

Diversity of carbonatite-related REE deposits: The key example of the Mianning-Dechang belt

Yan Liu*

Institute of Geology, Beijing, Beijing, China, *e-mail, ly@cugb.edu.cn

More than 500 carbonatite intrusions have been found on all of Earth's continents, but giant carbonatite-related rare earth element (REE) deposits (CARDS) are rare. The REEs are essential for high-technology industries and defense systems. China hosts one-third of the world's known REE reserves and produces 97% of the global REE + Y. A wide variety of REE deposits are found in China, including CARDS that formed from REE-rich fluids exsolved from carbonatitic melts. This type of deposit is the most significant form of REE mineralization in China, accounting for approx. 65% of China's REE reserves. The known CARDS in China include Bayan Obo and deposits in the Mianning–Dechang belt. All of these deposits are located along cratonic margins and share a number of similarities. Among these giant deposits, the Mianning–Dechang REE belt contains the Maoniuping, Dalucao, Lizhaung, and Muluozhai deposits, and a dozen occurrences of REEs. The Cenozoic Mianning–Dechang REE belt in eastern Tibet and western Sichuan Province, southwest China, is 270 km long and 15 km wide. The belt contains REE deposits that all formed under the same strike-slip geological conditions and also the carbonatite-syenite complex host rocks were controlled by the same strike-slip structure. The rocks were emplaced at ca. 27-25 Ma and ca. 12-11 Ma, and their associated deposits have various grades, reserves, and REE mineralization styles. As such, the study of these variable features in the deposits with regards to REE mineralization may further our understanding of the formation of giant CARDS. The geological characteristics, formation processes, and ore types are synthesized based on previous studies and new research. Several lines of evidence help explain these similarities and differences. First, all these deposits have the same host rock and carbonatite-syenite complex source based on geological observations and Sr-Nd-Pb isotopic values for both gangue minerals and the complex. But the ratios between volumes of carbonatite and syenite differ greatly. Secondly, all these deposits exhibit magmatic, pegmatitic, and (or) hydrothermal stages, but only large or giant deposits have the pegmatitic stage. For example, this pegmatitic stage is very developed in the Dalucao and Maoniuping deposits but rare in Lizhaung and Muluozhai deposits. Thirdly, based on petrographic studies, all bastnaesite formed at the latest hydrothermal stage under similar fluid temperatures and overlapped with most gangue minerals. Finally, the most important reason responsible for the variety is the local structure. For example, ore in the Dalucao deposit is highly brecciated. In contrast, tensile fissures in Dagudao at the Maoniuping deposit contain ore-bearing veins as the main mineralization style. Finally, we integrate these data with geochemical data for the syenite–carbonatite complexes and gangue minerals in order to constrain the processes that formed these REE deposits.