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Paleomagnetic constraints on duration of Deccan trap emplacement in an attempt to estimate their environmental impact.

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Two main causes are generally advanced for the Cretaceous-Tertiary (KT) mass extinction: impact of an extraterrestrial object or emplacement of a large flood basalt. These would have injected dust (impact) or tephra (flood basalt) and caused massive pollution, leading to environmental change. The two causes differ in terms of time-signature. Impact is quasi-instantaneous, whereas a flood basalt would have taken some 10^5 years. This has been advocated to refute the contribution of volcanic eruptions to mass extinctions (because of the time required to rebalance the climatic system). Yet, the more severe mass extinctions all coincide with emplacement of a large flood basalt. The climatic impact of a trap would be linked to the time-sequence of basalt eruptions. We attempt to estimate this in the case of the Deccan traps, with constraints provided by detailed magnetostratigraphy (geomagnetic secular variation) and alteration processes (red bole formation). We have studied 12 (chemically defined) geological formations along the Western Ghats. Altogether, we have analyzed 168 paleomagnetic sites (collected in well-exposed flows along 10 traverses around Mahabaleshwar, Nasik and Pune). Rock magnetic experiments show the presence of a single thermally stable ferrimagnetic phase (likely low-Ti titanomagnetite) in the pseudo single-domain grain-size range. Samples were analyzed, using mainly thermal demagnetization, in order to determine site-mean directions of characteristic magnetization and recover a magnetostratigraphy. Evolution of directions as a function of stratigraphic position shows a succession of distinct flows, some of them associated

within thicker lava “pulses” (based on correlated directions). Micromorphological and mineralogical analyses from intervening red boles are discussed in a companion abstract (Gérard et al). Taken together, these data indicate that the eruptive sequence was remarkably short, with a small number of discrete intense eruptive phases, without significant times of quiescence between them. Geochemical analyses of lavas from all sites allow an estimate of the amount of volcanic gases emitted during each eruption (principally SO_2). Amounts injected by a single large flow or pulse are on the same order as those generated by the single Chixculub impact. Using a climate model, we have reconstructed the volcanic forcing function (both in amplitude and time), which supports that climate change induced by the emplacement of the Deccan traps was the main agent of much of the K-T crisis.