

A Metallogenic Model for REE Mineralization in Shandong Province, China

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Deposits of REEs are mainly distributed in the Luzhong uplift, Jiaolai basin, and Jiaonan orogenic belt in Shandong Province. The Chishan magmatic REE deposit is the largest of the REE deposits in Shandong Province. The development of a regional metallogenic model can help clarify the evolution processes of this REE deposit and further exploration efforts for REE deposits in the region. The Chishan REE deposit probably formed in Yanshanian based on a Rb-Sr mica date of 119 Ma. The deposit, a medium-low temperature hydrothermal type, has spatial relationship with the alkaline intrusive activity. The Chishan pluton is exposed as a NE-SW-striking stock, which is composed of syenite, quartz syenite, and aegirine quartz syenite. Ore minerals are dominated by bastnaesite-(Ce) and parisite-(Ce), with lesser monazite, thorite, uranium-rich pyrochlore, and britholite. The gangue minerals are mainly quartz, barite, fluorite, calcite, muscovite, K-feldspar, and albite. The boundaries between vein-hosted orebodies and surrounding rock are well defined and there is little alteration, but the surrounding rocks for the stockwork type orebodies are strongly altered with obvious alkaline metasomatism that includes K-feldsparization and albitization. Other altered wall-rock areas are characterized by formation of carbonate, fluorite, barite, pyrite, and chalcopyrite. Faults are the ore-controlling structures in the deposit, and they control the shape and occurrence of the orebodies. The orebodies can be divided into NW-, NE-, N-S-, and E-W-striking mineralized zones, with the NW faults and fractures hosting the main mineralization.

During the Yanshanian period, the alkaline syenite magma intruded along a deep fault zone. The REE minerals began to form in the later stages of magma evolution and then the mineralization was mainly developed at high levels during magmatic-hydrothermal events. Many of the REE minerals show evidence of weathering and are enriched in the supergene environment.