

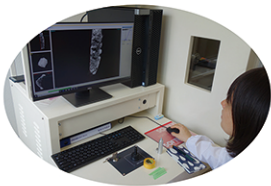
The background of the cover is a black field filled with numerous white, translucent fossil images. These fossils include various plant parts like leaves, seeds, and flower structures, as well as animal remains such as insects (beetles, flies) and small marine organisms. The fossils are scattered across the entire page, creating a rich, textured backdrop for the title.

The World of Fossils within Pottery

2022

OBATA, Hiroki

**'I am sorry to wake you up. I did not mean to wake you up.
When and why were you trapped in earthenware?
It is okay if you tell me just that' .**



A scene from the investigations

All the images displayed here are 3D rendering of creatures derived from prehistoric pottery in Japan, which were detected using an X-ray equipment.

Preface

In pottery, there often are small plants, insects, shellfish, and other creatures that existed around the potters themselves. Occasionally, they appear on the surface of earthenware and are called 'impressions', but they are originally, creatures mixed into the clay. A typical example is the impression created by rice husks. Archaeologists in Japan have long focused on the impressions of rice husks on the surface of pottery when investigating the beginning and diffusion time of rice farming. In addition to rice husk impressions, spiders, mites, and other insects were also found on pottery surfaces. In Japan, such impressions attracted public attention around the 1980s, when Tsuyoshi Ushino practised the 'replication method' of moulding impressions using silicone rubber and changing the imprint into a positive cast. This is more reliable than the conventional method. Afterwards, Michihiko Nakazawa used the replication method to verify rice husk impressions nationwide. In the 2000s, Sumio Yamasaki, who was also interested in the origin of rice cultivation, started a comprehensive survey of the Jomon pottery to discover rice and maize weevils. This marks the beginning of a modern method for surveying earthenware. A comprehensive survey of pottery using this method led to the 2007 discovery of soybeans in the Jomon period.

Starting in 2011, we utilized X-ray imaging equipment, such as soft X-ray devices and X-ray CT scanners, to investigate earthenware impressions, search for organic inclusions embedded in earthenware fabric, and construct three-dimensional (3D) images. We then investigated the exact number of perilla in pottery that contain numerous perilla impressions. We also found unexposed impressions in pottery that left no traces on the pottery surface. Since the start of this pottery impression survey, we have searched for unexposed impressions using a soft X-ray device.

This book describes the detection and examination of organic inclusions, especially fossils, such as seeds and insects, inside earthenware walls using X-ray equipment. The seeds and insects found in pottery reveal new discoveries that archaeologists, who are engrossed with pottery patterns and shapes, have been unaware of. These include lifestyle and food in the era, and the potters' thoughts on such organic inclusions.

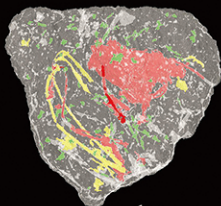
Please enjoy the world inside pottery.

OBATA, Hiroki

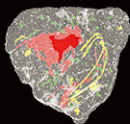


Plant inclusions

Fibres or stems
Unknown species



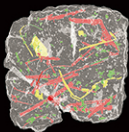
1 cm



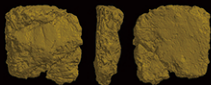
1 cm



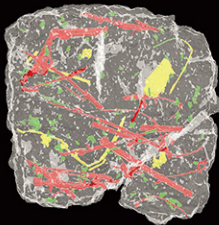
1 cm



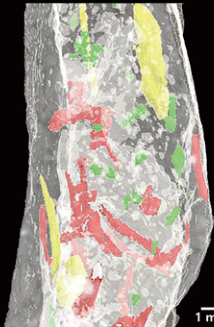
1 cm



1 cm



1 cm



1 mm

'Go outside and take the stalks of the grass' .
'Yes, mom, but for what purpose?'
'I will mix them into the clay' .

The fragments of fibres and rice husk kneaded into earthenware clay are not easily visible from the surface of pottery. However, they play an important role in making them. The practice of mixing silica-rich plants into clay is a traditional technique typically inherited from the mother.

This tradition dates to ca. 16,500 BP when pottery started in the Japanese archipelago.

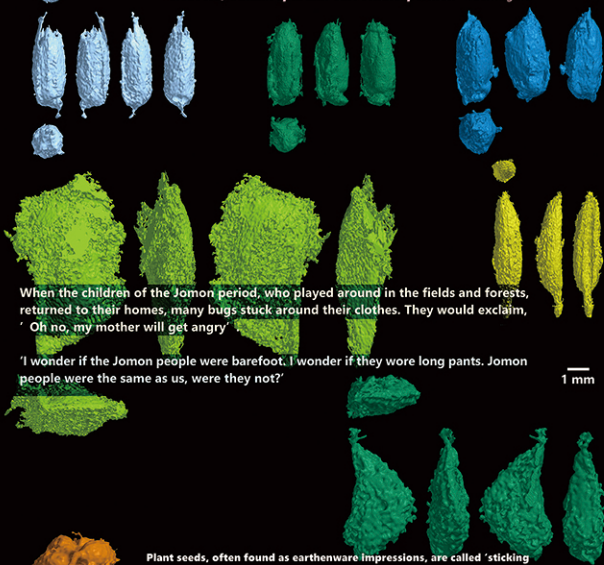
Pig's knee; *Achyranthes bidentata* Inokozuchi

Torilis japonica Yabujirami

Beggar lice; *Desmodium podocarpum* subsp. *oxyphyllum* Nusubito-hagi

Circaea mollis Sieb. et Zucc. Mizutamasou

Cleavers; *Galium spurium* var. *echinospermon* Yaemugura



When the children of the Jomon period, who played around in the fields and forests, returned to their homes, many bugs stuck around their clothes. They would exclaim, 'Oh no, my mother will get angry'

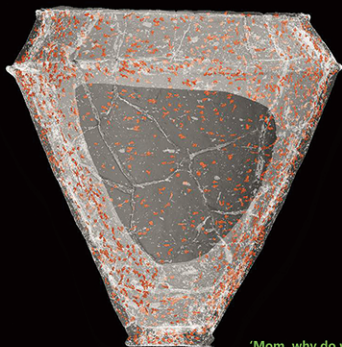
'I wonder if the Jomon people were barefoot. I wonder if they wore long pants. Jomon people were the same as us, were they not?'

