A PREDICTIVE EXPLORATION MODEL FOR METALLIC MINERALIZATION IN CENTRAL TEXAS: INSIGHTS FROM THE SOUTHEAST MISSOURI LEAD DISTRICT

Nathan Williams

ABSTRACT
Minor Pb-Zn occurrences on the flanks of the Llano Uplift in central Texas have many geologic similarities to the world-class Mississippi Valley Type (MVT) deposits of southeast Missouri. In both areas, metallic sulfides are hosted in dolomitized Cambrian carbonates and appears to be favored in areas where local basement highs forced depositional pinch-outs of the basal sandstone. In southeast Missouri, mineralization has been attributed to basinal fluid migration associated with Ouachita deformation and appears to be spatially related to regional faults that may have served as fluid conduits. In central Texas, there is also evidence that mineralization is associated with basinal fluids tied to Ouachita deformation and abundant regional faults serve as plausible fluid pathways. Moreover, southeast Missouri and central Texas are distinctly rich in Pb with respect to Zn, potentially resulting from their stratigraphic proximity to underlying granitic basement rocks. These numerous similarities suggest that a thorough understanding of spatial associations between sites of known mineralization and regional geology, geochemistry, and geophysics in southeast Missouri will be a useful guide in future exploration efforts for central Texas.

Regional datasets including geology, geochemistry, and geophysics are evaluated and ranked by the strength of their spatial association with known MVT deposits in southeast Missouri using the data-driven weights of evidence approach. Model parameters (weights) from each evidence layer are quantitatively derived from these relationships, then combined to produce probability maps that can be used to identify areas likely to contain undiscovered mineralization. Areas with multiple overlapping evidence layers have a higher probability of a deposit occurring. The southeast Missouri models are evaluated via blind testing. The best performing model predicts 88% of the test deposit locations in southeast Missouri in under 17% of the model area.

The model parameters calculated for the southeast Missouri Pb district are then applied to the Llano Uplift region of central Texas. All eight central Texas Pb-Zn occurrences fall in likelihood values that occupy less than 14% of the study area. The model results are also compared with semi-quantitative geochemical data from insoluble residues from wells throughout the Llano region and indicate that the model may be useful in explaining the measured Pb concentrations in these wells. Several new permissive areas are identified that may warrant additional follow up investigation. This work illustrates the potential utility of mineral potential modeling to identify undiscovered MVT mineralization in central Texas and suggests that a higher resolution basement structure map should be a collection priority for future exploration efforts.

Advisors: J. Richard Kyle/Brent Elliott