Short Paper

Effect of Magnesium Ion Concentration on the Types of Crystals Deposited by Marine Bacteria in Sea Water*

Drew¹⁾ and Molisch²⁾ reported that marine bacteria take part in calcium carbonate deposition in the ocean. Monaghan and Lytle³⁾ showed that aragonite was formed during the growth of sulfate-reducing bacteria in sea water containing sodium lactate as a carbon source. According to them, presence of magnesium ion in the sea water caused the calcium carbonate to precipitate physico-chemically as aragonite rather than calcite. Recently, Greenfield⁴⁾ also observed formation of aragonite during the growth of marine bacteria in an artificial sea water containing alkaline reagents.

In this work is studied the effect of magnesium ion concentration on the types of crystals in the peptone media prepared with artificial sea water and inoculated with a marine bacterium identified to be *Pseudomonas calciprecipitans*⁵⁾. From the result, a noticeable fact was observed that the magnesium ammonium phosphate hexahydrate (MAPH) was precipitated on the media, beside the crystallization of calcite and calcium carbonate monohydrate (CCM). This finding suggests the ratio of magnesium ion to calcium ion is considered to be most important factors controlling the types of crystallization.

The following media were used: (A) Sea water, Peptone (0.5%), (B) Lyman and Fleming's⁶⁾ artificial sea water, Peptone (0.5%), (C) Herbst's⁷⁾ artificial sea water, Peptone (0.5%), (D) Lyman and Fleming's artificial sea water containing various amounts of magnesium ion, Peptone (0.5%). The

pH value of the media was adjusted to 8.1 with 1 N NaOH soln. Volumes of these 1,500 ml from (A) to (D) were autoclaved in 3-liter flasks for 15 min at 15 psi. The flasks were then inoculated and incubated for two months at 25°C as stationary cultures. The crystals formed in the medium during incubation were analyzed by X-ray diffraction. No crystal could be observed in each uninoculated medium over a two month period at 25°C.

The crystals formed in the medium (A) and (B) were identified as CCM. While, the crystals from medium (C) were identified as MAPH. In this regard, the results with medium (D) are of particular interest. That is increases in magnesium ion concentration caused a change in crystal form from calcite to CCM, and further to MAPH.

The production of carbon dioxide and alkalization as a result of bacterial metabolism, such as respiration and decarboxylation or deamination of nitrogenous substances is recognized as one of the role of the marine bacteria played in the crystal formation. Further experimentation is considered to be necessary to explain this noticeable observation fully from the standpoint of microbiology. In addition, the possibility of the formation and its type of common "struvite" on marine food products by bacterial action may reasonably be proposed, and we are now in progress about this.

References

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Table 1. Effects of magnesium ion concentration on crystalline form

Media	Ca ⁺⁺ (ppm)	Mg ⁺⁺ (ppm)	Mg ⁺⁺ Ca ⁺⁺	X-ray analysis*
A	430	1,350	3.14	a
B	397	1,272	3.20	a
C	294	1,862	6.33	c
D	397	392	1.0	b
"	"	590	1.5	b
"	"	801	2.0	b
"	"	990	2.5	b
"	"	1,198	3.0	a, c (trace)
"	"	1,594	4.0	c, a (trace)
"	"	1,980	5.0	c

* a: CaCO₃·H₂O, b: CaCO₃ (Calcite),
c: MgNH₄PO₄·6H₂O

* 海水中で海洋細菌により沈積される結晶の結晶型に対するマグネシウムイオン濃度の影響 (信濃晴雄・坂井 稔: 北海道大学水産学部)