Metal enrichments in Paleoproterozoic black shales: global or regional controls?

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The widespread occurrence of black shales between 2.1-1.9 Ga provides unequivocal evidence for enhanced productivity and organic matter accumulation, but their relationship to other global Paleoproterozoic events as well as the controlling mechanisms of their metal enrichments remain poorly established. New geochronologic results on Fennoscandian black shales and comparison with age constraints on other broadly contemporaneous organic-rich units demonstrate that Paleoproterozoic black shale depositional episodes were temporally discrete and with many linked to conditions in individual basins strongly influenced by magmatic activity.

The association of black shales with lavas and co-magmatic sills intruding the sedimentary successions raises the likelihood that metal enrichments, particularly base metals, were of magmatic/hydrothermal origin. Distinct enrichments of redox sensitive metals to levels not seen in Archean black shales can be attributed to a combination of oxidative weathering of landmasses and mobilisation of metals and consequent enhanced productivity driving changing redox conditions, including fluctuations from euxinic watercolumn conditions to (sub)oxic conditions at the seafloor. New results from the 2.0 Ga Zaonega Formation (shungites), NE Russia that will be discussed in detail show that stratigraphic trends of metal abundances are associated with lihologic changes and C isotope anomalies that are best explained by basinal/regional processes. These findings indicate that metal enrichments are significantly influenced by specific conditions in individual basins.