

Rent-a-core service: in-class observation of a sediment core substituted to field observation of outcrop

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The “Rent-a-core service” is a new educationally supporting system in that school teacher rent a core from researcher and use a core in the class. In-class observation of a sediment core is substituted to field observation of outcrop. We conducted a preliminary class practice in high school using a standard drilling core. Sentence analyses of worksheets revealed positive response for students. The Rent-a-core service has a comprehensive merits for school teacher, student and researcher, so future development and advertisement are expected.

1. Introduction

The course of study of Ministry of Education, Culture, Sports, Science and Technology (MEXT) stated that curriculum should provide field observation of outcrop as an hands-on experience, in the science class of elementary and junior high school, and in the class of earth science field of science of high school. It is effective to understand geology and geomorphology, in primary and secondary educations¹⁾. However, slightly old data are only available in that field observation of outcrop was done by 33 % and 12 % of primary and junior high schools around Japan^{2, 3)}, and by 58 % of high schools in Tokyo Metropolitan area⁴⁾. This is due to complicated reasons, including a lack of time, budget, accessibility, information and teacher’s speciality, as well as traffic accident and urbanization^{5, 6, 7, 8)}. Watching a photograph and movie has been used frequently as a substituted material and method to field observation of outcrop. Material and method with much reality are proposed additionally for the last 10 years; in-class observation of peel specimen of sediments^{9, 10, 11, 12, 13, 14, 15)} and existing drilling core^{16, 17, 18, 19, 20)}. We proposed a

new educationally supporting system, the “Rent-a-core service”²¹⁾, and attempted a preliminary class practice in high school using a standard drilling core.

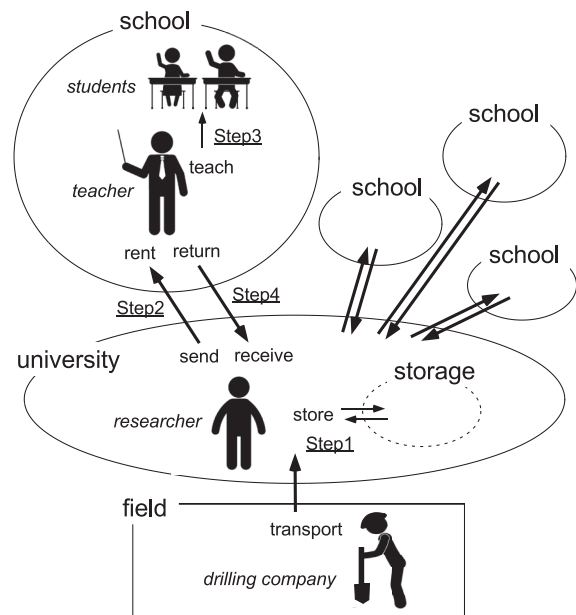


Fig. 1 Diagram showing the “Rent-a-core service”

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2. Outline of the Rent-a-core service and the standard drilling core

The Rent-a-core service is newly proposed educationally supporting system developed from in-class observation of a drilling core. Outlined sequence of the Rent-a-core service is as follows (Fig. 1).

Step 1: Researcher prepares and stores a standard drilling core previously.

Step 2: School teacher rent a core from researcher via parcel delivery.

Step 3: School teacher use a core in the class of science or researcher does the same way as a visiting lecturer.

Step 4: School teacher return a core to researcher via parcel delivery.

