Trace Element Distributions in Sphalerite from the Anarraaq Zn-Pb-Ag Deposit, Red Dog, Alaska

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The Red Dog district of Alaska is a world class sediment hosted Zn-Pb district. The Anarraaq deposit lies approximately 10 km NW of the main Red Dog deposits and contains an additional 18 Mt of 23% Zn and Pb. Zinc-Lead mineralization in the Red Dog district is hosted in organic-rich mudstone which was deposited in a passive margin setting in the mid-late Mississippian.

Sphalerite is the dominant ore mineral in the Anarraaq deposit and the textural variation and trace element content of this mineral may reveal information about mineralizing processes. The Anarraaq sphalerite has been divided into 6 distinct generations based on textural variation and cross-cutting relationships. Variability in texture and color also exists within each of the 6 sphalerite stages including spherical, fibrous, bladed, and oscillatory zoned colloform banding.

Minor and trace element mapping of Fe, Cu, Ge, As, Ag, Cd, Sb, Hg, Tl, and Pb was conducted using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS). The laser was modified with an aerosol rapid introduction system (ARIS). This advanced mapping technique involved using a series of high speed laser ablated line scans combined with unconventional laser ablation operating conditions such as low laser fluence and high laser repetition rate.

The results of this technique show abundant trace element heterogeneity in the Anarraaq sphalerite. A strong agreement in spatial distribution of Fe and sphalerite color indicate that Fe was the main influence in sphalerite color variation. Additional elements such as Cd and Hg show a more complicated distribution which only sometimes conform to the Fe influenced color zonation. Many trace elements display a very fine oscillatory zonation which is also independent of the main color zoning however mimics the orientation of the color banding and this represents pulses of trace element rich phases. This application of LA-ICPMS mapping provides new information about the complexities of trace element distributions in Anarraaq sphalerite and therefore within the hydrothermal fluid which ultimately led to this world class ore deposit. Additionally, trace element distributions in sphalerite determined using this method suggests whether elements are hosted in the sphalerite itself or as microscopic mineral inclusions.

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