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Masaaki KIMURA, Toshio NAKAMURA, Koichi KOBAYASHI, Hidenori YAGI,  
Yoshiko ISHIKAWA, Mie UEDA, Michiko SAKAMOTO, and Takuya CHIHARA

Department of Physics and Earth Sciences, Faculty of Earth Science,  
University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa 903-0213, Japan

Email: kimura@sci.u-ryukyu.ac.jp

Dating and Materials Research Center, Nagoya University,  
Chikusa, Nagoya 464-8602, Japan

Research Center for Nuclear Science and Technology,

The University of Tokyo, 2-11-16

Yayoi, Bunkyo-ku, Tokyo 113, Japan

Reprinted from the  
Bulletin of the Faculty of Science  
University of the Ryukyus  
No. 72 September, 2001

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Masaaki KIMURA\*, Toshio NAKAMURA\*\*, Koichi KOBAYASHI\*\*\*, Hidenori YAGI\*,  
Yoshiko ISHIKAWA\*, Mie UEDA\*, Michiko SAKAMOTO\*, and Takuya CHIHARA\*

\*Department of Physics and Earth Sciences, Faculty of Earth Science, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa 903-0213, Japan

Email: kimura@sci.u-ryukyu.ac.jp

\*\*Dating and Materials Research Center, Nagoya University, Chikusa, Nagoya 464-8602, Japan

\*\*\*Research Center for Nuclear Science and Technology, The University of Tokyo, 2-11-16 Yayoi, Bunkyo-ku, Tokyo 113, Japan

### Abstract

Submarine research surveys using SCUBA and sonic surveys reveal detailed topography similar to submarine, pyramidal features looking like a stepped pyramid off Yonaguni in Okinawa, Japan. The site is called Isoki Point (ruins site) as a leisure diving spot. Yonaguni Submarine Pyramid (YSP) is the major structure that stands under approximately 25 meters of ocean. Essentially, it has a cliff face like the side of a stepped pyramid, and dimensions of about 290 m (length) by 120 m (width) by 26 m (height). Flat terraces, straight walls and its surface structure of walls with scars of tool marks driven in by a wedge on the structure are identified to be artificially fabricated. Appearance and size of YSP are similar to the biggest, ancient castles such as Shuri and Nakagusuku Castles in Okinawa Island, where they are called '*gusaku*'. Roads associated with drainage canals were recognized, surrounding YSP, and that a retaining wall was found along a road. The southern point of the wall is composed of huge rock fragments. Stone tools and other artifacts were discovered from the sea bottom. These evidence strongly shows that the YSP has not been manufactured by nature. It is identified to be man-made. The formation age is estimated to be about 10,000 years ago based on  $^{14}\text{C}$  and  $^{10}\text{Be}$  age determinations.

### 1. Introduction

Recently, many submarine configurations looking like artificial ruins have been found



Fig. 1. Location of Yonaguni.

off Okinawa islands in Japan (Kimura, 1997). There are many artificially fabricated configurations beneath the sea off Yonaguni Island (Fig. 1). The location where is widest and most elaborate one is called Iseki Point. Part of it may have been known by fishermen about 60 years ago, and then a local diver found it in 1986 while looking for new leisure diving spots. He called it "Iseki Point" (ruins point) because the appearance is similar to ruins (Kimura, Aratake *et al.*, 2000). However, it has been believed to be a natural phenomenon. The whole shape was never known until our scientific dive team, "Submarine Research Group of the University of the Ryukyus" conducted detailed surveys.

Detailed surveys such as SCUBA diving and sonic sounding using SEABAT with multi-narrow beams have been carried out in the ruins sites by the Submarine Research Group of the University of the Ryukyus since 1992 (Kimura, 1997; Kimura, Aratake *et al.*, 2000; Kimura, Nakamura *et al.*, 2000). Iseki Point is located off the southern coast of Yonaguni Island, about 100 m offshore from the Arakawa-bana Cape (Fig. 2). Over 80 samples for age determination were also collected (Nakamura *et al.*, 2000) (Fig. 3).

Detailed analyses revealed that the Yonaguni pyramid is a monolithic structure composed of layers of sandstone and mudstone. It would be relatively simple to separate the layers and move them apart. They are separated, fractured, and slipped to make flat terraces and straight walls. This was the condition of the stair-like formation we surveyed.

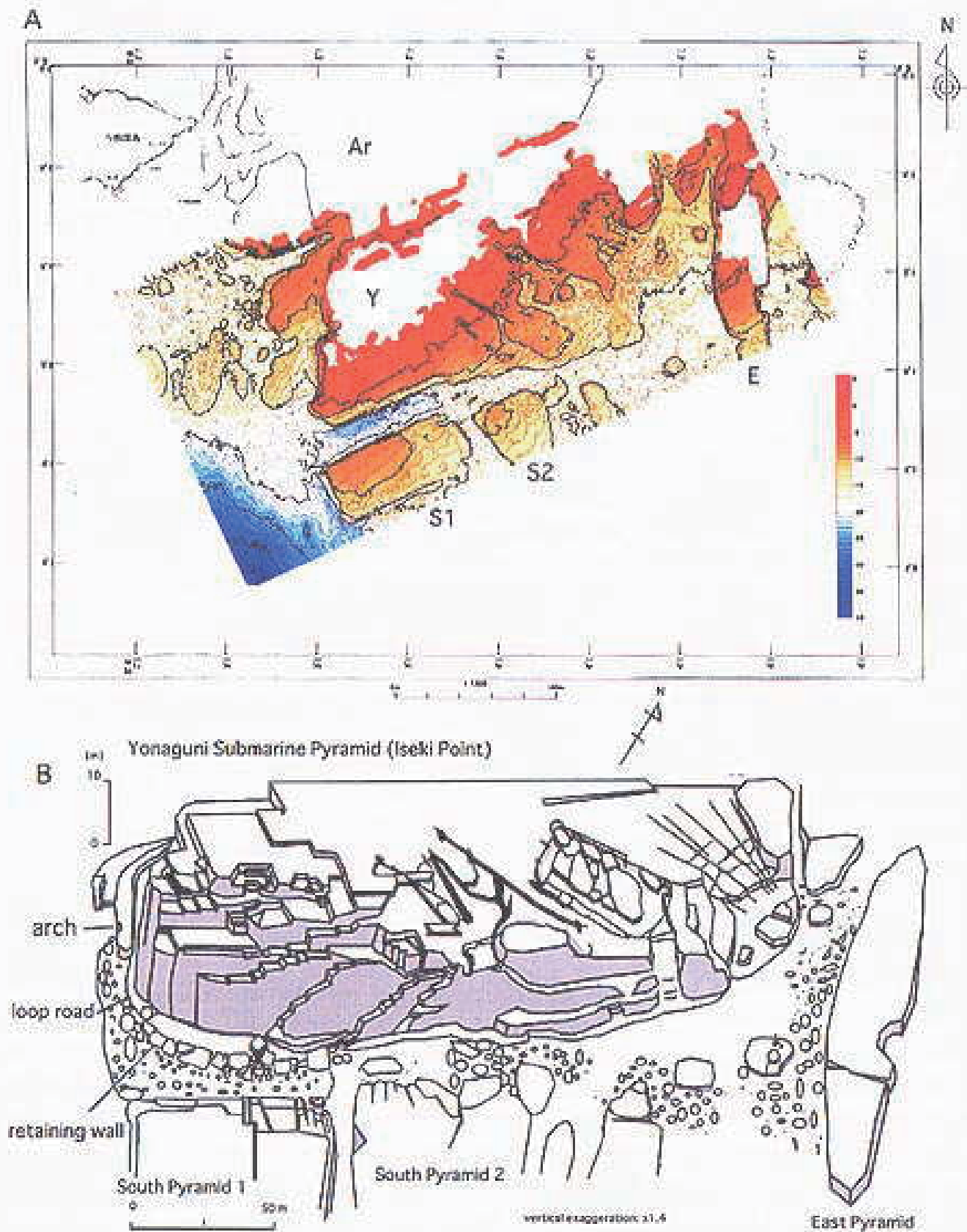


Fig. 2. Submarine topography by SEABAT (A), and compiled topography of Yonaguni Submarine Pyramid (YSP) (B). Ar: Arakawa-bana Cape, Y: Yonaguni Submarine Pyramid, S1: South Pyramid 1, S2: South Pyramid 2, and E: East Pyramid.