The standard drilling core was obtained from the alluvial plain of Tsuchiura area, and was stored in the Chiba Institute of Science (CIS) in Choshi, central Japan (Fig. 2). Holocene alluvial deposits occur in the area and a detailed geologic cross section was drawn there²²⁾. The core is 30 m long and 86 mm in diameter, divided into 6 units in descending sequence (Fig. 3). Unit 1 is a modern artificial deposits of fill and rice paddy soil from 0.00 m to 1.27 m in depth. Unit 2 is a Late Holocene fluvial deposits of sorted sand from 1.27 m to 2.27 m. This unit is related to the progradation of delta into the Kasumigaura Lake. Unit 3 is composed mainly of massive silt of Middle Holocene bay deposits from

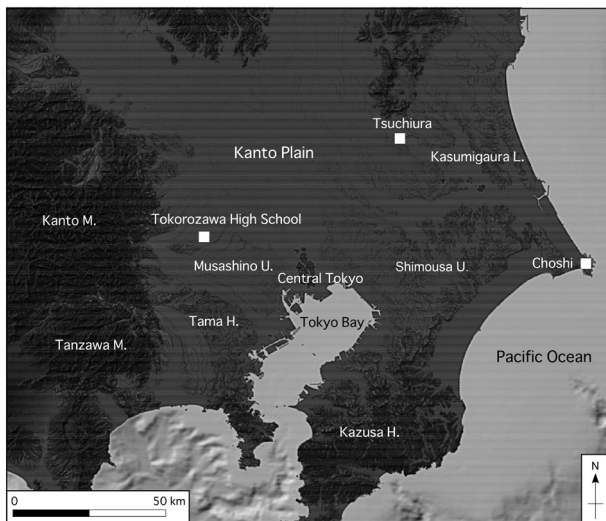


Fig. 2 Location of the site of standard drilling core and the Tokorozawa High School

Base map is after GSI Maps by the Geographical Survey Institute of Japan. H., Hill; L., Lake; M., Mountains; U., Upland.

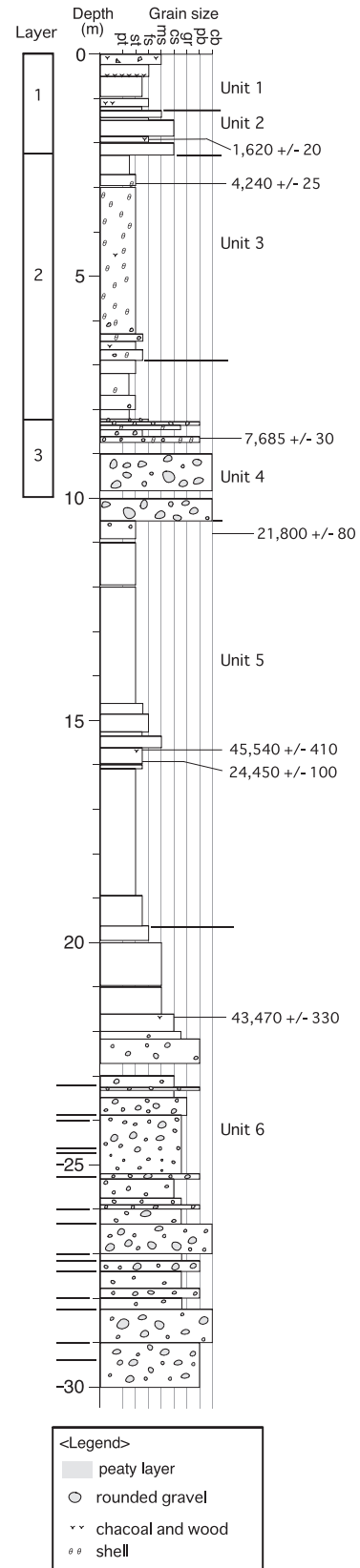


Fig. 3 Columnar section of the standard drilling core
 Numerical values are ¹⁴C ages (yrs BP)

2.27 m to 6.95 m. This unit contains entirely abundant molluscan fossils. Unit 4 is an Early Holocene fluvial deposits from 6.95 m to 10.65 m that has muddy facies overlying gravelly facies. Units 3 and 4 provides an information on Holocene climate and sea level changes. Fining-upward facies change from Units 4 to 3 indicates the latest transgression (the Jomon Transgression) in the Postglacial. Units 5 and 6 are Late Pleistocene fluvial deposits from 10.65 m to 19.62 m and from 19.62 m to 30.00 m. Remarkable facies change from gravelly Unit 6 to muddy Unit 5 would be influenced by the westward shifting of trunk stream and resultant decrease in stream flow in the Last Glacial.

