INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA) OF OKINAWAN POTTERY: CAN IT BE USED TO INDICATE PREHISTORIC CONTACT?

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INTRODUCTION

The development of Okinawan culture cannot be understood in the context of a closed system. The general belief is that the island was in some way associated with the surrounding regions during the major part of its prehistory. For example, at the later end of the prehistoric continuum, during the Gusuku (proto-historic) period (*c.* 10th to 16th centuries AD), Okinawan kingdoms were heavily involved in trade with China, Korea, Japan and Southeast Asia (e.g. Takemoto 1983; Toma 1983; 1987; Pearson, this volume).

At the early end of the continuum is the beginning of the Jomon period, which is defined by the appearance of pottery. It is commonly believed that the oldest Okinawan pottery culture was established through influence from the Jomon culture of Kyushu (Takamiya and Kishimoto 1982). Based on ceramic evidence, there appears to have been a relationship between Okinawa and Kyushu during most of the Jomon period.

At about 300 BC a significant and crucial change in subsistence strategy occurred with the introduction of rice agriculture in the northwestern part of Kyushu. This change in subsistence strategy marks the beginning of the Yayoi period in Japan. During the next 600 years, rice agriculture and Yayoi cultural elements spread through most parts of Japan, which eventually experienced significant social change with the emergence of a non-egalitarian society. The Yayoi period provided the basis for complex society to emerge in Japan.

One of the most important and intriguing issues in Okinawan archaeology has been the question of whether or not the Yayoi culture reached the island of Okinawa during the course of Yayoi expansion. Takamiya (1985b:316) writes that

> [when one considers the development of unique Okinawan culture], it has been of great interest among the scholars whether Okinawa developed its culture independently after the Jomon period, or whether the island was once again involved with Kyushu-Yayoi which eventually influenced the later development of the Okinawan culture.

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PALAEOLITHIC PERIOD				
KYUSHU	OKINAWA	POTTERY TYPES	AVAILABLE C-14 DATES	KYUSHU-RELATED POTTERY FROM OKINAWA
INITIAL JOMON	EARLY I	Yabuchi Agaribaru	6670±140 B.P. 6450±140 B.P.	Tsumegata-mon
EARLY JOMON	EARLY II	Murokawa-kaso Sobata Jokon-mon	4880±130 B.P.	Sobata Jokon-mon
MIDDLE JOMON	EARLY III	1.Gushikawa 2.Kamino C 3.Omonawazentei		
LATE JOMON	EARLY IV	Iha Ogido Oyama Murokawa	3370±80B.P. 3600±90B.P.	Izumi Ichiki
FINAL JOMON	EARLY V	Murokawa-Joso Uzahama	ca. 2480±100 B.P.	Kurokawa
EARLY YAYOI	LATE I	Maezato		Itatsuke II
MIDDLE YAYOI	LATE II	Gushibaru		Yamanoguchi
LATE YAYOI	LATE III	Akajangah		Menda

TABLE 1: CHRONOLOGY OF OKINAWAN PREHISTORY
(after Takamiya 1985b)

Due to recent excavation conducted in Okinawa it is now believed that at least some Yayoi elements reached the island as early as 300 BC. Yayoi pottery has now been recovered at several sites on Okinawa.

In order to elucidate the nature of the relationship between Okinawa and the islands to its north, and thus to provide some basic information with which to help answer the question addressed by Takamiya (above), a chemical analysis of pottery sherds was carried out in order to provide a quantitative basis for distinguishing "foreign" pottery

from the locally manufactured Okinawan pottery. Instrumental neutron activation analysis (INAA) is considered to be one of the more useful methods for ceramic analysis (Harbottle 1970; Hancock 1978). The technique was used to characterize both Okinawan pottery sherds of Final Jomon and Yayoi and Final Jomon sherds from Kyushu, along with several sediment samples.

BACKGROUND

Okinawa is located approximately 2200 km southwest of Tokyo, 700 km south of Kyushu, 700 km east of China and 700 km northeast of Taiwan. The island has not been connected by a land bridge to the surrounding land masses at least for the last 10,000 years. In spite of its geographical isolation, however, archaeological evidence suggests that Okinawa cultures had contacts with the surrounding regions throughout most of prehistory (Takamiya 1983:62-68; 1985a; Tanigawa 1983). Although the island may have been in contact with other regions during the Palaeolithic period, at the present time there is no evidence of this. The earliest firm trace of a relationship with another cultural region is understood to occur at the beginning of the Jomon period, which is divided into five subperiods in Kyushu: Initial, Early, Middle, Late, and Final (Table 1).

The Initial Jomon period in Okinawa is characterized by two pottery types - Yabuchi and Agaribaru - believed to be derived from the Jomon culture of Kyushu. About 12,000 years ago pottery appeared in northwest Kyushu (Serizawa 1977) and the era defined as the Jomon period began. One of the earliest pottery types recovered from archaeological sites is called finger-nailed pottery (10,000 BP in Kyushu). Both the Yabuchi and Agaribaru types, dated approximately 6500 BP, are considered to be related to the finger-nailed pottery of Kyushu (Takamiya 1983:69, 1986a: 142-144). The distribution of the finger-nailed pottery types is shown in Fig. 1.