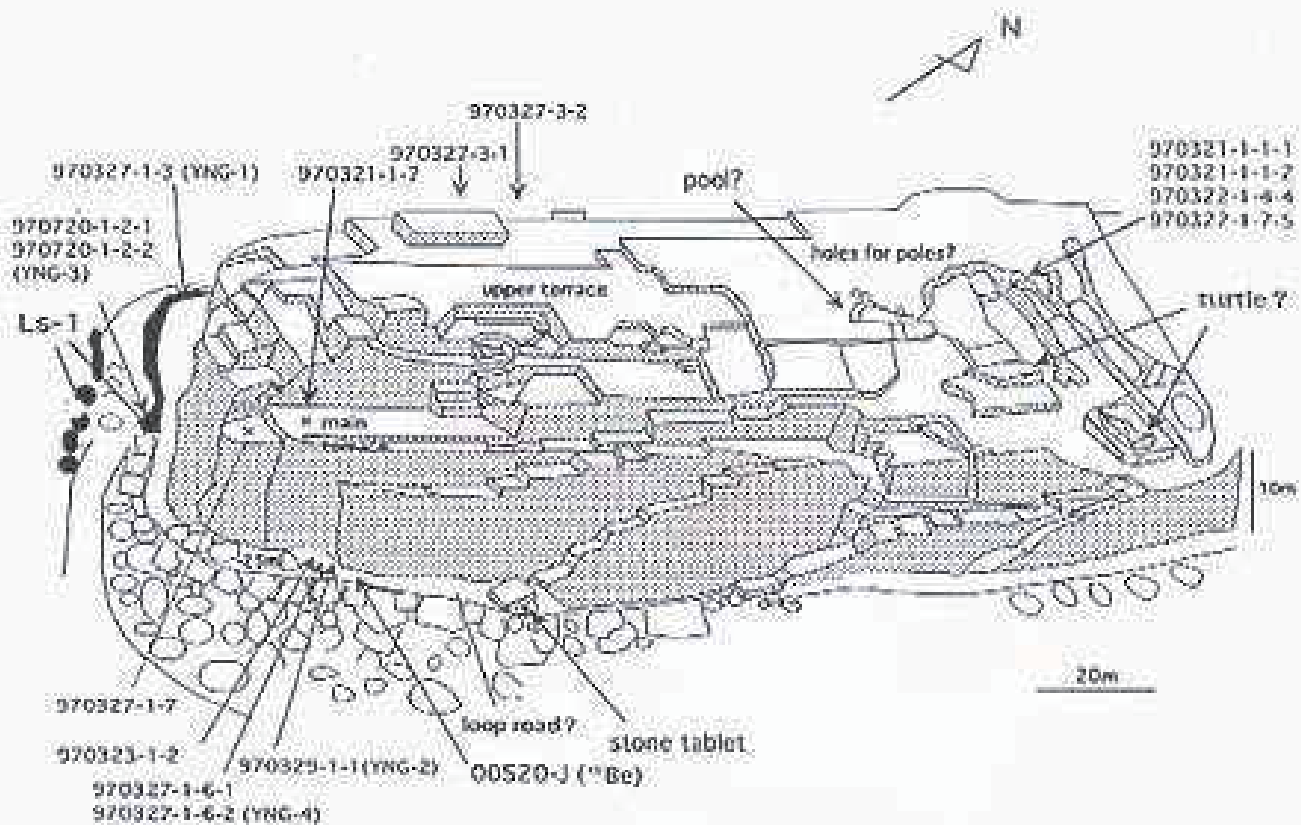


Fig. 3. Schematic 3-D model of the western half of YSP and its vicinity. Samples used for  $^{14}\text{C}$  age determination are shown in numerals. Samples for  $^{14}\text{Be}$  is shown in parenthesis.

Therefore, it would seem to have been formed by nature at the first glance (Hara, 2000; Asato, 2000; Schöck, 1999), though many believe it man-made (for example: Hancock, 1998; Hiraki, 2000).

## 2. Yonaguni Submarine Pyramid and Sanninu-dai Tower

Our surveys revealed the whole shape and specific features of Yonaguni Submarine Pyramid (YSP) (Kimura, 2000a). Three-dimensional maps of it were created. Based on those data, a shape of a kind of stepped pyramid, or fortress, with steps running up its sides appeared. It is a rough rectangle, about 290 m in length, 120 m in width and 26 m in height. It lies about 25 m deep in the water and 1 m above sea level. The upper terrace can be found at only 5 m deep in the water (Figs. 2, 3 and 4).

Structures such as flat terraces, straight walls, and the surface structure of the walls are formed by cutting a huge, monolithic mass of sandstone. These strongly show characteristics of being constructed by humans. It seems to have been fabricated on the land and then been submerged underwater. Its cliff steps resemble a stepped pyramid (Börger, 1998).

Also, there is another, big, pyramidal feature, "Sanninu-dai" or "Sanninu Tower", on



the southern coast of Yonaguni Island (Fig. 5). It stands on the coast but the lower part extends underwater to a submarine depth of about 10 m. At the highest point on the island, a place called Urabu-dake that is 231 m above sea level, is a step-shaped formation strongly resembling the submarine ones.

### 3. Evidence for artifact

#### 3.1 Tool marks

Scars of tool marks driven in by a wedge and others on the structure have been found. It strongly supports the idea that this formation shows the hand of man in its construc-

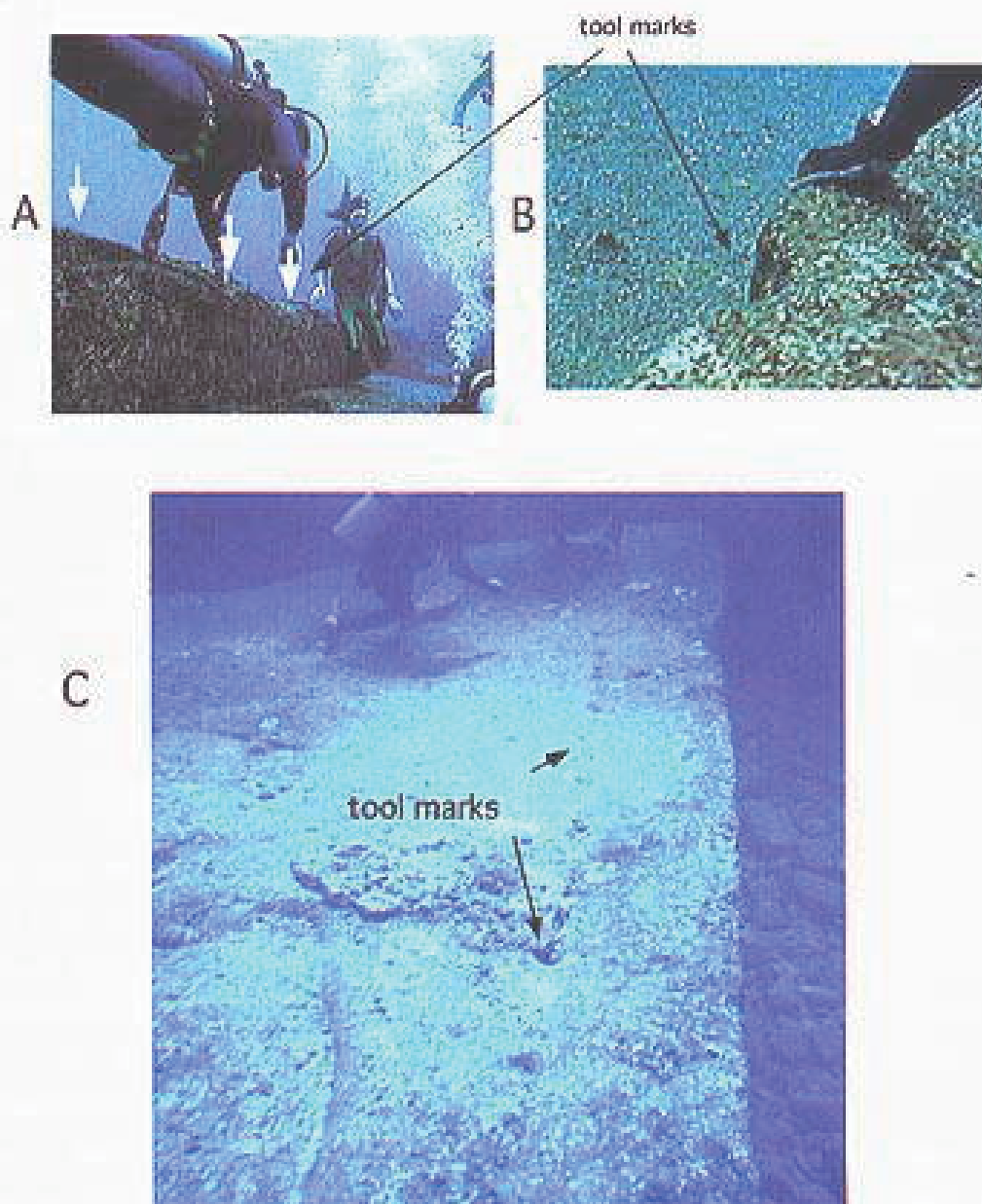


Fig. 6. Tool marks for cutting the stone wall at the upper terrace of Iseki Point (white arrows in A and B). Tool marks driven with edge on the Sekihi (stone monument) Site off Tachigami-iwa (C).

tion. "kusabi" is the name for the wedge-shaped cutting tool used by other ancient people. The photo in Fig. 6 shows the upper terrace of the Yonaguni pyramid (A and B), and B is a photo of the corner edge on the eastern side of A. Look where my left hand is in the picture. It looks like half of a funnel shape. These funnel-shaped depressions are evenly spaced from 20 to 30 cm apart. Fig. 6-C shows a line of holes 'Sekih Stone' off Tachigami-iwa'. This is identified as a tool mark for hole before cutting the rock. It lies at 15 meters underwater on a megalith we nick-named "Sekih (monument) Stone". There we counted more than 70 rectangular cuts lined up at even intervals on the Sekih stone

