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Paleoenvironmental and paleoclimatic changes associated with the Deccan Volcanism, examples from terrestrial deposits from Central India

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Since the 80's, numerous authors have established the connection between Deccan volcanism in India and the KT events. Chenet et al (2008) showed that Deccan Traps erupted in three main phases with 6% total Deccan volume in phase-1 (base C30n), 80% in phase-2 (C29r) and 14% in phase-3 (C29n). Recent works indicate that the main phase-2 (80%) occurred over a relatively short time interval in magnetic polarity C29r, which coincides with the KTB events (Blair et al., in press, Keller et al, 2012).
The biotic evolution is well understood in marine environments, but only few data are available concerning the terrestrial environmental changes. In central India, sedimentary beds associated with the Deccan Traps are represented by infratrappean (Lameta Formation) and intertrappean sediments, which were deposited during periods of volcanic quiescence. These deposits are located at different stratigraphic levels within the basaltic pile and are therefore crucial to evaluate the changes on land induced by the onset of the volcanism. The sedimentary beds exposed in the central part of India in the Jabalpur-Mandla-Chhindwara sector (Madyha Pradesh) and in the Nand-Dongargaon basin (Maharashtra) were studied using a sedimentological, geophysical, geochemical and mineralogical approach. Our results indicate that the intertrappean sediments deposited during the Deccan volcanism do not reflect the same characteristics than the infratrappean sediments preceding the volcanic eruptions. Indeed, palynological studies of the Lameta Formation indicate a dominance of angiosperms and a rich canopy of gymnosperms (Conifers and Podocarpaceae) and an understory of palms and herbs. Moreover, sedimentological and mineralogical observations indicate alluvial-limnic environment under arid climate. The eruption of Deccan volcanic flows severely affected the environmental conditions. Intertrappean sediments associated with the three Deccan phases were deposited in terrestrial to lacustrine environments under arid climate with contrasted seasons alternating dry and humid cycles, which are highlighted by the predominance of smectites, resulting from the basalt alteration. Rockeval analyses show that organic matter is well preserved in the sediments deposited between phase-1 and 2 and reflect a mixed source of lacustrine organic matter and terrestrial inputs. In contrast, the subsequent intertrappean sediments exhibit a sharp decrease in pollen and spores coupled with the appearance of fungi, which mark increasing stress conditions apparently as a direct result of volcanic activity. The organic matter analyses indicate a strong degradation suggesting that the biomass was probably oxidized by the strong volcanic activity and acidic conditions. These intertrappean sediments, corresponding to phase-2 and phase-3 (85% of Deccan basalt emissions), are characterized by the highest alteration CIA index values. Values of mass specific magnetic susceptibility are two order lower than analogue lake sediments developed under basaltic bedrock, suggesting phenomena of iron oxides dissolution by reduction/acidity. This is probably better explained by increased acid rains due to SO_2 emissions than a global climatic shift; since clay minerals from the corresponding sediments do not reflect a significant climatic change. This increased alteration is coeval with the sharp decline in pollen and an increase in fungal spores and corresponds to the main phase of Deccan activity.