

Geochronology and geochemistry of two triassic A-Type granites in South China: Implication for petrogenesis and Indosinian transtensional extension

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We carried out a detailed study of LA-ICP-MS zircon U-Pb dating, major and trace element compositions, and Sr-Nd-Hf isotope geochemistry of the Caijiang granite in Jiangxi Province and the Gaoxi granite in Fujian Province, South China. Both of the Caijiang and Gaoxi granites were emplaced at Triassic with ages of about 228-230 Ma. Textural examination of the two granites reveals that biotite crystals occur along the boundary of euhedral plagioclase and quartz, which imply the primary magma could be anhydrous. The two granites have high total alkalis contents ($\text{Na}_2\text{O}+\text{K}_2\text{O}=7.81-12.15\%$), high field strength element contents (e.g. $\text{Zr}=240-458\text{ppm}$, $\text{Y}=16.8-38.0\text{ppm}$, $\text{Nb}=13.5-33.8\text{ppm}$ and $\text{Zr}+\text{Nb}+\text{Ce}+\text{Y}=382-604\text{ppm}$), Ga/Al ratios ($10000\times\text{Ga}/\text{Al}=2.41-3.53$). The Caijiang granite has relatively high ($^{87}\text{Sr}/^{86}\text{Sr}$)_i ratios (0.71288-0.72009), low $\epsilon_{\text{Nd}}(t)$ values (-9.9--9.3) and low zircon $\epsilon_{\text{Hf}}(t)$ values (peak value of -7.5). Whole-rock Nd isotopic model ages and zircon Hf isotopic model ages mostly vary from 1.65 to 1.80 Ga. The Gaoxi granite has also high ($^{87}\text{Sr}/^{86}\text{Sr}$)_i ratios (0.71252-0.71356), low $\epsilon_{\text{Nd}}(t)$ values (-13.8) and zircon $\epsilon_{\text{Hf}}(t)$ values (peak value of -12.0). Nd isotopic model ages and zircon Hf isotopic model ages mostly vary from 1.95 to 2.10 Ga. The two granites might be derived from partial melting of pre-Cambrian crustal rocks that had been granulitized during an earlier thermal event. Our study of the Caijiang and Gaoxi granites, together with previous studies on Triassic alkaline syenites (Tieshan and Yangfang) in Fujian Province and A-type granite (Wengshan) in Zhejiang Province in South China, define a wide transtensional tectonic environment in the Cathaysia Block at least lasting from 254 to 225 Ma. When combined with all the available studies for the Indosinian granites and tectonic evolutions in South China, we suggest that the formation of A-type granites was related to the local NE-trending extensional faults which were caused by collision between the South China Block and the Indochina Block or the North China Block.

CO₂ absorption and precipitation in MgCl₂-NH₃·H₂O Solutions: Relevance to CO₂ sequestration

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Mineral sequestration of CO₂ is one of the safer options in the portfolio of available CCS stratagems. To optimize the absorption of CO₂, numerous approaches, such as MEA/DEA/Ammonia based post combustion scrubbing and O₂/CO₂ recycle combustion, were tested. These methods, however, did not address the costly issue of carbon storage. Following a newly proposed pH-swing CO₂ mineralization process (Kodama, *et al.*, 2008) which showed capability of capturing and storing CO₂ simultaneously, we investigated the rate and kinetic controlling factors for CO₂ absorption and mineralization in MgCl₂-NH₃ solutions. Experiments were carried out at 298 K in solutions of different compositions (0.05-0.2molL⁻¹ MgCl₂) to measure the reaction kinetics using a wetted wall column setup similar to those reported in Pacheco (1998) and Victor (2011). Conditions were maintained where brucite precipitation was not allowed, and magnesium concentration was analyzed by ICP-AES with interval sampling. The absorption solution was then cycled between the column and a jacketed glass reactor with its pH maintained constant and the transmittance at 546 nm monitored in real-time. Preliminary results indicate that initial concentration of Mg in solution has little effect on CO₂ absorption. Although absorption rate increased slightly over time with increasing ammonia addition, pH appeared to be the dominant controlling factor. The higher the solution pH was, the faster the absorption rate increased. Upon reaching saturation, nesquehonite precipitated as indicated by the decreased laser transmittance, leading to rapid addition of aqueous ammonia. However, precipitation of nesquehonite unexpectedly showed little influence on CO₂ absorption, suggesting that the interaction between aqueous CO₂ and OH⁻ or ammonium ions in liquid film may be the rate limit step during the absorption process, further indicating that the gas-liquid interaction barrier should be treated seriously in order to optimize CO₂ capture efficiency. Due to the low gas-liquid reaction area (0.005 m²L⁻¹), extended time period (2-3 hours) was needed to dissolve enough CO₂ for nesquehonite to reach supersaturation. Measured typical absorption rates under these experimental conditions are between 0.000668 mol s⁻¹m⁻² (pH=8.74, pCO₂= 15495Pa, 298K) and 0.001997 mol s⁻¹m⁻² (pH=9.16, pCO₂= 15403Pa, 298K).