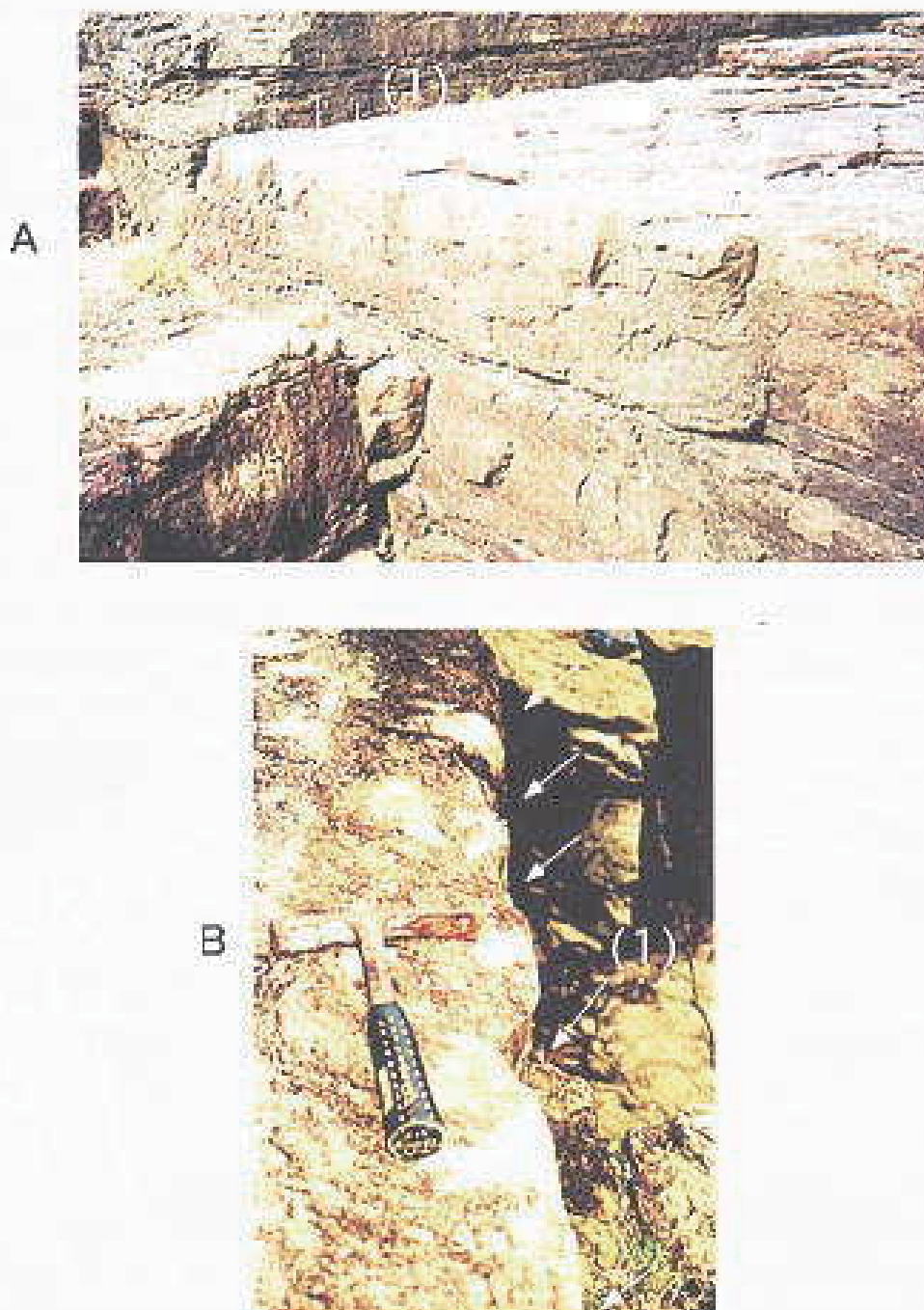


Fig. 7. Scar of tool marks on the flat terrace at Sanninu-dai.



(Fig. 6-C). We made plaster casts of their distinctive shapes to show to marine biologists, who confirmed that these holes are not the work of creatures such as sea urchins.

The tool marks in stone are the strongest evidence so far supporting a man-made explanation for the structure. Having once identified these marks, we began to find them everywhere: on land at Sanninu-dai (Fig. 7). A flat stone in Sanninu-dai on the land bears the scars of stone cutting tools, *kusabi* or *teko* named for their wedge shape.

### 3.2. Terrace formation

The rock layers composing YSP today are inclined 10-12 degrees southeast, and it seems that tidal currents and wave action pulled them apart, and they slipped southward with the help of gravity (Fig. 4). However, it is difficult to explain the formation process of the shape of terrace by natural forces by next evidence:

- 1) There are also terrace-like formations on the west and east, and north (Fig. 4). These are difficult to be explained away by nature and gravity.
- 2) At the top terrace of YSP, there is a formation that looks like a fan-shaped pool, already mentioned (Figs. 3 and 4). Its walls are 2 m high, and the inside is perpendicularly cut but other parts not. For a feature of this shape, where there is no gravitational sliding down the slope by the surrounding walls. The handiwork of man offers the most sensible explanation for its appearance.
- 3) The formation has nearly perpendicular walls all the way from 25 m underwater to

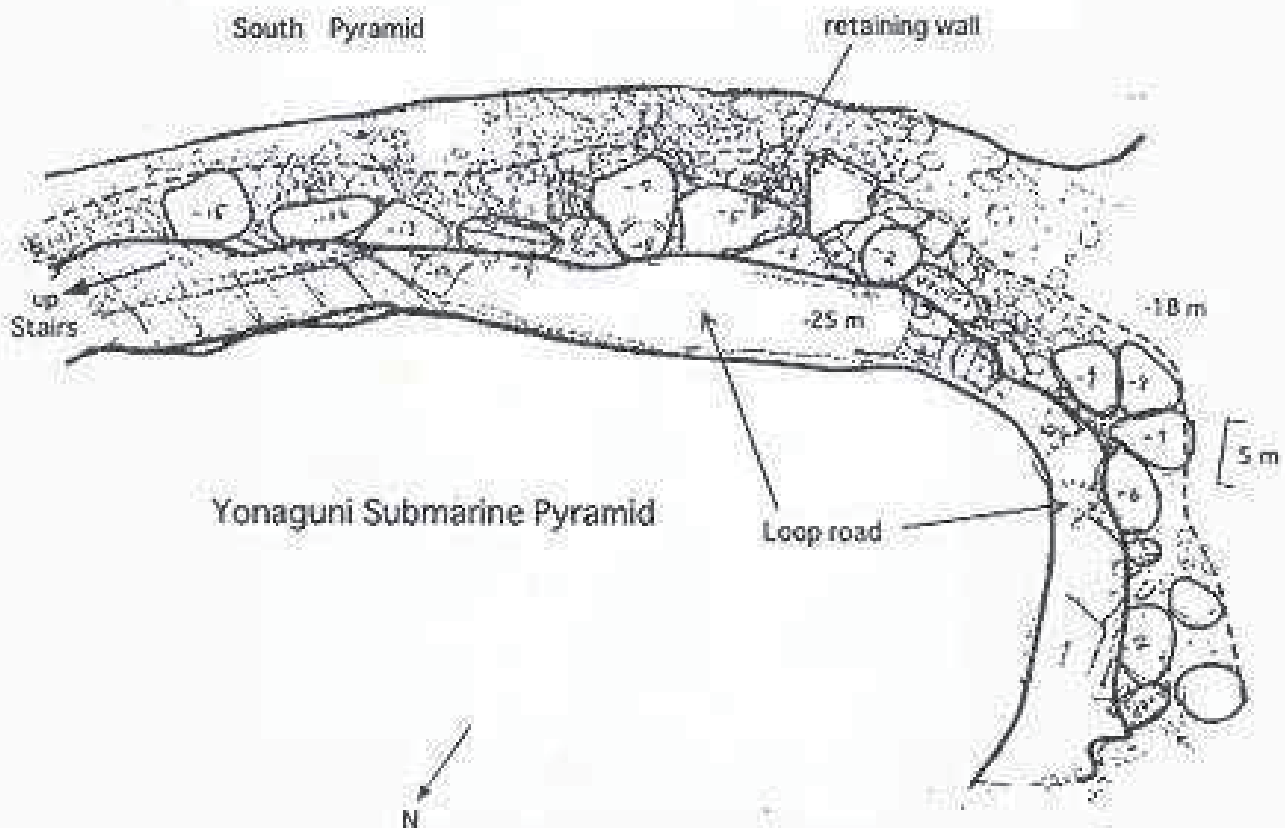


Fig. 8. Loop road surrounding YSP. Huge rocks are lined aside the road.

within a few meters of the water's surface. A natural explanation would require that the same force has been exerted equally all the way up and down and around, but the distributional pattern of natural forces to cut the wall varies from the shallow to the deep. In other words, it shows signs of having been worked on by human beings using stone tools.

