoal analyses in paleosols (n=48) were performed. The degraded paleosols exhibit higher charcoal count which confirms its exposure to burning event. The age of three paleofire events (in ka BP) were i) ∼97, ii) ∼58 and iii) ∼26. The dominance of woodland over grassland cover and humid climatic condition during these events were not favorable for wildfires. In addition, the last fire event temporarily overlaps with Mahagara and Koldihwa archaeological site. The absence of any major sign of thermal alteration of paleosols in Koldihwa and Mahagara indicate the local nature of the paleofire events. Hence, the present study postulates the presence of human induced paleofire in Belan valley.

E. Eckmeier., GLB. Wiesenberg., 2009. Short-chain n-alkanes (C_{16}-C_{20}) in ancient soil are useful molecular markers for prehistoric biomass burning. *Journal of Archaeological Science*, 36, 7, 1590-1596.