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Abstract

In this paper we have examined the material source of mochu-sen coins, which were minted privately in imitation of Chinese coins during the medieval period in Japan, based on the results of weight and dimension measurement and lead isotope analysis of coins in the Currency Museum of the Bank of Japan. We have also looked at the historical significance of the analytical results and have attempted to make predictions of their implications.

The development of mochu-sen coins can be divided into the following three stages from the standpoint of material supply:

Stage 1: Coins were made mainly with Chinese lead for example the Shima-sen coins, around the 14th century.

Stage 2: Coins were made from both Chinese and Japanese lead for example the Iutsushi-sen coins, made around the 15th century.

Stage 3: Coins were basically made with Japanese lead, for example the Kajiki-sen and Kanode Gen'yu coins, in the 16th and-early 17 centuries, though some foreign lead was also used.

Key words: Mochu-sen coins; Shima-sen coins; Iutsushi-sen coins; Kajiki coins; Kanode Gen'yu coins; Dimension and Weight Measurements; Lead Isotope Analysis

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1. Introduction - Recognition of the problem and the direction of this paper

Although the circulation of coins dwindled temporarily with the suspension of minting of the Kocho-junisen（皇朝十二銭） or Kocho-sen（皇朝銭） coins, the twelve types of coin first minted by the Japanese imperial court from the 8th century to the 10th century, a large quantity of coins were imported from China and other foreign countries during the Medieval period. Aside from these imported coins, Japanese coins minted in imitation of Chinese and the coins of other countries, namely the mochu-sen（模鋳銭）[1], were also in circulation. Recently, molds for the mochu-sen and other related remains were excavated in Kyoto, Kamakura, Sakai and Hakata, providing evidence of domestic production of the mochu-sen coins.[2]

In order to discuss the circulation of coins during the Japanese medieval period, we must clarify the actual situation of the mochu-sen coins minted in Japan. Because there is very little historical documentation[3] of the mochu-sen coins in this period, we have no choice but to rely on the actual materials themselves. With regard to this point, it should be noted that many numismatic studies have been carried out on the mochu-sen coins over a period of many years. However, as will be discussed later in this paper, the various theories and opinions in the above-mentioned studies have been arrived at intuitively and are based on observation of external appearances, thus it is

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[1] In the Japanese Coins and Notes in Pictures (Zuroku Nihon no Kahei), Research Department, The Bank of Japan, 1972, these are referred to as “Japanese coins minted privately” (honpo shichu-sen).

[2] “Coin Production in Japan - Summary of the Report made at the 4th Meeting of the Excavated Coin Research Committee”, Excavated Coin Research Committee, 1997.

[3] It is known from the Diary of Gion Proceedings（Gion Sigyo Nikki 祇園執行日記） that the mochu-sens were minted privately by coppersmiths in Kyoto.

hard to conceive that they can withstand thorough examination. Recently, mochu-sen coins have been extracted and examined from an archeological standpoint, in view of the size or legibility of the inscriptions on the coins, but the criterion for determining whether the coins were made in Japan or abroad is still rather vague and it is difficult to clarify the source of material supply merely by observation of the external appearance of the coins. Based on the above, we have decided to conduct a chemical study of the mochu-sen coins in this research paper.

Several pieces of research have been done in the past on these coins based on analytical science, though such studies are few in number. The research methodologies can be largely divided into two types: element composition analysis and lead isotope analysis. In the case of the former some analytical data on the mochu-sen coins have been recently reported.[4] In contrast, there are very few pieces of research that have utilized lead isotope analysis, as in the case of the comprehensive research of coins by Hisao Mabuchi and his coworkers.[5] For this reason, we have decided to apply the latter method of analysis in the paper. Moreover, even though element composition analysis indicates that imitation coins are similar in composition, it is difficult to prove that they were produced in Japan and not in China. With lead

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4 Shin'ichi Sakuragi, Hideo Akanuma and Keiko Ichihara, 1995, "Element Composition of the Kobu Tsuho and Distribution Problems in Kyushu - Focusing on the Excavated Coins from Kurokimachi", Kyushu Teikyo Junior College Memoirs, Volume 7. Takeshi Tomizawa, Tetsuya Yokoyama, Nakashiro Yonezawa, Yoshitaka Minai, Takeshi Tominaga and Kazuhiko Shimatani, 1997, "Chemical Composition of Medieval Coins", Summarized Report on Research of Cultural Properties in Sakai-city, Volume 61, and others.

5 Hisao Mabuchi, Yoshimitu Hirao, Seiji Sato, Noriko Midorikawa and Kenzo Igaki, 1983, "Lead Isotope Ratios of Ancient East Asian Coins", Archaeology and Natural Science, Volume 16.

isotope analysis, however, it is highly feasible to specify the origin of the lead used in the coins. From this point of view, this method can be shown to be effective.

The aforementioned lead isotope analysis of coins by Hisao Mabuchi includes oriental coins of each period and region and is viewed as embodying valuable basic findings which track a general trend. However, it has not reached a consistent conclusion due to the shortage of analytical samples, particularly in the case of the mochu-sen coins, of which only two pieces of data have been shown. Furthermore, with the emphasis placed on submitting the analysis results themselves, full consideration has not been given to their historical significance and the results cannot be linked to the study of numismatics or archaeology as rubbings and size measurements have not been obtained.

Based on the above considerations, this study will be carried out by the following procedure. After gathering basic data such as rubbings and size measurements, we will conduct lead isotope analysis of the mochu-sen coins from the medieval period in Japan in the Currency Museum of the Bank of Japan, in an attempt to unveil the mystery of the source material of the mochu-sen coins. Furthermore, by viewing the historical significance of the analytical results, we will be able to learn their implications.

Dr.Saito mainly conducted the lead isotope measurements in this paper, then Mr.Takahashi and Mr. Nishikawa conducted the compilation of rubbings and size measurements. As for documentation, Mr.Nishikawa drew up the outline and Mr.Takahashi wrote the paper. Sections 1, 3-(2), and 5 were elaborated by Dr.Saito, and Section 2 and 6 by Mr.Nishikawa. Finally, the paper was summarized after consultation by all three parties.