4) No rock fragments can be found at the foot of YSP. Next, we checked the deepest point around Iseki Point to look for fallen rock, rock that would have been peeled off and dropped into the abyss by natural forces. But there was not any. Instead of fragments and eroded debris, the area at the foot of the structure, some 25 m deep, looked cleanly swept (Figs. 4 and 8).

### 3-3. Construction works

#### Road

1) It is very significant that there is a space that looks like a road, and that it surrounds YSP (Fig. 8). Usually the thickest sediment should exist in this place, because it is in the deepest part in the narrow valley topography represented in the detailed map in Figs. 2 and 4.

The road is curved along the western corner of the Point at the same width of about 6 m. It is very unlikely that this road was formed naturally, since the surface of the road is clear and there are no rock fragments from the pyramid on the road, as there would be if it was the product of erosion. A road surrounding the structure strongly indicates that human beings made the structure, because any bottom currents never wipe off all heavier rock, weighing as much as 10 tons, from the foot along the structure like Fig. 8.

2) Several stairways are recognized from the road to the main terrace, middle terrace and upper terraces. These seem to be artificially fabricated (N. Ogura, personal communication, 1997).

### Drainage system

Depressions looking like a drainage canal is well preserved on the south side of the main site where the loop road is. These are a feature 20 to 30 cm wide and just as deep parallel to the road (Figs. 4 and 9). The drain crosses the road at the lowest portion toward the more lower place. It could carry water at a rate of 0.02 tons per second. This is too much volume for such uses as irrigation or "city water", but is a useful volume for drainage (Fukumoto, 2000).

This highly functional drainage canal is still visible on the upper terrace and the summit of the pyramid structure. The pool-shaped feature is a case in point.

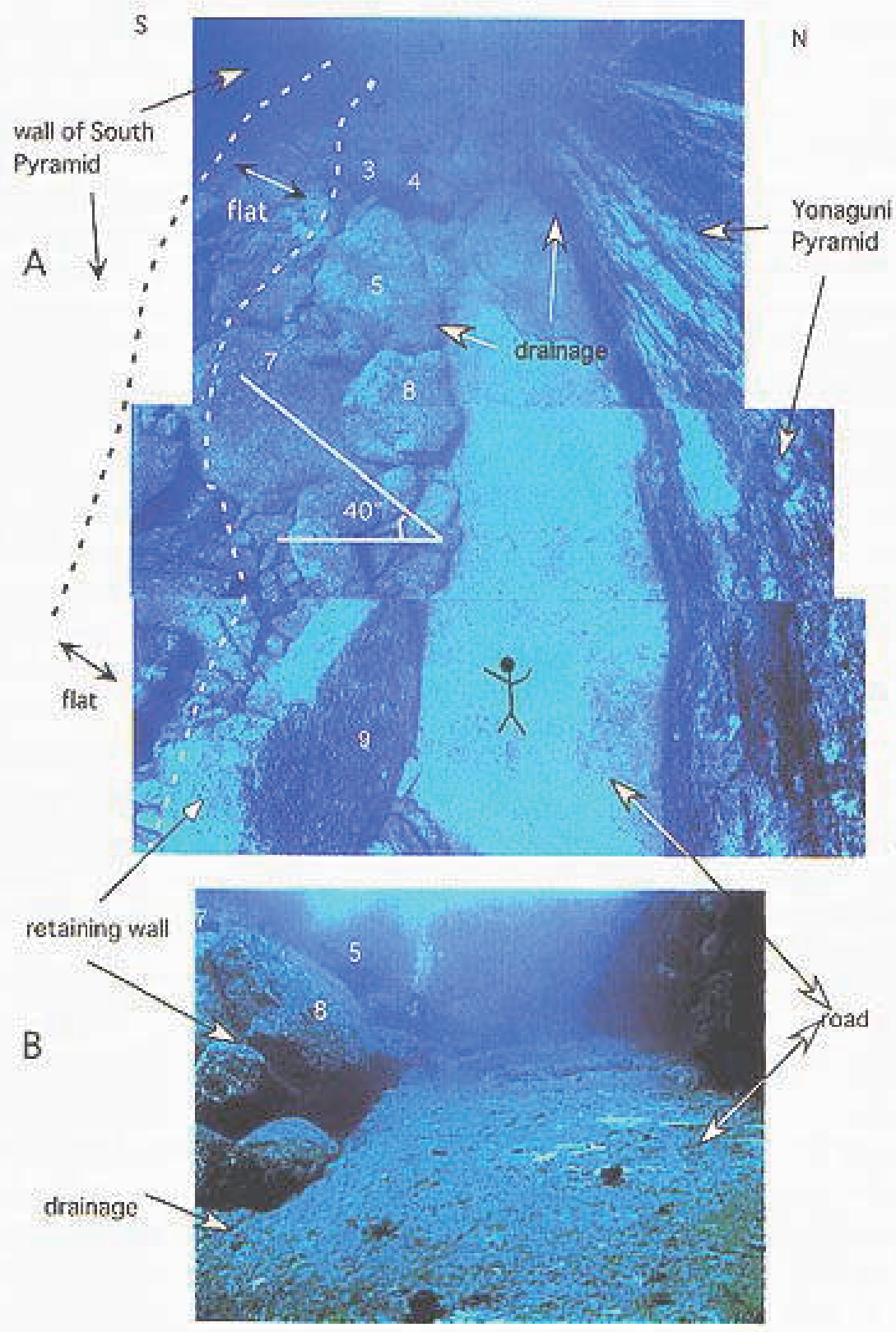


Fig. 9. Plane photo of the road southwest to the pyramid (A). There are no rock fragments fallen from its terraces on the loop road (center of the figure) surrounding the pyramid. Numerals are named for each, giant rock fragment in order to measurement.

### Retaining wall

The huge stones, with diameters of about 2 to 6 m are arranged in a row along the road on the other side of YSP, and form what is like a foundation of a retaining stone wall. It is very unlikely that natural current would form a road and a retaining wall surrounding the pyramid.

Along the southern side of the loop road, following the edge and going straight up, huge rocks are piled up. The height is about 5 m above the road. Strange to say, huge rock fragments stand a line facing the road. The inclination of the wall is about  $40^\circ$ . However,