3. Class practice in high school

We conducted a class practice using the standard drilling core in June 2018 in the Tokorozawa High School, Saitama Prefecture (Fig. 1), as an application of the Rent-a-core service. The class applied 50 minutes (1 class hour) and 40 students of 2nd grade were participated. The standard drilling core up to 10 m in depth was sent to the high school previously and used in the class. Ueki and Shoda assigned roles of a main lecturer and an assistant. We arranged the desks in a row and put the core on them. A worksheet was prepared for promoting the understanding of class, shown in Fig. 4.

A series of activity in the class is described below. Example of a worksheet written by a student and typical photographs of students' attitudes are shown in Figs. 5 and 6.

Step 1 (10 minutes): We handed out a worksheet to each student. Students answered about 2 questions; what information was extracted from the core and how did we investigate subsurface geology in a plain. They wrote an assumption and answer on Chapters 1 and 2 of the worksheet.

Step 2 (20 minutes): We hinted to students that the core was dividable into 3 layers, based on the grain size of mud, sand and gravel (left side of Fig. 2). And then, students approached to the core and observed it carefully. They tried to determine the depth of upper and lower boundaries of each unit, and described the grain size and apparent features of all units on Chapter 3.

Step 3 (5 minutes): Students described and draw a columnar section of the core on the left part of Chapter 4.

Step 4 (15 minutes): Students answered about 2 questions; 'what did facies change of the core mean?' and 'why did facies change occur?' . They wrote an assumption

and answer on the right part of Chapter 4.

Step 5 (outside-class time): Student answered a question printed on the back page, 'what was geological investigation useful for?' and wrote an answer on Chapter 5. Also, they wrote an impression about the class on Chapter 6.

4. Effectiveness and future perspectives of the Rent-a-core service

We evaluate the class practice in June 2018 below. Sentence analyses were conducted for students' commentaries on Chapters 5 and 6 in the worksheet. Answers to question, 'what was geological investigation useful for?' were categorized as, (1) reconstruction of earth history and paleo-environments (70 % of students), (2) geotechnical evaluation (33 %), (3) disaster prevention and mitigation (10 %), and (4) paleontology (8 %). All categories are included in the earth science field of science in high school. The class practice contributes to motivate students to learn earth science. It also made an opportunity that students considered sustainability, safety and future earth. Students' impression responded almost positively in these categories: (1) interesting (55 % of students), (2) understanding well (43 %), (3) surprising (33 %), (4) good (25 %), (5) want to do by themselves (23 %), (6) difficult (5 %), and (7) mysterious (3 %). Students enjoyed the class with unaffected attitudes and favorable feelings.

Our class practice and worksheet analysis shows that the Rent-a-core service is helpful for all of school teacher, student and researcher. It makes teacher possible to show a raw sediment or rock for students in the classroom, instead of field observation of outcrop. Watching a raw sediment of a standard drilling core in the class practice, facilitates students' understanding and raises their interesting. For researcher, the class practice using a standard drilling core would be an outreach activity as a part of social contribution. Other merits of the Rent-a-core service is that the system is simple, not expensive, not laborious and not time-consuming. To support teacher of science in school, the Rent-a-core service should be developed to accumulate class practice and promoted wider, via internet and personal communication.

Acknowledgements

We thank Dr. Takayuki Nuimura to improve an early version of English.

