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Rhenium isotopic signatures in black shales spanning the past ~2.5 billion years: a potential proxy for past redox conditions

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The element rhenium (Re) has emerged as a potential proxy for understanding Earth's redox history. Although being one of the least abundant elements in Earth's crust, Re can become enriched in organic rich mudrocks (shales) in oxygen-deficient environments[1,2]. This is because its reduced form (Re^{IV}) is highly insoluble and is removed from the aqueous environment through either complexation with organic matter and/or incorporation into sulfides. Recently, mass-dependent fractionation between the ^{187}Re and ^{185}Re isotopes has been established as a signature to evaluate oxidative weathering at Earth's surface[3], with the vast majority of Re isotopic measurements having been done on weathering profiles, river water[4], and modern sea water samples[5]. These studies show loss of the heavy isotope (^{187}Re) during weathering, with a lighter signature left in the unweathered residue. However, by measuring unweathered, well preserved shale samples, the Re isotopic system also has the potential to shed light on Earth's surface redox conditions through time. We will explore first-order temporal trends in the sedimentary Re isotope record and the influence of local redox conditions by measuring the Re isotopic composition ($d^{187}Re$) in 20 black shales with ages from 2550 to 359 Ma and [Re] from 4 ng/g to 280 ng/g. These samples also range in total carbon content (TC) from 0.9 to 15.3 wt.%. The potential changes in Re isotopic composition through time may provide valuable new insight into Earth's past redox history.

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