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**Title: VMS DEPOSITS OF THE PERALKALINE-HOSTED
BONNIFIELD AND CALC-ALKALINE-HOSTED DELTA
DISTRICTS, EAST-CENTRAL ALASKA**

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Abstract: Volcanogenic massive sulfide (VMS) deposits of the Bonnifield and Delta districts occur in a belt of greenschist-facies Devonian and Mississippian volcano-plutonic complexes and associated siliciclastic and graphitic metasedimentary rocks that formed along the ancient Pacific margin of North America. The largest deposits in the Bonnifield district, Dry Creek (DC) and WTF, have a combined historical resource of 6Mt of 10% Zn, 5% Pb, 0.3% Cu, 300g/t Ag, and 1.7g/t Au. The deposits are hosted in peralkaline metarhyolite that is spatially associated with alkali metabasalt; both have within-plate geochemical signatures and elevated Nd isotopic compositions indicating an enriched mantle component and formation in an extensional setting. U-Pb zircon ages of 372 ± 3 , 363 ± 2 , and 356 ± 3 Ma for the metarhyolite suggest two periods of mineralization. VMS horizons occur both within aphanitic, siliceous metarhyolite and pyritic metamudstone, interpreted to have been deposited in a synvolcanic sedimentary basin. Textual observations suggest that magmatic-hydrothermal deposition of HFSE and REE minerals and fluorite overlapped with precipitation of submarine-hydrothermal Fe-Zn-Pb sulfides. The Anderson Mountain deposit (AM) occurs within 363 ± 2 -Ma felsic metavolcanic rocks and associated graphitic phyllite. Metarhyolite that hosts the AM is associated with rocks of intermediate to mafic composition with arc geochemical signatures.

Delta district VMS deposits have a combined inferred resource of 15Mt of 3.8% Zn, 1.7% Pb, 0.6% Cu, 62g/t Ag, and 1.7g/t Au in seven deposits, and occur in metasedimentary rocks and felsic to intermediate-composition metavolcanic rocks with arc geochemical signatures. Most deposits are associated with metarhyolite to metadacite of the Lagoon (372 ± 6 Ma) and Drum (363 ± 7 and 359 ± 6 Ma) units, separated by a barren metavolcanic unit. Base and precious metals are highest in graphitic phyllite and thin felsic interlayers in the lower Lagoon. Drum mineralization is dominantly hosted by rhyodacite-dacite and is relatively enriched in Cu and Au, up to 2.8% and 3.1 g/t, respectively.

Bonnifield and Delta rocks have similar U-Pb ages of metavolcanic host rocks and inherited Precambrian zircon cores, and a dual association of volcanic- and graphitic sediment-hosted mineralization. The occurrence of calc-alkaline (Delta and AM) and peralkaline, bimodal (DC and WTF) metavolcanic host rocks is consistent with mineralization in a paired, continental-margin arc and back-arc setting. Modern analogs are submarine back-arc basins such as the Woodlark and Manus Basins, and the Okinawa Trough, which show: 1) complexity of plate configurations and extensional domains (leaky transforms, spreading segments), 2) local occurrence of peralkaline rhyolite or other HFSE-enriched magmas, and 3) mantle upwelling, consistent with Nd isotope data and a high predicted solidus temperature for Bonnifield metarhyolite hosts, as suggested by a scarcity of zircon in some samples.