

Early Cambrian black shale-hosted Mo-Ni and V mineralization on the rifted margin of the Yangtze Platform, China: Reconnaissance chromium isotope data

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The transgressive basal unit of the Early Cambrian black-shale sequence along the rifted margin of the southeastern Yangtze Platform hosts a wide spectrum of marine sedimentary rocks distributed over more than 1000 km length. A-few-cm thick sulfide-rich black shale units have spectacular metal tenors (Mo and Ni in the percent range, PGE + Au around 1 ppm) and consist of sub-mm-scale laminated sulfide and carbonaceous material and cm-sized pebble-like rip-up clasts of Mo-S-C compounds, pyrite, and Ni-rich polymetallic sulfides in carbonaceous and apatite-rich matrix.

The $\delta^{53/52}\text{Cr}_{\text{auth}}$ values of Mo-Ni-sulfide-rich black shale samples from the Huangjiawan mine (Guizhou province), as well as from the Sancha district (Hunan province), 400 km NE, have a mean of $0.96 \pm 0.22 \text{‰}$ ($n=8$), while V-rich black shale from both districts has a mean of $1.34 \pm 0.46 \text{‰}$ ($n=5$). These data indicate significantly positively fractionated values compared to igneous silicate Earth. The Cr isotope values of the studied shales compare with recent findings of positively fractionated $\delta^{53/52}\text{Cr}$ values in Late Neoproterozoic – Phanerozoic marine carbonates and shale/mudstones and attest for the operation of an intensified oxidative surface Cr cycle from at least around ~ 0.75 Gyr ago.

The Cr isotope data confirm earlier conclusions from Mo and Os isotopes which indicate a seawater metal source with ultimate metal supply by oxidative weathering of continental crust. The Mo-Ni-sulfide rich sediments can be regarded as the euxinic variant of the marine hydrogenous ore deposit spectrum, where ferromanganese nodules/crusts represent the oxic end-member of extreme fractionation.