Plant seeds, often found as earthenware impressions, are called 'sticking bugs'. They were seeds stuck to clothes or body parts, and brought to the pottery-making place from outside.



Rice husk

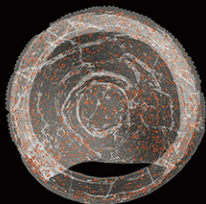
Inemomi
Oryza sativa



10 cm



10 cm

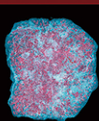


10 cm

'Mom, why do we put rice husks in the pottery clay?'

'The pottery becomes more robust and harder to break' .

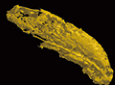
'Hmm. Then we should not throw away the rice husks' .



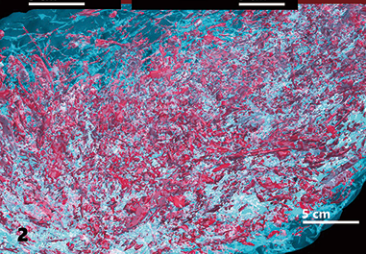
3 cm



3 cm



1 mm

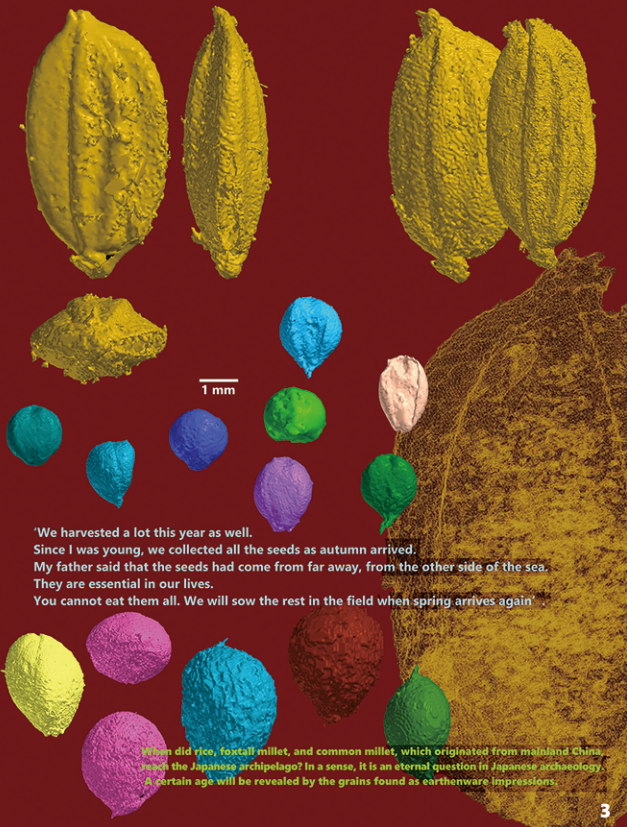


5 cm

Grains (Rice, Foxtail millet, Common millet)

Ine, Awa, Kibi

Oryza sativa, *Setaria italica*, *Panicum miliaceum*



'We harvested a lot this year as well.

Since I was young, we collected all the seeds as autumn arrived.

My father said that the seeds had come from far away, from the other side of the sea.
They are essential in our lives.

You cannot eat them all. We will sow the rest in the field when spring arrives again'.

When did rice, foxtail millet, and common millet, which originated from mainland China, reach the Japanese archipelago? In a sense, it is an eternal question in Japanese archaeology. A certain age will be revealed by the grains found as earthenware impressions.

Legumes (Soybean, Adzuki bean)

Daizu, Adzuki
Glycine max, *Vigna angularis*

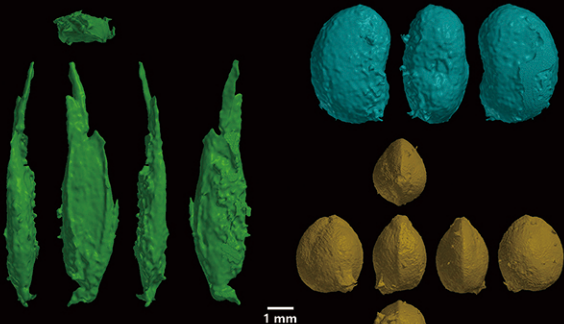


Earthenware impressions verified the existence of soybeans and adzuki beans during the Jomon period. Today, they are thought to be representatives of the plants cultivated in that period, along with perilla and chestnut. However, the timing of their cultivation remains unclear.

Giant foxtail; *Setaria faberi* Akinoenokorogusa
***Rumex* sp.** Gishigishi
Pueraria montana* var. *lobata Nusubito-hagi
***Elymus tsukushiensis* Honda var. *transiens* (Hack.) Osada** Kamojigusa
Hemp; *Cannabis sativa* Asa



'Mom, I collected seeds as you said. How do you eat them?'
 'First of all, you have to hull their husks' .



Wild grass seeds that are found as earthenware impressions are unlikely to have entered houses accidentally. In some cases, many wild grass seeds were present in the pottery clay. Therefore, it appears that they were intentionally collected and brought to the house. These tiny wild grass seeds from archaeological soils were previously not considered to be edible. However, their discovery, as the impressions in earthenware suggest, included them in the human diet.

It seems that hemp was also used for food and fibre. Carbonized seeds were found at the Okinoshima site in Chiba Prefecture about 10,000 years ago, making it the oldest perilla seeds in Japan. Although rare as an impression of earthenware, a vessel mixed with more than 1,000 seeds has been found in a site of the Zokujomon culture (ca. 1,600 BP) in Hokkaido.