The next phase, the Early Jomon period, is defined by three pottery types - Murokawa Kaso, Sobata and Jokon-mon, in chronological order (Figs 2 and 3). Both Sobata and Jokon-mon types are characteristic of the Early Jomon on the island of Kyushu (Kagawa 1965:273; Otomasu 1965:252). The Murokawa Kaso type was probably derived from the Jokon-mon pottery type (Takamiya 1983:75-76; Takamiya and Takemoto 1986:125-126). The limited distribution of the Murokawa Kaso pottery type indicates the emergence of what can be termed "pure Okinawan pottery". However, Takamiya (1982:171-172; 1983:75-76) includes this pottery type within the Kyushu Jomon series based on the decorative techniques.

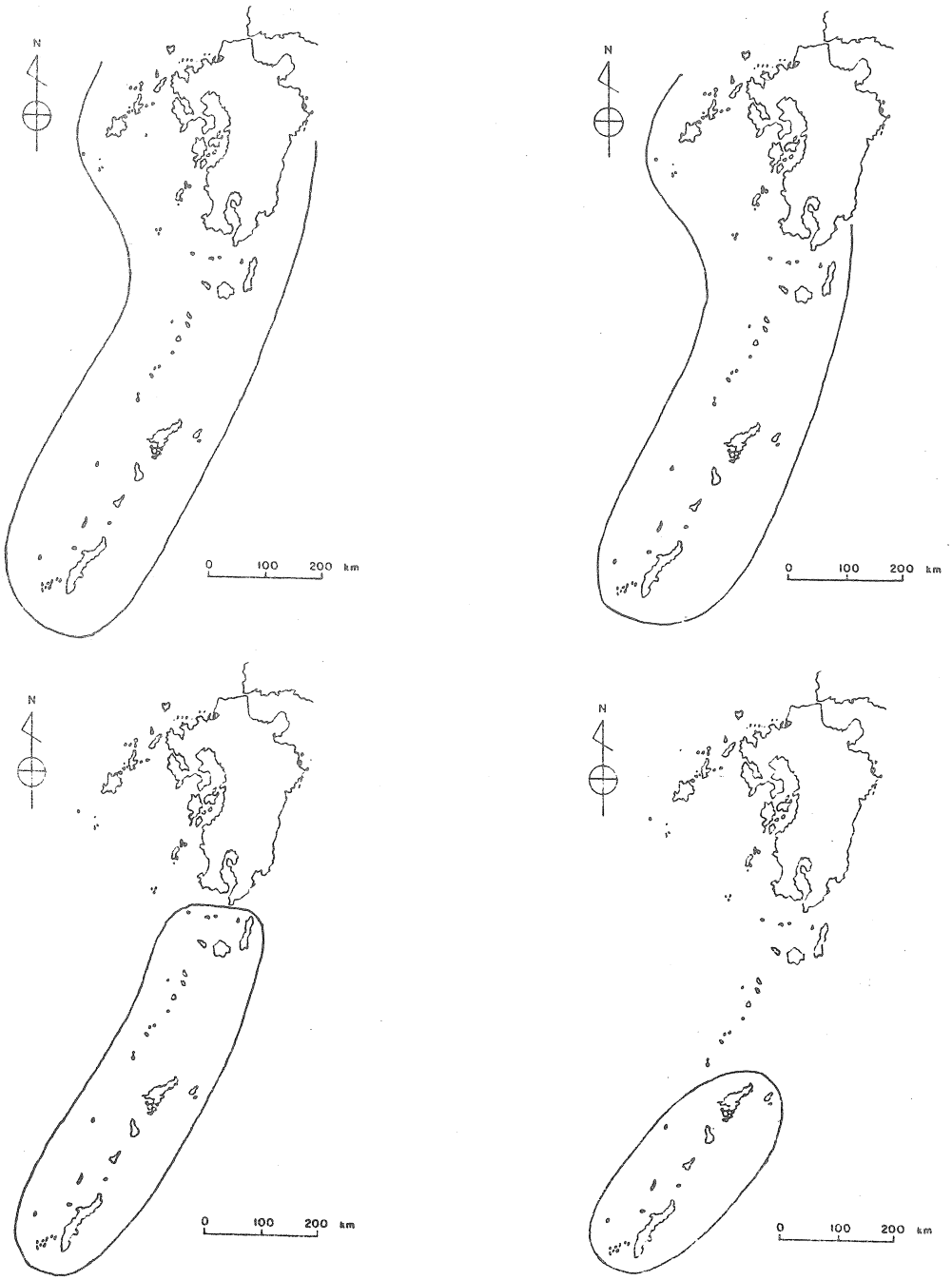
It was during the Middle Jomon period that ceramic regionality developed in Okinawa (Figs 4 and 5). This subperiod consists of three pottery types - Gushikawa, Kamino C and Omonawazentei. Recently, several sites containing these pottery types have been reported. But interestingly, their distribution is limited to the Central Okinawan area of Okinawa itself and the Amami islands. Moreover, no Kyushu-related pottery has been recovered in association. Takamiya (1985a:122; 1985b:313) has coined the term "Chu-Ryukyu (central Ryukyu or Central Okinawa) types" to describe these and, at the same time, to indicate the beginnings of regional pottery types in Okinawa.

