The remains of obsidian trade preserved under volcanic ash: the excavation of Yoko-o Site, Oita City, Japan

Takumi Furukawa (Cultural Assets Division in Board of Education, Oita City)

Yoko-o Site is a relay station site of obsidian trade on water route in early Holocene. This site shows humankind' s environmental adaptation under marine transgression, and remains of the greatest volcanic disaster since the Japanese Archipelago formed.

Yoko-o Site is located in Kyushu Island, the west of Japanese Archipelago (**Fig 1**). Oita City, Yoko-o Site locating, is in the east of Kyushu Island and facing inland sea, Seto Island Sea. Yoko-o Site had continued intermittently from the latter half of Initial Jomon period (7900 cal BP) to late Jomon period (4000 cal BP) in Japan. My colleagues and I excavated the remains of obsidian trade in Yoko-o Site. Those were preserved under volcanic ash that fell down in 7300 cal BP.

At this time, early Holocene climatic optimum caused rapid marine transgression. In Japan, marine transgression in early Holocene caused to form of inland sea, Seto Island Sea. Formation of Seto Island Sea means that whole area of Western Japan was connected by marine route. People in Western Japan started marine trade then. One of the archaeological materials that indicate existence of this marine trade is obsidian from Himeshima Island. Himeshima Island is located in Seto Island Sea and the center of main islands of the Japanese Archipelago, Honshu, Shikoku, and Kyushu (**Fig 1**). Himeshiman obsidian trade via Yoko-o Site had been done mainly from the latter half to the end of initial Jomon period (between 7900 and 7300 cal BP), at the nearly peak of marine transgression.

