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Making hydrothermal Zn-Pb deposits in laboratory: role of carbonate minerals

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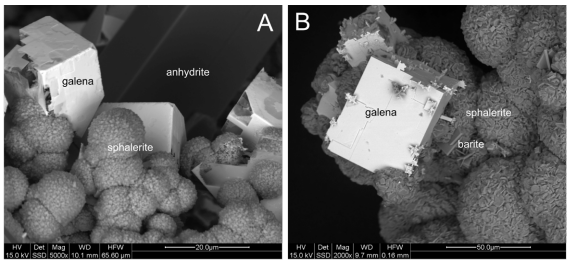

Fig. 1 Backscattered electron (BSE) images of sphalerite, galena and anhydrite (A) and sphalerite, galena and barite (B) formed by reacting metal-bearing brines with native sulfur and calcite at 200 °C and water-saturated pressure.

Sediment-hosted Zn-Pb deposits provide most of the world's Zn and Pb resources. Carbonate minerals are common in many sediment-hosed Zn-Pb deposits and have close relationship with Zn-Pb mineralisation (e.g, Spinks et al., 2021). The Zn-Pb deposits hosted in carbonate rocks are hypothesized to form by mixing acidic metal-bearing hydrothermal brines with reduced sulfur-bearing fluids, while dissolving sedimentary carbonate. To test the role of carbonate in the ore-forming process, we conducted hydrothermal experiments to react Zn±Pb±Ba-bearing brines with H_2S and SO_4^{2-} produced by native sulfur. These experiments were performed with and without carbonate minerals (calcite or dolomite crystals) at 200 °C and water-saturated pressure (Liu et al., 2021). Sphalerite, galena, barite and anhydrite crystals formed only when carbonate was present in the experiment, accompanied by carbonate dissolution (Fig. 1). The textures of sphalerite clusters are like ore texture observed in natural sphalerite from hydrothermal deposits and modern seafloor hydrothermal systems. Thermodynamic modelling at 150 and 250 °C demonstrates that mixing of metal-rich brines and H_2S causes most of the Zn in solution to precipitate as sphalerite, only when carbonate dissolution occurs to sequester H^+ ions produced by sphalerite dissolution, consistent with the experimental observations. The need for a pH buffer increases with increasing temperature, and different pH buffers may play a role for different deposit types. We propose that *carbonate-buffered fluid mixing* is a critical process to form post-sedimentary (epigenetic) Zn±Pb±Ba deposits in sedimentary carbonate rocks.

References:

Liu, W., Spinks, S.C., Glenn, M., MacRae, C. and Pearce, M.A. (2021) How carbonate dissolution facilitates sediment-hosted Zn-Pb mineralization. Geology 49, 1363-1368.

Spinks, S.C., Pearce, M.A., Liu, W., Kunzmann, M., Ryan, C.G., Moorhead, G.F., Kirkham, R., Blaikie, T., Sheldon, H.A., Schaubs, P.M. and Rickard, W.D.A. (2021) Carbonate Replacement as the Principal Ore Formation Process in the Proterozoic McArthur River (HYC) Sediment-Hosted Zn-Pb Deposit, Australia. Economic Geology 116, 693-718.