

# **Astronomically forced global large explosive volcanic eruptions and their climatic feedbacks**

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Volcanism plays a crucial role in shaping Earth's surface system and influencing human civilization. However, the study of long-term volcanic periodicity and its climatic feedback is complicated by the uneven preservation of eruption records. By analyzing the volume of global large explosive volcanic eruption with an ejected magma volume  $\geq 0.1 \text{ km}^3$  as a proxy, our statistical investigation identifies significant periodicities of ~23, 41, and 100 thousand years, correlating with Milankovitch cycles and associated climate change. Notably, a transition from a dominant 41-kyr cycle to a 100-kyr cycle is observed across the Mid-Pleistocene Transition. The strong coherence between change rates of global mean surface temperature and volcanic eruption volumes suggests that warming during deglaciation enhances the frequency of volcanic eruptions, indirectly paced by orbital forcing. These findings imply a direct causal link between cyclical climate change and periodicity of volcanic eruptions, and demonstrate that large volcanic eruptions are more likely to occur at the onset of deglaciation, potentially contributing to positive feedback mechanisms in global warming through the release of volcanic carbon. Understanding past volcano-climate interactions is thus crucial for predicting the upcoming rhythm of volcanic activities and anticipating the long-term impacts of both natural and anthropogenic climate drivers.