Regionalism developed further during the Late Jomon period (Figs 6 and 7) when five pottery types were manufactured - Kayauchibanta, Iha, Ogido, Oyama, and Murokawa. While the first appears to have been manufactured throughout this subperiod, the other four were produced for a limited time and are "index fossils" listed in chronological order. These pottery types appear to have been derived from locally-produced antecedents in Okinawa and do not appear to be related to Kyushu materials (Takamiya 1986a:146). Furthermore, their distribution is limited to Okinawa and the Amami islands. However, while the distribution of local pottery types could suggest greater isolation during this period, a close examination of the archaeological record reveals that this was not really the case (Kin and Toma 1986). The Izumi and Ichiki pottery types, which characterize the Late Jomon period of southern Kyushu, have been recovered from several sites in Okinawa. In addition, bone ornaments which are peculiar to this period may have originated in southern China (Kin and Toma 1986).

During the Final Jomon the distribution of Okinawa pottery, which includes the Murokawa-Joso, Uzahama and Kayauchibanta types, was again expanded but appears never to have reached Kyushu (Takamiya 1985b:316) (Fig. 8). The Murokawa-Joso type is thought to be derived from the Murokawa type of the Late Jomon and is considered to be the ancestral form of the Uzahama types (Takamiya 1982:176). The Kayauchibanta type originated during the previous period and continued to be produced. Okinawa was not completely isolated during this period since Kurokawa pottery, characteristic of the Final Jomon period of Kyushu, has been recovered from several sites. Furthermore, a Chinese coin of the Yen dynasty has been recovered from a Final Jomon period context in the Gusukudake shell midden site (Takamiya 1986a:147-148).

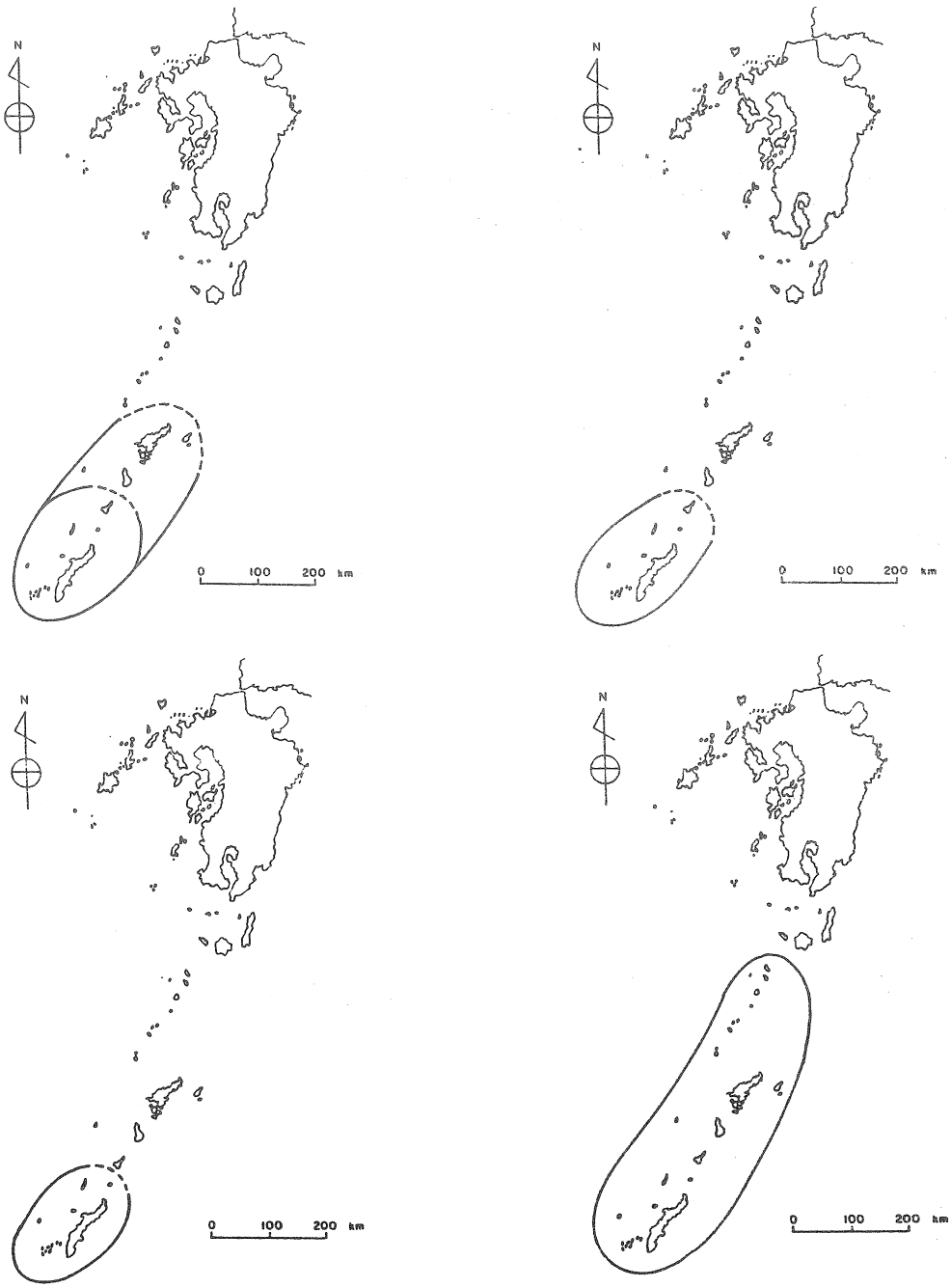
The Final Jomon period was followed by the Yayoi period in most of Japan. This period witnessed important changes in the history of the archipelago (Aikens and Higuchi 1982). It was during this period that new cultural elements such as metal, Yayoi pottery, glass artifacts and weaving were introduced (Komoto 1978). New modes of subsistence developed and the Yayoi period served as the precursor to the beginning of state society in Japan. Archaeological evidence indicates that Yayoi cultural traits reached Amami island, 150 km north of Okinawa, during the Early Yayoi period. Kurokawa type pottery (Final Jomon-Kyushu) also reached Okinawa.