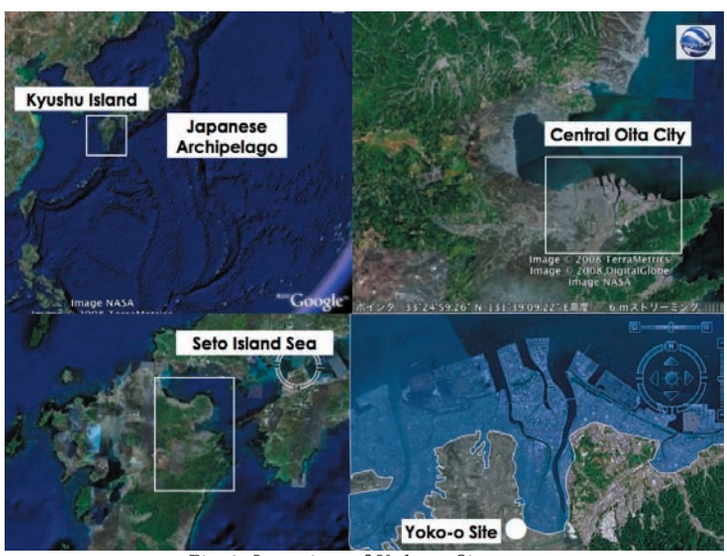

Fig 1. Location of Yoko-o Site

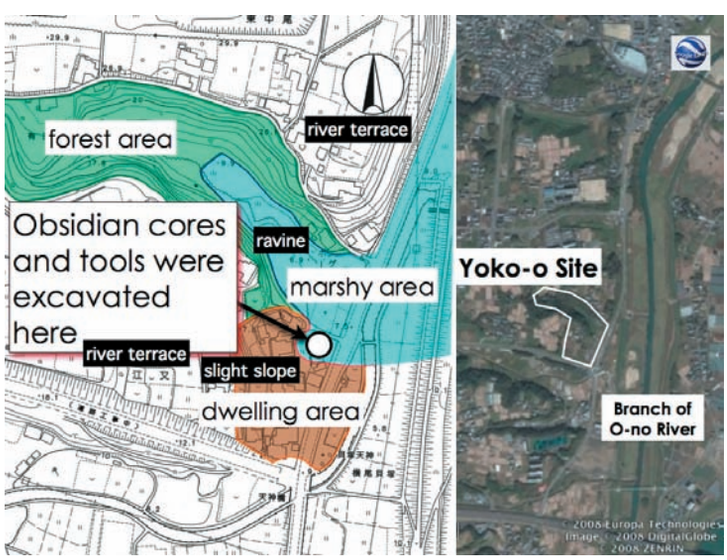

Fig 2. Found point of Obsidian at Yoko-o Site

Yoko-o Site is now at side of branch of O-no River, and 8 km upstream from the river mouth. But in early Holocene, under marine transgression, Yoko-o Site was located in the inner part of the bay, facing sea and mainstream of O-no River. Yoko-o Site was formed at the foot of river terrace and ravine facing O-no River. Slope

between terrace and ravine is slight. River terraces besides the lower O-no River have been almost steep except for Yoko-o Site. Thus, Yoko-o Site was only and best place for water trade in initial Jomon period. According to previous excavations and environmental investigation, this site can be divided into the marshy, dwelling, and forest area (**Fig 2**). We found many obsidian cores, flakes and tools at one point at the marshy area.

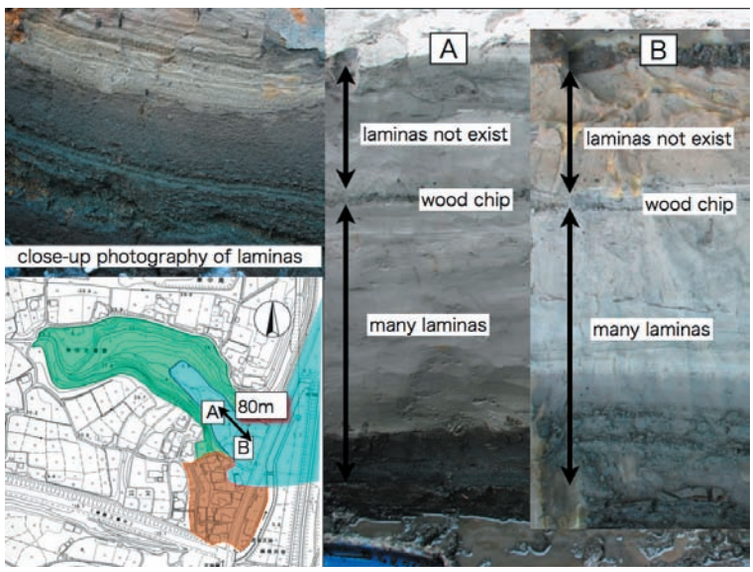

Fig 3. Laminas on layers of volcanic ash(AKAHOYA)

At this point, we found nut' s storage pits in 4000 cal BP. The marshy area was the land after marine transgression, people made several pits looking for water from the ravine. In storage pits, we found that white gray colored sand accumulated, and water gushed out from this layer. It was the layer of volcanic ash has been called "AKAHOYA" . AKAHOYA fell down in 7300 cal BP. At the marshy area of Yoko-o Site, water from the ravine has been continuing so that AKAHOYA has been kept original white gray color. We detected this volcanic ash at whole area of Yoko-o Site. Especially we found that it accumulated thick at the marshy area. Diatom analysis indicated that the marshy area was the inner bay because of marine transgression as the volcanic ash fell down. AKAHOYA was derived from Kikai Caldera in south sea of Kyushu. We found a lot of laminas in volcanic ash layers (**Fig 3**). The laminas existed in only lower layer of volcanic ash. In upper layer, no laminas were observed. Thus, laminas showed that running water occurred during very short time when volcanic ash was falling. Laminas in volcanic ash layer existed at two points at intervals of 80m. It shows running water occurred in greater part of inner bay. Water flowed two-way between land and sea. According to Mr. Osamu Fujiwara (Active Fault Research Center Geological Survey Of Japan), these layers show repeated arrival of high-density currents and evidence of a very long wave period that is characteristic of a tsunami. Eruption of Kikai Caldera caused tsunami with volcanic ash falling.

