U-Pb zircon geochronology of the end-Permian mass extinction

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The age of the end-Permian mass extinction and duration of the subsequent biotic recovery are crucial for evaluating the cause of extinction. The highest achievable dating precision is necessary for assessing global synchroneity and possible links to large environmental perturbations, such as eruption of the Siberian flood basalts. New developments in the U-Pb ID-TIMS method allow for the determination of weighted mean $^{206}Pb/^{238}U$ ages of zircon from volcanic ash beds at a precision of ± 0.1% (internal error) or better. Dating at this level of precision is capable of establishing a high fidelity record of extinction, sediment accumulation rates, and rates of change of proxies for seawater chemistry.

We dated zircon from 24 volcanic ash beds in seven marine and non-marine sections in south China that record the mass extinction at the Permian-Triassic boundary, including the intensively studied Meishan and Shangsi sections. The age of the boundary, which we interpreted from six ash beds within a few meters below the boundary and four beds within 1 m above it, agrees with that obtained during a recent U-Pb zircon study at Shangsi [1] at a precision that is two times better (± 100 Kyr with internal error only and ± 400 Kyr including tracer calibration and decay constant uncertainties). The improved precision is mainly a result of significantly lower Pb procedural blanks, and it allows for the identification of grains that are younger or older than the ash bed by as little as 200-300 Kyr due to minor Pb loss or slightly older xenocrysts, respectively. Five beds are composed entirely of grains that vary over several million years; xenocrysts are more common than grains with Pb loss.

There is no apparent difference in the age of the boundary between sections, including marine and non-marine sections. At Shangsi, average sediment accumulation rates were 3-6 m/myr between 257 and 254 Ma, except when they increased to 16 m/myr from 254 to 253 Ma (immediately before the end of the Permian). At these rates, the extinction event appears to have occurred over a short time period.

The integration of high-precision geochronology with carbon isotope stratigraphy and paleontology should allow for detailed testing of oceanographic models for reorganization of the carbon cycle.

References

[1] Mundil R., Ludwig K.R., Metcalfe I., and Renne P.R. (2004) *Science* **305,** 1760-1763.