Mulberry; *Morus bombycis* Yamaguwa

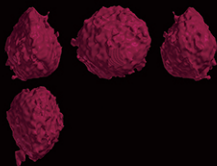
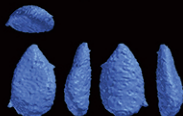
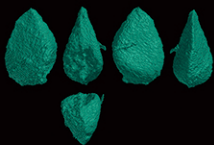
***Broussonetia* sp.** Kouzo

Japanese red elder; *Sambucus sieboldiana* Niwatoko

***Vitis* sp.** Budou

***Ampelopsis* sp.** Nobudou

Ehretia ovalifolia Chishanoki

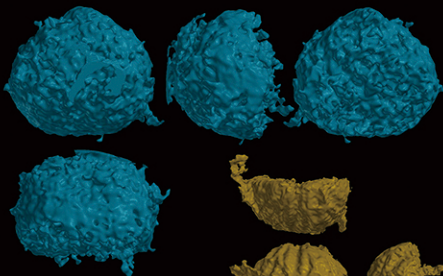


'Do you know?

The old owl living in the forest taught me:

The fruits of the raspberry have grown in the edge of the forest again this year.

When the sun rises tomorrow, let us go and get them together' .



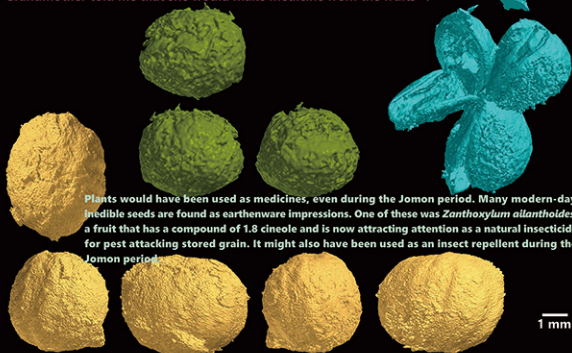
1 mm

Rubus, grape genus, and mulberry are delicious fruits that can be consumed without cooking. However, why did the raspberry pips, which people now eat with flesh, enter pottery clay?

Japanese Prickly-ash; *Zanthoxylum ailanoides* Karasuzanshou
Swida macrophylla Kumanomizuki
 Giant dogwood; *Cornus controversa* Mizuki



'My grandmother asked me to go to the forest.
 I saw a large tree that bore black fruits, and climbed it to obtain the fruits.
 Grandmother told me that she would make medicine from the fruits' .



Plants would have been used as medicines, even during the Jomon period. Many modern-day inedible seeds are found as earthenware impressions. One of these was *Zanthoxylum ailanoides*, a fruit that has a compound of 1.8 cineole and is now attracting attention as a natural insecticide for pest attacking stored grain. It might also have been used as an insect repellent during the Jomon period.

1 mm

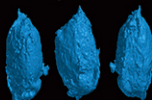
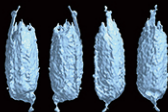
Pig's knee; *Achyranthes bidentata* Inokozuchi

Torilis japonica Yabujirami

Beggar lice; *Desmodium podocarpum* subsp. *oxyphyllum* Nusubito-hagi

Circaea mollis Sieb. et Zucc. Mizutamasou

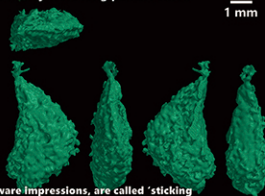
Cleavers; *Galium spurium* var. *echinospermon* Yaemugura



When the children of the Jomon period, who played around in the fields and forests, returned to their homes, many bugs stuck around their clothes. They would exclaim, 'Oh no, my mother will get angry'

'I wonder if the Jomon people were barefoot. I wonder if they wore long pants. Jomon people were the same as us, were they not?'

1 mm



Plant seeds, often found as earthenware impressions, are called 'sticking bugs'. They were seeds stuck to clothes or body parts, and brought to the pottery-making place from outside.



The insects that came into Jomon houses

Mushi
Insects and small animals

Twisted-wing parasites; **Strepsiptera** Ari, Hachi

Beetles; **Coleoptera** Kouchu

Wood louse; **Armadilloidea** Dangomushi

Millipede; **Diplopoda** Yasude



Fly : 'It smells delicious' .

Longhorn beetle : 'The house is old, so there may be delicious rotten timbers'

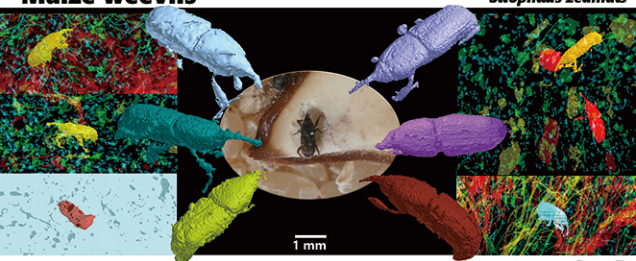
Woodlouse : 'It is easy to live in because there are various gaping spaces'

Spider : 'There are many delicious insects, so I will make a trap here'

Insects are also representatives of the organisms found as earthenware impressions. These may be flies, cockroaches, skin beetles, and *Aphodius*. Most insects live in people's homes, however, there may also be mites that come into the house from being stuck to the bodies of humans and animals.

King of Jomon pests Maize weevils

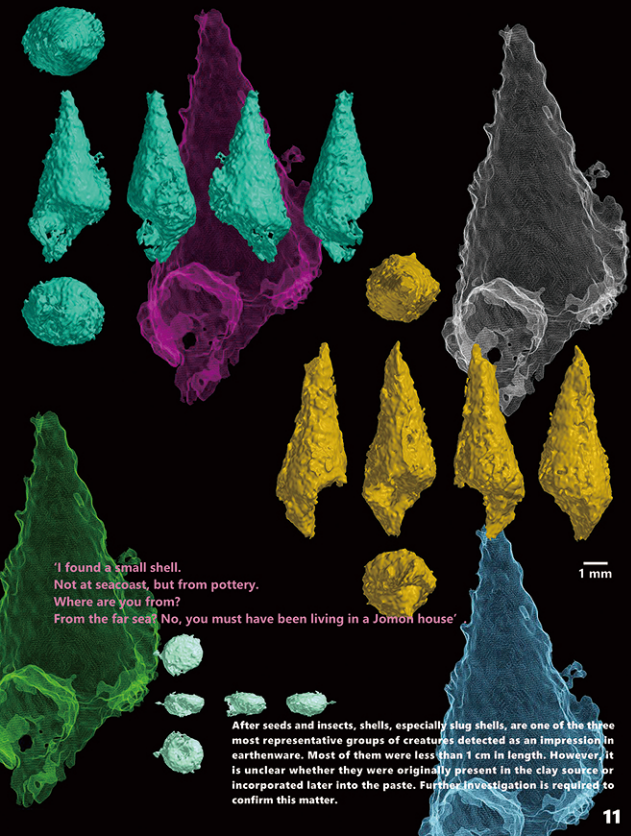
Kokuzoumushi
Sitophilus zeamais



I frequently encounter you wherever I go, whether a distant southern island or cold northern land.

