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New Insights into the Rare Earth Element Mineralization of the Storkwitz Carbonatite, Germany

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The Storkwitz carbonatite breccia, located near Delitzsch, Germany, is one of the few European domestic rare earth elements (REE) deposits. However, it is relatively understudied owing to more than 100 m of Cenozoic sedimentary cover. We present the results of a petrological investigation of the recently acquired ~700 m-deep SES 1/2012 borehole. The Storkwitz breccia is composed of ankeritic carbonatite matrix cementing clasts of country rock and carbonatite ranging from 1 mm to ~30 cm in size. Extensive fenitization and biotitization mainly affects clasts of coarse-grained granitoids and medium-grained dolomite-calcite-carbonatites. An intersection of the breccia at 425 m to 542 m contains local REE enrichment up to ~1.7 wt.% total rare earth oxides, which is predominantly contained in a REE-fluorcarbonate bearing mineral assemblage. This mineral assemblage locally forms irregularly shaped vug-like features and rare hexagonal pseudomorphs in clasts of fine-grained ankerite-carbonatite. The REE-fluorcarbonate mineral assemblage formed prior to brecciation in the ankerite-carbonatite. This paragenetically fits with recent experimental and fluid inclusion data demonstrating the importance of late magmatic processes in forming carbonatite-hosted REE mineralization, possibly from an evolved ‘brine-melt’ phase. Our results indicate that late-stage hydrothermal or supergene processes led to minor REE recrystallization and redistribution, without resulting in significant REE enrichment in the upper part of the breccia compared to the lower part. Cross-cutting faults represent the last deformation event and post-date carbonatite intrusion and fenitization. They may represent important conduits for late-stage hydrothermal or supergene fluids, which recrystallised the breccia matrix to a cryptocrystalline oxide mineral assemblage. Our findings highlight the importance of REE enrichment in late-stage ‘brine-melt’ phases through magmatic fractionation and in situ hydrothermal replacement.