

# SEG 2022 Conference: Minerals For Our Future

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## **Mantle-derived Volatile-rich Fluids Induced HREE Enrichment of Previously Differentiated Precambrian Crust to Form the Round Top Laccolith, Trans-Pecos, Texas**

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The Round Top rhyolitic laccolith hosts economic amounts of REEs, particularly HREEs, and is enriched in a variety of other critical elements and minerals. While Round Top and the greater Sierra Blanca Complex (SBC) have been heavily explored from an economic perspective, their geologic origins are poorly understood. Previous geochemical studies suggest the SBC may be the result of crustal melting of differentiated Precambrian plutons via mantle-derived F- and H<sub>2</sub>O-rich fluids. Crustal melting began towards the end of flat-slab subduction of the Farallon plate around 40Ma in the Trans-Pecos region, indicated by regional ignimbrite flareups. Slab roll-back induced inflow and circulation of hot asthenosphere beneath freshly exposed SCLM previously enriched with CO<sub>2</sub>, F<sup>-</sup>, and H<sub>2</sub>O from the under-riding oceanic Farallon plate. This influx of hot asthenosphere would have promoted heating and further metasomatism of the SCLM, generating melts and concentrating volatile-rich fluids. These fluids ascended through the lower crust, reaching the MOHO, where mafic melts and volatile-rich fluids would pond. These melts may stagnate and begin differentiation or continue upward via vertical extension-induced structures. Similarly, the volatile-rich fluids may interact with mafic melts or Precambrian crust and, in combination with ductile extension and crustal heating, form local volatile-enriched felsic melts within the MASH zone. These newly formed volatile-enriched melts could then further evolve to enrich the HSFES and LILEs via F<sup>-</sup> ligands and typical differentiation processes, and continue their ascent to the surface via previously emplaced igneous structures such as dikes and sills and or deep-seated NW-SE trending structures derived from crustal compression or extension. After several partial crystallization and eruption events, the later evolved melts erupted to form the Round Top and Little Round Top ore deposits. Regional fluorite deposits and porphyry-style Ag-Pb-Zn mineralization in Texas and Mexico may be genetically related via a deeply rooted magmatic-hydrothermal system.