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Geochemical analysis of REE minerals and their relation with the Colombian emerald belts

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The Colombian emerald deposits are confined in both flanks of the eastern Cordillera. Those deposits are referred to as; the eastern emerald belt (EEB) and the western emerald belt (WEB). The formation conditions of the Colombian emeralds are unique in the world considering the differences in the host rock and the hydrothermal fluids. They are hosted in sedimentary rocks with a significant amount of Cr, V, and organic matter. Besides, the fluids are not linked with a magmatic source. Indeed, they are the result of basinal fluids combined with brines. Two main processes define the typical mineralization: albitization and carbonatization influencing the major crystallization of minerals like calcite, dolomite, quartz, albite, pyrite, emerald, and minor minerals as fluorite, apatite, rutile, tourmaline, and zircon.

We observed three trace minerals not typical in emerald mineralization. Those are two phosphates (Monazite and Xenotime) and a fluoro-carbonate (Parisite). To them, we make petrographic analysis to identify their paragenetic relation in the sequence, and with the use of an Electron Probe Microanalyzer in 93 samples (50 Monazites, 36 Parisites, and 7 Xenotimes), we suggest formation condition features. Those minerals determine different moments in the mineralization process. Before the mineralization, monazite crystallized in the host rock, displaying euhedral crystals with wedge shapes not correlated to detrital formation. Latter, the first stage of mineralization takes place on the rock-vein contact. Where the albitization plays an important role and the xenotime crystallized in a tabular-elongated habit. This stage is proceeding for a carbonatization phase, it is usually linked with the emerald production and the crystallization of parisite, which exhibits a subhedral shape determined by a double pyramid like a pseudo-rhombohedral habit.

The hydrothermal fluids originated from the salt diapirism in the processes of albitization and carbonatization leached and released the REE elements from the oldest part of the basin. Besides, each mineral is linked with different hydrothermal pulses, and paragenesis implying an evolution in pressure and temperature conditions.