
Mercury analyses of fossil plant substrates as indicators of Early Jurassic atmospheric Hg loading and LIP volcanism

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Abstract

Past global environmental change events were commonly associated with Large Igneous Province (LIP) volcanism, however, the causal relationship between them has not been unambiguously accepted. In recent years, elevated levels of bulk sedimentary mercury concentrations across stratigraphic archives, have been commonly used as indicators of past large-scale volcanic activity, as volcanism is the largest source of natural Hg emission in the present-day environment. But this proxy is highly dependent on and impacted by variations in dominant lithology and/or depositional environment, and its usefulness is therefore debated. Furthermore, elevated Hg shuttling from terrestrial environments can obscure possible Hg loading into Earth's surficial environments.

Here, we present a new approach to reconstruct changes in past Hg-fluxes, more specifically past atmospheric Hg-concentrations, by analyzing Hg-levels in modern and fossil *Ginkgo* leaf tissue. The adoption of fossil leaf material as a past atmospheric mercury proxy is here tested as an independent approach to the validation of mercury as a proxy for past volcanism. Fossil leaves have been proven as a reliable indicator of paleo-*p*CO₂. Importantly, leaves gain their Hg-concentration dominantly through direct atmospheric uptake.

We present new results on (i) the natural variability of Hg-concentration in *Ginkgo* leaves, and (ii) the possible impacts of changes in climatic conditions on leaf-Hg-concentrations utilizing leaves that were grown during controlled growth-chamber experiments (with variable atmospheric CO₂ concentrations, humidity and atmospheric S concentrations). With this, a baseline for variability in leaf-Hg concentrations was established.

Subsequent analyses of the Hg-concentration in Early Jurassic fossil leaf-cuticle and wood fragments from two stratigraphic successions, spanning the Triassic–Jurassic transition at Asartekløft (Jameson Land, Greenland) and the Sinemurian–Toarcian interval in the Mochras core (Cardigan Bay Basin, UK), show 2–3 orders of magnitude variability in plant Hg-concentrations, significantly larger than natural plant or climatic Hg-variability observed in modern *Ginkgo* leaves. This suggests that plant tissue may be used to examine geochemical variations in past atmospheres, and thus tracing possible temporal occurrences of past volcanic events.

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Keywords: mercury (Hg), Ginkgo biloba, Large Igneous Province (LIP), direct atmospheric uptake