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Eolian Organic and Pyritiferous Siltstones as Redox Traps for Sediment-Hosted Ore Deposits

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Stratigraphic and spatial controls on organic- and pyrite-rich fine-grained sediments are critical for base metal exploration because they are both redox traps for metal-bearing fluids and a potential sulfur source for sulfide precipitation. In the modern ocean, windblown silt and clay accumulates on the seafloor together with organic matter downwind from active eolian systems adjacent to deserts and recently deglaciated landscapes. Bioessential P, Fe, and other micronutrients derived from eolian dust delivered to the surface ocean increases primary productivity and export of organic carbon to the seafloor. Authigenic pyrite may form as bacterial sulfate reduction degrades accumulating sedimentary organic matter. Such eolian derived siltstones are mineralogically immature, punctuate the stratigraphic record, and are thickest in the Neoproterozoic. When placed in a paleogeographic and sequence stratigraphic context, the deposition of Neoproterozoic organic-rich sediments peaked in the arid horse latitudes (30°N and 30°S) during interglacial periods between the low-latitude Sturtian (ca. 717-660 Ma) and Marinoan (ca. 650-635 Ma) snowball glaciations. The relationship between an extreme icehouse climate, paleogeography, black shales, graphite deposits, hydrocarbons, and thick siltstone successions is compelling evidence for nutrient mobilization to the Neoproterozoic ocean via eolian processes. The occurrence of framboidal pyrite assists with preconditioning these organic-rich sediments to reduce more effectively oxidizing metal-bearing fluids and provide a sulfur source for sulfides forming sediment-hosted ore bodies. Thus, understanding the stratigraphic and spatial distribution of wind-derived, organic-rich siltstones through time is an important exploration tool for identifying areally extensive redox traps for base metals that are correlative across and between basins.