

# Arc volcanism promotes lacustrine ecosystem recovery

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Multiple biological turnovers in geological history are closely linked to environmental changes caused by frequent arc volcanism. The earliest complex lacustrine ecosystem recovery after the end-Permian mass extinction is found in the Yanchang Formation of Middle Triassic, in the Ordos Basin, western North China. Extensive interbedded volcanic ash layers and organic-rich shales, as well as complete lacustrine biological chain, are found in this formation. However, it is unclear how volcanism affects ecological recovery, especially for phytoplankton, which serve as an important primary productivity of a complete food chain.

We used petrology, sedimentology and mercury (Hg) isotope geochemistry to reconstruct the origin and tectonic setting of arc volcanism, combined with palaeontological evidence to identify the impact of arc volcanism on lacustrine ecosystem recovery. Tuff elements identify the source of volcanic ash from arc volcanism in the subduction zone during the closure of the Middle Triassic Paleo-Tethys Ocean. The magnitude of arc volcanism, ash deposition patterns, and gas releases are estimated based on Hg anomalies and positive isotopic excursions. Increases in hygrophilous plants and humid palaeoclimatic conditions coincide with peaks in volcanic activities, revealing the contribution of volcanism to locally humid climates. A model of lacustrine ecosystem recovery was established. The release of large quantities of nutrients such as iron and phosphorus during frequent volcanic eruptions encourages the proliferation of planktonic algae and lower organisms such as green algae and cyanobacteria, making them dominant populations. The high primary productivity provides energy sources for organisms, such as notostracans, ostracods, and insects, which facilitate the development of high-level consumers, such as codfish. These insights contribute to the understanding of the mechanisms by which volcanism controls the environment.