Although it is still premature to discuss the full establishment of the Yayoi culture in Okinawa, some other Yayoi cultural elements have been found in the archaeological record. For example, at the Toguchi-momenbaru site, individuals were buried in *sekkan* (stone walled coffins). This burial practice is not known among the Jomon populations in Japan and is considered to be characteristic of the Yayoi (Takamiya 1985b:320-323). Furthermore, Yayoi artifacts, perhaps originally derived from Kyushu, have been recognized in the form of lithics (axes and adzes), metal and shell artifacts (Takamiya 1985b:317-318). However, among the Yayoi artifact types found in Okinawa, pottery is the most common. By 1986 at least 30 sites had yielded Yayoi pottery (Takamiya 1986b:138), and from this material the Yayoi period in Okinawa has been divided into three subperiods: Early, Middle, and Late Yayoi (Table 1).



FIGURES 1-4: DISTRIBUTIONS OF OKINAWAN PREHISTORIC POTTERY

Top left: Finger-nailed pottery (Yabuchi and Agaribaru types). Top right: Sobata type. Bottom left: Murokawa-kaso type. Bottom right: Chu-Ryukyu type. After Takamiya 1985b.



FIGURES 5-8: DISTRIBUTIONS OF OKINAWAN PREHISTORIC POTTERY

Top left: Kamino D and E types. Top right: Iha type. Bottom left: Ogido type. Bottom right: Uzahama type. After Takamiya 1985b.

Kyushu-Yayoi influence has been identified at several Early Yayoi sites in Okinawa and seems to have increased in the following Middle Yayoi. Indeed, according to Takamiya (1985b:318), Yayoi influence is more recognizable in this subperiod than in any other. It is interesting to note that two types of sites seem to be present by this time. One produces many artifacts which are related to Kyushu, suggesting an acceptance of "Yayoi culture". The second type of site, however, indicates a development of indigenous culture (Takamiya 1985b:329). By the Late Yayoi, the mainland influences seem to have ceased and only one site has yielded Kyushu-related pottery.

Thus, Okinawa seems to have been most connected with Kyushu between 7000 and 2000 BP. One of the most significant changes in Kyushu occurred during the Jomon-Yayoi transition and the following Yayoi period. What was the nature of the relationship between Kyushu and Okinawa at this time?

THE INAA RESEARCH

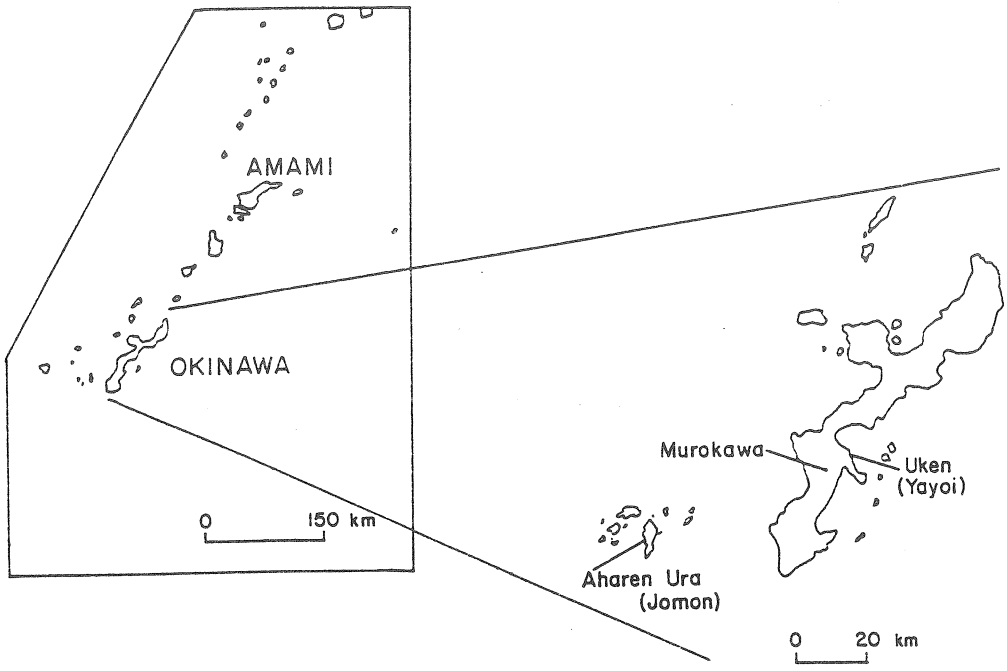


FIGURE 9: LOCATIONS OF SAMPLE COLLECTION SITES

Preliminary INAA of Late/Final Jomon period pottery sherds recovered from the Murokawa shell midden has indicated the possibility that this analytical method could aid in understanding prehistoric exchange in Okinawa (Takamiya 1988). Further analyses presented here are of pottery sherd samples from the Final Jomon shell midden site of Aharenura and from the Okinawa-Yayoi period shell midden site of Uken (Figure 9 Table 2). The samples from Aharenura include sherds which were a) possibly produced in

