Strains of *Clostridium* sp. induce formation of carbonate minerals

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Large amounts of natural sediments and bacterial experiments have evidenced that microorganism in nature might be very important in formation of carbonate minerals. In order to study the mechanism of bacterially induced formation of carbonate minerals, a series of culture experiments using Lagoa Vermelha medium with 6:1 molar Mg/Ca ratio within 55 days at 28℃ and starting pH=7.5 was made under the mediation of two stains of *Clostridium* sp., which were isolated from the Nanjing suburb soil (named MH18 strain) and from the Qinghai Lake sediment in NW China (named SN-1 strain), respectively. At the same time, the aseptic experiments were carried out as control.

In the mediation experiments with strains, the morphologies of formed carbonate minerals were various, including club-shaped, dumbbell-like, spherical, rhombohedral and irregular. However, in the sterile experiments, only the rhombohedral minerals appeared. We propose that this morphological variation might be related with different nucleation sites and with different growth stages. At the initial stage, the microbe-generated organic acid with low molecular weight and extracellular polymer substance (EPS) could only affect the microenvironment surrounding the bacteria bodies. The carbonate crystals might be nucleated and grew on the cell surfaces of the bacteria, and the rod-like minerals with a morphology closely analogous to bacterial shape were formed. Afterwards, these "clubs" gradually developed to dumbbells, as well as spheres. However, in the EPS, the carbonate could be nucleated and grew with an irregular shape. Along with the longer reaction times, deamination of bacteria resulted in rising pH values of the whole medium. Consequently, carbonate super-saturation and homogeneous nucleation took place locally. Finally, the carbonate crystals were formed with a rhombohedral shape.

It is usually considered that the high-magnesium environment is favourable for formation of aragonite, but not for calcite. At the same time, the monohydrocalcite is a thermodynamically unstable mineral. Nevertheless, our study results showed that high-magnesian calcite and monohydrocalcite were dominant minerals in our experiments by using MH18 and SN-1 strains.

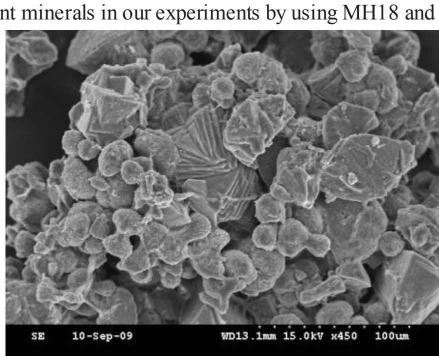

Figure 1 SEM images of carbonate minerals with different morphologies at the 55-th day by using SN-1 strain

Geochemical signatures of Tibetan dust

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Asian dust is one of the major components of global dust inventory. Provenance identification of Asian dust is helpful for understanding the paleo-environmental implications of the eolian deposits such as the loess on Chinese Loess Plateau, the pelagic sediments in North Pacific, and the dust in Greenland ice cores. Geochemical methods are effective ways to trace the provenance of eolian dust. Previous source tracing of Asian dust using geochemical methods mainly focus on the arid lands in North China and the neighboring Mongolia as the major potential source regions. However, recent studies indicate that Tibetan Plateau is probably an important source region of Asian dust. Tibetan dust, which only needs to be uplifted by 1-2 Km, could be carried into westerly jet and thus enable a long-distance transportation. The northern Tibetan Plateau, especially the arid lands in Qaidam Basin, is also probably an important source region of the loess on Chinese Loess Plateau. This study will systematically investigate the geochemical compositions of the surface materials on Tibetan Plateau, hoping to find out the geochemical signatures of Tibetan dust. Through comparing the geochemical compositions, this study will also confirm the possible contribution of Tibetan dust to the loess on Chinese loess, the pelagic sediments in North Pacific, and the dust in Greenland ice cores.