It is so mysterious. Because of this mystery, you have now become my most favourite insect. I wonder what the Jomon people thought of you? I wonder if they felt the same as I do?

At present, more than 800 maize weevil impressions have been detected in approximately 60 sites that were occupied during the Jomon period. These sites range from Tokunoshima in the south to southern Hokkaido in the north. In modern Japan, maize weevil is known as a rice-eating pest; however, during the Jomon period, their main target seemed to be stored nuts, such as acorns and chestnuts. The maize weevil in north-eastern Japan, during this period, was about 20% larger than the maize weevil in western Japan, where they evidently attacked chestnuts, not acorns.



'I found a small shell.
Not at seacoast, but from pottery.
Where are you from?
From the far sea? No, you must have been living in a Jomon house'

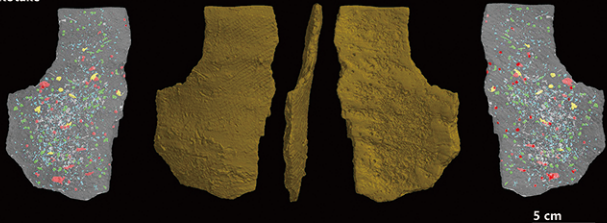
After seeds and insects, shells, especially slug shells, are one of the three most representative groups of creatures detected as an impression in earthenware. Most of them were less than 1 cm in length. However, it is unclear whether they were originally present in the clay source or incorporated later into the paste. Further investigation is required to confirm this matter.

The world of earthenware mixed with many seeds and insects:
Jomon people with prayers for a good harvest

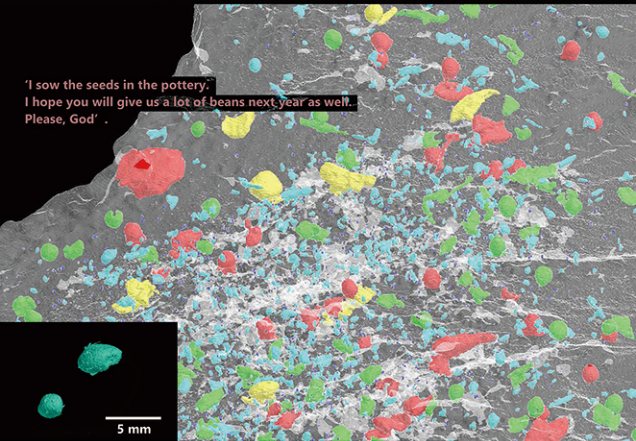
Perilla

Egoma
Perilla frutescens

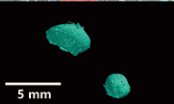
Kotake



'I sow the seeds in the pottery.
I hope you will give us a lot of beans next year as well..
Please, God' .



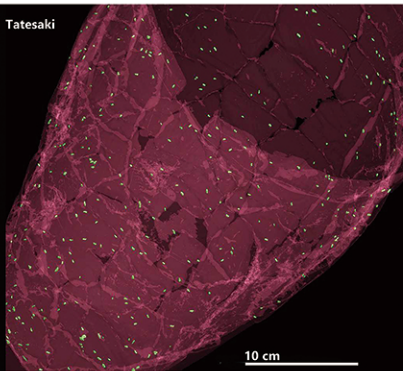
The act of embedding seeds of cultivated and useful plants into the clay used for earthenware began in the early Jomon period. The seeds are not expected to have a visible decorative effect or act as a tempering agent that makes earthenware almost unbreakable. Instead, this act is thought to be equivalent to praying for a good harvest.



Maize weevils from Hokkaido

Kokuzoumushi
Sitophilus zeamais

Tatesaki



'Recently, the cold summer has continued.
Perhaps because of this, chestnuts have become less fruitful.
The size of the fruit is also smaller.
Chestnut god, please give us a lot of chestnuts' .

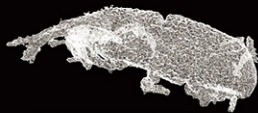


We also found vessels containing many maize weevils. The Jomon people, being unaware of the ecology of insects, believed that the maize weevils that came out of the chestnuts were incarnations of the chestnut god. They embedded these into the pottery clay hoping for a good harvest of chestnuts.

Maize weevils from Kyushu

Kokuzoumushi
Sitophilus zeamais

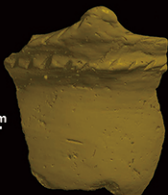
Kozako



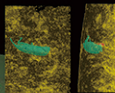
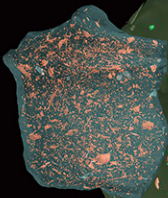
3 mm



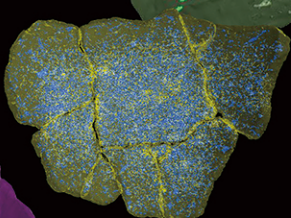
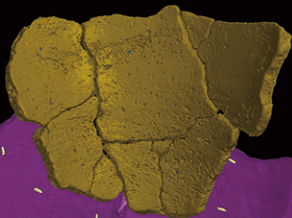
3 mm



10 cm



3 mm



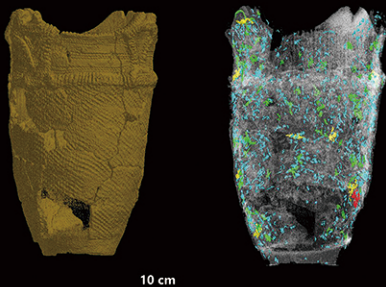
10 cm

Earthenware containing many maize weevils have also been found in the Kyushu region. Although they are small pieces of earthenware, the density of maize weevils in the clay is the highest among earthenware found in Japan. Many other inclusions, which are thought to be acorn shells, were mixed in the clay in addition to the maize weevils. There were seemingly various ways for the maize weevil to enter the pottery clay.