This disaster brought change in vegetation, too. According to Prof. Masaaki Kanehara (Nara University of Education), pollen analysis indicated that population of chestnut trees and tall evergreen oaks increased, on the other hand, population of hackberries suddenly decreased after volcanic ash falling. Identifying tree species of buried wood shows deciduous broad leaf trees decreased sharply after volcanic ash falling except for chestnut trees. The eruption of Kikai Caldera caused not only volcanic ash falling, but also tsunami and sudden change in vegetation.

Just under the volcanic ash layer we found two large timbers and a basket filled with obsidian (**Fig 4, 5**). This basket seems to be put on the earth because structural remain of deposit was not found. Notably, volcanic ash (AKAHOYA) in 7300 cal BP covered over directly the timbers and basket. Two timbers were set up on the slight slope between dwelling and marshy area. They were fixed with wood post. At that time, according to diatom analysis, this point was boundary zone of fresh water, sea, and land. Thus, Its ground was very soft. Two timbers had functioned as slope protections and footholds. This point was facing inner

bay and O-no River in this time. Near by this point, there must have been loading or unloading point used for water trade. Two timbers were connecting unloading or loading point to dwelling area for transporting obsidian. In 7300 cal BP, tsunami didn' t come here. But there were remain of a severe earthquake. People gave up transforming obsidian halfway, and abandoned a basket filled with obsidian.

Fig 4. Two timbers and a basket filled with obsidian just under volcanic ash layer

This point was the carrying way connecting unloading or loading point to dwelling area in 7300 cal BP. Himeshiman obsidian was transported by boat on sea and carried Yoko-o Site' s dwelling area through slight slope. The basket filled with obsidian might have been brought from Himeshima to Yoko-o Site. Or the basket might have been carried out from Yoko-o Site to another site. Because we can' t make sure where obsidian flakes and small cores in the basket were broken. Any way this basket

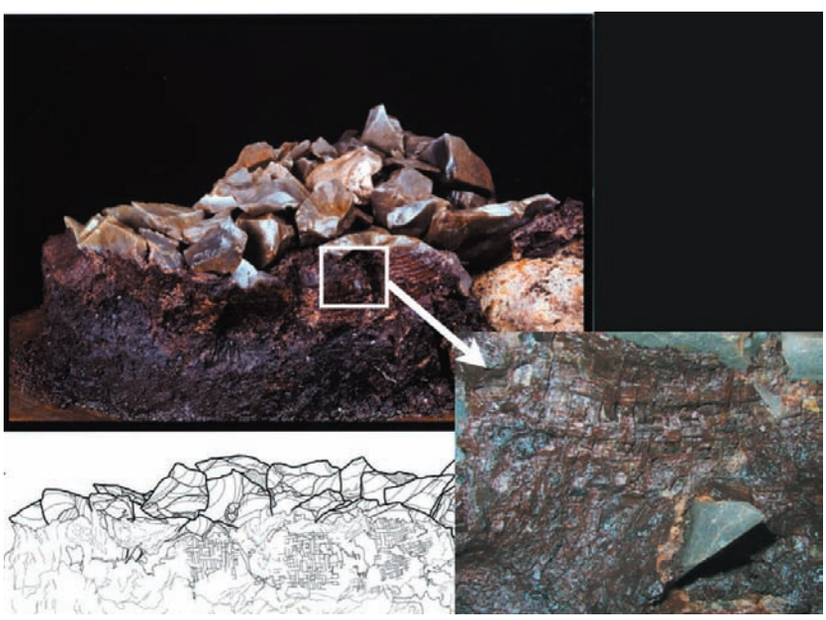
Fig 5. Close-up of a basket filled with obsidian

