When the sky fell and the swamps Spoke: the far-field stratigraphic record of Deccan volcanism

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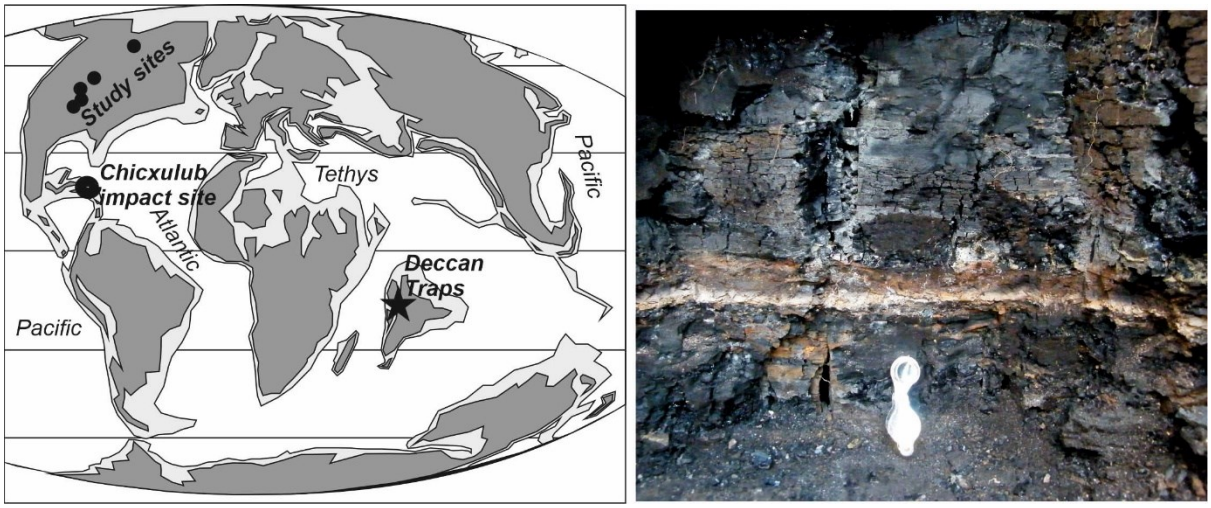
Overview

The part played by Deccan Volcanism in staging or triggering the Cretaceous-Paleogene (K-Pg) mass extinction remains contentious (e.g. Chiarenza et al., 2020). Recent high-precision radiometric dating of Deccan lavas (i.e. "near field" studies) have not yielded a consensus over whether they were erupted quasi-continuously over 1 Ma (Sprain et al., 2019), in several discrete, short-duration events (e.g. Schoene et al., 2019), nor whether the volume of lavas can be scaled to the volume of erupted gasses (Hernandez Nava et al., 2021). CO_2 outgassing from Deccan volcanism has been invoked as a trigger of hyperthermals (e.g. Schoene et al., 2019; Hull et al., 2020). Conversely, volcanic sulphate aerosols reflect incoming solar radiation and have the propensity to induce major global cooling and ecosystem disruption. However, it is unclear whether (phases of) Deccan Volcanism were stratospheric (c.f. Glaze et al., 2017; O'Connor et al., 2024) – a key requirement for global, profound cooling.

In this study, the student will reconstruct the "far field" record of Deccan Volcanism from 5-10 fossil peats (now coals) that were accumulating in the Western Interior of North America coevally with the main phases of Deccan Volcanism. Peats accumulate very steadily compared to clastic terrestrial sediments (e.g. Large and Marshall, 2015) and they derive most of their mineral nutrients from the atmosphere when they mature into ombrogenous systems (Ingram, 1983). Consequently, they are sensitive archives of atmospherically-derived (including volcanogenic) materials. The fossil peats benefit from in-situ high-precision radiometric age-dates generated by the supervisory team, and others (Renne et al., 2013; Clyde et al., 2016), the show that the peats span

These radiometric data will also tightly constrain the tempo of and duration of the record of volcanism they preserve. The student will perform sulphur isotope analyses by EA-IRMS (Stüeken et al. 2019) and possibly MC-ICPMS on extracted sulphide phases and analyse trace elements by ICP-MS in bulk sample digests. These will be used as proxies for influxes of volcanic material, providing high-resolution "far-field" (i.e. global) record of the tempo and nature of Deccan Volcanism. The results will be used to test hypotheses of the impact of Deccan volcanism by comparison with the established record of climate change at this time from the geochemical and fossil proxies.

We encourage applicants with a 2:1 or equivalent degree in an Earth or Environmental Sciences discipline. The student will be based at the School of Earth and Environmental Sciences, University of St Andrews, and integrate into a rich postgraduate research community with access to workshops on research methods and transferrable skills through the St Leonard's College. The student working on this cross-disciplinary project will gain training in isotope geochemical techniques the stratigraphy and dynamics of peatlands, the sulphur cycle, and atmospheric transport processes. The student should be prepared to undertake substantial laboratory work at world-class facilities at the School of Earth and Environmental Sciences, University of St Andrews. Study materials have already been collected, but fieldwork in North America to collect additional material from other study sites may be possible. The training will provide the basis for a future career in Earth and Environmental science, in the industrial, government or academic sectors, in a rapidly expanding research area of international societal importance.



Left, K-Pg palaeogeography, and location of some the sample sites in the Western Interior of North America, with respect to Deccan Volcanism and the Chicxulub bolide impact site. Right, detail of the lignite at one of the sampling sites - Wood Mountain Creek (Saskatchewan). The pale layer in the coal is the air-fall layer of the Chixculub impactor within. Coal below is Cretaceous and coal above is Paleocene.

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