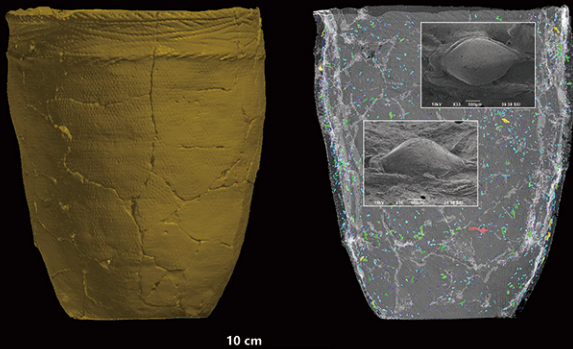
Pottery incorporated barnyard millets

Hie
Echinochloa esculenta

Tatesaki



The genus *Echinochloa* has been a part of the diet in the southern part of Hokkaido and the northern part of the Tohoku region since approximately 8,000 years ago. It is regarded as a plant cultivated by the Jomon people. Pottery, with the impression of these seeds, eloquently demonstrates their consumption of barnyard grass seeds.

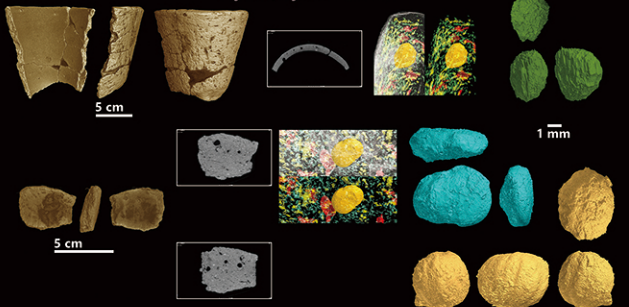


Cultivated or useful plants

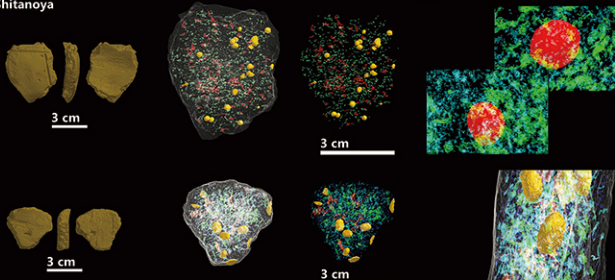
Insecticide, Lacquer, Medicine, Food

Japanese Prickly-ash; *Zanthoxylum ailanthoides* Karasuzanshou
 Lacquer tree; *Toxicodendron* sp. Urushi
 Giant dogwood; *Cornus controversa* Mizuki
 Perilla; *Perilla frutescens* Egoma
 Soybean; *Glycine max* Daizu

Torikakenishi



Shitanoya



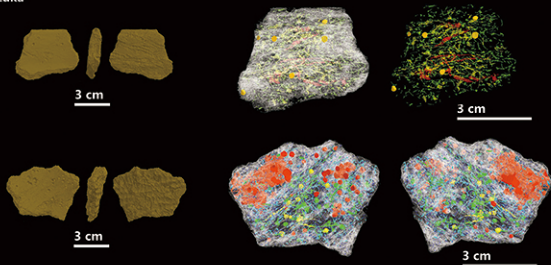
The act of mixing seeds of useful plants into earthenware clay dates to the Initial Jomon period, approximately 9,000 years ago, and coincides with the discovery of many cultivated plants. At the Torikakenishi shell midden site in Chiba Prefecture, seeds of various useful plants such as *Glycine*, *Rhus*, *Perilla*, and *Zanthoxylum* were mixed in earthen clay. The most common species are perilla fruits, soybeans and adzuki beans. Additionally, earthenware containing many seeds of the Amur cork tree and Japanese red elder have been discovered.

Cultivated or useful plants

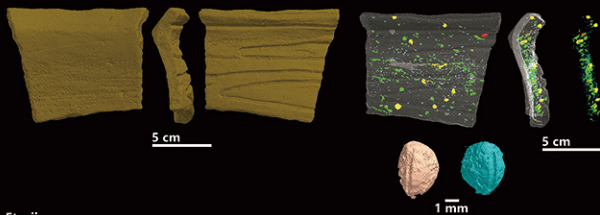
Insecticide, Food

Perilla; *Perilla frutescen* Egoma
 Japanese Prickly-ash; *Zanthoxylum ailanthoides* Karasuzanshou
 Foxtail millet; *Setaria italica* Awa

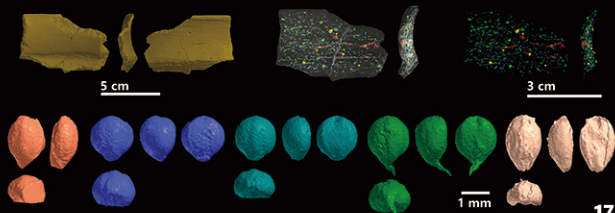
Inuzuka



Hougaki



Etsuji



Chronology of Prehistoric Japanese events

BP (years)

20,000

Late Paleolithic

15,000

Incipient phase (Ic. J.)

10,000

Jomon Period

Initial phase (I. J.)

5,000

Early phase (E. J.)

Middle phase (M. J.)

Late phase (L. J.)

Final phase (F. J.)

