



## **Episodic Subaerial Volcanism During the Phanerozoic**

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Volcanism is often proposed as a cause for dramatic changes in the environment that lead to mass extinctions. Studies of large-scale volcanic episodes and their relationship to mass extinctions have mainly focused on Large Igneous Provinces (LIPs). While LIPs are very important, tephra preserved in sedimentary rock represent another significant record of large-scale volcanic episodes. Previous studies of tephra preserved in Neogene marine sediments have shown that volcanism is episodic over large areas of the Earth, perhaps representing global magmatic events. The Cambrian to Paleogene distribution of tephra has not been previously examined. Pre-Cenozoic tephra are difficult to identify in the field, but they have been increasingly reported in published literature because of recent advances in stratigraphy and geochronology. In this literature-based study, numbers of tephra (i.e. ash-fall beds, K-bentonites, tonsteins, tuffs, volcanoclastics) in sedimentary rocks were tallied so as to test whether global-scale subaerial volcanic episodes can be detected. Tephra have been compiled into a database that includes age, formation, location, geographic coordinates, and bed thickness. The distribution of tephra indicates globally episodic subaerial volcanism at the epoch-scale with maxima in the Late Ordovician, Pennsylvanian, and Eocene. Subaerial volcanic episodes are identified by temporally and spatially related clusters of tephra where the numbers of beds gradually increase and then decrease in frequency per unit time. Some portions of the data set are temporally resolved to the stage and biozone scales and show multiple episodes associated with specific orogenic events. This episodic nature of the tephrostratigraphic record persists when compared to outcrop exposure data. Preliminary results suggest that subaerial volcanic episodes are temporally related to global cooling episodes near the Ordovician-Silurian and Carboniferous-Permian boundary intervals; however, more age constraints are required to test these correlations. It is important to note that evidence of the subaerial volcanic episodes is preserved in the same sedimentary rocks as that for mass extinctions and environmental change. Also, the tephra in these strata represent very large eruptions that ejected voluminous amounts of ash and aerosols into the atmosphere. The numbers of tephra in the stratigraphic record may provide a measure of sustained volcanic activity. This is important because relatively continuous subaerial volcanism over millions of years and at a global scale could have serious consequences for Earth's climate.