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REE fluorocarbonates within rocks and emerald-bearing veins in eastern emerald belt, Colombia

Javier García Toloza^{1,2}, Andrés González¹, James Day¹, Valeria Ramirez Juya¹, Camilo Betancur¹, and Luis Angarita¹

¹Technological development Centre for the Colombian Emeralds, Bogota, Colombia (geologist@gemlabcdtec.com)

²National University of Colombia, Faculty of Sciences, Department of Geosciences

In Colombia, emerald deposits are sediment-hosted in two parallel belts (Western and Eastern Emerald Belt). Host rocks are calcareous mudstones and limestones of Lower Cretaceous age. The emerald genesis is associated to the flow and mixing of basinal and evaporate derived fluids; a process that took place in organic-rich beds, the leached and released elements like beryllium, chromium, vanadium essentials for emerald formation were present there. The mineralization is found in veins and hydrothermal breccias, frequently includes carbonates, pyrite, albite; less common minerals as: emerald, parisite, apatite, fluorite. In the host rocks is common to find trace minerals such as pyrite, rutile, and, remarkably, the REE carrier monazite. Parisite—Ca(Ce,La)(CO)F— was first and only described in Colombian emerald mines associated with sedimentary rocks. The Western Emerald Belt is the one where parisite and emerald have been found together. Nevertheless, we report the occurrence of parisite-(Ce) and synchysite-(Ce)—Ca(Ce,La)(CO)F— in Eastern Emerald Belt. Both minerals have similar Ce/La ratios. Chondrite normalized REE patterns show a relative enrichment in the light-REE and a subtle negative europium anomaly; no significant difference with authigenic monazite REE patterns was observed, thus suggesting a genetic link. The fluorocarbonates were found in emerald-bearing veins consisting of albite, dolomite, pyrite, and apatite. The mineral assemblage suggests that fluorocarbonates were formed under similar P-T conditions \approx 250-350°C and 0.8-1.2 kbar (Giuliani et al 1993; Cheilletz et al 1994; Romero et al 1999; García-Toloza et al 2017) of emerald-bearing fluids with approx. composition: Na-Ca-K-Fe-Be-Cl-F-CO-N-CH (Banks et al 2000). It is proposed that monazite-bearing black shales are the likely source for the REE, and the interaction with F-CO-rich saline hydrothermal fluids led to the dissolution of monazite and eventual precipitation of REE as fluorocarbonates in veins.