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Seafloor Massive Sulfide Deposits: Uniformitarianism and the search for the missing big deposits

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Seafloor massive sulfide (SMS) deposits are the modern equivalent of ancient volcanogenic massive sulfide (VMS) deposits. These deposits form at sites of hydrothermal venting along submarine tectonic plate boundaries. A classification scheme has been developed for VMS deposits, linking specific mineralogical and geochemical characteristics to different tectonic settings. Modern SMS deposits can be similarly linked to specific tectonic and local geological settings based on mineralogy and bulk chemistry, providing an effective tool for linking modern submarine geological processes to interpretations of the ancient record. In addition, centuries to millennia of mining of VMS deposits on land has led to a well constrained record of typical deposit grades and tonnages. Similar resource assessment of the modern seafloor, however, have resulted in disparities in the range of size and grade of deposits, relative to the ancient record. Specifically, there has been a lack of discovery of large and high-grade deposits on the modern seafloor. If we invoke the inverse of the law of uniformitarianism ("the past is key to the present"), we should expect the ranges in size and composition of SMS and VMS deposits to be similar. The disparity could be a result of the still limited state of knowledge of SMS deposits, relative to their ancient equivalents, including exploration effectiveness and our ability to evaluate grade and tonnage at the seafloor. Alternatively, or, in addition, this disparity reflects the invalid invocation of the law of uniformitarianism, especially when comparing the modern marine geological environment to the Archean and Proterozoic marine environment, which is characterized by a different ocean chemistry and perhaps also tectonic regime. In this talk, we will compare our understanding of the formation of modern SMS and ancient VMS deposits, and explore the similarities and potential sources of differences between modern and ancient deposits. We will discuss the implications of these differences for the resource potential of SMS deposits as a new source of metals.