Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29639

Copper and zinc isotopic compositions in Southern Ocean sediments

XIAOTONG ZHANG, YI LIU, RUOYU SUN, WANG ZHENG AND JIAXIN SUN

School of Earth System Science, Institute of Surface-Earth System Science, Tianjin University

Essential bioavailability makes Cu and Zn highly promising for marine biogeochemical cycles. Marine sediments can reveal elemental sources and cycling processes as a primary depositional medium. Most studies on sedimentary Cu and Zn isotopes have focused on continental margins[1-4], with fewer reports from open oceans such as the Southern Ocean[3, 5-6]. The Southern Ocean is key in replenishing global ocean nutrients, making it a hub for global trace elements and their isotopes[7]. In this study, we investigate the elemental and isotopic signatures of Cu and Zn in surface sediments from the Southern Ocean, covering a wide range of water depths (500m~4300m) and zones (Subantarctic Zone~Southern Zone, 49°S~77°S). The abundance and isotope data show a clear correlation with depth and latitude. Enrichment factors (normalized by PAAS) of sedimentary Cu and Zn deposited in deep waters and low latitudes are higher than in shallow waters and high latitudes. Elemental ratio estimates indicate an increasing trend in lithogenic inputs to sedimentary Cu and Zn with latitude, with sedimentary Zn dominated primarily by non-lithogenic sources (Zn_{litho}<33%), whereas sedimentary Cu exhibited a transition from predominantly non-lithogenic sources at low latitudes to lithogenic dominated sources at high latitudes. The sedimentary Zn isotope values show a negative deviation with depth and Zn enrichment (deviating from BSE value), suggesting that the input of isotopically lighter non-lithogenic Zn (such as biogenic Zn) is the key control on the sedimentary Zn isotope composition in the Southern Ocean. In contrast, the sedimentary Cu isotope values show a positive deviation with depth (approaching BSE value) but a negative deviation with latitude (deviating from BSE value). The elemental and isotopic results collectively suggest that the sedimentary Cu isotope composition in the Southern Ocean is likely determined by the complex equilibrium of addition and loss processes to the sediments (such as external inputs and benthic release).

Little et al (2016), Geology 44, 207-210; Little et al (2017), GCA 212, 253-273; Dickson (2022), CG 605, 120971; He et al (2023), GCA 343, 84-97; Maréchal et al (2000), GGG 1, 1015; Zhang et al (2024), Geology 52, 789-793; de Souza et al (2024), Oceanography 37, 46-59.