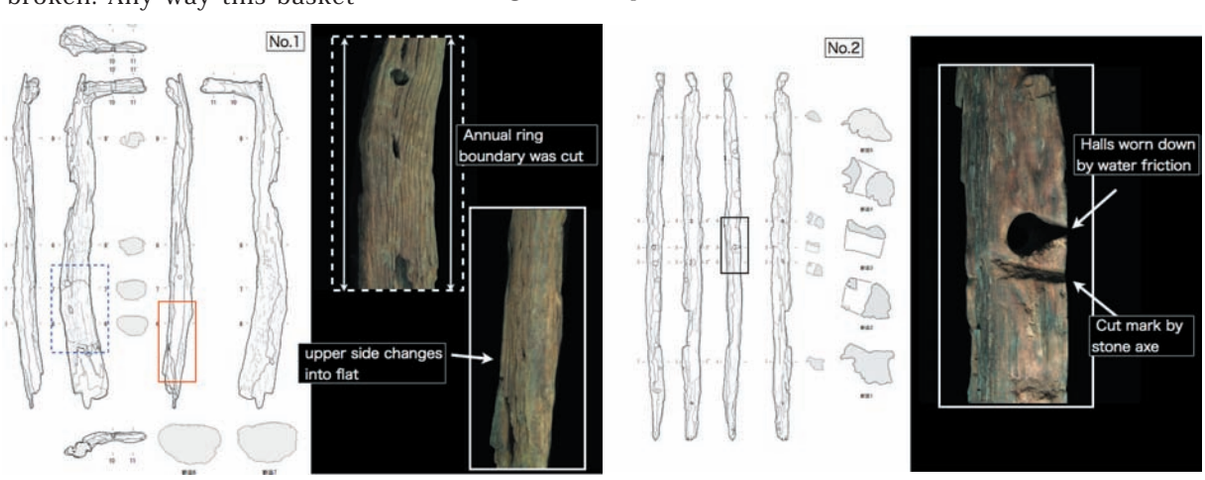

Fig 6. Close-up of two timbers(left: No.1 right: No.2)

shows carrying way of obsidian.

Two timbers besides a basket were carried and set up in this point by Jomon people. The subgenus of No.1 wood species is tall evergreen oak (**Fig 6 left**). Its annual ring boundary was cut artificially. It has branch and small holes. At first, we think that the holes are artificial, and it might have been used for a timber of house. But according to Prof. Masahisa Yamada (Tokyo Metropolitan University), woodpeckers made these holes. Upper side of No.1 changed into flat partially, and its surface had been worn downed (**Fig 6 left**). Probably these evidences are remains that human being walked on this timber at that time. Radiocarbon dating, identified by Prof. Toshio Nakamura (Center for Chronological Research, Nagoya University), shows that timber was cut between 7600 and 7400 cal BP.

Wood species of No.2 is cladrastis (**Fig 6 right**). It is a rare tree, strong and suited for timber of house. This wood didn' t distribute around Yoko-o Site. We found a cut mark by stone axe on its surface. No.2 also has holes made by woodpeckers. Correspondence with diatom analysis, these holes were worn down by water friction (**Fig 6 right**). No.1 and No.2 were not timbers of house contrary to our assumption, but at least it' s sure that they were formed artificially.

At same point, we found two large-sized obsidian cores on the deepest layer. Two cores are 12.2 and 10.3 kg (**Fig 7**). They were found in the layer of landslip, and remain of deposit was not found. So they may have been abandoned accidentally under natural disaster, too. The wood next to cores indicates around between 7900 and 7700 cal BP. They are the oldest artifacts in Yoko-o Site. According to diatom analysis, this point was seaweed then. The distance from Yoko-o to Himeshima is 55 km. So, It is unlikely that large-sized obsidian cores were transported on land. They must have been transported on sea route directly from Himeshima Island to this point.

