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Degradation of mercury (Hg) signals on incipient weathering refines use of Hg as a volcanic paleoproxy

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Perceived mercury (Hg) enrichments and elevated ratios of Hg to total organic carbon (Hg/TOC) in sedimentary rocks have often been linked to volcanism from large igneous provinces (LIPs) and mass extinctions, prompting the hypothesis that elevated Hg concentrations are a proxy for intense volcanism from LIPs. However, primary Hg and TOC contents of sedimentary rocks can be altered by secondary processes, for example, *intense* weathering [1]. Before endorsing cause-and-effect between volcanic Hg emissions and biotic crises or mass extinctions, the magnitude of measured Hg and Hg/TOC anomalies in weathered outcrop samples must be compared to equivalent units in core samples, where the outcrop sample provides, in effect, a minimum concentration value.

Here, we investigate the effects of *incipient* weathering on Hg contents and Hg/TOC ratios. We quantify the behavior of Hg during incipient weathering by determining Hg concentrations in visually pristine black shales from outcrops of the Upper Permian Ravnefjeld Formation in East Greenland, comparing these data to equivalent intervals acquired from drill core taken from a plateau 7 km from the outcrop. Directly correlative Upper Permian shales (drill core) from the mid-Norwegian shelf further enhance our comparison. Using detailed geochemistry and principal component analysis (PCA), we characterize the main host phases of Hg and relate different Hg contents from pristine samples from East Greenland and the mid-Norwegian shelf to different Hg inputs during shale deposition. Importantly, we show the vulnerability of Hg contents and Hg/TOC ratios to *incipient* weathering of fresh-appearing outcrops of organic-rich shale.

Working with drill core rather than outcrop samples is essential to circumvent the problem, and to provide accurate Hg concentration data for primary events in the paleo-record.

[1] Charbonnier, G., Adatte, T., Föllmi, K.B., and Suan, G. (2020) Effect of intense weathering and postdepositional degradation of organic matter on Hg/TOC proxy in organic-rich sediments and its implications for deep-time investigations. Geochemistry, Geophysics, Geosystems, 21(2).

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