Self-assembly of nanocrystallites into non-crystallographic morphologies (and the problem of primitive life detection)

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The existence of a sharp boundary dividing the realm of biology and sensuality and the realm of the geology (as inorganic materials) and cold reason has pervaded the landscape of arts and philosophy for centuries. Crystals and crystallographic theories have played an important role in the intellectual construction of that proposed boundary. However, bizarre as it might seem, purely inorganic processes may yield self-assembled complex materials that –like those produced by living organisms- are not controlled by crystallographic symmetry. I will present in this lecture a synthetic type of material that share with life complexity, morphology, hierarchy and self-organization yet it is remarkably simple in chemical terms (see Figure). Because of their morphological properties, they were named "silica biomorphs". The synthesis is very simple, requiring only a source of carbonate ions (e.g. atmospheric CO2), strong alkaline aqueous solutions, silica and alkaline-earth cations (Ba and Sr, Ca) at room temperature. Under these alkaline conditions, the precipitation of alkaline-earth carbonates (witherite, strontianite or calcite/aragonite) coupled with silica interactions yields crystal aggregates made of millions of nanocrystals exhibiting self-assembled non-crystallographic morphologies (*J.M. García-Ruiz. Geology 26 (1998) 843-846*). These morphologies are highly reminiscent of the shape of primitive organisms, but the precipitate are clearly inorganic in origin and form without involvement of biological compounds or living organisms (*J.M. García-Ruiz, et al., Science 302 (2003) 1194-1197*). I will introduce the formation, morphological behaviour and textural arrangement of these complex self-organized crystal aggregates and their relevance on primitive life detection studies.