Fig 7. Two-large obsidian cores on the deepest layer at same point

Since the latter half of initial Jomon period, Himeshiman obsidian had been utilized as allow head, drill, etc. Its distribution expanded throughout the coastal area of Seto Island Sea. **Fig 8** shows distribution of Himeshiman obsidian between initial and late Jomon Period. Himeshiman obsidian has also been found at the settlements at riversides. Each river route from Seto Island Sea had delivered obsidian. At every river mouse, there were settlements functioned as relay stations of obsidian trade. Deposits of large- or middle-sized cores have been excavated in those sites. The relay stations at river mouth had a lot of Himeshiman obsidian. As going against the stream, quantity of Himeshiman obsidian decreased, and its cores tended to be

miniaturized.

Himeshiman obsidian seldom distributed until the latter half of initial Jomon although Himeshima was recognized as the stone resource in the former period. Why distribution of Himeshiman obsidian could be expanded rapidly such a wide area? According to Prof. Hiroshi Machida (emeritus professor of Tokyo Metropolitan University), Himeshima changed from mountain to island about 9000 cal BP caused by marine transgression. Before 9000 cal BP, quarry of obsidian had been on a mountainside of Mt.Himeshima and perhaps not cropped out. Under marine transgression, the quarry became to face the seashore from that time. Therefore it became very easy to load obsidian cores on a boat directly from the quarry. Himeshima obsidian outcrop is now 120m widths, 40m high, the greatest outcrop of obsidian in Japan. Then people could bring Himeshiman obsidian widely and extensively across Seto Island Sea by boat. People adapted marine transgression in early Holocene, started Himeshiman obsidian trade across Seto Island Sea. As a matter of course, trade across Seto Island Sea has been taken over in later period.