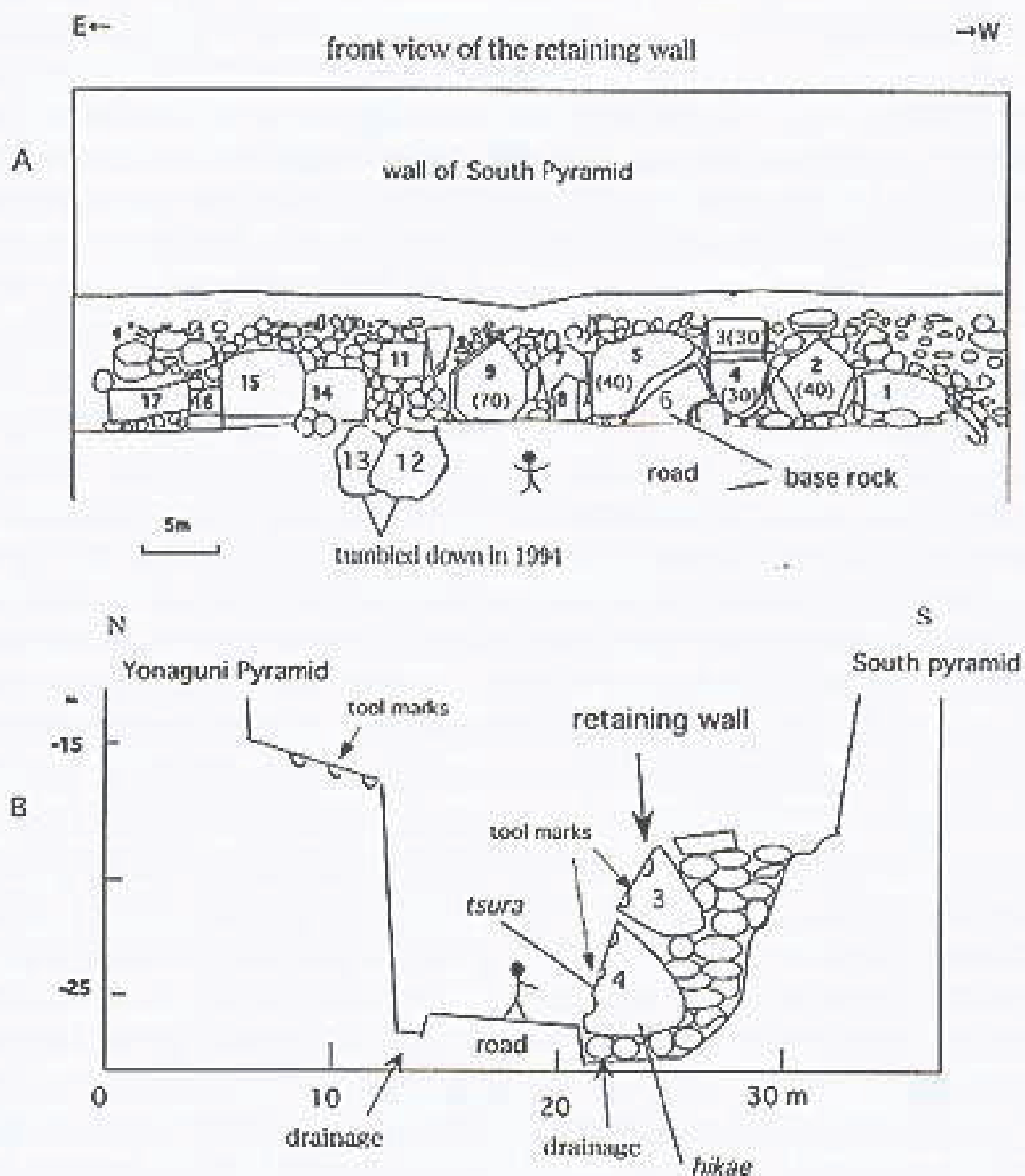


Fig.10. Road and retaining wall system. A: Front view of the wall, numbers on huge rocks are the same in Fig. 9. Number in parenthesis show inclination of the rocks. B: Cross section showing a road, drainage canal and retaining stone wall.

the zone from the wall of South Pyramid to the top of huge rocks is almost flat or low angle (Fig. 9), as represented by the schematic cross section is shown in Fig. 10. Those huge rocks are quadrilateral shapes, and five- or six-sided rubble, piled to heights sometimes exceeding 5-6 m and roughly fitted together, although they appear random at a glance. Along the outer margin of the loop road has a straight wall cutting down to the outside. The huge rock fragments are set along the outside of the cutting wall, and they are distributed in a single row.

Most of them are at least the same dimensions or longer than their front-facing side. The shape of the huge rock fragments accords with what modern stonemasons call the "*hibae*" (counterfoil) and "*tsura*" (face), and besides that, there are tool marks as mentioned later along the edge of the face (Fig. 10). This is interesting to note because the "*tsura*" part facing the road angles back, away from the road, at an angle of 30° to 70°, 40° on average (S. Fukushima, personal communication, 1998). That the bottom part of each corner stone is a wide flat shape, solidly seated in a bed of smaller, rounded stones, also abides by present-day building wisdom. A smooth, clean line follows the edge of the road, scooped out to hold the foundation stones firmly in place. That is, those huge rocks are identified as corner rocks of the retaining wall (Ueno, 2000, and M. Togashi, personal communication, 1999).

Thus, instead of setting huge rocks directly on the bedrock, they are seated in a bed of gravel, and backed by small stones. In modern terms, "*Uragame-ishi*", both are recognized ways to keep road and wall well drained. On the far side of the road from the wall, the south side, the indentation following the curve of the road would provide proper drainage for the road.

Very important evidence for calling it an artifact is recognized as follows. That is, two kinds of rocks such as angular and rounded ones compose of the wall south of the road. Huge rocks belong to the former, and they are put facing the road. The latter is smaller and they are set beneath and behind the former one. It is very difficult to explain this relationship, because formation processes of both ones are quite different. The former may be from YSP, the latter may be from river side or coast. Thus, both have definitely different origin. Necessarily, it is clearly understood that they were certainly put in place later and arranged by human artifice.

By the way, the width of the wall is about 10 m and the length is about 100 m. The volume of the piled rocks is estimated as less than 5,000 m<sup>3</sup> including rounded gravels. On the contrary, volume of peeled rocks is estimated as 10,000 - 30,000 m<sup>3</sup>. Therefore, volume of the retaining wall should be easily filled by rock fragments derived from YSP.

Based on mentioned above evidence, huge rock fragments are identified as corner stones namely foundation stones of a retaining wall, and their edges show the traces of *tusabi* or such kind of stone-cutting-tool marks (Fig. 10) where they were cut to fit together as mentioned later. Therefore, they should be identified a true retaining wall constructed by

human being.

### 3.4 Overall feature looking like "gusuku"

Our surveys reveal that the overall shape and features of Iseki Point are greatly similar to "gusuku" in ancient Okinawa, Ryukyu. There is a tunnel in front of Yonaguni pyramid similar to the arch gate of the *gusuku*. Also, a pool similar to "Kaa" (= artificial spring, for drinking water) is observed, and holes for pillars (?) are found. In reality, the overall features of Iseki Point especially resemble Shiuri and Nakagusuku Castles, called "gusuku" in Okinawa Island. Those *gusukus* were registered as World Heritage Sites in 2000.

The *gusuku* have steps, and the stone structure seems to be a pyramid (Bürgen, 1998). However, there is a difference between them. Namely, walls of YSP are monolithic while *gusuku*'s walls are composed of laying regularly shaped rocks. Any way, it is sure that features of YSP show a kind of a pyramid. Therefore, it is tentatively named "Yonaguni Submarine Pyramid" (YSP) or "Yonaguni pyramid" as a field name.

The *gusuku* has been thought to be something like a combination of a castle and a temple. Now that there are only their stone walls remaining. Thus, most *gusukus* look like a sort of a pyramid.

### 3.5 Rock art monument

Two big animals estimated as turtles are carved in relief on the underwater bed rock at the upper terrace of YSP (Fig. 3). Also, a submarine statue looking like a "Mooi" in Easter Island is found 1.5 km east of the Yonaguni pyramid near Tachigami-iwa (Kimura, 2000b). It stands on the sea floor about 15 m deep and shows a carved mouth, and eyes with clearly defined eyeballs on the coast. It is definitely a man-made construction.

Giant relief of a bird and turtle are found in relief carving the central terrace of Sanninu-dai, on the coast. The total length of the bird's wings are 20 m, and its relative height is 30-50 cm from the ground. Their overall shapes become clearest when seen from an airplane as with the drawings of Nazca in Peru. The site is about 2.5 km east of the same Arakawa-bana location that served as a reference marker for Yonaguni Submarine Pyramid.

Sanninu-dai (=Sanninu Tower) itself is regarded as ruins showing pyramidal shape continued from the underwater formation, an impressive feature testifying to the presence of ancient peoples. A fireplace was discovered on the tower. Charcoal in the 2-meter square hollow showed  $^{14}\text{C}$  age of  $1,650 \pm 80$  yr BP (Nakamura *et al.*, 2000).

## 4. Remains

### 4.1 Stone tools

Two pieces of rocks identified to be stone tools have been collected near YSP (Fig.11). They were identified by 13 archaeologists of Japan, Korea and Taiwan. One stone tool was found 1 km northeast of Sanninu-dai in sandy ground 18 m below sea level in 1999. It measures 16 cm by 9 cm, and is 3.5 cm thick (Fig. 11-C). It was made by chipping away parts of sandstone of the Yaeyama Group and it was a tool used for works. It is a stone adze, a small hand tool, like an axe. Usually, a simple stone axe has one cutting face, but this one seems to have been sharpened on the sides, too. From the marks on it, it seems that first the shape of the tool was chipped from the stone, and after that the edges were ground away. This could have happened while it was lying on the bottom of the sea, being churned around in the sand floor. However, it shows signs of wear, from having been used as a tool. Another archaeologist commented that the wear and tear shows up only on the sharpened cutting face of the tool. If it were being ground away by natural forces, the wear and tear would show up all over, not just on the cutting face (S. Oda, personal communication, 1999).

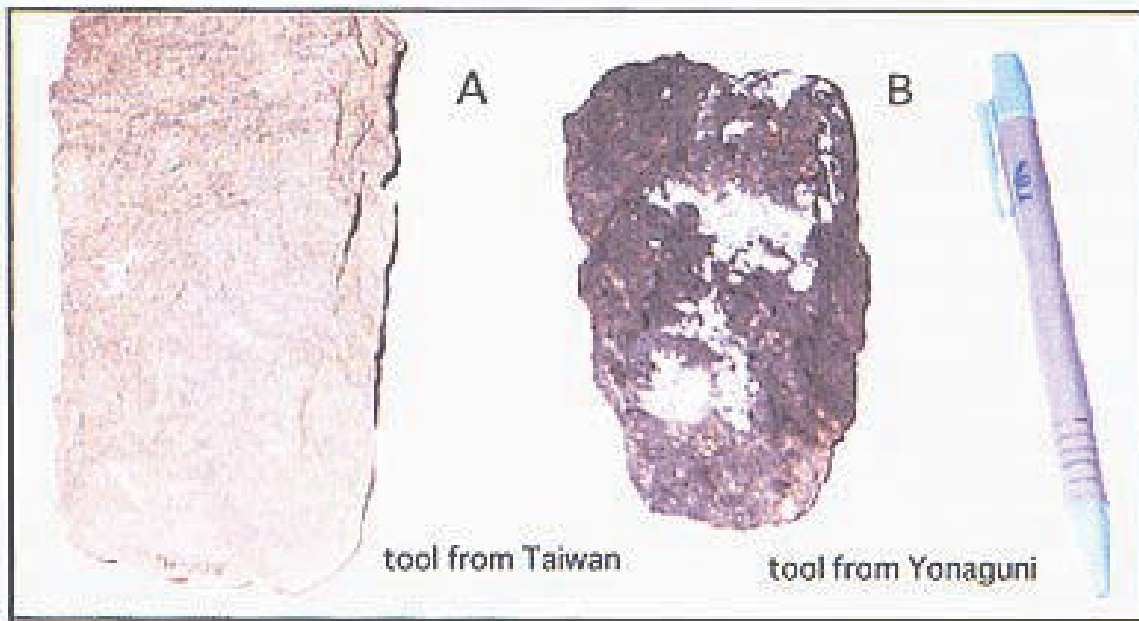
It was about a 10 m square of sandy ground and the terrain around it includes a steep cliff face, a tunnel, and other complicated formations—not the kind of place where an object that had been carried away from what is now dry land would end up. It looks different from other stone age tools that have been unearthed from Yonaguni Island. Therefore, it should be uniquely related to the submerged ruins of YSP.

