Predicting the sea level change in the Ariake bay through analysis of diatoms and pollens

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<Goal>
We set two goals for our study.
One goal is to research the sea level change in the Ariake bay in the past. The other goal is to predict the sea level rise in the Ariake bay in 50 years.

<Outline about the stratum>
We took 40 samples from the core bored in two spots, Aitsu and Amura, in every 10 cms. These two spots are both located in the mouth of the Ariake bay. We named the core in Aitsu “KZ”, and one in Amura “KM”. We found out the age of each layer of the core by radiocarbon rating and researching documentary records. It is shown in figure 1.

<Method>
In order to study the environment in the past, we analyzed diatoms and pollens in the samples. We draw diagrams after judging 200 fossil diatoms, and also 200 fossil pollens per sample, except pinus. Then, we calculated the temperature and precipitation in the past, using modern-analog method. We also investigated the data archaeologically with local historical records. Through these three processes, we learned about the paleo-environment of the land and sea. By examining how the environment has changed, we can clarify how it has affected our lives.

<Results>
The following is what we discovered through diatom analysis. We found a large amount of *Paralia sulcate* and *Cylotella Litoralis* in most samples. *Paralia sulcate* inhabits the seawater, which is known as an indicator species in bays. It is shown in figure 2. On the other hand, *Cylotella Litoralis*, inhabits the freshwater. *Tryblionella granulate,* which also inhabitants the brackish water, was found in all the samples. What we discovered through pollen analysis is as follows. Pollens of *Castanopsis sieboldii* and trees which belong to the *Quercoideae* family consist of as much as 80 –90 % of all pollens. It is shown in figure 3. The calculated temperature shifted between 16.0℃ and 17.4℃, and it rose 1.0℃ from KM-11 to KM-10. The precipitation changed between 1,800mm and 2,200mm.

<Considerations>
Analyzing pollens of the core bored in Amura, we assume there used to be broad-leaved evergreen forests there. The results we got with all the data we collected from the core and historical records are shown in figure 4. There are three assumable facts from this figure. The core of 7,700 –6,500 years ago contain the largest proportion of sea diatoms. It shows there was the Holocene glacial retreat in the *Jomon* period. Samples of 500 years ago contain small proportion of sea diatoms, and the temperature declined 0.7℃. It is because of little ice age then. In Amakusa, there was a period in which we had frequent heavy rains, floods, or droughts.

<The sea level change of Amakusa>
The observation of the sea level change of Amakusa. As mentioned before, we found *Tryblionella*

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granulate in diatoms of all samples, which is known as an autochthonous indicator species of tidal flats. According to Sato (2014), the spots which *Tryblionella granulate* were found indicate the sea level of the time they die and accumulate. In short, they can tell us how the sea level has changed. The estimated could sea level in Amakusa.

<The future prediction>
We found the sea level by focusing on *Tryblionella granulate.* Referring to the sea level *Tryblionella granulate* show, we found that the sea level rose 0.18cm a year on average during the period between 93 to 500 years ago. Thus, we assumed the sea level rose 2.5cm during the period of KM-7 to the top of the core, which means it took 14 years from the time KM-7 accumulated to the time of the boring. We learned that the temperature from the time of KM-7 to the top of the core was 0.011℃ on an average, since the temperature rose for 0.15℃ in that period. Therefore, it can be said the sea level rises 16.7cm/℃. According to the IPCC report in 2018, if the temperature rises 0.5℃ by 2030, it will be 0.042℃ hotter every year, and in 50 years, the temperature will rise 2.1℃ in total. Combining this IPCC forecast and 16.7cm/℃ sea level rise, it can be said that the sea level will rise 34.7cm in 50 years. If the temperature rises more moderately, 0.5℃ by 2052, it will be 0.015℃ hotter every year, and the temperature will rise 0.73. This will make the sea level 12.2cm higher. There are shown in figure 5.

<Conclusions>
Our study can be concluded in the following three points. First, we revealed how the environment in the Ariake Bay has changed since 7,700 years ago. Secondly, we calculated 0.7℃ decline of temperature during the little ice age in Amakusa. Lastly, we forecasted the sea level in 50 years will be 34 cm higher at most.

<Our future study>
In our future study, we are to calculate the area of the sandy beaches which can disappear because of the sea level rise. We also would like to calculate the sea level rise of other areas by discovering how to apply our results to the area at different latitudes.

Keywords: Sea level change, Diatom analysis, Pollen analysis

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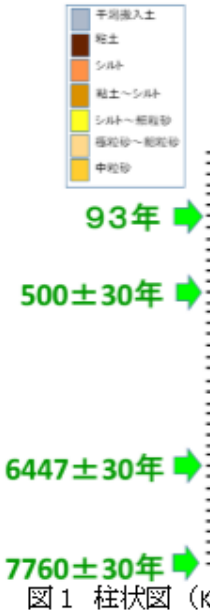


