Dental hypoplasia in Siwalik Rhinos: additional information on Neogene climate of South Asia

Ghazala Roohi[1], S. Mahmood Raza[2], Muhammad Akhtar[3]

[1] Pakistan Museum of Natural History, Islamabad, Pakistan, roohi@pmnh.gov.pk
[2] Peabody Museum, Harvard University, Cambridge, MA, USA
[3] Zoology Department, University of the Punjab, Lahore, Pakistan

The developmental or usage patterns experienced by certain mammals during their growing age or later in their life often are preserved in their fossilized remains which have extensively been used in reconstructing their life-history or the habitat in which the animals lived. One such, though lesser emphasized, feature is the *enamel hypoplasia* (*hypo*-low and *plasis*-forming), which is a failure for the enamel to form properly leaving distinct linear or curved marking(s) on the teeth. *Enamel hypoplasia* (EH) is caused by environmental or physiological stresses in an animal life at that particular time when the growth was taking place. Hence, the EH analysis in a faunal accumulation have been used for providing a unique perspective into environmental conditions present during the growing years of an extinct animal's life, which indirectly reflects the climatic conditions prevailing during that period of time (for example: Franz-Odendaal, 2004; Franz-Odendaal et al., 2004). Another line of evidence used for interpreting local environment is the stable Oxygen and Carbon isotope analysis in fossilized mammalian bones (Balasse et al., 2002). For interpreting the Neogene environmental and climatic changes in South Asia, scholars have coupled the studies of microwear patterns on mammalian teeth with stable isotopes of carbon and oxygen in paleosols carbonates from the Miocene Siwalik of Pakistan (Martin et al., 2011; Morgan et al., 2009; Nelson 2007). The present study on enamel hypoplasia of Siwalik Rhinocerotids has provided another tool for not only understanding their past life-history but also reconstructing local paleoenvironment and regional paleoclimate of the region.

The Rhinocerotid dental remains collected from the entire Neogene continental sediments (colloquially termed as the Siwaliks in South Asia) exposed in the Himalayan Foreland belt in Pakistan and India were examined for this study on enamel hypoplasia. A total of 1754 Rhinocerotid teeth housed in major museums and institutes of Pakistan (Islamabad and Lahore), France (Paris and Toulouse), UK (BMNH, London) and the USA (New York, Yale and Harvard) were examined for the presence or absence of hypoplasia, if present its location on the crown, shape and measurements, eruption state and wear stage of the tooth, etc. The Siwaliks Rhino teeth studied included 34 species in which 11 species have enamel hypoplasia and represented a time period ranging from 25 Myr to about 2 Myr from a vast area extending from the Bugti Hills in central Pakistan, through Potwar Plateau and Kashmir in northern Pakistan to the Siwalik Hills in western India (Fig. 1).

The 11 species showing hypoplasia occur almost at all the intervals of the Neogene. It is difficult to directly correlate the hypoplasia occurrences with global or regional climate changes but there exists a broad relationship, which is discussed here. The Rhino species with EH are apparently more prevalent at four time periods; around 22-20 Myr, ~16 Myr, 12-8 Myr and ~2 Myr in the Pliocene. It has been argued that climate, especially seasonality with prolonged draught periods, might have been the cause of stress for these animals having hypoplasia. It would, however, bring credence to the hypothesis proposed here that climate change has caused the EH in Rhinos if other mammalian groups are also examined for the same time span. This is my next project which will examine another common Siwalik herbivore, the giraffids.

References

Balasse, M., Ambrose, S.H., Smith, A.B. and Price, T.D., 2002, The seasonal mobility model for prehistoric herders in the South-western Cape of South Africa assessed by isotopic analysis of sheep tooth enamel, Journal of Archaeological sciences, 29, 917-932.

Franz-Odendaal, T.A., 2004, Enamel hypoplasia provides insights into early systematic stress in wild and captive giraffes (Giraffa camelopardalis), Journal of Zoology, 263, 197-206.

Franz-Odendaal, T.A., Chinsamy, A. and Lee-Thorp, J., 2004, High prevalence of enamel hypoplasia in an early Pliocene giraffid (Sivatherium hendeyi) from South Africa, Journal of Vertebrate Paleontology, 24 (1), 235-244.

Cite as: Roohi, G. et al., 2014, Dental hypoplasia in Siwalik Rhinos: additional information on Neogene climate of South Asia, in Montomoli C., et al., eds., proceedings for the 29th Himalaya-Karakoram-Tibet Workshop, Lucca, Italy.

Martin, C., Bentaleb, I. and Antoine, P.–O., 2011, Pakistan mammal tooth stable isotopes show paleoclimatic and paleoenvironmental changes since the early Oligocene, Palaeogeography, Palaeoclimatology, Palaeoecology, 31, 19-29.

