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Zebra Rocks – The Curse of the Precursor

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Mississippi Valley Type (MVT) ore deposits often show zebra textures consisting of millimeter to centimeter scale bands of minerals that vary in composition, association with accessories, crystal size, or a combination thereof. Commonly, it is assumed that these bands to some degree replace a precursor lithology. Although the mechanisms driving the rhythmic mineral growth have been extensively and sometimes controversially discussed, the factors controlling the initial localization of replacement remain poorly constrained. While this uncertainty is expected to the replacement obliterating the precursor, it renders prediction of the location of zebra rocks and concomitant mineralization difficult.

Salt diapirs sometimes host MVT deposits and occasionally display zebra rocks in their caprocks. We found several outcrops of well-exposed zebra limestones at the Gypsum Valley salt diapir, Colorado. While they do not display mineralization, they show a rich variety in zebra textures, as well as varying degrees of replacement in a host rock that consists of layered silty dolomudstones that are interbedded with limestones. This offers a unique opportunity to identify if there is a preferential replacement of any of those carbonate rock bands to elucidate the underlying initiation mechanisms.

Our petrographic, XRD and XRF observations of the zebra limestones reveals that replacement preferentially nucleated along preexisting heterogeneities in the carbonate host rock, such as the presence of hydrocarbons, dominance of limestone over dolostone lithology and clusters of fine grained carbonates. These features offer reactive surfaces which favor initial diagenetic replacement, highlighting the importance of precursor rock properties in controlling zebra texture development. A comparison to zebra textures from MVT deposits indicates that the insights gained from zebra limestone formation can inform how hydrothermal fluids cause localized replacement in carbonate systems that host MVT mineralization.