2,000

Yayoi Period

16,500 ← Beginning of earthenware production

← Beginning of a sedentary life

9,500 ← Beginning of plant cultivation

← Outbreak of pests

6,100

← Appearance of large-scale settlement

4,700

4,000

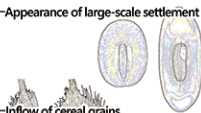
3,100

2,850

800

← Inflow of cereal grains

← Start of rice cultivation in the paddy field



Numbers in the images of impressions



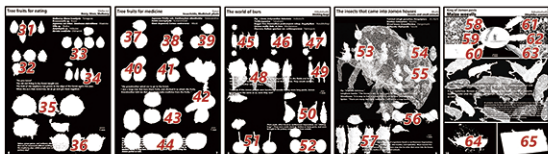
1

2

3

4

5



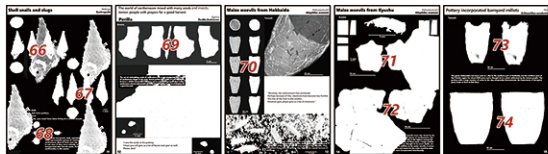
6

7

8

9

10



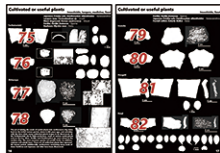
11

12

13

14

15



16

17

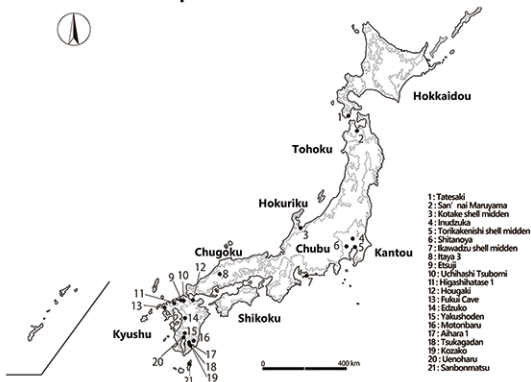
Types and excavated sites of impressions and pottery

Page	No.	English name	Species of inclusions	Japanese name	Site name	Town, City	Prefecture	Era, phase	Age	Registered No.
1	1	Potsherd with fibre	Unknown species	-	Fukui Cave	Sasebo City	Nagasaki	Ic. J.	ca. 15000 BP	FKI 0663
	2	Potsherd with fibre	Unknown species	-	Fukui Cave	Sasebo City	Nagasaki	Ic. J.	ca. 15000 BP	FKI 0223
2	3	Vessel with rice husk	<i>Oryza sativa</i>	Iine	Edzoku	Kumamoto City	Kumamoto	E. Y.	ca. 2600 BP	EDZ 0013
	4	Potsherd with rice husk	<i>Oryza sativa</i>	Inemori	Uchihaishi Taubomi	Kasuya-machi	Fukuoka	M. Y.	ca. 2600 BP	UHT 0001
3	5	Rice	<i>Oryza sativa</i>	Iine	Kazako	Shibushi City	Kagoshima	E. Y.	ca. 2600 BP	KZK 5002-1
	6	Rice	<i>Oryza sativa</i>	Iine	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-293-1
	7	Rice	<i>Oryza sativa</i>	Iine	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-299-1
	8	Fortal millet	<i>Setaria italica</i>	Awa	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1002-3
	9	Fortal millet	<i>Setaria italica</i>	Awa	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-21-9
	10	Fortal millet	<i>Setaria italica</i>	Awa	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1002-2
	11	Fortal millet	<i>Setaria italica</i>	Awa	Ikanedzu s. m.	Takara City	Aichi	F. J.	ca. 2500 BP	IKZ 0001-14
	12	Fortal millet	<i>Setaria italica</i>	Awa	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1002-5
	13	Fortal millet	<i>Setaria italica</i>	Awa	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-21-10
	14	Fortal millet	<i>Setaria italica</i>	Awa	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-21-7
	15	Fortal millet	<i>Setaria italica</i>	Awa	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1002-4
	16	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-434-1
	17	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-434-4
	18	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-434-4
	19	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-330-1
	20	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-385-2
	21	Common millet	<i>Panicum millicum</i>	Kibi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-407
4	22	Soybean seed	<i>Glycine max</i>	Daizu	Motonobaru	Miyazaki City	Miyazaki	L. J.	ca. 4000 BP	MNB 0199-3
	23	Soybean cotyledon	<i>Glycine max</i>	Daizu	Yakushoden	Ehino City	Miyazaki	L. J.	ca. 3800 BP	YSD 0004-2
	24	Adzuki bean cotyledon	<i>Vigna angularis</i>	Adzuki	Motonobaru	Miyazaki City	Miyazaki	F. J.	ca. 3000 BP	MNB 0482
	25	Adzuki bean seed	<i>Vigna angularis</i>	Adzuki	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17 0074
	26	Giant foxtail	<i>Setaria faberi</i>	Akinokunokogusa	Aihara 1	Miyakonojima City	Miyazaki	L. J.	ca. 10000 BP	AHR x1
5	27	-	<i>Rumex</i> sp.	Gishigishi	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0133
	28	-	<i>Pennisetum montanum</i> var. <i>lobatum</i>	Katze	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0179
	29	-	<i>Elymus tenuiflorus</i>	Kamogijusa	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1033-x2
	30	Hemp	<i>Cannabis sativa</i>	Aza	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-152
	31	Chinese mulberry	<i>Morus australis</i>	Yamagawa	Tatesaki	Fukushima City	Hokkaido	E. Y.	ca. 5000 BP	TSK 285-116
6	32	-	<i>Broussonetia</i> sp.	Kouzo	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-281-1
	33	-	<i>Broussonetia</i> sp.	Kouzo	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0114
	34	Japanese red elder	<i>Sambucus sieboldiana</i>	Niwatoko	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-7
	35	Wild vine	<i>Vitis</i> sp. or <i>Ampelopsis</i> sp.	Budou	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0114
	36	-	<i>Elettaria ovalifolia</i>	Chishanaki	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-155-1
7	37	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Tokikanishi s. m.	Funabashi City	Chiba	L. J.	ca. 5000 BP	TKN 0015-x3
	38	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-0076
	39	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-0147
	40	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-170-6
	41	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-170-5
	42	Japanese Prickly-ash	<i>Zanthoxylum alanthoides</i>	Karasuzanshou	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-272-5
	43	-	<i>Sida macrophylla</i>	Kamanomizuki	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0287
	44	Giant dogwood	<i>Cornus controversa</i>	Makui	Tokikanishi s. m.	Funabashi City	Chiba	L. J.	ca. 5500 BP	TKN 0009-x5
8	45	Pig's knee	<i>Achyrocline bidentata</i>	Inokazuchi	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 0149
	46	Pig's knee	<i>Achyrocline bidentata</i>	Inokazuchi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-243-1
	47	Pig's knee	<i>Achyrocline bidentata</i>	Inokazuchi	Itoya 3	Inan-chou	Shimane	F. J.	ca. 2600 BP	ITY 0145-x1
	48	-	<i>Tordella japonica</i>	Yabujirami	Uenoharu	Kirishima City	Kagoshima	F. J.	ca. 2800 BP	MNS 0003-x2
	49	Beggar lice	<i>Desmodium podocarpum</i>	Nuzubihagi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-269-1
	50	Beggar lice	<i>Desmodium podocarpum</i>	Nuzubihagi	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 1009-3
	51	-	<i>Cleome macleodii</i>	Mitsumasa	Itoya 3	Inan-chou	Shimane	F. J.	ca. 2600 BP	ITY 0131-x3
	52	Cleavers	<i>Galium aparine</i>	Yaemura	Etouji	Kasuya-machi	Fukuoka	F. J.	ca. 2600 BP	ERS4 100-x1
9	53	Ant or bee	<i>Strepsiptera</i>	Ari or Hachi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-170-20
	54	Beetle	<i>Coleoptera</i>	Kouchu	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-0003
	55	Milipede	<i>Diplopoda</i>	Yasude	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-152-2
	56	Wood louse	<i>Armadillidae</i>	Dangomushi	Higashihatae 1	Saga City	Saga	E. Y.	ca. 2600 BP	HHT-17-152-3
	57	Milipede	<i>Diplopoda</i>	Yasude	Motonobaru	Miyazaki City	Miyazaki	L. J.	ca. 4000 BP	MNB 0131-3

