Formation of amorphous silica with distinct morphologies and implication for biosilification

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Biosilica displays many kinds of intricate patterns that are constructed on a nanometer-to-micrometer scale. At the nanoscale, for example, it involves the polymerization products of silica apparently mediated by the interactions between different biomolecules with special functional groups. An emerging consensus is that organic amines (e.g., long chain polyamines), proteins, and polysaccharides are general organic components in diatom's cell walls, and are responsible for the formation of hierarchical silicious structures. Another basic fact in biosilicification is that the silica formation occurs within a specialized compartment known as the silica deposition vesicle (SDV), whose membrane, called the silicalemma, consists of a typical lipid bilayer. Several researches have revealed that the membrane-bound SDV could provide not only spatial constraints but also possibly distinct chemical influences for the polymerization and morphogenesis of the silica. Nevertheless, there are few publications illuminating the interactions between amines and lipids in biosilicification. Herein, dodecylamine (DA) and phospholipid (PL) were selected as model organic additives to influence the precipitation of silica in biomimetic silicification. The results show that increasing PL concentrations leads to the formation of siliceous elongated structures, and the localized enlargement is also clearly observed during the further growth of the elongated structures, displaying some features of silica biomineralization at the earliest recognizable stage of biosilica development in diatom. Moreover, a series of NH_3-PL experiments reveal that no elongated structures can be obtained in the presence of PL, suggesting that the cooperative interactions between PL and DA molecules cause the silica structures to be elongated. Based on the special importance of both organic amines and phospholipid membranes (e.g., silicalemma) for biosilicification, our results may provide a novel pathway towards a deeper insight into the biosilicification mechanism.

Source characteristics of a high-K to ultrapotassic volcanic rock zone in NE China:A typical EMI signature from an orogenic belt

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As a common sense by previous global study, the enriched mantle end-member, i.e. EMI in continental region has been always attributed to craton-related subcontinental lithosphere (eg. Zindler and Hart, 1982, Hofmann, 2003). Based on updated isotopic geochemical survey, we report a case study on high-potassic to ultra-potassic volcanic rock zone in NE China, which shows a typical EMI source geochemical characteristics and located near the east end of East-Central Asian orogenic belt.

The systematic Sr-Nd-Pb-Hf isotopic composition, along with REE and spider diagram patterns of ultra-potassic volcanic rocks, mostly are leucitite, do show a typical EMI end-member signature, not only for entire Phanerozoic mantle-derived rocks in eastern China, but also on global scale, such as compare with those from Lucite Hill and Smoky Butte, North America, and lamproites in Aldan Shield, Far East Russia (eg. Davies et al., 2006). In addition, a sires of metasomatic minerals, such as phlogopite, apatite and so on have been recognized from mantle-derived xenoliths of these host rocks. Detailed mineralogical and geochemical studies have demonstrated the multiple and distinct mantle metasomatism, occurred in different geological time, from ancient one (Archearn) to recent one. Furthmore, the regular geological occurance, NW trending, of these potassic volcanic rocks, accompanied with tectonic rifting, seismic activities and geothermal anomaly would provide severe and further geological and geophysical constraints on the origin of such enriched mantle source beneath an orogenic belt.

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