2. Measurement Material and Its Preceding Research

In our analysis, we have selected representative mochu-sen coins from the Japanese Medieval period in the Currency Museum of the Bank of Japan. Concretely, they include 15 Kajiki-sen, 27 Kanode Gen'yu, 6 Chikuzen Kobu, 5 Heian Tsuho, 10 Shima-sen, 41 Iutsushi-sen as well as 5 Keicho Tsuho and 31 Chinese coins as comparison material. Below, we will summarize the characteristics of each coin and the present state of the analysis.

(1) Kajiki-sen（加治木銭） coins

The Kajiki-sen coins were privately minted in Oosumi Kajiki town (in the Kagoshima Prefecture in Southern Japan) in what was then known as the Shimazu Territory from the late Medieval period to the early Yedo period. These coins have one of the Chinese characters "ka（加）", "ji（治）" or "ki（木）" engraved on the reverse of the coin. Surface writings of the Kajiki-sen coins are the "Kobu Tsuho（洪武通寶）" and "Daichu Tsuho（大中通寶）". In the numismatic study, there were cases where coins without the above characters on the reverse were also grouped in the same way as the Kajiki-sen coins; that is, (a) coins of equal quality and weight as the Kajiki-sen coins, and more generally (b) coins minted in Japan.[6] The classification of coins in the Bank of Japan collection is also based on the above (a) basis. As this classification is rather vague, however, we have limited our paper to those coins with

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[6] There is also the theory that silver coins for awards and gifts from Toyotomi Hideyoshi（豊臣秀吉） were also minted in Kajiki.

the characters “ka”, “ji” or “ki” engraved on the reverse.[7]

As for their period of mintage, the most common theory is that they date from the Tensho era (1573-1591) to the Kan’ei era (1624-1643), but there are some who argue that the Kajiki-sen coins were first minted in 1448 and that their minting was suspended in 1694.[8] However, both views lack sufficient evidence to clearly support their claims.[9] As for archaeological excavations, a large quantity of coins amounting to some 6,264 pieces including one Kajiki-sen coin was dug out from Lot SKT 448-3 in the moat city sites of Sakai, of which the Keicho Tsuho (1596-1615?) was the most recent coin.[10] Hence, it is highly possible that the mintage of the Kajiki-sen coins dates back to before the date of the Lot SKT 448-3 coins, i.e. 1615 AD. Moreover, Kajiki-sen coins are often excavated from graves along with Ko-kan’ei coins (古寛永, which are an older version of the Kan’ei Tsuho coins, which date from : 1636-1657), but there are no cases of Kajiki-sen coins being excavated with Medieval coins from ruins older than Lot SKT 448-3.

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7 In the column of “BOJ classification” of Table 1, the name of the “Kajiki-sen” is applied according to basis (a).

8 Referring to data from Kajiki Meishoshi (Kajiki-cho Library)and Japanese History Dictionary (Kawade Shobo) quoted in Local History of Kajiki, Editing Committee of the Local History of Kajiki, 1966

9 On p.158 of Currency Problems in Japanese Feudal Society, Kiyoyasu Maruyama, 1939, it states that the Kajiki-sen was minted in Tensho era in imitation of the Kobu Tsuho, Daichu Tsuho, Gen’yu Tsuho and other coins according to the History of Myoho-ji (妙法寺記). However, as pointed out in “Field Investigation of the Mintage of Kajiki-sen”, Fumio Yamashita, 1978 of Bonanza, Volume 14, September Issue, the quotation does not exist in the document. Most likely, it was misquoted for Revised Version of Circulation History of Japanese Coins, p. 234, Atsushi Kobata, 1943.

10 Kumio Nagai and Yasuji Kondo, 1997, “Buried Coins Excavated from the Ruins in the Sakai Moat City Sites (Lot SKT 448-3), Excavated Coins of Yedo Period, Research

It is pointed out that many of the coins are magnetic. From element analysis, it is clear that such coins contain higher concentrations of iron and arsenic and lower lead and tin concentrations than the original Kobu Tsuho coins, which were minted in China.[11] As for the material source, one researcher guess that the Kajiki-sen coins were made of copper originating from the Kokubu mine[12] was attempted, but there seem to be no grounds for that statement.

(2) Kanode Gen'yu（叶手元祐） coins

The inscription on the obverse of this coin is the same as that of the Gen'yu Tsuho （元祐通寶） coin of the Northern Song Dynasty in China, but the calligraphic style differs. In the numismatic study, the two characters "ko（口）" and "ju（十）" on the left and right side of the hole on the reverse is read "kano（叶）", and the group of Gen'yu Tsuho coins with similar scriptures is commonly called "Kanode Gen'yu（叶手元祐）". In order to distinguish these coins from the original Chinese coins, we will apply the general definition of the term "Kanode Gen'yu" in this paper. Aside from the above characters "ko" and "ju", some coins have the characters "ichi（一）", "ue（上）",

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Committee of Buried Coins in Hyogo Prefecture.

11 Yuji Sano, Kenji Notsu and Takeshi Tominaga, 1983, "Studies on Chemical Composition of Ancient Coins by Multivariate Analysis", Scientific Papers on Japanese Antiques and Art Crafts, Volume 28, and Madoka Sakiyama, Hideo Akanuma, Shin'ichi Sakuragi and Minoru Sasaki, 1997 "A Comparative Study of Distinctive Shape and Material Source of Excavated Medieval Coins - Part One", Production of Coins in Japan, Research Committee on Excavated Coins.

12 It is said that this point is written in the World History of Copper, which quoted in the Additional Note 6 of "Field Investigation of the Kajiki-sen", Bonanza, Volume 14, September Issue, Fumio Yamashita, 1978, but the original text can not be found.

“shin（真）” and other symbols on the reverse of the coin, while there are some with plain reverses. In this paper, we have examined the various characters on the reverse of the coins, including “ko” and “ju”. Kanode Gen’yu coins are sometimes referred to as “Nagasaki-sen（長崎銭）” and “Bungo Gen’yu（豊後元祐）” coins. In the Bank of Japan, this coin is classified under Nagasaki-sen coins, but the place of mintage is unknown.

