Geochemical and petrological evidence for dehydration melting in ultrahigh-pressure metamorphic rocks during exhumation

YONG-FEI ZHENG*, Z.-F. ZHAI AND Q.-X. XIA

School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China
(*correspondence: yfzheng@ustc.edu.cn)

The important possibility of generating hydrous melt or/and supercritical fluid phase in deep continental subduction zones is increasingly being examined. Although some degree of dehydration melting was suggested in some of ultrahigh-pressure (UHP) metamorphic rocks, it is not easy to demonstrate its occurrence because of extensive retrograde reaction and reequilibration of mineral assemglages during exhumation. We report here geochemical and petrological evidence for partial melting of Triassic UHP metamorphic rocks in the Dabie-Sulu orogenic belt, China. Breakdown of phengitic muscovite during the initial exhumation is considered to be responsible for the melting, resulting in observed variations in lithochemistry.

Two continuous core segments of about 3 m length from the Chinese Continental Scientific Drilling (CCSD) main hole in the Sulu orogen show large variations in the abundance of such elements as SiO_2, LREE and LILE at the contact between high-T/UHP eclogite and granitic gneiss. This provides insight into melt-induced element mobility between different slab components. The presence of partial melts is corroborated by petrographic observations: (1) occurrence of biotite + plagioclase coronas around phengite in some samples of eclogite and gneiss, indicating melt generation by phengite breakdown; (2) aggregate of granitic minerals such as quartz, feldspar and biotite in some gneisses, suggesting the presence of hydrous granitic melt; (3) occurrence of felsic vein in some eclogites and gneisses, which may represent melt channelway.

Some low-T/UHP granitic gneiss in the Dabie orogen exhibits extremely low contents of FeO + MgO + TiO_2 (1.04 to 2.08 wt%), high SiO_2 contents of 75.33 to 78.23 wt%, and high total alkali (Na_2O + K_2O) contents (7.52 to 8.92 wt%). They are comparable with compositions predicted from partial melting of felsic rocks by experimental studies. Petrographic observations also provide evidence for the presence of partial melts: (1) breakdown of phengitic muscovite to biotite plus melt quartz, and (2) felsic veins of fine-grain minerals occurs locally between coarse-grain minerals. The local accumulation of felsic minerals suggests microscale transport of granitic melts relative to the host rocks. Nevertheless, the partial melts did not escape from the host gneiss, resulting in a kind of metatexite migmatites.

Hierarchically organized aragonite rods and implication for biomineralization

G.-T. ZHOU[1]*, Q.-Z. YAO[2], J. NI[1] AND G. JIN[2]

[1]CAS Kay Laboratory of Crust–Mantle Materials and Environments, School of Earth and Space Sciences, University of Science and Technology, Hefei 230026, P. R. China (*correspondence: gtzhou@ustc.edu.cn)
[2]School of Chemistry and Materials, University of Science and Technology, Hefei 230026, P. R. China

Highly oriented aragonite tablets have been found in the nacre layers of molluscan shell and mother of pearl. Several theories have been advanced to explain the biofabrication of this architecture, including (1) crystallization within preformed organic matrix compartments, (2) episodic secretion and subsequent crystallization, layer by layer, of interlamellar organic sheets and mineral crystals, (3) termination of crystal growth by poisoning or heteroepitaxial capping, followed by heteroepitaxial nucleation of the next crystal layer, and (4) the mineral bridge model that explained the formation of aragonite tablets in a nacre layer. Our experiments show that in the absence of any bio- or organic- macromolecules highly organized aragonite rods can be formed over a broad range of pH values at the temperatures of 95 to 70 °C. FESEM results reveal that the mesoscale aragonite rods are not only assembled with aragonite microrods by end-to-end, and side-to-side, but also partially fused one another, forming flat faceted surfaces, i.e. mesocrystal structure. Similar assembly process also occurs for the mineral strontianite of aragonite group and the room-temperature precipitated aragonite, revealing a general self-assembly process occurring. The driving force controlling the self-assembly process may originate from the inherent anisotropic dipole-dipole interactions between the assembled units. Such dipole interaction may generally occur in biomineralization of nacre layers in molluscan shell and mother of pearl, and orchestrate aragonite nanocrystals in an aragonite tablet to coherently orient and array, further leading to the common crystallographic *a, b, c* orientations of the aragonite tablets in the same nacreous column. Therefore, our experimental results may offer an improved insight into biomineralization mechanisms. It appears that the biological genetic and crystallochemical factors may synergistically operate in biomineralization.