Amami and brought to Okinawa); b) a foreign sherd of unknown origin (possibly either from Amami or Kyushu); and c) locally manufactured sherds. The samples from Uken

A) AHAREN URA SHELLMIDDEN

INAA Sample#	Provenance	Layer(cm)	Comments
1-3	Ha-17	III(10-20)	Introduced from Amami
4-6	Ha-19	V(30 +)	Introduced;Origin unknown (Amami or Kyushu?)
7-9	Ha-19	VI(0-10)	Locally produced
10-12	Ha-18	IV(10-20)	Hamayabaru type-locally produced.

B) UKEN SHELLMIDDEN

INAA Sample #	Provenance	Layer(cm)	Comments
19-21	B-16a	III(10-20)	Yayoi Pottery-Introduced
22-24	A-21	II(10-20)	Locally produced
25-27	A(G.7.52)	---	Locally produced
28-31	A-22	II(10-20)	Locally produced
32-33	A-22	II(0-10)	Locally produced

C) WAKIMISAKI SHELLMIDDEN, Nagasaki, Kyushu

INAA Sample #	Pottery types	Comments
13-15	Kurokawa type pottery	Finely manufactured
16-18	Kurokawa type pottery	Roughly manufactured

D) CLAY SAMPLES FROM MUROKAWA SHELL MIDDEN : INAA Sample # 34-43

TABLE 2: THE SHERD AND SEDIMENT SAMPLES ANALYSED

consist of an "introduced Yayoi" sherd and locally manufactured pottery sherds with different tempering agents. In addition, two types of Kurokawa (Final Jomon) sherds (fine and coarse wares) from the Wakimisaki midden near Nagasaki on Kyushu and clay/sediments from the Murokawa shell midden sites on Okinawa were analyzed.

The objectives of the INAA analysis are threefold; firstly to distinguish foreign from local sherds, secondly to build up a data register of sourced sherds for further comparison

with excavated samples, and thirdly to characterize the Kurokawa type pottery from Nagasaki, Kyushu, which has been reported from several sites in Okinawa.

METHODS

Relatively large samples of between 500 and 800 mg were used for INAA in an attempt to ensure that they would be representative of the ceramics from which they came. To determine the concentrations of U, Dy, Ba, Br, Ti, I, Mg, Na, V, Al, Mn, Ca, Si, Sr and Cl, which produce short-lived radioisotopes, all samples were irradiated serially for 1 minute at a neutron flux of $1.0x10^{11}$ $n.cm^{-2}.s^{-1}$ in the SLOWPOKE nuclear reactor at the University of Toronto. After about 20 minutes, to allow for the decay of short lived ^{28}Al to acceptable levels, each sample was assayed using 5 minute counts with gamma-ray spectrometers as discussed by Hancock (1984).

RESULTS AND DISCUSSION

The presence of higher Ca depositions in the pottery due to burial in a shell midden (e.g. samples 7-9, 31-33 in Table 2) and/or the occasional use of shell as a tempering agent (e.g. samples l0-12, 22-24), along with sediment samples with relatively low Ca (e.g. samples 34-35, 38-39), helps blur the general inverse correlation shown in the Al/Ca data (Table 3).

The Na/Cl data show that salt is not a serious problem in the samples analyzed with the possible exceptions of samples 4-6 which may contain 0.2% salt. The majority of the Na contribution is from Ca/Na rich minerals.

The Al/Ba plot indicates that the sherds analyzed from western Kyushu (samples 13-18) are barium-rich by factors of 2 to 5 with respect to Okinawan materials (Fig. 10). Samples 1-3 and 19-21 are high in barium relative to the rest of the Okinawan sample, but are probably related to the samples analyzed since sample 1 correlates strongly with 36-37 and 42-43.

The Al/V plot in Figure 11 shows three general clusters of samples. Cluster one includes the sediment samples 34-43. It is clearly shown that these samples are chemically similar using positive correlation values from the x-y plot of Al/V. In addition, the pottery samples 25-27 in this cluster are highly correlated. The clay materials used in the other pottery analyzed suggest that either more weathered sediments were used in their manufacture, with a correspondingly lower V with respect to Al, or that clay with lower absolute V values was used. It is noteworthy that the amount of geological or pre-manufacture weathering of the material used will in most instances probably have a greater influence on overall chemical makeup than archaeological or post-manufacturing *in situ* weathering. Therefore, this approach to sorting ceramic materials would rarely have chronological significance unless very good local sediment analyses were carried out.