The excavated coins of Kanode Gen’yu are included in the unearthed articles from Shonokutsu cave（笙ノ窟）, in Kamikitayama in Nara Prefecture.[13] Like the above coins, the period of mintage is unknown, but seeing that the Kanode Gen’yu coins were not among the excavated coins from the Medieval period, it can be concluded that they were minted in the early Yedo period. From the standpoint of numismatic study, the mintage period of the Kanode Gen’yu coins is roughly estimated to be the same as that of the Kajiki-sen coins in view of the many characteristics they share, such as being magnetic.

(3) Chikuzen Kobu（筑前洪武） coins

Like the Kajiki-sen coins, Chikuzen Kobu coins have the same inscription as the Kobu Tsuho and a similar calligraphic style to that of the original Chinese coin, but differ in appearance. According to the Japanese Coins and Notes in Pictures (Zuroku Nihon no Kahei), these coins were considered to have been minted without using

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13 Board of Education of Kamikitayama Town, 1995, Research Report on the Excavation of Shonokutsu in Kamikitayama Town of Nara Prefecture.

original Chinese coins as patterns to make molds, but with newly made patterns.[14] So we will reexamine about this point in this paper. Although these coins were named "Chikuzen Kobu" coins in the field of numismatics, this term is not necessarily appropriate, as there is no solid proof of their having being minted in Chikuzen (Fukuoka Prefecture). The term, however, has already become widely used to indicate this group of coins and as there are no other alternatives, we have decided to apply this term in our paper.

According to Jun Ishikawa, Chikuzen Kobu coins were included among the massive volume of coins unearthed from the 57th Research Excavation from the ruins of Asakura clan Ichijodani (朝倉氏一乗谷).[15] As the Kasei Tsuho (嘉靖通寶) coins of the Ming Dynasty in China, first minted in 1527, were the most recent coins among the findings of the 57th Excavation, it is estimated that the excavated coins were buried in the well some time between 1527 and the downfall of Asakura clan in 1573.[16] Furthermore, while the 1128 Kobu Tsuho coins were found among coins excavated from Daimon, Mori-cho of Shizuoka Prefecture[17], the Chikuzen Kobu was not seen among them. Although further information is needed, it is conceivable that the Chikuzen Kobu coins were minted from the latter half of the 16th century onward as Koji Tsuho (弘治通寶 : coins, first minted in 1503,) during the Ming Dynasty was the

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14 Research Department, The Bank of Japan, 1972, Japanese Coins and Notes in Pictures (Zuroku Nihon no Kahei). 1

15 Jun Ishikawa, 1996, "Mochu-sen of Medieval Ages to Yedo period Part 2- Form and Production Method", Hosenka, Volume 14.

16 Fukui Prefectural Museum in sites of Asakura clan, 1988, Special Historical Remains of Ichijodani Asakura, 19.

17 Mori-machi Committee of Education, 1993, Research Report of Ancient Coins Excavated from Daimon.

most recent coin among those found in the Daimon excavation.

The results of the element composition analysis indicates a unique composition, with the concentration of lead extremely high compared to that of copper and the amount of tin is relatively small.[18]

(4) Heian Tsuho（平安通寶） coins

The inscription on the obverse, “Heian Tsuho”, is a unique name not seen in any of the officially minted coins in China or Korea, so the term “Mochu-sen” coin is not necessarily appropriate for it. The Heian Tsuho coin, however, is considered to be within the category of mochu-sen coins as its method of mintage is similar to that of the Kajiki-sen and other mochu-sen coins, and thus we will apply this classification to it. In numismatics, this coin was conceived to be one of the An’nan-sen（安南銭） coins, but at present the theory that it was made in Japan is the most influential. Although some estimations have been attempted of the place of mintage, such as that it is a type of Kajiki-sen coin or that it was minted in Kyushu e.g. at Buzen (in Oita Prefecture), there seem to be no grounds for these opinions and the place of mintage is still unknown.

Examples of Heian Tsuho coins have been unearthed from the Shiozawa-kita ruins in Miyagi Prefecture, Asukadaichi Lot 1 ruins in Iwate Prefecture and Haraguchi ruins in Kanagawa Prefecture.[19] At the Shiozawa-kita ruins, two Koso Tsuho（皇宋通

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18 Madoka Sakiyama, Hideo Akanuma and Minoru Sasaki, 1997, “Element Analysis of Excavated Coins Using Negligible Sampling and Its Restoration Method”, Stocked Coins and Their Excavation, Research Committee of Excavated Coins.

19 Miyagi Prefecture Board of Education, 1980, Research Report of Ruins Along the

寶） coins, one Gen'yu Tsuho（元祐通寶） coin and one Shosei Genpo（紹聖元寶） coin were also discovered along with one Heian Tsuho coin. As there were no examples of Kan'ei Tsuho（寛永通寶） coins among the findings, it is believed that the Heian Tsuho coin was minted some time between the end of the Medieval period and early Yedo period, as is the case with the Kajiki-sen coins.

The element composition analysis revealed that the Heian Tsuho coin was made of about 80% copper, 9% lead and 6% tin. The concentration of copper is slightly higher than is generally found in Chinese coins.[20]

(5) Shima-sen（島銭） coins

This is a group of mochu-sen coins bearing a unique style of inscription. This group of coins has characters from Chinese coins and kocho-sen coins, or completely meaningless characters. The coins were named "Shima-sen" coins as they were believed to have originated from South-east Asia, perhaps from An'nan（安南：, which is now part of Vietnam）. Again, it is hard to say that the terminology is appropriate, but we will use the term "Shima-sen" coins in this paper following popular usage. There are numerous theories regarding the place of mintage, such as the Vietnamese or Chinese coin theories, as well as the theory that they were made in North Kyushu, Japan.

Tohoku Highway, Volume 69. Research Center of Buried Cultural Property, Iwate Prefecture Cultural Promotion Enterprises, 1988, Research Report of Excavations from the Asukadaichi Lot 1 Ruins (Research Report on Buried Property by the Iwate Prefecture Cultural Promotion Enterprise, Volume 120). Kumio Nagai, 1996, "From Medieval Ages to Yedo period", Excavated Coins from the Medieval Ages Appendix I.

[20] Yoshimasa Koga, 1919, "Analytical Chart of Ancient Coins", Journal of the Archaeological Society of Nippon, Volume 9, Issue 7.