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<div style="border: 1px dashed black; padding: 5px;"> <p>6.自由に感想を書いて下さい.</p> <p>→impression</p> </div>		Chapter 6																																									

Fig. 4 A worksheet distributed to students

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名前

surface page

地下の地層（ボーリングコア）から、土地の成り立ちを読み取る

水は礫 石が混じり
 土は土 砂が混じり
 泥は泥が混じり

1. 地層からわかることは何でしょうか？

予想: 昔、その土地が海だったから、14m以下が、地震が起きたから。

答え: 昔のことが記録されている。人によって、土地の成り立ちがわかる。

2. 平野（低地や台地）で地層を調べるには、どうしたらよいでしょうか？

予想: 穴をほる。

答え: 鉄のパイプを回してほる（ボーリング）、電気でほる、地震の記録から。

3. 茨城県土浦市のボーリングコアを観察してみましょう。いくつかの地層に分かれそうですか？

5層 → 3層

地層1 0 ~ 2.28 m 地層の種類 砂 特徴 車が混じっている。

地層2 2.28 ~ 2.34 m 地層の種類 泥 特徴 白い点々が混じっている。

地層3 2.34 ~ 9 m 地層の種類 礫 特徴 まわりの礫が細かい、砂も細かい。

地層4 ~ m 地層の種類 特徴

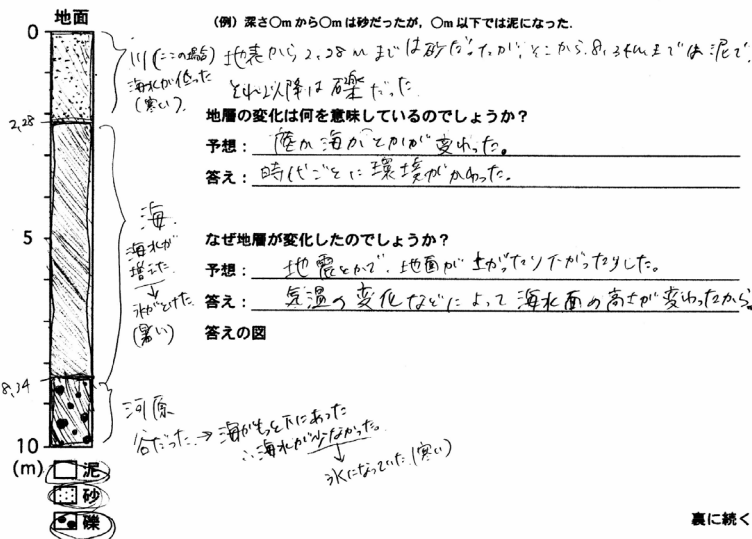
地層5 ~ m 地層の種類 特徴

地層6 ~ m 地層の種類 特徴

柱状図を作りましょう。

地層は深さによってどのように変化しましたか？

(例) 深さ0mから0mは砂だったが、0m以下では泥になった。



地層1 (0 ~ 2.28m) 地層から2.28mまでは砂が混じっている。そこから8.34mまでは泥。

海水が(浅い)と海水が(深い)は異なる。

地層の変化は何を意味しているのでしょうか？

予想: 海が海から泥に変わった。

答え: 時代によって環境がかわった。

なぜ地層が変化したのでしょうか？

予想: 地震が起きた。地面が土が下にたつた。

答え: 気温の変化によって、海水の高さが変わったから。

答えの図

裏に続く

5. 地下の地層を調べることは、何に役立つと思いますか？

過去の記録から、災害は、人の生活に大きな被害を与えたとの
 の対策ができるようになる。

6. 自由に感想を書いて下さい。

ボーリング調査の名前は聞いたことが、その結果を見るの
 に初めてだったので、すごくびっくりした。

地層から昔の自然がわかることは知っていたが、そこから寒かった、
 暑かったとかわかるのは、たしかにいい、たしかにすごく楽しくて、た
 しかにその2つ3つをわかってわかる地層は、とても面白い
 のだとわかった。

