Ordered chain of nanomagnetite: Implication for magnetosome mineralization

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Magnetotactic bacteria (MTB) are a diverse group of microorganisms that have the ability to use geomagnetic fields for orienting with the help of magnetosomes, nano-sized magnetite crystals enveloped by a lipid bilayer membrane. Because of the distinctive properties of magnetosomes and their chain-like alignments, MTB and their biomineralization have intensively been investigated in diverse disciplines from geomicrobiology to biotechnology. Several studies suggest that specific proteins, such as Mms6, MamK, and MamJ, may be directly involved in biomagnetite formation and their assembly into chains. Our experiments in the absence of bio- or organic-macromolecules show that an ordered arrangement of nanomagnetite crystals similar to the magnetosome chains can be obtained through a inorganic synthetic method at low temperature. XRD, Micro-Raman, SEM, and HRTEM indicate that the ordered chains are self-assembled by roughly cuboidal nanomagnetite crystals, and the cuboidal nanoparticles in the chains are connected, face to face, with {100} or {111} facets. Therefore, a magnetic dipole-dipole interaction mechanism is proposed for the formation of magnetite chains. This implies that in MTB, except for some specific proteins, the dipole-dipole interactions may also contribute to the organization of magnetosomes into chains. It appears that biological genetic and crystallochemical factors may synergistically operate in the formation of magnetosome chain in MTB. In addition, our experimental results show that a weak alkalic environment (pH = 8.0) is essential to form cuboidal nano-magnetite that is similar to the morphology of magnetosome magnetite found in some MTB. This suggests that in the membrane vesicles a favorable pH to the growth of cubiodal crystals should be close to 8.0. Therefore, membrane vesicles in MTB not only furnish specific proteins to direct the nucleation and growth of mineral phase, but also function as an incubator of magnetic crystals by supporting a suitable alkali environment. These results may contribute to deepen understanding of the entire circumstance of magnetosome formation and chain assembly and to improved knowledge of functions of magnetoreceptive organelles in vivo.

SHRIMP zircon U-Pb dating and geochemical characteristics of the Guiken pluton, south China: Implication for early Mesozoic tectonic evolution

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Guiken pluton is located at the boundary area of Jiangxi, Fujian and Guangdong Provinces as a batholith, in broad north-south stretching, with an total area of ca. 700km^2. Zircon U-Pb ages and geochemistry of Guiken are reported here to decipher the early Mesozoic tectonic evolution.

The granite batholith were emplaced at 220.4±3.2Ma, belonging to Indosinian periods. It mainly consists of medium-coarse grained biotite granite. It exhibits metaluminous and peraluminous characteristics, in major element compositions (A/CNK=1.03 to 1.29), enriched in SiO_2 (from 70.55% to 76.55%), total alkali (K_2O+Na_2O from 6.9% to 9.8%), and has high FeO*/MgO ratios (3.24 ~ 7.94). In trace elements, it has high LILE (such as Rb, Th, U, Zr, Y)and LREE and depleted in HREE and HFSE. It has significant negative Eu anomalies and depletion of Ba, Sr, Nb~Ta, P, Ti in primitive mantle normalized spiderdiagrams. Isotopically, it has high initial Sr ratios (from 0.710~0.726) and pronounced negative εNd(t) (from -8.6 to -10.2), and T_{2DM} values is between 1.60Ga to 2.03Ga.

In comparison with related geology, petrology and geochronology of granites in adjacent regions [1-3], it can be concluded that Guiken pluton belongs to the crust-source S-type granite formed by partial melting of Proterozoic meta-greywacke in post-collisional stage after the major collision of Indosinian Movement in Indo-China Peninsula.

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