Apatitic micronodules in Namibian shelf sediments: Mineralized microbes or diagenetic precipitates?

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Modern phosphogenesis in upwelling shelf areas is thought to be strongly influenced by microbial processes. Sulphur bacteria inhabiting modern shelfs act as bacterial "pumps" leading to the increased concentration of phosphate in sediment pore water [1] and the precipitation of the Ca-phosphate mineral apatite. Apatite precipitation is significantly enhanced in certain environmental conditions, e.g. in the presence of suitable nucleation substrates, such as organic matrices and bacterial ultrastructures [2].

Microstructures of phosphatic grains from modern Namibian shelf sediments were examined using scanning electron microscopy. The grains are mainly composed of massive Ca-phosphate containing some microscale pores in which conspicuous apatitic cylindrical particles were revealed along with framboidal pyrite aggregates. Such particles co-occur with biofilm and measure around 1 μm in length and 0.3 μm in diameter. They possess consistent shapes and sizes and are composed of small nanocrystallites aligned along the long axis. Superficially, they strongly resemble mineralized microbial cells. However, some morphological characteristics are not typical of microbes – many of the particles intersect, usually at angles close to 60 and 45 degrees, which may be the result of recrystallization. However, it is important to note that similar aggregates have been previously described from authigenic calcite and phosphorites [3] as well as in phosphate aggregates produced in laboratory experiments [4] forming at relatively high supersaturation levels.

Our findings indicate that precaution must be taken while assessing the microbial origin of authigenic precipitates. Nevertheless, the common association of apatitic particles with organic matrices is consistent with the influence of biological processes on phosphate availability and precipitation.

[1] Schulz & Schulz (2005) *Science* **307**, 416-418. [2] Benzerara *et al*. (2004) *Earth Planet Sc. Lett*. **228**, 439-449. [3] Föllmi *et al*. (2005) *Geol. Soc. Am. Bull*. **117**, 589-619. [4] Ruan *et al*. (2013) *Acta Biomater*. **9**, 7289-7297.