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The Formation of Banded Zebra Rocks, Permeability Changes and Ore Formation

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Dolomites can develop characteristic patterns of white and dark bands that form so called “Zebra” rocks. Often these patterns are mineralized and host ore deposits. How the Zebra stripes form and what effect their formation has on permeability changes within rocks is not well understood. In this contribution we study striped dolomites from the San Vicente Lead-Zink mine in Peru in order to understand how the pattern forms and how it influences the development of the ore deposit.
We analysed thin-sections under an optical microscope and the SEM in order to map the difference between the white and dark bands of dolomite. The main difference between the two is the grain size, where dark bands always contain smaller grains than white bands. This leads to a marked difference in permeability, with the large grains in the white bands containing open space and ore-filled holes. EDS mapping of Si and Al shows that the dark bands mainly contain these elements and that they are absent in the large grains. This can also be seen in thin-section where the dark bands seem to contain the main impurities. Because of the difference in grain size and impurity content we argue that the pattern forms due to a grain-growth process where grains in the white bands grow without including impurities whereas grains in the dark bands shrink and collect impurities. This in turn also influences the permeability of the system where white layers become more permeable. Lead seems to precipitate mainly in these high permeability regions in the middle of the white bands whereas Zink travels to the boundary between white and dark bands where Sphalerite precipitates. Structures of the precipitated ore minerals indicate that the dolomite dissolves while the ore minerals precipitate. We will discuss implications of our model for this specific type of ore deposits.