

Anatomy and Mineralogy of REE Mineralization in an Eocene Alkaline Breccia Pipe, Richmond Hill, Northern Black Hills, South Dakota

Nicolas Saintilan¹, Mike Terry², Ava Rudd¹, Jordan Faltys³, Lindsay Chasten², Bill Gehlen²

¹The University Of Alabama, Tuscaloosa, United States, ²Dakota Gold Corp., Lead, United States, ³Alabama Material Institute, Tuscaloosa, United States

The Richmond Hill (RH) gold deposit (339.4 Mt at 0.5 g/t) is located on the northwestern portion of the Lead-Deadwood dome, to the north of the main Black Hills uplift that is related to the intrusion of Tertiary igneous complexes in the waning stage of the Late Cretaceous-early Tertiary Laramide Orogeny. These igneous complexes are associated with diatremes and heterolithic breccia pipes, many of which host several significant gold and Rare Earth Elements (Au-REE) deposits (Bear Lodge deposit, WY; Richmond Hill deposit, SD). At RH, development drilling hit high grade REE mineralization (up to 12.9% total REE oxides over 1.5 m) in and around the Twin Tunnels breccia pipe within the delineated gold resource. The REE mineralization (900m², 300m deep) is hosted in a heterolithic breccia comprising clasts of trachyte with subordinate clasts of rhyolite, lamprophyre, syenite, and phyllite along a reactivated major structure between Lower Proterozoic graphitic phyllite in the East and Lower Proterozoic greenstone in the West. Textures of the “mud-looking” cement are testament of injection of hydrothermal fluids and dynamic cementation of clasts. The cement comprises REE-bearing carbonates displaying tree-ring-like concentric growth, zircon, fluorite, barite, quartz, pyrite, Fe-bearing-K-feldspars, and clays. SEM-EDX mapping reveals that the tree-ring-like texture of massive REE-carbonates corresponds to successive growth of Y-rich, La-Ce-Pr-poor, F-poor, hydroxyl(?)bastnäsite and Y-poor, La-Ce-Pr-Nd-rich, fluorobastnäsite. Where REE-carbonates are absent, La-Ce-Nd mineralization is borne by fluorite needles. Outside the breccia pipe, carbonate veins with fluorite-barite-quartz-pyrite-Fe-K-feldspar rims are common in all facies of the alkaline magmatic suite (aegirine syenite, lamprophyre, pseudoleucite porphyry, trachyte, and earlier rhyolite). REE mineralization is surrounded by a halo of fenitization comprising clinopyroxene, pyrite, K-feldspar and barite. Two pods encountered ~150m south and ~600m north of the breccia pipe comprise phlogopite-aegirine±plagioclase phenocrysts in scandium-carbonate-K-feldspar groundmass and are interpreted as rims of alkali-rich carbonatite intruding silica-rich country rocks.