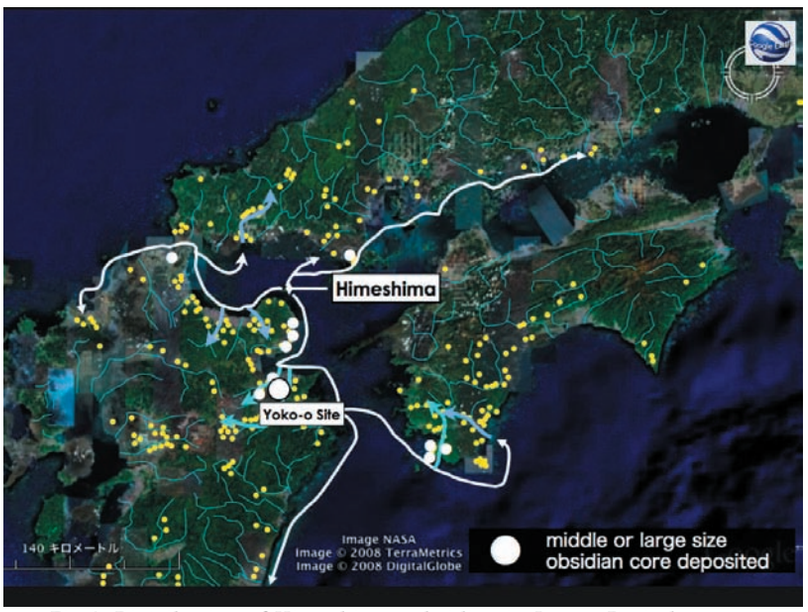

Fig 8. Distribution of Himeshiman obsidian in Jomon Period

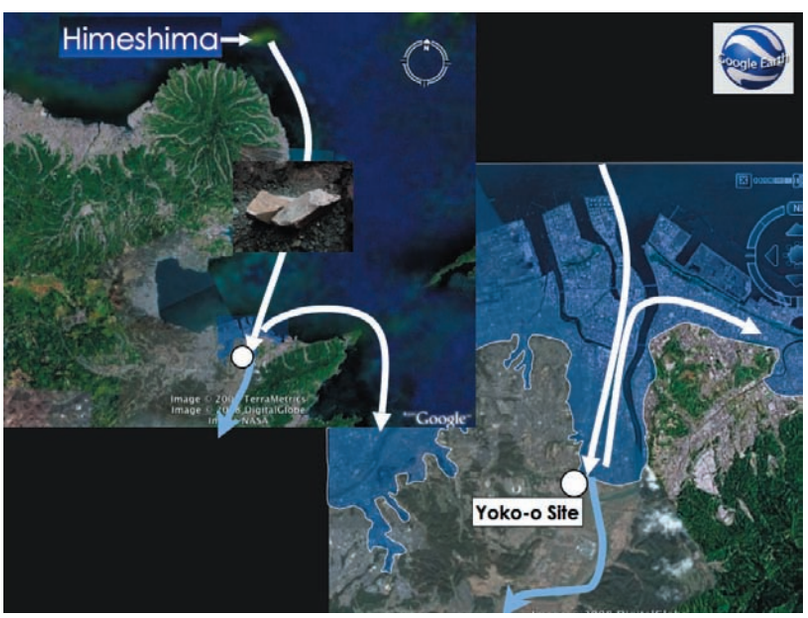

Fig 9. Water trade route of Himeshiman obsidian via Yoko-o site

Yoko-o Site had been functioned as a relay station of Himeshiman obsidian trade across sea and along O-no River (**Fig 9**). This site is the important site because a lot of obsidian cores and tools were found there. In the latter half of initial Jomon period, Yoko-o Site had been suitable location for trade across sea and river. Two large obsidian cores must have been brought directly from Himeshima to Yoko-o settlement across sea. Large-sized obsidian cores brought to Yoko-o were divided into small- or middle-sized cores, or made into tools. Then they were transported to the upper reaches of O-no River, or far-off coastal area. Yoko-o settlement had functioned as a relay station of Himeshiman obsidian' s trade from that time. Kikai Caldera' s eruption wiped out obsidian trade at Yoko-o Site once. But Yoko-o Site revived 7000 cal BP, and obsidian trade restarted. Oita Prefecture Board of Education excavated deposit of a middle-sized Himeshiman obsidian core.

Conclusion

1. We detected the detail of disaster caused by Kikai Caldera. This eruption was the greatest volcanic disaster since the Japanese Archipelago formed. Eruption of Kikai Caldera destroyed many villages in South Kyushu. Our excavation of Yoko-o Site shows severe effects of this eruption on the vegetation and obsidian trade.

2. We acquire a lead to clarify marine trade of Himeshiman obsidian in early Holocene. Two large cores indicate direct transport from Himeshima (obsidian resource) to Yoko-o (relay station) by boat. And a basket filled with obsidian informs us another form of carrying obsidian. We can' t identify this basket had been brought from Himeshima to Yoko-o, or it had been brought from Yoko-o to another settlement. But we want to emphasize it is a rare material showing the way of carrying obsidian.

3. Marine trade route in Seto Island Sea started at this time. Himeshiman obsidian trade via Yoko-o Site was wiped out once by volcanic disaster. But marine trade route in Seto Island Sea has been taken over since then.

Bibliography

Oita City Board of Education ed. 2008 YOKO-O KAIDUKA: The Excavation of Yoko-o Site. Oita City Board of Education

Osamu Fujiwara, Ken Ikehara and Futoshi Nakayama ed. 2004 The geological society of Japan Memoirs 58. The geological society of Japan

The history of Oita City editorial committee 1987 "The history of Oita City" first volume. Oita City

Oita prefecture museum of history 2007 "Account of excavation in Oita" Oita prefecture museum of history

Satoshi Shiga 2003 'Topographic Reconstruction of the Himeshima Island and Utilization of Himeshiman rocks in Paleolithic' Stone Sources No.3

Shun' ichi Watanuki 2003 'Lithic Economy and Distribution System of Himeshiman Obsidian' Stone Sources No.3