

Paragenesis of the Anarraaq deposit in the Red Dog Zn-Pb-Ag±Ba District, northwestern Alaska, USA

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The Anarraaq deposit is located in the Red Dog Zn-Pb-Ag±Ba District in northwestern Alaska. Anarraaq comprises a massive sulfide deposit stratigraphically overlain by a massive barite deposit. The sulfide and barite deposits are both hosted in the Mississippian Kuna Formation but are separated by approximately 60 m of carbonaceous mudstone and limestone. Observations from hand specimen and thin-section petrography, back-scattered electron (BSE) imaging, and electron probe microanalysis have been used to construct a detailed paragenesis for the Anarraaq sulfide deposit. New observations include rare examples of barite incompletely replaced by sphalerite and unequivocal petrographic evidence for a widespread, volumetrically important phase of sphalerite-bearing quartz. At least 6 phases of pyrite have been identified, ranging temporally from earliest diagenetic framboids to cubic pyrite in quartz-calcite veins interpreted to have been formed during the Cretaceous Brookian orogeny. Ore-stage pyrite is geochemically distinct from other generations of pyrite in that it is commonly enriched in lead, arsenic, and / or antimony. Lead concentrations in pyrite can range up to 3.5 wt. % and commonly form concentric zones of enrichment visible in BSE, indicating rapid fluctuation of fluid chemistry and / or conditions of crystallization. In one place, zoned ore-stage pyrite crystallized within the open space of a siliceous radiolarian, which is consistent with relatively early diagenetic timing of mineralization. Secondary ion mass spectrometry (SIMS) of sulfur isotopes in pyrite and sphalerite will be used to interpret source of sulfur and reduction processes in sulfide phases over time. Additional SIMS analyses of sulfur isotopes in remnant barite compared with replacive sphalerite will be used to evaluate the contribution of reductive dissolution of barite as a source of sulfide in the formation of the deposit.