There is another sample recovered from a place southern foot of Iseki Point, at a depth of 15 m in 1997 (Fig.11-B). This is composed of dark, fine-grained sandstone of the Yaeyama Group, resembling the one from off Sanninu-dai. Archaeologists in Japan and Taiwan agree with that it is definitely a stone age tool. There is a comment that tools of this type are often found on the Yaeyama Islands in the same chain as Yonaguni dating from 10,000 - 2,000 years ago (S. Oda and Shijun Asato, personal communications, 2000).

Archaeologists of Taiwan University concurred that our rock samples strongly resembled stone tools frequently found on Taiwan. They are pointed out as a farming tool for chopping up the ground, like a hoe or mattock. The ages are 4,000 to 2,000 years ago.

In any case, the samples we discovered underwater differ from those usually found on the dry land, including in Yonaguni, in that the land ones have been ground into shape, but ours were the product of a chipping away process.

Stone tools found in the Ginama Submarine Stalactite Cave in northern Okinawa Island, their ages estimated at from 20,000 to 7,000 years ago (Kimura, Kato *et al.*, 2000). They are a type of stone tool, a piece of stone peeled off from a large piece. We are inclined to believe that the ones found on Yonaguni must be from around 10,000 years ago.



tool from Yonaguni

Fig.11. Stone tools recovered from the Yonaguni Submarine Pyramid and its vicinity.  
A: Hand ax in Taiwan, B: Adze from the Yonaguni Submarine Pyramid in 15m deep.  
C: Stone ax recovered from the vicinity of the submarine Pyramid in 10 m deep.



All experts said that these are tools used in farming. If those are farm tools, there must have been farms at or around Isoki Point in ancient times. In addition to the above samples, we have a collection of other pieces of worked stones, such as tools or toys.

#### 4.2 Stone tablet carving symbols

Beneath a huge rock, recently collapsed a part of the retaining wall, an interesting tablet-shaped piece of stone was retrieved from the end of the loop road at the depth of 23 m in 1998 (Fig. 12). It measures about 24 cm long, and 16 cm wide, and is 2 cm thick. It is made of black shale of the Yaoyama Group, distinguished by very thin black layers, and inscribed on it are two symbols. One looks like a cross mark, or the Roman numeral for ten, and the other like a V, or the Roman numeral five. Those are similar to markings on the "Rosetta Stone of Okinawa" that was found on land in Okinawa, the main island. There are also two holes drilled through it, and a vague indentation in the submarine tablet (Fig.12).

We examined it for signs of erosion, or some natural explanation for the markings. Geologists and oceanographers who also checked it over found no fractures or fissures that would indicate, or contribute to, natural underwater erosion. That left marine biologists. What if some innocent shellfish had traced the marks or drilled the holes? As the result, the palette-shaped table was identified as an artifact after I discussed it with eleven different biologists and archeologists.

The cross-shaped mark, composed of two lines scratched into the rock, measures 2.7 cm by 1.5 cm. Clearly, it is a man-made symbol. The reason for that verdict lies in a close-up look at the place where the two lines cross. Just like at a traffic intersection, there are four corners. Three of the corners are worn away. One is sharply pointed. That sharply pointed corner is the key point. It means that when the mark was carved, the carving tool was moved in one direction, a hallmark of hand carving.

While I am on the subject of that particular shaped mark, I want to point out another artifact, not from YSP, but an inscribed tablet on display at the Okinawa Prefecture Museum. It is known as the "Rosetta Stone of Okinawa" because of the mysterious writing it bears (Kimura, 1987). That writing has several points in common with the palette stone found at YSP.

How much can be seen in a single inscribed character? First, one end of each line is rounded, and is carved more deeply than the other end. Secondly, you can see which line was carved out, and which was carved over. Third, there are traces of a straight, narrow line down the middle of each wing of the cross mark. While the palette stone from YSP has a generally rounded shape, the "Okinawa Rosetta stone" — even though it is a fragment — shows a layout that tends to be squared, and is much more deeply carved.

Could the palette stone markings not be some kind of trail left behind by a marine animal? The marine biologists consulted say it is hardly likely. No such case has ever been

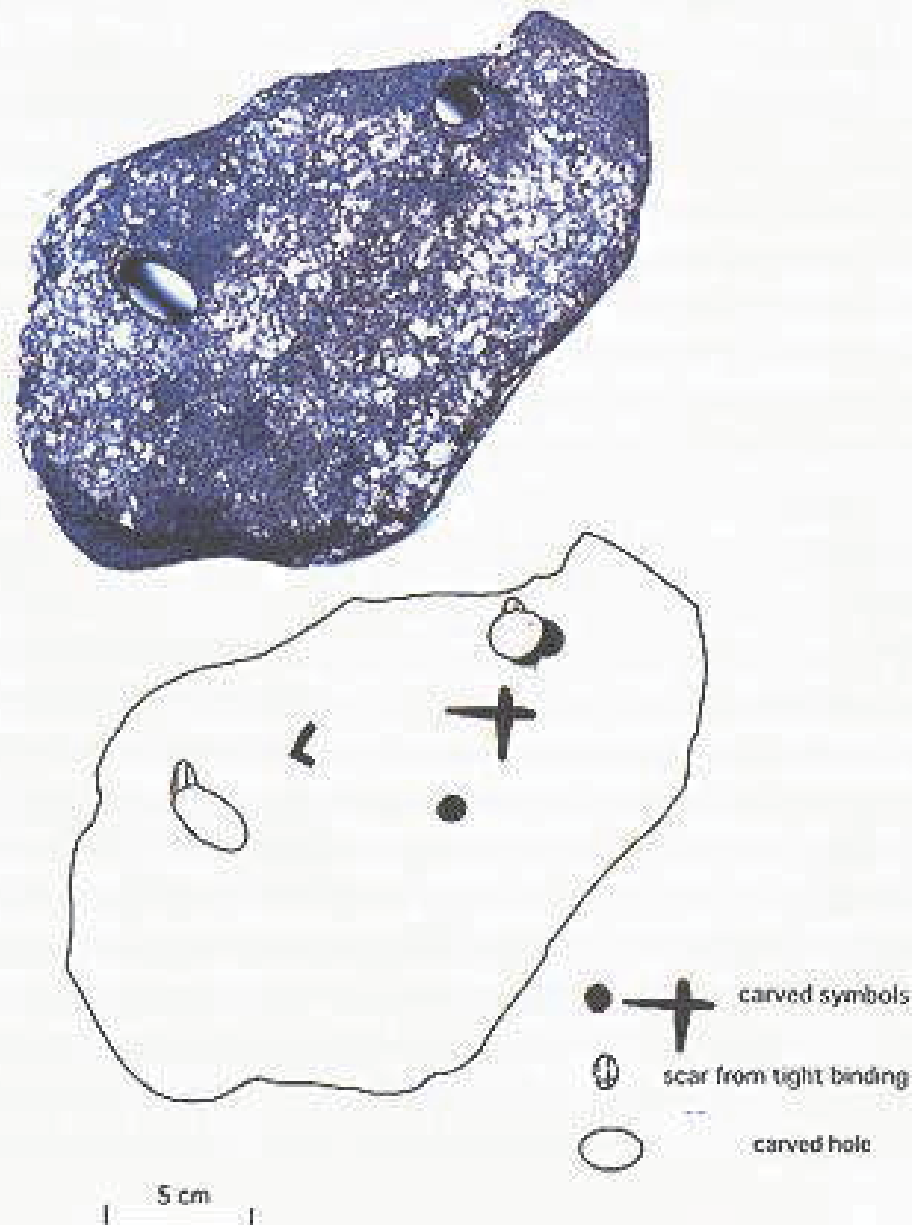


Fig.12. A stone tablet carving some symbols, retrieved from a southern foot of the Yonaguni Submarine Pyramid at the depth of 23 meters in December of 1998.

reported. As for the V-shaped mark, the verdict is the same as for the cross-shaped one. The depth and width of the grooves are strikingly similar.