If the Al/V plotted clusters are representative of different clay qualities then cluster two contains the western Kyushu samples 13-l8 and is somewhat similar to samples 1-6, 19-21, and 28-30. The third cluster consists of Final Jomon sherds from Okinawa (samples

	Al (%)	Ba	Br	Ca (%)	Dy	I	Mg (%)	Mn	Na (%)	Ti	U	V	Si (%)	Sr	Cl
1	9.44	781	106	3.04	3.86	29	1.06	411	0.56	4454	2.4	111	32.7	480	180
2	9.23	451	48	2.45	4.20	24	1.07	493	0.53	5142	3.6	100	21	307.40	157.82
3	9.70	575	70	2.46	4.50	29	1.20	440	0.54	5519	3.5	115	23	330	170
4	10.95	325	45	1.75	2.43	22	0.74	213	0.53	3952	3.3	112	27	335	1886.50
5	11.90	376	63	1.88	2.75	27	0.60	184	0.58	4428	3.0	124	24	280	1135.77
6	10.16	431	61	1.51	2.35	21	0.52	162	0.44	4287	3.8	111	24	300	1468.42
7	13.76	347	40	1.52	2.71	13	0.88	295	0.48	3502	4.3	78	34	460	220
8	13.52	312	28	1.58	2.20	9	0.72	308	0.57	3388	2.7	70	23	280	150
9	13.73	227	67	2.02	1.42	10	0.31	258	0.62	3078	2.3	66	23.1	276.47	120
10	11.56	229	48	4.69	2.58	16	0.49	354	0.41	2370	3.2	48	21	478.34	202
11	11.99	282	33	3.40	2.81	19	0.63	304	0.40	2514	2.7	40	27	513.12	185
12	12.62	274	40	3.39	3.16	18	0.81	267	0.44	3000	3.9	58	30.9	330	192
13	10.16	1274	46	1.66	4.99	12	0.68	929	0.90	4799	3.6	100	35	595.09	300
14	10.05	1634	40	2.06	5.64	10	0.92	1161	0.91	4860	3.5	88	29	538.04	242
15	10.16	1446	115	1.81	5.20	12	0.43	1284	0.91	4492	2.3	85	26	450	160
16	9.39	1702	66	1.13	3.62	13	0.78	924	1.47	4546	3.8	100	31.9	466.43	180
17	9.36	1662	85	0.89	4.91	17	0.70	955	1.42	5060	3.9	95	34.1	482.22	170
18	9.17	1652	58	0.97	3.62	14	0.60	711	1.39	5120	3.5	99	26.5	447.36	150
19	10.07	603	89	1.27	2.88	18	0.57	199	0.97	4047	3.1	97	28.4	318.29	250.67
20	10.07	593	49	1.18	4.38	16	0.24	194	0.81	3797	4.1	85	26.0	354.78	244.68
21	11.18	581	85	1.42	4.20	21	0.44	279	0.94	4763	3.4	95	24.5	340	280.28
22	12.29	381	93	6.00	2.36	23	0.45	118	0.26	2685	4.1	43	21	600.85	397.21
23	12.73	311	70	5.81	2.11	11	0.41	120	0.29	2637	3.1	52	26	831.74	266.04
24	12.56	443	49	5.96	3.18	16	0.29	104	0.26	3194	5.8	50	35	559.97	344.49
25	10.22	--	37	2.40	4.91	18	1.91	774	1.29	5824	3.0	161	29	450	260
26	9.45	406	37	2.54	5.08	19	1.84	767	1.41	5100	3.0	154	29	440	270
27	9.98	274	40	1.95	4.78	12	2.26	802	1.30	5862	3.1	165	28	430	260
28	11.03	463	37	1.61	2.65	8	0.49	63	0.19	4640	4.5	82	27	300	202.37
29	11.00	449	32	1.51	2.53	6	0.43	61	0.21	4440	3.7	91	23.0	250	148.90
30	11.23	493	53	1.59	2.44	11	0.19	76	0.22	4340	3.2	92	20.4	323.31	201.05
31	12.15	306	61	2.29	6.49	15	0.46	187	0.65	2488	2.5	37	32.6	250	131.91
32	12.52	267	40	2.30	6.29	12	0.54	190	0.68	2768	4.2	42	22	276.92	178.92
33	12.70	316	74	2.25	5.87	10	0.53	183	0.75	2382	2.7	43	19.8	250	227.09
34	5.47	437	111	0.39	6.33	32	0.42	972	0.11	3184	3.1	81	36.8	537.22	100
35	5.44	289	32	0.60	6.33	15	0.60	884	0.09	3136	4.0	90	22.8	360	134.27
36	7.93	525	64	3.35	4.10	7	1.23	582	0.52	3946	3.4	123	23.9	330	130
37	8.11	557	44	3.50	4.14	7	1.23	621	0.52	4267	3.2	130	32.1	340	130
38	4.96	370	76	1.45	5.05	25	0.43	549	0.10	2504	2.4	77	31.2	340	98
39	4.74	560	112	1.28	4.73	23	0.27	547	0.09	2383	3.2	68	37.0	300	89.50
40	6.23	478	83	5.75	5.09	14	0.77	827	0.26	3265	3.9	99	25.1	390	132
41	5.40	433	32	5.05	4.83	14	0.46	598	0.19	3036	4.5	91	32.2	381	155
42	8.86	659	48	3.32	4.91	7	1.59	581	0.62	4325	3.4	140	26.1	317	132
43	8.44	606	44	2.86	4.15	7	1.41	487	0.61	4598	3.0	133	27.5	300	118

TABLE 3: INAA DATA FOR THE ANALYSED SAMPLES

(ppm unless noted)