Strictly speaking, the place of origin remains unknown, but in numismatic studies, the theory that they were produced in Japan remains the strongest, following the thesis written by Kinrai Nakagawa.[21] Analytical materials in this paper include three coins appearing to be in imitation of kocho-sen coins and three coins appearing to be in imitation of Chinese coins.

However, few examples of the Shima-sen coins have been found among excavated medieval coins. Kumio Nagai who detected less than two hundred Shima-sen coins among two million excavated coins, most of the Shima-sen coins were unearthed in excavations of sites dating back to the 14th century, decreasing drastically thereafter.[22] From the inscriptions on the coins, we can also estimate that the Shima-sen coins were minted mainly during the 14th century, though there are few examples from later periods. Compared with the mochu-sen coins in the above sections (1) - (4) of this report, the number of Shima-sen coins found among excavated Medieval coins is greater, reflecting different periods of minting prosperity.

(6) Iutsushi-sen（鋳写銭） coins

These coins were minted in imitation of the original Chinese coins and of mochu-sen coins. Literally “Iutsushi” means mintage-copying coins with using them as the patterns to make molds. In this paper, we will limit the term “Iutsushi-sen” to those coins directly copied from the original, and not those coins where characters were added onto the coin such as the above Kajiki-sen. Of the coins classified as the

21 Kinrai Nakagawa, 1895, “Theory Concluding the Shima-sen as a Japanese Coin”, Report to the Tokyo Kosenkai, Volume 2.

22 Kumio Nagai, 1996, “Shima-sen and Senkoku-sen: Privately Minted Coins during

Kajiki-sen in the Bank of Japan[23], we have included those without any of the characters "ka", "ji" or "ki" on the reverse of the coin in this category as it fits the above definition of Iutsushi-sen coins (we will temporarily call them "Iutsushi-sen A coins" as the appropriateness of the categories in terms of numismatic study still need to be determined). For our analysis, we have selected the few Iutsushi-sen coins with the inscriptions of Chinese coins in the Song（宋）, Jin（金）, Yuan (Mongol)（元） and Ming（明） Dynasties as well as the inscriptions of Korean and Japanese (Kocho-sen) coins.

Furthermore, coins referred to as "Iutsushi Bitasen（鋳写鐚銭） coins" by the Bank of Japan are also included in this category. There are numerous types of Iutsushi Bitasen coins, making it difficult to determine their origin by appearance alone. For the purpose of this paper, we have chosen Iutsushi Bitasen coins bearing inscriptions of Japanese coins (kocho-sen), as they are most likely to be minted in Japan (hereafter referred to as "Iutsushi-sen B coins").

The majority of the mochu-sen coins excavated from the Medieval period consist of these Iutsushi-sen coins, and mochu-sen molds unearthed from the Medieval ruins throughout Japan are basically for the "Iutsushi" process. In view of the coin molds unearthed from the late 13th century ruins in Kyoto, it is evident that the method of "Iutsushi" was already applied to coin mintage in Japan around this period.[24]

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the Medieval Ages", Excavated Coins from the Medieval Period: Appendix I.

23 There are no clear criteria for the categorization of "Kajiki-sen" in the Bank of Japan. Generally speaking, however, the characteristics of these coins are that they are whitish in color, they are magnetic and have randomly scattered dots on the surface as though it was poked through with a needle.

24 Masakazu Yamamoto, 1996, "Coin Molds Excavated from Heiankyo Sakyo Hachijo

Moreover, the mochu-sen coin molds excavated in Sakai indicates that the Iutsushi-sen coins were still in production in the third quarter of the 16th century, along with the Iutsushi-sen coins of the Keicho Tsuho coins unearthed from Lot. SKT 448-3[25], also in Sakai, suggests that the minting of "Iutsushi" coins continued for some time.

(7) Keicho Tsuho（慶長通寶） coins

The inscription on these coins is very distinctive as it carries the name of a Japanese era, "Keicho（慶長）". With no historical documents remaining, however, it is unclear whether the coin was officially or privately minted. One theory is that the Keicho Tsuho was first minted in 1606, but there is no sound evidence supporting this opinion. From the inscription on the coin, it is reasonable to assume that the coin was minted during the Keicho era, that is, 1596-1615. In the same manner, the Keicho Tsuho is apparently distinguished from the aforementioned mochu-sen group of coins. It is estimated that these coins were minted around the same time as the above-mentioned Kajiki-sen, and thus the Keicho Tsuho is a valuable source of information in discussing the domestic mintage of coins during that period. Given this, we have decided to examine Keicho Tsuho coins in this paper.

As mentioned in the section on the Kajiki-sen, a sizable number of Keicho Tsuho coins, amounting to 70 in all, was discovered from the excavation of the Sakai

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Sanbo", Research Records of Buried Cultural Properties in Kyoto City, Volume 3.

25 Kumio Nagai and Yasuji Kondo, 1997, "Buried Coins Excavated from the Ruins in the Sakai Moat City (Lot. SKT 448-3), Excavated Coins of Early Yedo Period, Research Committee of Buried Coins in Hyogo Prefecture.

Moat city ruins Lot. SKT 448-3.[26] Although the age of these coins lacks solid grounds as an official excavation, as they were unearthed by observatory research, they were estimated to be buried in the calamity accompanying the Osaka Natsu no Jin (Summer War of Osaka) in 1615. Hence, it is appropriate to assume that the first mintage of the coin began before 1615 as also indicated by the inscription of the coin. In fact, a coin smaller in diameter considered to be a Iutsushi-sen (copy) coin of the Keicho Tsuho coins was found among the excavated coins, thus implying that the Keicho Tsuho coins were already in production for some time and in circulation by 1615.

3. Analytical Procedure

(1) Dimension and Weight Measurements

We have taken photographs and made rubbings of the coins and measured their dimensions and weight. We have measured both the horizontal and vertical measurements of the outer and inner diameters and the outer and inner widths of the outer edge of the inside hole, and the thickness of the coin in two different places (refer to the Figure 1). Using a digital slide caliper (Mitutoyo CD-S20C), we were able to measure with an accuracy of 0.01mm, while the electronic balance scale (Shinko Denshi HG-2000) allowed us to take weights with an accuracy of 0.01g.

