The multiple structures of vaterite

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Vaterite ($CaCO_3$) is a metastable polymorph that plays a fundamental role in the nucleation and crystal growth of calcium carbonate under biogenic conditions. In particular, the nucleation of vaterite is often observed from amorphous calcium carbonate precursors, with biomolecules acting as structural stabilizers [1,2].

Because of the role of vaterite in biomineralization, the nature of its disordered structure has been object of intense debate for several decades, leading to a multitude of different structural models [3,4,5]. Through first principles calculations, a link between the most recent models proposed in the literature has been established [6]. This new model, consisting of multiple structures, is in agreement with all of the current experimental evidence. The disorder of vaterite is here interpreted in terms of different orientations of the carbonate anions, different stacking sequences of the carbonate layers, and possible chiral forms. Hence, vaterite should be considered as a combination of different forms exhibiting similar average properties, rather than a single "disordered" structure. Furthermore, chirality represents a new and important direction for future investigation that may influence which of the possible vaterite structures is obtained.

More generally, a wide variety of structures exhibiting minor structural and energetic differences might exist in nature, as a result of nucleation in different environments and at different conditions, which might promote the formation of a particular stacking sequence or chirality.

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Comparison of trace metal bioaccumulation potential in the three different ocean's zones

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An estimation of the trace metal' accumulation potential (TMAP) of the biological communities based on the integrated median average content of metals and average biomass of the dominated organisms was proposed [Demina, 2011]. A comparison of the TMAP in the three geochemically different zones such as: 1. coastal and estuarine areas (plankton, macroalgaes and mollusks) 2. euphotic layer of the ocean (phytoplankton), and 3. deep-sea hydrothermal vent fields (bottom fauna), is made in this work (table). These areas are known to be a highly productive ones, where the biogeochemical processes are very intensive. Average biomass of In the hydrothermal biotopes the *Bathymodiolus spp.* bivalve mollusks demonstrate the largest biomass (whole bodies) – up to 60 kg·m-^{2} [1].

Metal	1	2	3
Mn	470	6.3	894
Fe	9128	105	63060
Co	19.4	0.54	258
Ni	78.5	1	1092
Cu	102	6.3	4272
Zn	656	24.7	17100
As	7.8	5.7	2142
Cd	7.1	0.3	142
Pb	87	4.19	1013

Table: Trace metal bioaccumulation potential in the biomasses of the dominant communities (mg·m^{-2}of the biotope).

From the comparison it follows that benthic fauna of hydrothermal fields (column 3) is characterized by the highest value of bioaccumulation potential of nine metals, which exceeds from tens to thousands times that in the estuaries (column 1) and euphotic zone of the open ocean (column 2). Thus, the hydrothermal fauna may be considered as a newly discovered local biological filter of the ocean.

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