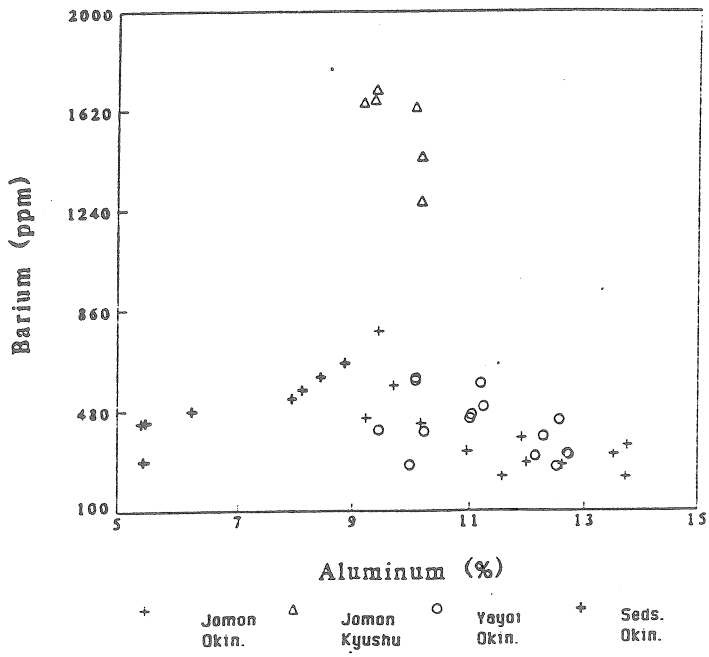


FIGURE 10: ALUMINIUM/BARIUM SCATTERPLOT DIAGRAM

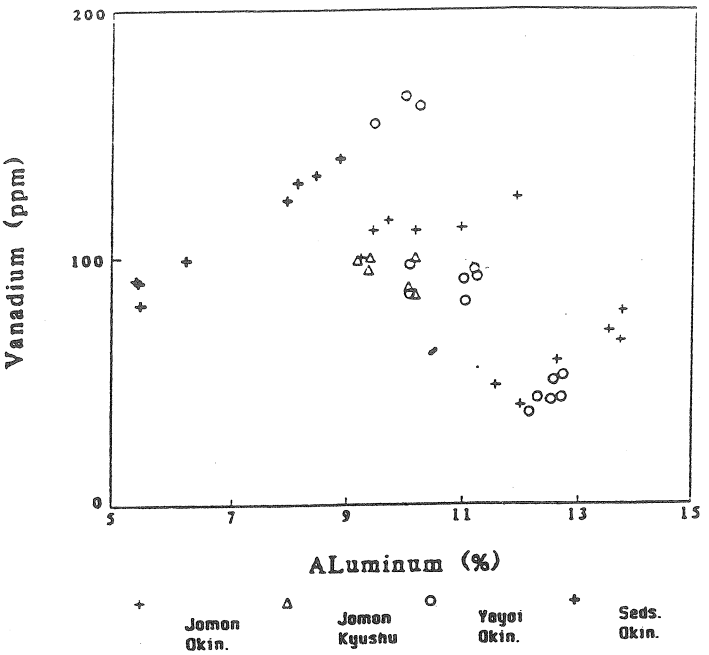


FIGURE 11: ALUMINIUM/VANADIUM SCATTERPLOT DIAGRAM

7-12) that are somewhat similar to Yayoi materials from Okinawa (samples 22-24, 31-33). This latter observation is also evident in the Al/Ti data.

It is worth mentioning that cluster two in Figure 11 contains pottery sherds of Amami type, of unknown origin, and of Kyushu-Jomon and Okinawa-Yayoi origin. On the other hand, cluster three consists of Okinawa-Jomon and Okinawa-Yayoi pottery sherds. In other words, the second cluster is made up of one local sherd and "foreign" sherds and the third cluster is all local pottery sherds recovered from the Okinawan sites.