back page

Fig. 5 Example of a worksheet answered by a student

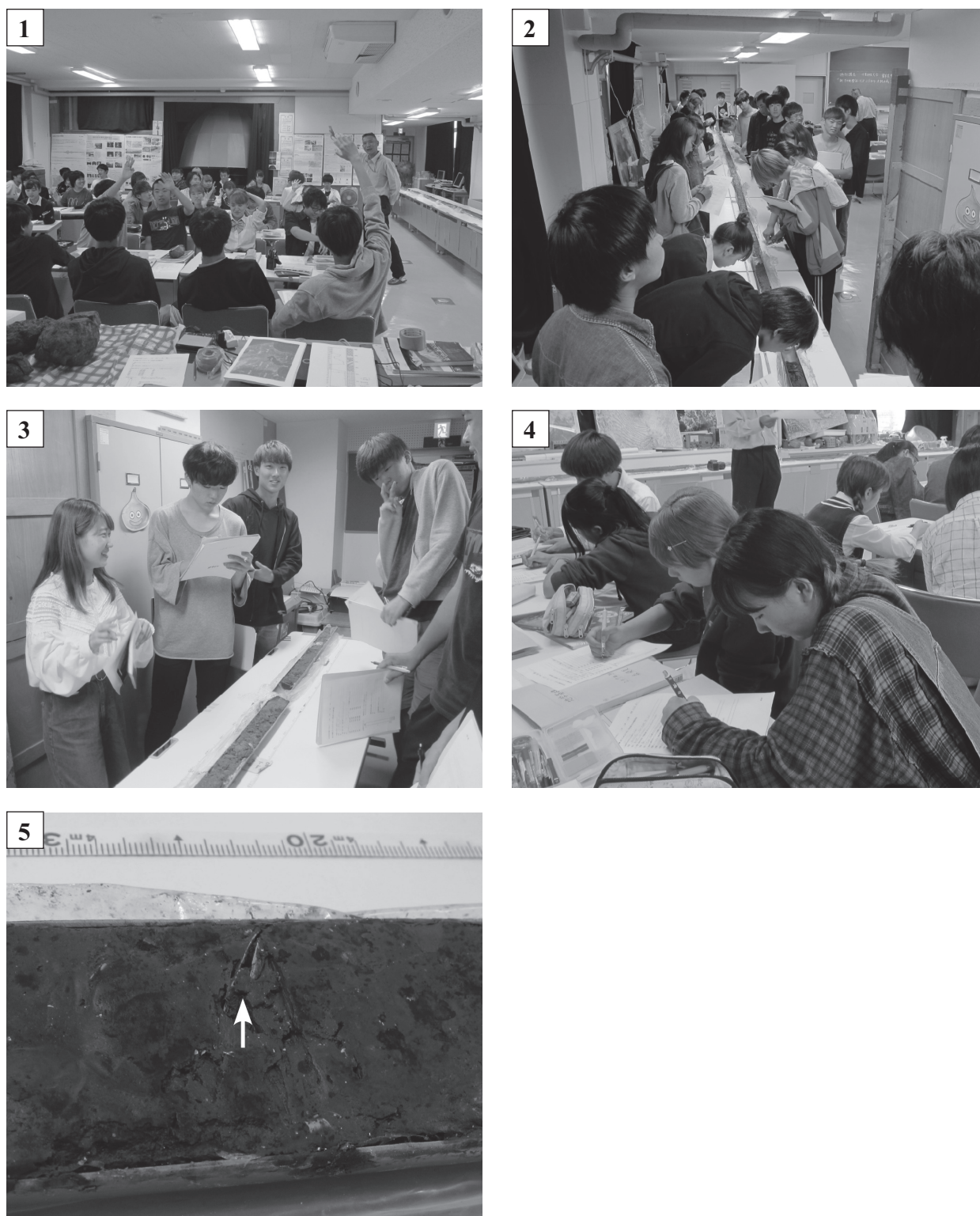


Fig. 6 Typical photographs of students' attitudes in the class practice

1. answer to queries during the lecture; 2. observation of the standard core 10 m long; 3. description of apparent features of the core; 4. making a columnar section with color pencil; 5. articulated fossil shell in the core (arrow).

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