A stone with a large hole and a small hole drilled all the way through — could it be that some kind of shellfish once made its home there? Because of the vertical and horizontal striations, the best guess is that — even if some kind of sea creature drilled the original hole — whatever was there was deliberately enlarged, by man. Above each of the holes, there is a further indentation, both indentations pointing the same way. It looks as if the stone had been suspended from a line strung through the holes, and the stone worn away. If true, that gives the palette stone an “up” and “down”.

As for the round indentation, biologists have no firm opinion on whether or not a shell fish might have started drilling a hole. There are, however, marks inside the indentation

that indicate it was worked on with a tool of some sort by a man. All things considered, the specialists who examined this specimen conclude that the symbols and holes are man-made.

Next, it is very important to look at the relationship between the stone tablet and Yonaguni Submarine Pyramid (YSP). Here is how we know it was not carried there from someplace else. First, it was pretty well held down in place by a thick growth of seaweed. Now, on the surface, if you overlook the accumulated growths, the lines carved into it look sharp enough to be new. But the color inside the grooves and the rest of the stone does not look any different. Fossilized bits of sea life are covered at the portion inside the carved-out grooves, and the red earth from long ago. It is this detail that spells the difference between something that has been sleeping for ages beneath the sea, and a recently scratched-out item.

Here is another point of view. Suppose this stone with the holes in it was a kind of weight used by fishermen, and their line snapped and the stone they were using sank. Thinking this may be a worthwhile point of doubt, a survey of traditional fishing methods in the area did show that similar stones are used as weights, with one difference. The fishermen pass the line through just one hole, not two.

We went back to the site where the stone tablet was found, and searched again. This time, several stones with similar features – holes drilled all the way through and circular depressions – were found. We picked up four new samples. What is more, among the stones that we did find, there were many with circular depressions that were not drilled all the way through. That rules out their use as weights strung from a fishing line. The fact that so many stones of a similar type were concentrated in one place is not entirely natural looking. Perhaps someone collected them, and dumped them in shallow waters, so that they all collected in one place.

Surveys conducted so far have turned up examples of inscriptions on the bedrock surrounding Yonaguni Island. There was no way to get them up on dry land and study them carefully, but with these “portable” samples for comparison, we have been able to conclude that at least two of the others are also man-made markings.

A symbol carved on the basement rock of the sea floor was found in February 1999, at a point 20 m deep, west of Iseki point. It resembles the alphabet letter “U” and is about 20 cm from side to side and top to bottom. It is scratched to a depth of 1cm or more, not a scar left by erosion and equally unlikely to be a trail left by some sea creature in rock of that degree of hardness. Like the marking on the palette stone, the ends and edges of this groove, too, are cut sharply at right angles; and one end is cut wide and deep, the other end narrows and becomes shallow (Kimura, 2000c).

The other man-made mark was also found at Iseki Point, on the outside of the tunnel-like formation I call the arch, on the western side at a depth of 15 meters. This is the U-shaped symbol in the photo, about 30 cm in length and breadth. It is an open-ended mark,

perhaps closer to a "V" in shape than "U", and because of that, it might possibly be a symbol indicating direction (Kimura, 2000c).

All these marks may have been essentially inscribed for the same purpose, and done while the stones and bedrock were dry land. On the pair of stone pillars, many symbols unknown are carved on the west side of YSP, also reveal similar man-made "U" and "V" shapes on the cobble aside the tunnel similar to an arch gate. Sannin-dai yielded a "T" shape in the depths of the water offshore; and symbols very similar to "Koida-ji" letters, that is ancient unsolved letters in Yonaguni are seen beneath. The shallow seas off Irizaki (=west cape) have yielded several examples of carved depressions. And at the "Tachigami-awa" (=standing god rock), beside the *kasabi* tool marks of Sekibe Stone, symbols have also been detected just above the midpoint.

Allowing that these symbols are hand-carved, the question remains, for what purpose? Comparing the palette stone, with its two holes from which it was probably suspended, and the cross mark and "V" mark, with the Okinawa Rosetta Stone in the museum shows that both have these same kinds of marks. They are also found in traditional Okinawa tattoo patterns. Are they symbols used in ancient charms? Perhaps the palette stone was used as a kind of amulet to attract good or ward off evil.

#### 4.3 Cobble carved in relief of an animal

A big cobble carved in relief in the figure of a four-legged animal (Fig. 13) was recovered from the sea-floor off southwestern Yonaguni, where the water depth is 6 m deep. It is composed of very fine sandstone of the Yaeyama Group. It weighs 60 kg. Its dimensions are 70 by 30 by 25 cm. From the outline, we can guess that it is either a wild boar or a



Fig.13. A relief of a four-legged animal, Wild boar or cow?

cow. First, of course there are marks left behind by a carving tool. It is hard to believe nature would have left such a clear outline, in any case. Turning it to get a side view, it is clear that the raised animal shape does not arise from natural fracture lines inherent to the stone. The relief begins mid-layer.

## 5. Age

Two underwater stalactite caves were discovered in the vicinity of YSP on the time during our surveys. Stalactite caves definitely represent former dry land circumstances, at least 40,000 years ago based on dating of  $^{14}\text{C}$  (Kimura, Nakamura *et al.*, 2000).

The formation age of the Yonaguni Submarine Pyramid (YSP), or Isaki Point, can be estimated as about 10,000 years ago based on over 30 samples for  $^{14}\text{C}$  and  $^{10}\text{Be}$  age measurements (Kimura, Nakamura *et al.*, 2000; Kobayashi *et al.*, 2001) (Tables 1 and 2). It is very important that  $^{10}\text{Be}$  measurement showed age of about 800 years at YSP (Table 2). Because it showed that the point had stood on dry land for a duration of 800 years in the past (Kobayashi *et al.*, 2001). Samples, however, are not enough to determine the final result.

On the contrary, the sample taken from the ancient place of a fire in Sannin-dai showed its  $^{14}\text{C}$  age about 1,600 yr BP (Table 1). The measurement of  $^{10}\text{Be}$  shows that the formation age of Sannin-dai is about 3,000 years ago though data is still scarce (Table 2). It suggests that Sannin-dai on the land is younger than the submarine pyramid.

Add to this some of the other submarine archaeological configurations, one looking like a colosseum or stadium is found 300 m southeast from the main pyramid, and at a depth of 25 m. It spreads over a wide, flat surface and is 60 by 50 m in area. Steps, similar to the audience seats, or bleachers, for a baseball game surround it (Kimura, 2000a).

A paleo-geographic map was made based on research results including recent manned and non-manned diving researches by "Shinkai 2000" and "Dolphin 3K", both belonging to the Japanese Marine Science and Technology Center (JAMSTEC) (Kimura, 1997). It shows that the southern Ryukyu Islands formed a land bridge connected from the Chinese mainland through Taiwan sometime during about 200,000-15,000 years ago (Kimura, 2000d).

Along the land bridge, the Japanese ancestors of ancient man may have come to Japan from the Asian continent and/or southern paleo-land (Oppenheimer, 1998). The last land bridge has been subsided from the northern part since twenty thousand years ago because of crustal movements, and the accompanying sea level change after the last Ice Age.

Tokara and Kerama gaps have subsided at a rate of 1-3 cm per year over the last 20,000 years. The major cause of those subsidence can be explained by crustal movements both effects of subsiding of the Philippine Sea tectonic plate beneath the Eurasian Plate, on the east, and of extension of the "Okinawa Trough" which is an active backarc basin, on the west side. This southwest configuration is rare among the oceans of the earth, as is the fact that the axis continues to lengthen. This is also one of the most tectonically active

places on earth today.

It is reasonable to think that native people may have formed YSP, whose ancestors migrated to Yonaguni along the land bridge.

Table 1. <sup>14</sup>C ages list. Samples collected from Iseki Pointe and its peripheral area off Yonaguni.