(2) Lead Isotope Measurement

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[26] Kumio Nagai and Yasuji Kondo, 1997, "Buried Coins Excavated from the Ruins in the Sakai Moat City (Lot. SKT 448-3), Excavated Coins of Yedo Period, Research Committee of Buried Coins in Hyogo Prefecture.

In this paper we applied the "high-frequency heating method" for measuring the lead isotope ratio [27], recently developed by the National Museum of Japanese History. The advantages of this method are that (1) lead is extracted in a very short time (approximately 15 minutes), and (2) it is possible to minimize the contamination because of a simple manipulation and the use of a dry method. Concretely, the procedure is described below.

The sample is placed in a small quartz crucible, covered by a quartz vessel and heated for 15 minutes in a high frequency heating furnace. The precipitated lead collected on the inside wall of quartz vessel is dissolved in approximately 1 ml of diluted nitric acid and the amount of the collected lead is measured by an ICP mass spectrometer. Three hundred nanogram of the collected lead is loaded onto the rhenium single filament along with phosphoric acid and silica gel, set inside a thermal ionization mass spectrometer (TI-MS) and the lead isotope ratios are measured at a filament temperature of 1,200°C.

For comparison with reported data on East Asian bronze objects, the analytical results have been plotted according to methods used by H.Mabuchi and his co-workers.[28,29] We have used two types of graphs: "method A" plots $^{208}Pb/^{206}Pb$ on the vertical axis and $^{207}Pb/^{206}Pb$ on the horizontal axis and "method B" plots $^{207}Pb/^{204}Pb$ on the vertical axis and $^{206}Pb/^{204}Pb$ on the horizontal axis. According to the results

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27 Tsutomu Saito, Teruhiko Takahashi and Isamu Taguchi, 1994, Summary of the 16th Annual Meeting of the Association of Scientific Research on Historic and Artistic Works of Japan.

28 Hisao Mabuchi and Yoshimitu Hirao, 1987, "Lead Isotope Ratios of Lead Ores in East Asia", Journal of the Archaeological Society of Nippon, Volume 73, Issue.

29 Hisao Mabuchi and Yoshimitu Hirao, 1990, "Research of Bronze Mirrors by Lead

obtained, the transition in lead isotope ratios of bronze objects from the Yayoi Period to the Heian Period can be divided up into the following groups.

W: Within the boundaries of the Western Han style mirrors introduced in the Yayoi Period (lead from North China)

E: Within the boundaries of the Eastern to post-Han style mirrors (lead from Central and South China)

J: Within the boundaries of Japanese lead ores

K: Within the boundaries of the ancient Korean bronze objects introduced in the Yayoi Period (lead from Korean Peninsula)

The symbols W, E, J and K in the graphs refer to the above.

4. Results of the Dimension and Weight Measurements

The rubbings of the material are shown in the following pages (List of Coin Rubbings). The results of the dimension and weight measurements can also be found in the List at the end of this paper (Chart). We would like to point out that the discussions in the following sections will be limited to some of the characteristics of the coins examined in this paper.

(1) Iutsushi Kobu and Kobu Honsen coins (Figure 2)

Let us first examine the original Kobu Tsuho coins believed to have been made in China (hereafter referred to as Kobu Honsen or original Kobu coins) and their mochu-sen coins. Looking at the Kobu Honsen coins, the outer and inner diameters

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Isotope Ratios", Journal of the Archaeological Society of Nippon, Volume 75, Issue 4.

measure approximately 24.5 mm and 20.5 mm respectively. In contrast, the Iutsushi-sen coins (the copied coins) of the Kobu Tsuho coins (hereafter referred to as Iutsushi Kobu coins) is clearly smaller in size. It is presumed that the mold taken from the circulated Kobu Honsen coins may have shrunk during the drying process, and hence the Iutsushi-sen coins made from the mold are smaller than the original. Moreover, as opposed to the detection of Iutsushi-sen coins, which was in the past based on mere instinct, the coins can now be detected more precisely by the use of measurements (in particular, the inner diameter, which is not affected by deterioration in shape). The Iutsushi-sen coins examined in this paper constitute proof of identity of a mochu-sen coin using the Iutsushi process. Needless to say, however, there are many types of original Kobu Tsuho coins with differing inscription on the reverse and diameter. Thus, comparative analysis must be made accordingly.

(2) Kajiki-sen coins (Figure 2)

Like the Iutsushi Kobu coins, most of the the Kajiki-sen coins also clearly smaller than the Kobu Honsen coins. As estimated from a comparison of coin rubbings, the Kajki-sen coins share many traits with the Kobu Honsen coins in terms of coin inscription. In particular, coins having the unusual character “ho（寶）” in their coin inscription [30] is identical to Kobu Honsen coins with the character “fuku（福）” on the reverse, which is called “hai-fuku（背福）”, while coins having the usual character “ho（寶）” have traits in common with coins with the character “setsu（浙）” on the reverse, which are called “hai-setsu（背浙）” coins. It is apparent from this that many

30 In numismatic studies, this is generally called “hotogi takara”.

of the Kajiki-sen coins were made by first copying either the hai-fuku or hai-setsu type of Kobu Honsen coins and later added the characters “ka”, “ji” and “ki” on the reverse. Given this, it is presumed that the place of mintage marked on the reverse of the Kajiki-sen was made from the “hai-fuku” and “hai-setsu” coins of the Kobu Honsen coins. In exceptional cases, however, there are some Kajiki-sen coins with outer diameters almost the same as those of the Kobu Honsen coins. Some of the coin inscriptions on these coins are somewhat distorted and it is understood that they sometimes used new patterns and molds.

A close examination of the Kajiki-sen coins reveals that the character “bu（武）” of the Kobu Tsuho coins varies slightly among the coins; that is, the lower part of the character is “tsuchi（土）”[31] in some and “yama（山）”[32] in others. While there seem to be many “hotogi takara（缶宝）” among “tsuchi-bu” coins, the hai-fuku of the Kobu Honsen coins, assumed to be their distinguishing pattern, depicts the character “tsuchi（土）” in place of “tomeru（止）”, depending on whether it is the pattern of mold. Hence, the “tsuchi-bu” is determined to be produced from the Kobu Honsen coins by partially altering some strokes in the characters.

