Characteristics and Origin of the Li-Rich Hydrothermally Altered Granite: A New Type of Clay Li Deposit?

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Lithium (Li) is an energy-critical element due to the development of sustainable energy technologies. The discovery of new lithium resources is required to meet the growing global demand. Clay Li deposits are important Li resources (7% of the world's Li resources), commonly hosted in volcanic rocks and volcanic sediments, such as the McDermitt deposit in Nevada, USA, and the Sonora deposit in Mexico. Recently, a new type of clay Li deposit was discovered in eastern China, hosted in the hydrothermally altered Jingde granite. Li contents in the Li-rich altered granite range from 405 to 2,050 ppm with an average of 1,245 ppm. Li is structurally bound in cookeite in the Jingde Li deposit rather than hectorite and illitic clay, the main host minerals of the McDermitt and Sonora deposits. The altered mineral assemblage is cookeite + illite + kaolinite + chamosite. Calcite veins and fluorite veins are widely distributed in Li-rich altered granites, suggesting that CO_2 and F are the critical transport carriers for Li. Granodiorite and monzonite, the main rock type of the Jingde pluton, are lowly evolved and have relatively low Li contents (~50 ppm), making them unlikely to be the source of Li-rich hydrothermal fluid. It is worth noting that highly evolved aplite and pegmatite are widely distributed in the Jingde pluton. They (146.2–147.8 Ma) are contemporary with granodiorite and monzonite (147.2–149.8 Ma). As a moderately incompatible element, Li is theoretically enriched in the highly evolved granite. On the contrary, the highly evolved aplite and pegmatite are unusually depleted in Li (1–20 ppm) compared with the typical highly evolved granites (100-1000 ppm). This indicates that abundant Li has been released from the highly evolved melt during fluid exsolution. The exsolved Li-rich hydrothermal fluid from the deep, highly evolved melt is responsible for forming the Li-rich altered granite.