No.	Date	Sample No.	Sample Material	Depth (m)	<sup>13</sup> σ C (‰)	<sup>14</sup> C Age (yr BP)	Calibrated Age (cal BP)	Measured No.
1	99'9	970330	corallina	8	-1.0	modern	modern	NUTA-6847
2	98'	970327-3-1	corallina	8	1.0	modern	modern	NUTA-6045
3	97'10	970321-1-1-1	shell	10	+0.9	modern	modern	NUTA-5457
4	97'10	970321-1-1-2	shell	10	-4.2	modern	modern	NUTA-5458
5	97'10	970321-1-7	corallina	10	1.4	modern	modern	NUTA-5489
6	97'10	970322-1-4-4	shell	11	1.6	modern	modern	NUTA-5474
7	97'10	970322-1-7-5	fauna	11	1.4	4951±80	166	NUTA-5475
8	97'10	970327-1	corallina	11	1.0	modern	modern	NUTA-5488
9	99'9	970713-1	limestone	12	-1.6	modern	modern	NUTA-6841
10	98'8	980327-1-3	corallina	13	0.0	modern	modern	Beta-9070
11	98'9	980327-1-7	corallina	13	1.2	4108±80	modern	NUTA-6048
12	98'8	970720-1-2-1	corallina	18	2.1	5,790±80	6,199	NUTA-6175
13	98'8	970720-1-2-2	corallina	18	1.5	4,780±60	5,078	Beta-125737
14	98'	970323-1-2-1	corallina	23	-1.2	modern	modern	NUTA-6044
15	98'8	980327-1-6-1	corallina	23	1.8	1,490±70	1,041	NUTA-6190
16	98'8	980327-1-6-2	corallina	23	1.2	2,400±60	2,020	Beta-125736
17	98'7	980329-1-1	corallina	23	1.1	1,920±60	1,477	Beta-9071
18	99'9	970323-1-3	corallina	25	-2	230±105	modern	NUTA-6840
19	99'11	9811-1	balanus	25	1.2	modern	modern	NUTA2-245
20	99'11	991016-2-9	calcareous algae	25	1.1	modern	modern	NUTA2-247
21	99'9	970718-1-2	limestone	10	2.6	3,430±70	3,321	NUTA-6843
22	99'9	980328-2-1-10	limestone	25	0.5	740±90	409	NUTA-6846
35	99'4	990201-1 (YMG-5-1)	stalactite	5	-10.5	38,480±470	38,720	Beta-128120
36	99'4	990201-2 (YMG-5-2)	stalactite	5	-9.9	42,325±670	42,590	Beta-128121

Table 2. <sup>10</sup>Be ages measured with AMS.

Location	Sample No.	Alt. (m)	Lat.		Angle (deg.)	<sup>10</sup> Be <sub>p</sub> Production Rate		Measured <sup>10</sup> Be/ <sup>9</sup> Be (10 <sup>14</sup> )	Ox. Weight (g)	<sup>9</sup> Be Carrier (mg)	Calculated error (%)		<sup>10</sup> Be <sub>e</sub> Exposure age	
			Geogr.	Geomag.		Geogr.	Geomag.				<sup>10</sup> Be counts	Exposure age		
						(atoms/y.g-50y)	(10 <sup>14</sup> )			(years 1σ)				
Sannin-dai (middle)	000517-C	23	24.4	14.4	12	4.45	3.65	0.005	53.7	0.298	0.792	147	450±670	550±800
Sannin-dai (upper)	000517-D	30	24.4	14.4	6	4.54	3.73	0.057	79.2	0.298	1.42	71	3,100±660	3,800±800
Iseki-pointe (deep road)	000520-J	0	24.4	14.4	10	4.4	3.61	0.014	85.8	0.298	0.3303	58	750±420	910±500
Kubura (land)	000905-2-T	0	24.4	14.4	0	4.47	3.67	1.96	70.1	0.298	30.0707	2.2	68,000±1,600	84,000±2,000
	000905-2-R	0	24.4	14.4	0	4.47	3.67	1.105	70.4	0.298	31.3543	2.1	71,000±1,500	87,000±2,000

## 6. Conclusions

- (1) Submarine researches using SCUBA and sonic surveys revealed detailed features of the submarine structure (Iseki Point) looking like a stepped pyramid off Yonaguni in Okinawa, Japan. It stands under approximately 25 meters of ocean, tentatively named Yonaguni Submarine Pyramid (YSP).
- (2) YSP is the biggest one among fabricated, underwater structures off Yonaguni of which appearance and size are similar to the biggest, ancient castles such as Shuri and Nakagusuku Castles in Okinawa Island, where they are called '*gusuku*'. Essentially, it has a cliff face like the side of a stepped pyramid, and dimensions of about 290 m (length) by 120 m (width) by 26 m (height).
- (3) Flat terraces, straight walls and its surface structure of walls with scars of tool marks driven in by a wedge on the structure are identified to be artificially fabricated.
- (4) Surrounding YSP, roads associated with drainage canals were recognized and a retaining wall along the road that is composed of huge rock fragments, and entrance to the ruins are further evidence for artifact.
- (5) YSP have stood on the dry land during about 800 years after formation of the features, based on  $^{10}\text{Be}$  measurement.
- (6) The formation age of YSP is estimated to be about 10,000 years ago.

## Acknowledgements

The authors thank the cooperative scientists as well as professional divers, Kihachiro Aratake, and Yohachiro Izumi and Tokubiro Hiraki. We also thank Kotaro Maza, Yukishige Oshiro and Shigeru Takemura for identification of tool marks on rocks. Comments by Noriyuki Nasu were very useful for researches of submarine configurations. Michio Okamura, Shinpei Kato, Masahiko Togashi, Shizuo Oda, Shijun Asato, Susumu Asato and Yoshifumi Ikeda provided useful instruction for identification of remains to us. Coralline algae and shells submitted to  $^{14}\text{C}$  dating were identified by Masashi Yanaguchi and Robert Van Woesik. Additionally, we thank Yukio Okamoto, Fumihiko Yamada, Katsuichi Kagoyama, Kenichi Shindo and Koshiro Kizaki for discussion for underwater ruins. Discussions with Graham Hancock, Robert Schoch, Witcherd Wolf and Yoshikatu Goya were also very useful, a part of the research fund was owed by Asahi Beer Academic Promotion Foundation, JDC and TRS VISION. This paper was read by Satoshi Yamamoto and Celine Nisaragi.

## References

- Asato, S., 2000. Lithic culture in Yaeyama and its vicinity – Critique against submarine ruins –. *Chikyū Monthly*, 22 (2), 118-122 (in Japanese).
- Bürgen, L., 1998. *Geheimakte*. Bettendo, Germany, 279 pp.
- Fukumoto, J., 2000. Survey for submarine topography similar to ruins off Okinawa and its governmental correspondence. *Chikyū Monthly*, 22 (2), 123-125 (in Japanese).
- Hancock, G., 1998. *Heaven's Mirror*. Shocci-sha, Tokyo, 335 pp.
- Hara, T., 2000. Comment for submarine ruins point off Yonaguni Island. *Chikyū Monthly*, 22 (2), 115-117 (in Japanese).
- Hiraki, T., 2000. Scenery of the sea-floor off Yonaguni Island. *Chikyū Monthly*, 22 (2) 88-92 (in Japanese).
- Kimura, M., 1987. Line drawing in Okinawa – niraikanai-collapse of the kingdom? –. *The Okinawa Bunka*, 24 (1), 17-41 (in Japanese).
- Kimura, M., 1997. *A Continent Lost in the Pacific Ocean—Riddle of the Submarine Ruins in the Ryukyu Islands—*. Daisanbunmei-Sha, Tokyo, 281 pp. (in Japanese with English content).
- Kimura, M., 2000a (Ed.). *Diving Survey Report for Submarine Ruins off Yonaguni, Japan. The Masada*, Tokyo, 183 pp. (in Japanese with English Q and A and English captions for photos).
- Kimura, M., 2000b. Riddle of Underwater Ruins in Okinawa, Japan—Are They the Oldest Megalithic Civilization in the World?—Daisanbunmei-Sha, Tokyo, 211 pp. (in Japanese).
- Kimura, M., 2000c. Formation of Iseki (ruins) Point off Yonaguni Island—Is it artificial or natural? –. *Chikyū Monthly*, 22 (2), 101-111 (in Japanese).
- Kimura, M., 2000d. Paleogeography of the Ryukyu Island. *TROPICS*, 10 (1), 5-24.
- Kimura, M., Aratake, K. and Submarine Research Group of the University of the Ryukyus, 2000. Research surveys for submarine topography similar to ruins off Yonaguni. *Chikyū Monthly*, 22 (2), 77-83 (in Japanese).



Kimura, M., Nakamura, T., and Ishikawa, Y., 2000.  $^{14}\text{C}$  age measurement of carbonate samples recovered from the Iseki Point off Yonaguni-jima and the sea-floor off Okinawa-jima. *Summaries of research using AMS at Nagoya University (XI)*, 210-230 (in Japanese with English abstract).

Kimura, M., Kato, S., and Nakamura, T., 2000. Irregular shape of flakes of stone tools discovered in submarine stalactite cave off Ginama, Okinawa. *Chikyu Monthly*, 22 (2), 130-136 (in Japanese).

Kobayashi, K., Ueda, M., and Sakamoto, M., 2001. Dating of the submarine structure off Yonaguni with  $^{10}\text{Be}$  measurement. Symposium on Geohistory of Ryukyu Arc and Migration of living things. Geogr. Soc. Okinawa, Nishihara.

Nakamura, T., Kimura, M., Ishikawa, Y., and Oda, H., 2000. Carbon-14 age determination of samples recovered from the topography similar to submarine ruins off Yonaguni, Okinawa. *Chikyu Monthly*, 22 (2), 93-100 (in Japanese).

Oppenheimer, S., 1998. *Eden in the East – the Drowned Continent of Southeast Asia*. Weidenfeld and Nicolson, London, 560pp.

Schoch, R.M., 1999. *Voices of the Rocks*. Harmony Books, New York, 258 pp.

Uema, K., 2000. A consideration for submarine ruins off Yonaguni—based on the view point for a process of construction —. *Chikyu Monthly*, 22 (2), 84-87 (in Japanese).