# REE mineralization during hydrothermal conditions in the Mianning-Dechang REE belt, Sichuan Province, southwestern China

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The Mianning-Dechang REE belt (Sichuan, China), hosting economical deposits (Maoniuping, Dalucao, Muluozhai and Lizhuang), provides an excellent opportunity to investigate the transport and deposition of the REE under hydrothermal conditions. REE mineralization in this belt is hosted by Cenozoic carbonatite-syenite complexes (27-12Ma, zircon U-Pb ages). Magmatic, pegmatitic, hydrothermal, and REE stages have been recognized and the magmatic stage was responsible for the formation of carbonatite-syenite complexes. The magmatic and pegmatitic stages with high temperature of > 600 °C occur minor mineralization.The hydrothermal stage is dominated by $CO_2$-bearing, solid-bearing, and aqueous inclusions that are hosted in barite, calcite, fluorite, and quartz with moderate to high temperatures (260–350 °C), wide range of salinities (9.4–47.8 wt.% NaCl), and a fluid system of NaCl–$Na_2SO_4$–$CO_2$–$H_2O$. During the REE stage, pervasive bastnäsite-(Ce) containing abundant aqueous inclusions crystallized under low temperatures (160–240 °C) and low salinities (8.8–13.1 wt.% NaCl) with a fluid system of NaCl–$H_2O$. The composition datasets show that the ore fluids are rich in $Na^+$, $K^+$, $Cl^-$, $F^-$, and $(SO_4)^{2-}$, and have low $Cl^-/(SO_4)^{2-}$ ratios (0.78–2.00), showing a marked contrast with those of granite-related REE deposits and a similarity to subcontinental lithospheric mantle. H–O isotope analyses of quartz suggest that the hydrothermal fluids had a dominantly magmatic signature and were gradually diluted by meteoric waters. Hydrothermal REE transport was probably controlled by $F^-$, $(SO_4)^{2-}$, and $Cl^-$ as complexes. Taken together, the inclusion data and observations of alteration, paragenesis and mineralization have given a coincident mechanism of REE Mineralization in REE deposits of the MD belt, i.e., fluid cooling and mixing rather than immiscibility led to the precipitation of bastnäsite-(Ce) during the waning stage of hydrothermal activity.

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