Formation of anhydrous amorphous calcium carbonate and implication for biomineralization

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Amorphous calcium carbonate (ACC) has been found as a transiently stabilized precursor in biomineralization in a variety of organisms, and is thought to play a role in the biological control over the subsequent crystallization. However, transient and stable phases of ACC differ in their structure and composition. Stable ACC contains structural water at a ratio of 1:1, while transient ACC is an anhydrous phase, and usually is in a syncytic membrane-delineated environment. Despite the fact that little is known about the formation and stabilization of biogenic ACC, it has been shown that certain macromolecules and/or other additives, such as magnesium and phosphate, may be determinant factors in the processes. To the best of our knowledge, nevertheless, no anhydrous ACC has been successfully synthesize in vitro even in the presence of the macrobiomolecules extracted from biogenic anhydrous ACC. Herein, a biomimetic mineralization process was applied to synthesize $CaCO_3$ by use of phosphatidylcholine (PC) as a model mineralization modifier. The present results show that PC is capable of inducing formation of the unusual anhydrous ACC, and the anhydrous ACC can transform into calcite with the follow-up mineralization. It implies that membrane lipid can exert significant effect on the formation and transient stabilization of anhydrous ACC bound by the membrane. Moreover, an intriguing phenomenon is that there is a large amount of ACC exclusively overlying on the surface of the secondary calcite during the subsequent mineralization. Therefore, the secondary calcite may function as an “organic-inorganic composition substrate”, facilitating ACC deposition to its surface. This finding may indicate that even though the biogenic crystalline $CaCO_3$ and ACC intimately contact each other in organism, it does not means the exclusive origin of the crystalline polymorph from ACC. In contrast, the crystalline polymorph may facilitate the formation of ACC. Our results may provide a new insight into biomineralization mechanism of $CaCO_3$.

Geochemical character and tectonic implication of the Fuling composite pluton in Southern Anhui Province

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The Fuling composite granite located in the South of Anhui Province, is one of a tungsten-bearing granites in the east of Jiangnan orogenic belt. It crops out over an area of approximatedly 145km^2. The complex intruded into Precambrian to Cambrian siliceous shale, siliceous mudstone and limestones, with NE-SW direction. The complex is composed of 4 rock unites, the earliest units consists of spotted feldspar granite, the earlier units of feldspar granite, the later porphyraceous feldspar granite, and the last fine grain feldspar granite, named Jingkanling body, Yulongchuan body, Xiaochangxi body, and Fanzhengjian body respectively. Petrochemical data show that these granites are metaluminous to peraluminous and have high-silica (SiO_2>71%), total alkalis ($Na_2O+K_2O = 5.72$ to 10.75wt.%), rare elements (total REE = 99.14 to 533.86ppm) and Fe*(FeOt/(FeOt+MgO) = 0.83 to 0.97). In trace elements, they are enriched in Rb, Th, U, Zr, Hf and depleted in Ba, Sr, and Ti. Compared to the Xiaochangxi pluton and Fanzhengjian pluton, the Jingkanling pluton and Yulongchuan plutons are more depleted in Nb,Ta. $(La/Yb)_N$ ratios of the late granite unit lower than the early, average value is 11.93, 7.84, 5.15, 6.92 respectively. New LA-ICPMS zircon U-Pb dating suggests that the crystallization age of the Yulongchuan body is 127Ma, belonging to late Yanshan periods. Isotopically, Fangzhengjian granite has negative $\varepsilon_{Nd}(t)$(-5.5~ -5.91), and T_{2DM} values is between 1.35Ga to 1.4Ga. Petrographic, elemental and Sr-Nd isotopic characteristics indicate that the pluton belongs to an A_2 type granite. Fuling granite intrusion is enlongated in a NE-SW orientation, which is consistant with the distribution of regional Late Yanshanian granites in the coastal area and is parallel to the NE trending Jixi fault. A-type granites generally form in extensional tectonic environments regardless of the origin of the magma source. Combined with other A-type granites in the NE Yangtze Block, it can be concluded that Fuling A-type granite was derived by partial melting of metasediments in the back-arc extension environment, trigged by the subduction of the Pacific plate.