The “yama-bu” coins, on the other hand, are observed to be a size smaller than the usual Kajiki-sen coins, judging from the outer diameter of the coins. Clearly, the “yama-bu” is the product of repeated Iutsushi or copying. The characters in the inscription are illegible as their pattern was derived from repeated Iutsushi. It is assumed that the yama-bu is the result of changes in coin inscription and alteration of strokes in the characters.

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[31] In numismatic studies, this is generally called “tsuchi-bu”.

In addition to the above, there are some Kajiki-sen with the same inscription as the Daichu Tsuho（大中通寶）, but the two characters “dai（大）” and “chu（中）” in those coins are clearly simplified in form, and thus are not Iutsushi of the original Ming Dynasty coin, the Daichu Tsuho. In fact, the two characters “tsu（通）” and “ho（寶）” are the same as in other Kajiki-sen coins, and, as in the common Kajiki Kobu coins, the outer diameter is also a size smaller than is the case with the Kobu Honsen coins. As pointed out earlier, the two characters “ko（洪）” and “bu（武）” of the Kobu Honsen coins (in particular, the hai-setsu) are believed to have been scraped off and replaced with the two characters “dai” and “chu”.[33] This is exactly the same method as engraving one of the characters “ka”, “ji” and “ki” on those Kobu Honsen coins with character on the reverse.

(3) Chikuzen Kobu coins (Figure 2)

The Chikuzen Kobu coins are smaller in outer diameter than the Iutsushi Kobu and Kajiki-sen coins. As discussed in Section 2, the theory that the inscription on the coins differs slightly from the Kobu Tsuho coins is assumed to be a result of a pattern made from newly inscribed base coin. But the calligraphic style closely resembles that of the Kobu Honsen coins. The slight difference in style between Chikuzen Kobu and Kobu Honsen coins is assumed to be due to the reduced size in mold resulting from repeated Iutsushi and partial alterations. This is almost the same phenomenon seen in the “tsuchi-bu” of the Kajiki-sen, based on the process of Iutsushi. It should be noted,

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32 In numismatic studies, this is generally called “yama-bu”.

33 Nobuhisa Furuta, 1996, “New Categorization of Mochu-sen in the Medieval period

however, that the Chikuzen Kobu coins have a larger ratio of inner diameter to outer diameter compared to the Kajiki-sen coins. As pointed out above, it is evident that the Chikuzen Kobu was made distinctive by scraping off the inner edge of the outside circumference and enlarging the outer edge of the inside hole. Therefore, the Chikuzen Kobu coins basically fall into the category of Iutsushi coins modified by additional engravings, rather than coins produced with a new mold.

(4) Kanode Gen'yu and Gen'yu Honsen coins (Figure 3)

Next we will compare the Kanode Gen'yu coins with the original Chinese coins of the Gen'yu Tsuho (hereafter referred to as Gen'yu Honsen coins). Measurements of the Gen'yu Honsen coins vary somewhat from coin to coin, but the outer and inner diameters are perceived to maintain a fixed ratio. The Kanode Gen'yu coins are relatively identical in size, but there is a recognizable difference in the outer to inner diameter ratio from the Gen'yu Honsen coins. In particular, the Kanode Gen'yu coins are clearly distinguishable, with their inner diameter being larger than that of the Gen'yu Honsen coins. That is, as is evident from the style of the calligraphy on the coins, the Kanode Gen'yu coins are not Iutsushi or copies of the Gen'yu Honsen coins, but coins from a newly made pattern.

As the Kanode Gen'yu coins are sometimes referred to as Nagasaki-sen（長崎銭） coins, we have plotted the data for so-called Nagasaki boeki-sen coins (trade coins : 長崎貿易銭) and Gen'yu Honsen coins for purposes of comparison.[34] The

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to the Early Yedo Period Based on Production Method", Hosenka, Volume 14.

34 Measurement data on the Nagasaki boeki-sen and Gen'yu Honsen coins will be

Nagasaki boeki-sen coins were minted in 1759 in Nagasaki in response to a Dutch request. The majority of the coins have Gen'po Tsuho（元豊通寶） inscribed on them. A comparison of the Gen'po Honsen coins and Nagasaki boeki-sen coins indicates that their ratios of outer to inner diameter differ. With a unique calligraphic style, it is clearly evident that the Nagasaki Boeki-sen coins are coins which have emerged from a new pattern.

It is interesting to note that the Nagasaki boeki-sen and Gen'po Honsen coins have identical outer diameters. Considering the coinciding coin diameter with Chinese coins regardless of the different calligraphic style, it is imagined that a new pattern was produced in consideration of the contraction of the mold. Looking at the Kanode Gen'yu and Nagasaki boeki-sen coins, it is clear that the outer diameters are close to their respective original coins. With regard to the inner diameter, while the Kanode Gen'yu coins are larger than their originals, alluded to mentioned above, the Nagasaki boeki-sen coins are smaller. The two types of coin can be considered to be taking different directions. There exist many differences between the two, including element and weight measurement and possibly their mintage periods.

(5) Keicho Tsuho and Iutsushi Eiraku coins (Figure 4)

The Keicho Tsuho coins bear a coin inscription unique to Japan, but as pointed out in the past, this does not imply there was a newly made pattern for this coin. Seeing that the style of the characters "Keicho（慶長）" is not as well composed as that of "Tsuho（通寶）", we can presume that the character "Keicho" was added when the

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included in our chemical study of Kanei Tsuho and other early Yedo coins to be

mold was made.[35] Reasonably, the Eiraku Tsuho（永楽通寶） coin is conceived to be the original base coin for the Keicho Tsuho coins as pointed out previously. Although we did not examine the original Eiraku Tsuho coins, our measurements of their Iutsushi-sen reveal that the sizes of the above two are almost identical. Hence, it is confirmed that our assumptions that the Eiraku Tsuho was the pattern for both the Keicho Tsuho and the Iutsushi-sen of the Eiraku Tsuho and that the characters "Keicho" were later added to the former are appropriate. Moreover, in view of the varying size of the Keicho Tsuho coins, it is highly possible that parts of the Keicho Tsuho coins themselves were also copied.

