Effect of model organic macromolecules on calcite mineralization and implication for biomineralization

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Crystal morphology control is one of the hallmarks of biomineralization. Organisms can employ some of functional macromolecules to produce crystals with one special mineral type and a uniform morphology at the particular tissue sites. The control biomacromolecules associated with biogenic calcite are commonly an array of extracellular proteins, which are characteristically acidic and usually glycosylated in nature. At present, a general consensus is polyanionic macromolecules, such as proteins, induce nucleation of special polymorph and control unique morphogenesis of biogenic calcium carbonate with their carboxylate groups. Herein, a model organic macromolecule with massive –C-O-C- groups was used to influence crystallization and growth of calcium carbonate. Such model additive can mimic some nonionized functional groups, such as glycosidic group in glycosylated proteins associated with biomineralization. Indeed, the elongated calcite prisms, which are similar to the calcite spine of sea urchin or the calcite prisms in mollusk shell in shape, could be obtained by mimetic mineralization with the model additive. Another intriguing result in current experimental conditions is that model additive also initially induces and stabilizes an otherwise unstable amorphous calcium carbonate (ACC) phase notwithstanding the stabilization is transient and the unstable ACC eventually transforms into stable prismatic mesocrystals of calcite, displaying all of features of $CaCO_3$ biomineralization. In fact, the formation of biominerals from an amorphous precursor phase is a common phenomenon in biomineralization, and the elongated calcite within the mollusk shell prisms and sea urchin spines is a key feature of biomineralization, our results may provide another pathway towards a full insight into biomineralization mechanism.

Molybdenum isotope and geochemical evidence for palaeoenvironmental change at the Ordovician-Silurian boundary, South China

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Molybdenum isotopic composition from the Ordovician–Silurian transitional graptolite-bearing black shale intervals, the upper Wufeng Formation and the lower Lungmachi Formation in West Hubei on the Yangtze block of South China have distinctive ranges of $\delta^{98/95}$Mo values, respectively, whereas a prominent more similar and positive $\delta^{98/95}Mo$ values occurs in the interval of the lower Lungmachi Formation, with $\delta^{98/95}Mo$ values up to about +0.79~+1.21‰, more positively than that of the upper Wufeng Formation, approach to $\delta^{98/95}Mo$ for the anoxic conditions. This seems to indicate that a long of the anoxic conditions presented after the interval of the extinction boundary due to the possibility of the rise of sea-level in the lower Lungmachi Formation, caused by the melting of ice sheets on the Gondwana ice cap, and pushing an already poorly oxygenated ocean over a threshold into an anoxic state. The upper Wufeng Formation have a slightly positively $\delta^{98/95}$Mo signature (exception of a maximum of +2.14‰ in $\delta^{98/95}$Mo at the -50cm of the boundary), it is likely related to the physical disturbance, such as strong upwelling setting and glacial-interglacial transitions occurs multiple times during late Ordovician period.

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