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Some aspects of the Deccan traps history: duration of emplacement, potential environmental impact, and post-trap evolution

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The Cretaceous-Tertiary (K/T) crisis at about 65 Ma is both synchronous with emplacement of the Deccan traps in India and impact of a meteorite at Chicxulub in the Yucatan peninsula of Mexico. Both impact and volcanism are thought to potentially generate major environmental perturbations. Recent and historical eruptions showed that the environmental impact of a trap would be linked to the time-sequence of basalt eruptions, amount and composition of emitted gases.

In order to better constrain the time history of the lava pile of the Deccan traps, we analysed a detailed flow-by-flow magnetostratigraphy, looking at a high time resolution clock based on the typical time rates of the geomagnetic secular variation. Altogether, we have analyzed 168 paleomagnetic sites collected in well-exposed lava units along 10 traverses along the Western Ghats. Evolution of magnetic directions as a function of stratigraphic position shows a succession of distinct magnetic directions and packets of statistically similar magnetic directions corresponding to a succession of individual flow units and thick single eruptive events. In addition, the same magnetic directions have been observed in distinct traverses allowing to define a time marker over a large area. Then considering that the secular variation rate has not significantly changed through the past, we are able to propose that each single event was

erupted over a short time interval, possibly as short as a century or even less.

The analyses of the interflows (direct contact between lava units, thin or thick red bole formations) based on joint use of micromorphological and mineralogical analyses indicate that the eruptive sequence was remarkably short, with a small number of discrete intense eruptive phases, without significant times of quiescence between them; confirming the paleomagnetic results. Therefore, our K-Ar dating lead us to conclude that the emplacement of the whole Deccan traps lasted less than 500 kyrs, then shorter than previously thought.

Then we use geochemical analyses of lavas from all sites to estimate of the amount of volcanic gases emitted during each eruption. Among these gases, sulphur dioxide could lead to a greatest cooling, especially if the succession of pulses prevents after each sulphur emission the rebalance of the climatic system. We show that amounts injected by a single large flow or single eruptive events are on the same order as those generated by the single Chixculub impact. By consequence, the emplacement of the Deccan traps might have trigger the K/T boundary.

Finally, our paleomagnetic analysis and K-Ar dating have also allowed to point out some evidences of the post-trap tectonic evolution with the presence of normal faults, which were active after the final emplacement of the Deccan traps.