Page No.	English name	Species of inclusions	Japanese name	Site name	Town, City	Prefecture	Era, phase	Age	Registered No.
58	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Tatesaki	Fukushima-cho	Hokkaido	E. J.	ca. 5000 BP	TSK 285-117
59	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Higashihata 1	Saga City	Saga	E. Y.	ca. 2000 BP	MHT-17-064-2
60	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Motonobaru	Miyazaki City	Miyazaki	L. J.	ca. 4000 BP	MNB 2239
61	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Kozako	Shibushi City	Kagoshima	E. Y.	ca. 2600 BP	KZK 5009-1
62	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Tsukagadan	Se's City	Kagoshima	F. J.	ca. 3000 BP	TKD 0010-101
63	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Tatesaki	Fukushima-cho	Hokkaido	E. J.	ca. 5000 BP	TSK 285-115
64	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	Sanbonmatsu	Nishinomote City	Kagoshima	M. J.	ca. 9500 BP	SBN 024-6
65	Maize weevil	<i>Sitophilus zeamais</i>	Kokuzomushi	San'nal Maruyama	Aomori City	Aomori	M. J.	ca. 5000 BP	SNM 0122
66	Snail	Gastropoda	Makigai	Etsuji	Kasuya-machi	Fukuoka	F. J.	ca. 2800 BP	ERS4 0227-2
67	Snail	Gastropoda	Makigai	Etsuji	Kasuya-machi	Fukuoka	F. J.	ca. 2800 BP	ERS4 0228-1
68	Snail	Gastropoda	Makigai	Higashihata 1	Saga City	Saga	E. Y.	ca. 2600 BP	MHT-17-422-1
69	Vessel with pellira fruits	(<i>Pellira</i> sp.)	-	Ketake s. m.	Teyama City	Teyama	E. J.	ca. 5000 BP	OOS 0064
70	Vessel with maize weevils	(<i>Sitophilus zeamais</i>)	-	Tatesaki	Fukushima-cho	Hokkaido	L. J.	ca. 3800 BP	TSK 484
71	Potsherd with maize weevils	(<i>Sitophilus zeamais</i>)	Kokuzomushi	Yakushoden	Elino City	Miyazaki	L. J.	ca. 3800 BP	YSD 0003
72	Potsherd with maize weevils	(<i>Sitophilus zeamais</i>)	Kokuzomushi	Yakushoden	Elino City	Miyazaki	L. J.	ca. 3800 BP	YSD 0075
73	Vessel with banyard millets	(<i>Echinochloa esculenta</i>)	Hie	Tatesaki	Fukushima-cho	Hokkaido	M. J.	ca. 4500 BP	TSK 0928
74	Vessel with banyard millets	(<i>Echinochloa esculenta</i>)	Hie	Tatesaki	Fukushima-cho	Hokkaido	E. J.	ca. 5000 BP	TSK 0975
75	Potsherd with multi kinds of seeds	Japanese Prickly-ash etc.	Karasuzanshou-hoka	Torikakenishi s. m.	Fumabashi City	Chiba	L. J.	ca. 9000 BP	TKN 0015
76	Potsherd with multi kinds of seeds	Lacquer tree etc.	Urushi-hoka	Torikakenishi s. m.	Fumabashi City	Chiba	L. J.	ca. 9000 BP	TKN 0009
77	Potsherd with pellira seeds	(<i>Pellira fargesii</i>)	Egoma	Shitanoya	Nishikyo City	Tokyo	M. J.	ca. 5000 BP	STN 39
78	Potsherd with soybeans	(<i>Glycine max</i>)	Daizu	Shitanoya	Nishikyo City	Tokyo	M. J.	ca. 5000 BP	STN 68
79	Potsherd with pellira seeds	(<i>Pellira fargesii</i>)	Egoma	Inuduka	Kasukabe City	Saitama	E. J.	ca. 5000 BP	INZ 076
80	Potsherd with pellira seeds	(<i>Pellira fargesii</i>)	Egoma	Inuduka	Kasukabe City	Saitama	E. J.	ca. 5500 BP	INZ 026
81	Potsherd with Japanese Prickly-ash	(<i>Zanthoxylum armatum</i>)	Karasuzanshou	Hougi	Nakatsu City	Oita	L. J.	ca. 3600 BP	HGK 0012
82	Potsherd with foetal millets	(<i>Setaria italica</i>)	Awa	Etsuji	Kasuya-machi	Fukuoka	F. J.	ca. 2700 BP	ERS4 1002-4