(6) Others (Figures 5 and 6)

In this last section, we will briefly mention some of the coins not explained in the above.

Firstly, the Shima-sen coins. It is believed that these coins are not Iutsushi-sen coins, but rather were produced from a newly made pattern. Thus, it is not necessary for measurements to be consistent, but coincidentally the sizes are roughly equivalent to those of mochu-sen coins in general. This may be because the pattern was made with diameters in accordance with other circulated coins.

The outer diameter of the Heian Tsuho, like other mochu-sen, is on the whole smaller than original Chinese coins (Figure 5). Looking at the inner diameter, however, the measurements do not necessarily fit other mochu-sen. In the past, this

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announced following this paper.

35 Nobuhisa Furuta, 1996, "New Categorization of Mochu-sen in the Medieval period to the Early Yedo Period Based on Production Method", Hosenka, Volume 14.

coin has been presumed to be associated with the Kajiki-sen, but there are no direct connection between the two in terms of dimension and weight. Among the Heian Tsuho, there are some that appear to be a copy of the Heian Tsuho itself.

Finally we will refer to bearing the same inscriptions as the Kocho-sen (Figure 6). As the kocho-sen itself is not included in our study, we have plotted the measurement data from the National Museum of Japanese Historvey as reference. As pointed out in the past, the Man'nen Tsuho（万年通宝） is a size bigger than the Wado Kaichin（和同開珎） and the Jingo Kaiho（神功開寶） is generally smaller than the Man'nen Tsuho. Comparing those coins with what appears to be Iutsushi-sen analyzed in this paper, the outer and inner diameters of the Iutsushi-sen have diminished. As with the case of the aforementioned Iutsushi-sen of the Kobu Tsuho, it is observed that this reduction in size is the outcome of making a circulated coin to a base coin.

In the above, we have attempted to make an analysis based on measurement data. With these measurements, we have succeeded in taking a more objective perspective of categorization, which in the past was based on mere intuition, thereby enabling us to distinguish original Chinese coins from their mochu-sen and pursue their production methods by incorporating the characteristics of coin inscriptions in our analysis.

5. Results of Lead Isotope Analysis

In the following, we would like to discuss some points discovered from our lead isotope analysis (Chart).

(1) Kajiki-sen coins (Figures 7 and 8)

Firstly, the lead isotope ratios of the Kajiki-sen coins were basically distributed within the range for Japanese lead. This indicates that the main material source was within Japan. In comparison, the lead isotope ratios of the original Kobu Tsuho coins minted in China lie within the range of lead from Central and South China, area W. The lead isotope ratios of the Kobu Tsuho coins with the character "Setsu（浙：Zhe in Chinese）", meaning the Zhejiang region in China, on the reverse, are very similar to that of lead from the Chinese Huangyanwubu（黄岩五部） mine in Zhejiang Province. It is clear that the Kajiki-sen and the original Kobu Tsuho coins are made from different materials. Certainly, we cannot prove that these coins were minted in Kajiki, but this result is in accordance with the evidence that the Kajiki-sen coins were made in Japan.

Next, special attention should be given to the point that the lead isotope ratios were randomly scattered and not concentrated at specific points. This suggests that there is a strong possibility of the lead material not being supplied from specified mines. There is one theory being the abundant material supply from the Kokubu copper mine near the Kajiki area.[36] From our results that there are no indications of specific ratios, it is difficult to say that theory is founded.

In respect to lead isotope data outside the range of Japanese lead, there is one coin with a ratio in between that of Central to South Chinese and Japanese. Aside from this, two coins with slightly smaller $^{208}Pb/^{206}Pb$ and $^{207}Pb/^{206}Pb$ ratios were detected. Their material source is unknown, but their lead isotope ratios are close to

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36 Fumio Yamashita, 1978, "On-site Examination of the Kajiki Mochu-sen", Bonanza, Book 14, Appendix 6 of September Issue.

lead found in mines in the Korean Peninsula.[37] This deserves further examination in the future. Taking the above dispersion in lead isotope distribution, we can assume that the Kajiki-sen coins were minted from materials which they could gather to Kajiki, transported from various places, including abroad.

(2) Kanode Gen'yu coins (Figures 9 and 10)

It is noteworthy of the Kanode Gen'yu coins that their lead isotope ratios are mostly scattered roughly within the range of those that are characteristic of Japanese lead. This is the same feature seen in the Kajiki-sen coins. This indicates that the theory that the coins were minted in Japan is adequate, and also reveals that the lead material was not dependent on specified mines, but rather that it was by gathering resources then circulating in Japan that produced the coin.

Furthermore, the Kanode Gen'yu coins are similar to the Kajiki-sen in that there are some coins whose ratios lie outside the range of Japanese lead. It should be noted, however, that we did not detect any lead from China. As for their mintage, basically the Kanode Gen'yu coins did not use material from China. We can presume that Chinese materials were hardly in circulation in Japan during the years of the mintage of these coins, with the exception of special cases discussed later.

(3) Chikuzen Kobu coins (Figures 11 and 12)

The lead isotope ratios of the Chikuzen Kobu coins largely differ from those found in the Kajiki-sen coins, in spite of the fact that they both had the same coin

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37 Hisao Mabuchi and Yoshimitu Hirao, 1987, "Lead Isotope Ratios of Lead Ores in

inscription. Although the ratios are scattered close to those characteristic of lead in Central and South China, the data tend to deviate from the range of Chinese lead. From this, we know that this coin was not made from Japanese lead, but we do not necessarily conclude that Chinese lead was always used. A ratio comparatively close to this is that of lead bullets found among the excavation of the Ichijo-dani（一乗谷） ruins of the Asakura（朝倉） clan in Fukui Prefecture.[38] Quoting from the results by H. Brill[39], Hisao Mabuchi states that the lead is a Spanish type, assuming that its material source is in Europe, with the Iberian Peninsula emerging as the most likely source. If the Chikuzen Kobu coins were minted in Japan according to the accepted theory, then the assumption that they used imported lead, as represented by the above lead bullets, holds good.

