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Impact of post-depositional transformation on sedimentary rocks and implications for paleoenvironmental studies: Evidence from Mesoproterozoic (1.1 Ga) sediments from the Taoudeni basin, Mauritania

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Understanding and reconstruction of the paleo-condition dynamics linked to biological evolution in Earth history remain a big challenge because a majority of the ancient rocks have been affected by secondary modification processes, including tectonic, metamorphic, and hydrothermal activities. This study examines the influence of magmatic intrusion on sediment composition and paleo-environmental reconstruction from two drill cores (S1 and S2) drilled into the shallow-marine Mesoproterozoic (~1.1 Ga) El Mreiti Group of northeast Taoudeni Basin, Mauritania. Petrographic and mineralogical data show that the S1 drill core, intruded by dolerite sill, consists of a series of metamorphic minerals, including pyroxene, graphite, pyrrhotite, garnet, zeolite, talc, and saponite in sediments within the contact aureoles of the dolerite sill, indicating the influence of contact metamorphism and associated hydrothermal activities. The dominance of low-temperature minerals and the absence of metamorphic minerals in the S2 drill core sediments demonstrate that they are largely preserved and were only affected by high-grade diagenetic modifications. The anomalous enrichments of the Fe and redox-sensitive trace elements (RSTEs) in sediments within the vicinity of the dolerite sill coincide with increasing pyrrhotite contents, suggesting the transfer and remobilization of the RSTEs via thermal decomposition of pyrite to pyrrhotite during metamorphism and hydrothermal processes at elevated temperatures. This is supported by the absence of hematite, low Th/U ratios, and increasing Eu anomaly values in the dolerite sill and contact aureoles. This study reinforces the importance of screening and assessment of samples for post-depositional alteration effects before being used for the reconstruction of paleo-redox conditions in modern and ancient sedimentary rocks.