S. M.: shell midden

Distribution map of sites in this book



Main references

- MANABE, Aya • OBATA, Hiroki 2011 Detection of latent impressions from X-ray CT method. *Abstracts of research presentations in the 26th meeting of Japanese Association of Historical Botany*, pp. 82-83. (In Japanese)
- MANABE, Aya • OBATA, Hiroki 2017 Utilization of *Zanthoxylum ailanthoides* fruits estimated by analyses of taphonomy and components. *Japanese Journal of Historical Botany*. 26-1, pp. 27-40. (In Japanese)
- OBATA, Hiroki 2010 Cultivation of adzuki bean and soybean in the Jomon Period. *Prehistory and Archaeology* 5, pp. 239-272. (In Japanese)
- OBATA, Hiroki 2010 An advanced study on the Jomon, Neolithic in Japan, people's lifestyle using X-ray CT scans. *X-ray CT Visualization for Socio-Cultural, Engineering and Environmental Materials, X-Earth (IWX) 2010*, pp.62-67, Kumamoto University
- OBATA, Hiroki • MANABE, Aya 2013 Detection of organic impressions from the pottery excavated at Sanbonmatsu site by the replication method and X-ray scanning method and its significance. *Report of the Sanbonmatsu Site*, pp. 294-312. (In Japanese)
- OBATA, Hiroki • KANEMITSU, Michiko 2015 Examination of unexposed impressions by soft X-ray and innovation of impression method -Practice for the pottery from Hiraoka site in Totama City. *Annual report for survey of buried cultural properties in 2014 fiscal year of the Toyama Prefecture*, pp. 30-39. (In Japanese)
- OBATA, Hiroki 2015 Jomon pottery incorporated with perilla seeds – Examination and identification of unexposed seed cavities in pottery by soft X-ray. *Japanese Archaeology* 40, pp. 33-52. (In Japanese)
- OBATA, Hiroki 2016 Report on the potsherds tempered with plant fibre fragments. *Report of excavation in Fukui Cave*, pp. 291-294. (In Japanese)
- OBATA, Hiroki 2016 *The Jomon people sowing seeds*, Tokyo, Yoshikawa-kobunkan. (In Japanese)
- OBATA, Hiroki 2017 Report on the investigation of pottery impressions in the Tatesaki site. *Report of Tatesaki site in Fukushima-cho*, pp. 202-212. (In Japanese)
- OBATA, Hiroki 2018 *Entomological Archaeology*, Tokyo, Kadokawa. (In Japanese)
- OBATA, Hiroki 2018 Re-examination of rice impressions on the Kizamimetottaimon earthenware by x-ray CT scanner: An analysis of the deep bowl-shaped pottery from the ninth excavation at the Ezu-ko site, Kumamoto City. *Japanese Archaeology*, 46. pp. 35-42. (In Japanese)
- OBATA, Hiroki 2018 Report on the seeds and animals detected as pottery impression and from the soil samples at Hougaki site in Nakatsu City, Oita Prefecture. *Report of the Hougaki Site*, pp. 371-390. (In Japanese)
- OBATA, Hiroki 2019 Do the exposed cavities represent all of the cavities in pottery? Results of examining unexposed cavities from Jomon sites excavated for construction of the Kasegawa Dam, Saga Prefecture. *Quarterly of Archaeological Studies*, 65-4, pp. 38-59. (In Japanese)
- OBATA, Hiroki 2019 *Plant utilization and house pests in the Jomon Period—An innovation for impression method*, Tokyo, Yoshikawa-Kobunkan. (In Japanese)
- OBATA, Hiroki • MANABE Aya • NAKAMURA, Naoko • ONISHI, Tomokazu • SENBA, Yasuko 2011 A new light on the evolution and propagation of prehistoric grain pests: The world's oldest maize weevils found in Jomon Potteries, Japan. *PLoS ONE*.
(<http://doi.org/10.1371/journal.pone.0014785>)

- OBATA, Hiroki • MIYAURA, Mai • NAKANO, Kazuhiro 2020 Jomon pottery and maize weevils, *Sitophilus zeamais*, in Japan. *Journal of Archaeological Science: Reports*, 34, pp. 102599. (<https://doi.org/10.1016/j.jasrep.2020.102599>)
- OBATA, Hiroki • MIYAURA • Mai, KOBATASHI, Akira • NAKANO, Kazuhiro 2021 Research on the impressions on the pottery of the Late Jomon Period excavated from Yakushoden Site, Miyazaki Prefecture, as seen from X-ray analysis. *Kyushu Kokogaku*, 96, pp. 23-43. (In Japanese)
- OBATA, Hiroki • MORIMOTO, Katsura • MIYANOSHITA, Akihiro 2018 Discovery of the Jomon era maize weevils in Hokkaido, Japan and its mean. *Journal of Archaeological Science: Reports*, 23, pp. 137-156. (<https://doi.org/10.1016/j.jasrep.2018.10.037>)
- OBATA, Hiroki • SASAKI, Yuka • SENBA, Yasuko 2007 Impressions on pottery revealed cultivation of *Glycine max* subsp. *max* (soybean) in the late to latest Jomon periods in Kyushu Island, *Japanese Journal of Historical Botany*. 15-2, pp. 97-114. (In Japanese)

Postscript: Excavation of earthenware

Pottery is a mirror that reflects the life and spirituality of the Jomon people. In the 21st century, cutting-edge technology has made it possible to visualize a previously invisible world. This is the beginning of a new archaeological trend and the unveiling of a world through the excavation of pottery clay. However, there remain things that we do not understand, therefore, we must continue excavating earthenware.

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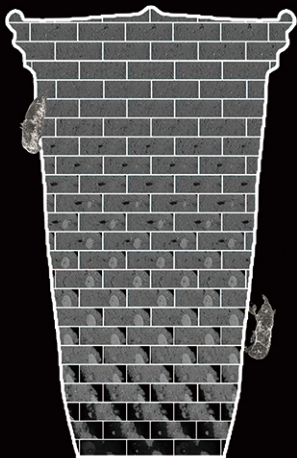
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