Morgan, M.E., Behrensmeyer, A.K., Badgley, J., Barry, J.C., Nelson, S. et al., 2009, Lateral trends in carbon isotope ratios reveal a Miocene vegetation gradient in the Siwaliks of Pakistan, Geology, 37 (2), 103-106.

Nelson, S.V., 2007, Isotopic reconstructions of habitat change surrounding the extinction of Sivapithecus, a Miocene hominoid, in the Siwalik Group of Pakistan, Palaeogeography, Palaeoclimatology, Palaeoecology, 243 (1–2), 204–222.

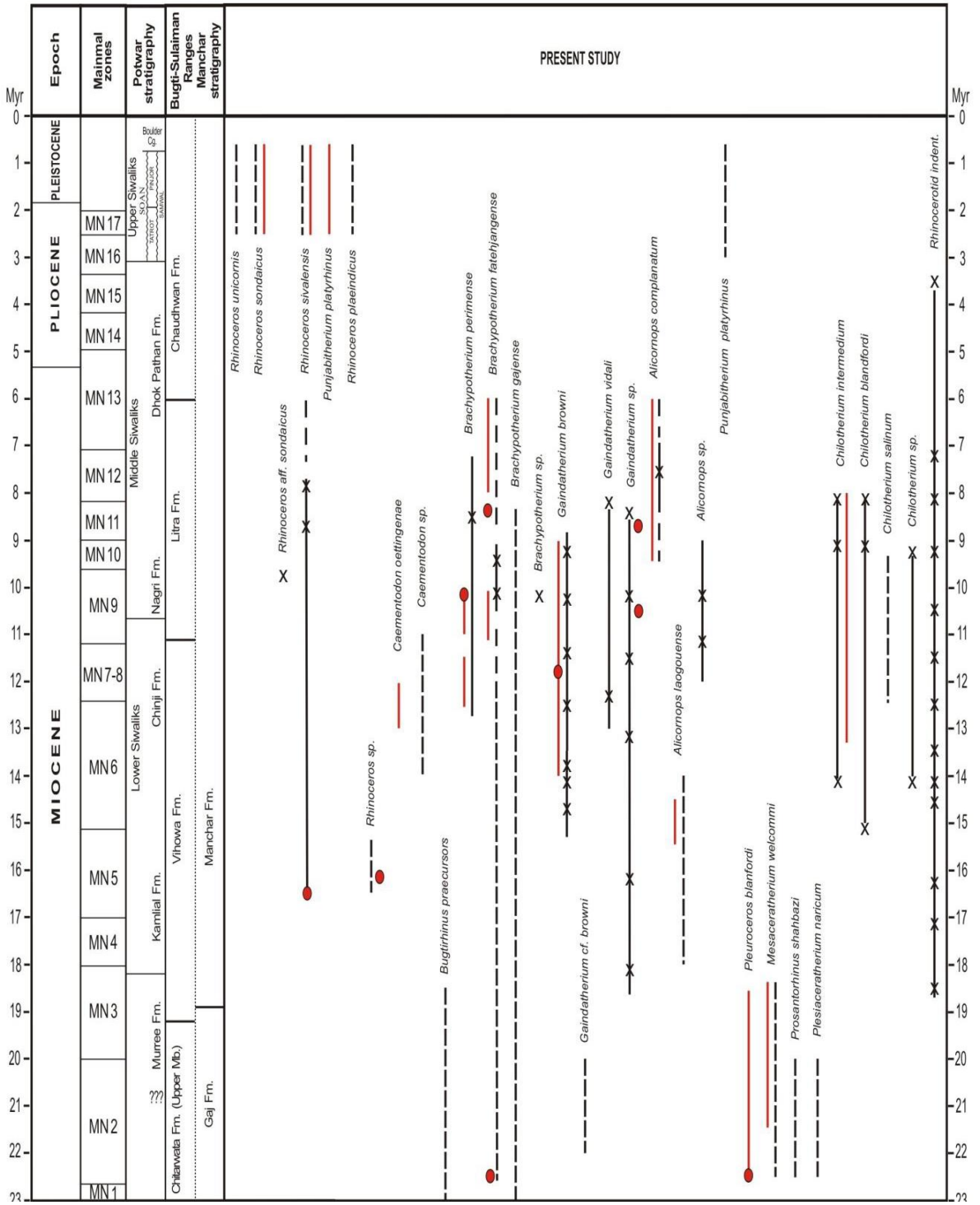

Figure 1. Ranges of 34 species in which 11 species have hypoplasia at one or more time period in their total range.