Evidence for contemporaneous Deccan volcanic aerosol deposition preceding the K-Pg boundary at El Kef, Tunisia

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The cause of the Cretaceous-Paleogene extinction remains debated between an asteroid impact and volcanism. Precise geochronology showed that the extinction coincided with a voluminous phase (Poladpur eruption) of Deccan volcanism (Schoene et al., 2019). Paleontological evidence indicates that microfossil diversity declined about 300,000 years before the K-Pg boundary, synchronous with the onset of Deccan volcanism (Keller et al. 2009). High concentrations of Ir in the K-Pg boundary supported the asteroid hypothesis but recent work indicates that siderophile accumulation at the K-Pg in El Kef is secondary (Humayun et al., this conf.). Here, we critically examine existing element data for the K-Pg boundary and examine new results at the El Kef site, Tunisia, for volcanogenic volatile element accumulation associated with the contemporaneous Deccan eruptions. In this study, we analyzed 60 elements by laser ablation ICP-MS in search of these volcanic aerosol enrichments in the K-Pg sediments at El Kef, Tunisia. A study of siderophile element distribution at global K-Pg sites found that the Ru/Ir ratio is sub-chondritic. Mixing of upper continental crust (Ru/Ir> CI) with a chondritic impactor fails to explain this trend. Volcanic aerosol emissions for Ir are well known but there is less data available for Ru. Relative emission rates of Ru were found to be lower than those of Ir for the Kudryavy volcano (Yudovskaya et al., 2008), so a possible explanation of the sub-chondritic Ru/Ir ratio observed in global K-Pg sites involves deposition of volcanic aerosols in sediments. We also modeled the effect of adding volcanic aerosols to sediments approximated compositionally as upper continental crust (UCC) to find that Re, Cd, Os and Ir are the first elements to become enriched in sediments by volcanogenic aerosol deposition. Sediments from El Kef below the K-Pg boundary are enriched in both Re and Cd. On a plot of Cd vs. Re, the K-Pg sediment from El Kef falls on a mixing line between volcanic aerosol (Erta Ale volcano) and UCC. Sediment at 3 cm above the K-Pg boundary has little enrichment of either Cd or Re, interpreted here to indicate that this sediment was deposited in the interlude between the Poladpur and the Ambenali eruption phases of the Deccan. The availability of chemical proxies of volcanogenic aerosol deposition in sediments enables direct correlation between fossil evidence and the contemporaneous intensity of volcanic outgassing, the likely destroyer of life by the Deccan eruptions (Keller et al., 2020).