図１ 柱状図（KM）

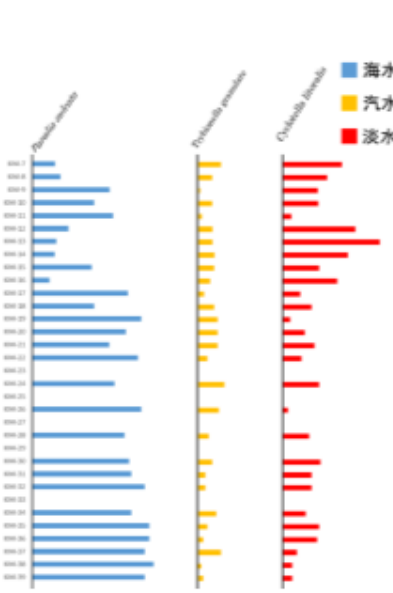


図２ 珪藻ダイアグラム（KM）

図３ 花粉ダイアグラム（KM）

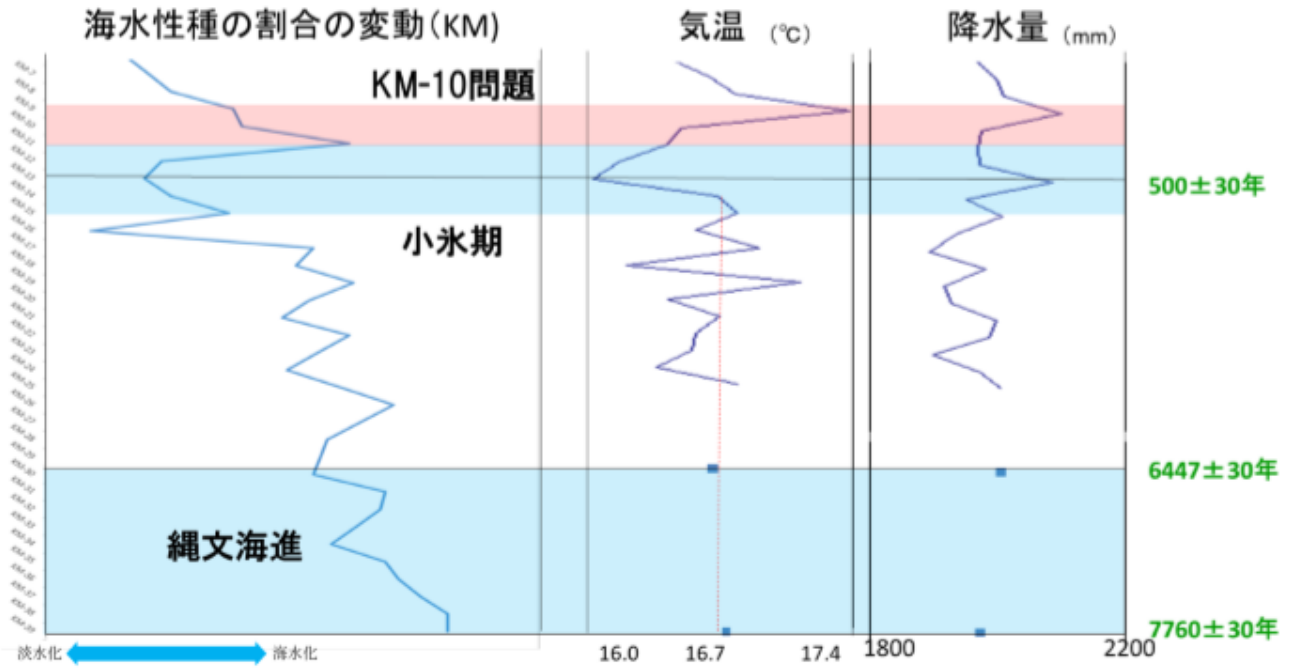
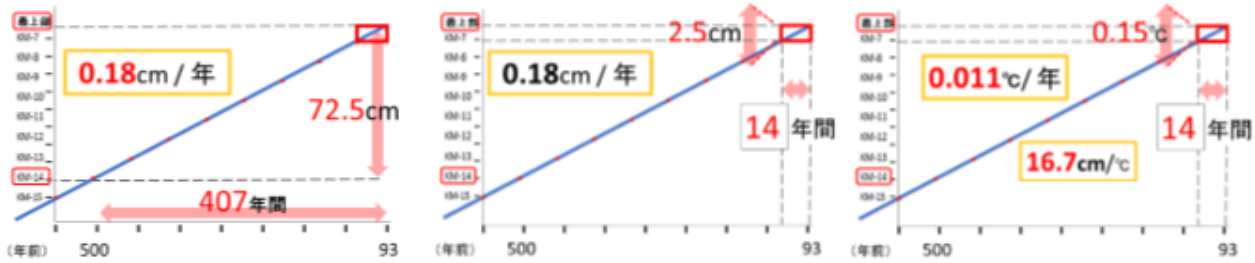


図４ 過去の環境変遷



	未来予測(50年後)	
	最大	最小
気温上昇速(℃/year)	0.042	0.015
気温(℃)	+2.1	+0.73
海水面(cm)	+34.7	+12.2

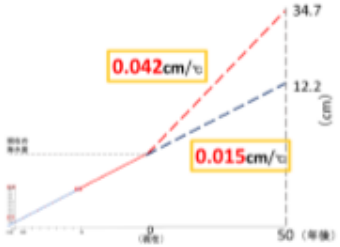


図５ 未来予測

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