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Triggering of the largest Deccan eruptions by the Chicxulub impact: Reply

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We appreciate the comments by Dole et al. (2016), and we also appreciate their having shared these views with some of us (Richards, Renne, Sprain, and Vanderkluyzen) on a joint field trip in January 2016. We agree with some of the issues raised in the comment, but these points do not undermine our basic conclusion that the stratigraphic transition from the Lonavala Subgroup to the Wai Subgroup within the Deccan Traps represents a fundamental change in the character of Deccan volcanism, and that this change was approximately coincident with the Cretaceous-Paleogene boundary. In fact, the geomorphic features in question are now understood to be a likely consequence of this fundamental change.

Our current view is that the terraces so widely developed near the contact between the underlying Lonavala Subgroup and overlying Wai Subgroup are not the result of a disconformity (hiatus), but rather they reflect a geomorphic feature produced by a contrast in susceptibility to erosion. The dominantly multilobed compound flows of the underlying Lonavala Subgroup and subjacent Kalsubai Subgroup are likely to be more

susceptible to erosion than the dominantly massive sheet lobe flow fields of the immediately overlying Wai Subgroup, thus favoring headward erosion and steep scarps at the contact.

From evidence acquired during our January 2016 field work, as well as more thorough examination of satellite images, we now recognize that the fractures noted by Richards et al. (2015) within the Lonavala Subgroup appear not to penetrate the lowermost Wai Subgroup flows because they are only weakly eroded, in contrast to their prominent erosional development within the underlying Lonavala flows. This is observed, for example, in exposures of the Bushe (Lonavala Subgroup) and Poladpur (Wai Subgroup) Formations in the steep cliffs of the Tail Baila Valley, to the west of Pune. (Photographs of these exposures illustrating the change in erosional character of near-vertical fractures crossing the Bushe-Poladpur contact are available upon request from Richards.)

The extensive terraces at the Lonavala-Wai transition that we noted in our paper (Richards et al., 2015) were but one among several lines of evidence (geochemical, volcanological, biostratigraphic, and tectonic) that suggested to us that a major transition in the nature of Deccan volcanism had occurred across the Lonavala-Wai Subgroup transition, possibly right at the contact between the Bushe (uppermost Lonavala) and Poladpur (lowermost Wai) Formations. This led to our hypothesis that this transition and the Chicxulub impact may have occurred within a time interval of less than ~100,000 yr, suggesting a possible causal connection.

Perhaps most importantly, our subsequent geochronological work to test this hypothesis (Renne et al., 2015) showed an increase in mean magma eruption rate at the transition but no evidence for a hiatus, and also that the remarkable events at ca. 66 Ma (Cretaceous-Paleogene boundary, Chicxulub impact, Lonavala-Wai transition) likely occurred within a time interval of only ~50,000 yr, strongly supporting our hypothesis. Dole et al. (2016) had the benefit of this information, whereas Richards et al. (2015) did not.

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