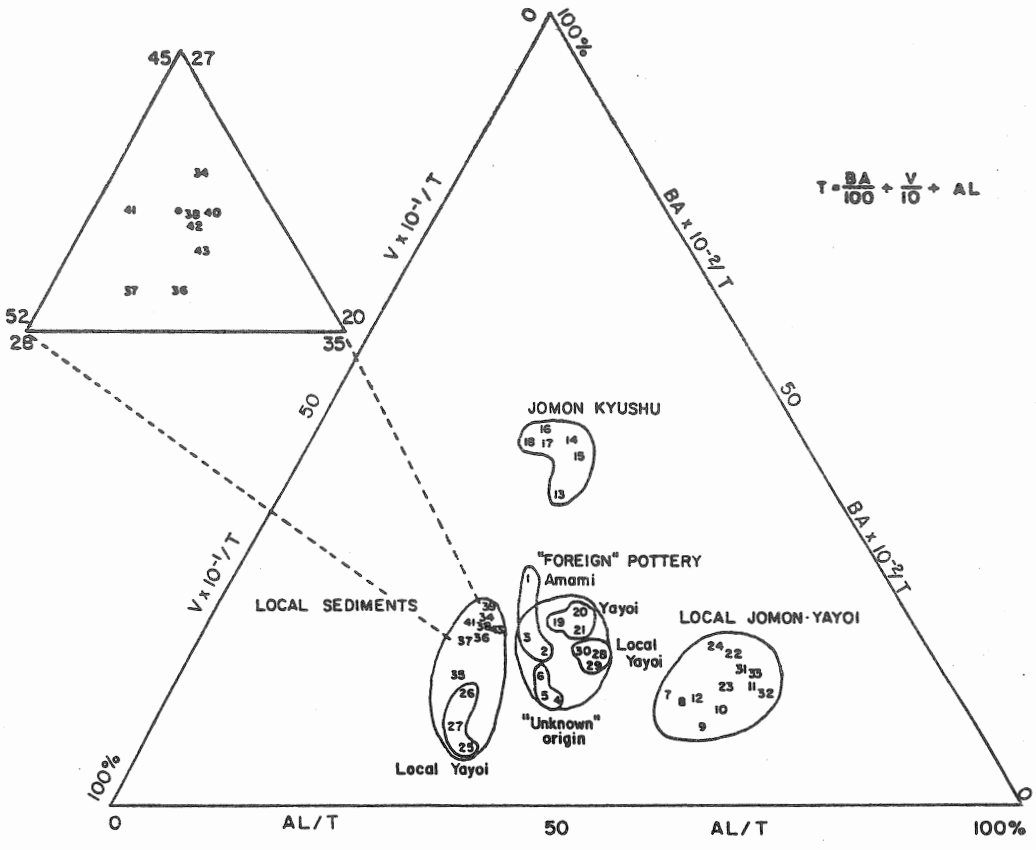


FIGURE 12: TERNARY DIAGRAM OF PROPORTIONS OF ALUMINIUM, BARIUM AND VANADIUM

This clustering observed on the Al/V plot becomes even clearer when these samples are plotted on the ternary diagram based on Al, Ba and V (Fig. 13). Four clusters are present. The second cluster mentioned above is further divided into two. One contains the Kyushu-Jomon (Kurokawa type 13-18), and the other "foreign" pottery sherds samples (2-3, 4-6, 19-20) with the Okinawa-Yayoi pottery sherd samples 28-30. The results suggest several significant implications.

Firstly, the Kyushu-Jomon pottery sherds are chemically distinctive from pottery recovered from Okinawa. Thus, if Kyushu pottery was traded into Okinawa it would be possible to distinguish it from locally manufactured pottery. Secondly, the presence of three INAA clusters in the pottery sherds recovered from Okinawa indicates two possible hypotheses. The first is that the prehistoric Okinawan people indeed traded pottery which is believed to be "foreign" by the Okinawan archaeologists, while using two chemically distinctive clay sources to manufacture local pottery. The second alternative hypothesis is that they had access to three chemically different sources from which they made local pottery. The fact that local Okinawa-Yayoi sherd samples are found in the three clusters indicates the plausibility of the latter hypothesis. If this is the case, it can be said that the Okinawan people "mimicked" the style of Amami and Yayoi pottery.

Choosing the correct hypothesis will depend on future study. However, in either case, the results of this research have provided interesting insights into Okinawan archaeology. If the trade/exchange hypothesis is true, the next step is to consider what items were exchanged between these regions. Furthermore, what circumstances necessitated an exchange system? Did it evolve in order to enhance group survival or chiefly prestige (Earle and Erickson 1977)? If the mimic hypothesis is true, what necessitated the Okinawan people to replicate foreign styles?

In addition, these results strengthen the belief that the Okinawan people were aware of the Yayoi culture to the north and thus knew of rice agriculture by the Okinawa-Yayoi period. What Yayoi culture elements were accepted or rejected? In what way did this contact affect the history of Okinawa? This is a particularly interesting question because it is known from the rest of Japan that wherever the Yayoi culture reached, it contributed to the emergence of non-egalitarian societies. Did this contact influence the formation of the Gusuku society in Okinawa?

The INAA results may also suggest the development of a local exchange system. For example, samples 26-27 do not cluster with the rest of the Uken sherds but cluster together with the clay source collected from Murokawa, more than 10 km away. If Arnold's (1985) statement that potters rarely travel more than seven kilometers for clay extraction and transportation because of the large amount of energy expenditure is applicable, then it seems likely that the Uken shell midden people exchanged this pottery.

CONCLUSION

The degree to which Japan influenced Okinawa in the later part of Jomon and Yayoi has been one of the most crucial questions in Okinawan archaeology because of its potential role in the development of later Okinawan culture. Although Yayoi elements have been unearthed from Okinawan sites the picture of the relationship is still far from complete. In order to provide further insight an INAA analysis of Okinawa and Kyushu pottery sherds was carried out.

The results offer several significant implications. First of all, if Kyushu pottery was ever imported into Okinawa it should be possible to distinguish it from Okinawan pottery by INAA. Secondly, the "foreign and possibly introduced" samples from Okinawa analysed

by INAA are indeed chemically dissimilar to locally-manufactured pottery samples, although it is not yet possible to decide whether Okinawans imported these wares or simply mimicked "foreign" pottery styles. In either case, the result would emphasise relationships between Okinawa and Kyushu during the Final Jomon and Yayoi periods. Thirdly, the results indicate that INAA can be used to understand the development of a local exchange system. It has distinguished Okinawan pottery sherds manufactured from at least two (possibly three, depending on the validity of the "trade" or "mimicking" hypotheses) different clay sources.

Also, the results indicate that analyses of sediment samples can be useful for identifying utilized clay sources and establishing the presence of ceramics that are made from non-local sediments. These kinds of comparative analyses are a necessary first step in chemically-based research into the origins of ceramic materials that may represent the movement of people, ideas, or both between the islands of Okinawa and Kyushu.

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