(4) Heian Tsuho coins (Figures 13 and 14)

The lead isotope ratio for the Heian Tsuho coins all lie within the range of Central and South China in a concentrated distribution. In the past, it was often pointed out that the Heian Tsuho coins were very similar to the Kajiki-sen and other coins from the Kyushu region. In terms of material, however, they use lead from completely different sources and hence it is not appropriate to treat them as being the same. As mentioned before, the Kajiki-sen and Kanode Gen'yu coins, both minted roughly during the same period as the Heian Tsuho coins, basically used Japanese lead

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East Asia", Journal of the Archaeological Society of Nippon, Volume 73,Issue 2.

38 Hisao Mabuchi, 1986, "Provenance Study on Materials Related to Firelock Using Lead Isotope Analysis" ,Bulletin of Museum in sites of Asakura Clan, 1985.

39 R. H. Brill, 1976, Isotope Studies of Ancient lead, American Journal of Archaeology,

as opposed to Chinese lead. The Chikuzen Kobu coins also used foreign lead, but they did not include Chinese lead. If we are to assume that the Heian Tsuho coins were made in Japan as stated before, this would imply that they were minted under special circumstances in a restricted region where a substantial amount of lead was supplied from a restricted mine in China. Given this supposition, we must also take into full consideration the possibility that the coins were minted in China.

(5) Shima-sen coins (Figures 15 and 16)

In this paper, we analyzed Shima-sen coins bearing both Chinese coin and kocho-sen inscriptions. The lead isotope ratios of the two types of coin were almost the same, with both ratios indicating a material source in Central or South China. Thus, we cannot but consider their material source to be in China. The question of place of mintage, however, is a different matter. As already stated above, the Shima-sen is considered to be minted in Japan given the following two points as sufficient evidence: (1) there were no Shima-sen coins found among excavated coins in China, and (2) there are some Shima-sen coins bearing the same writing as the kocho-sen coins. If this is the case, the Shima-sen coins were minted in Japan using raw materials from China. We will discuss this point further in later sections.

(6) Iutsushi-sen coins (Figures 17,18,19 and 20)

Looking at Iutsushi-sen Type A coins (i.e. those categorized as Kajiki-sen coins in the Bank of Japan) bearing the coin writing of Kobu Tsuho coins, the lead

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isotope ratios deviate from the range of Japanese lead. That is, we can see that it differs from the basic distribution range of Kajiki-sen coins. Hence, it is not appropriate to include coins without the characters of “ka”,”ji” and “ki” on the reverse in the same category as the Kajiki-sen coins based merely on a deduction that they share the same metal quality derived solely from eye observation. The Kajiki-sen coins should be distinguished from Iutsushi-sen coins and placed in a more limited category.

As for the lead isotopes of Iutsushi-sen Type A coins, except for Kobu Tsuho coins, the figures are distributed within the range between Japanese lead and Central and South Chinese lead. Values outside this range by far belong to coins having the inscriptions of the Chinese Jin Dynasty and the Korean Choson Dynasty. It is natural for the ratios to deviate from the range of Japanese lead and Central and South Chinese lead if they were minted in their respective regions. This deserves further research in the future.

Iutsushi-sen Type B coins are nearly the same as Type A coins, but the lead isotope ratios of all coins lie within the range of Japanese and Central and South Chinese lead. We intentionally extracted lead from Iutsushi-sen Type B coins with kocho-sen writings, with very few kocho-sen coins among excavated medieval coins. As written in the table titled “Ryosokumei (list of coins)” at “Daijyoin-jisha-zojiki（大乗院寺社雑事記）”, New Year - March, 1458,[40] for example, it is certain that the people of the Medieval period recognized the existence of kocho-sen coins, and it was not entirely impossible to mint mochu-sen coins in imitation of the kocho-sen coins. Undeniably, it is possible that coins copied during the Yedo period were included in the

[40] Shimizu Katsuyuki, 1997, “Table of Coins in Daijyoinjinson”, Excavated Coins,

analyzed samples. In the case of the copies dating from the Yedo period, the lead isotope ratios for all concerned should be within the range of Japanese lead because the raw materials for these copied coins were supplied domestically. Yet, it is noteworthy that there are some coins outside this range. Namely, the Iutsushi-sen coins of the Japanese Medieval period used materials from both Japan and China. This point does not contradict the results from analysis of the Iutsushi-sen Type A coins.

(7) Keicho Tsuho coins (Figures 21 and 22)

The lead isotopes of the Keicho Tsuho coins vary with some falling in the range of Japanese lead and others outside this range. From the aspect of coin inscription, the Keicho Tsuho coins are believed to have been minted in Japan. This paper clearly supports this point by showing that some Keicho Tsuho coins were made from Japanese lead. We could not specify the exact material source other than Japan, and as the ratios plainly differ from those of Chinese lead, the features are similar to those observed in the case of the Kanode Gen'yu coins. Furthermore, in view of the wide diversity in lead isotope data, it cannot be said that the lead material of the Keicho Tsuho coins came from a specific mine. The place of mintage is still unknown. It is presumed, however, that the coins were made by gathering materials, which they could get at the place of mintage at that time.

6. Conclusion- Changes in Raw Materials of the Mochu-sen coins

Thus far, we have provided a description of the individual types of coin. We will now summarize the development of the mochu-sen coins from the standpoint of material provenance and its implications, giving full consideration to the period of mintage.

Although it is difficult to pinpoint the exact period of mintage for all the above-mentioned coins, we can roughly estimate the period for the Kajiki-sen coins to be in the early 17th century. The Kanode Gen'yu coins, though appearing somewhat later, can also be placed in the same period as the Kajiki-sen coins. The lead isotope ratios of the two types of coin are relatively similar, mostly distributed within the range of Japanese lead. It is also characteristic that the ratios of the coins falling outside this range, with the exception of one coin from the Kajiki-sen group, show a material source other than China. Another common factor is that the ratios within the Japanese lead range are scattered, indicating that the coins were not produced with lead supplied from specific mines. Only, there is one point where the data are slightly concentrated, with data fairly similar to the Kan'ei Tsuho coins made in Bizen(備前) and the Ikuno(生野) mine.[41] It can be assumed that the Ikuno mine or lead mines near the Chugoku （中国） mountains were the most likely places of material provenance.

The above characteristics seen among the mochu-sen coins, such as the Kajiki-sen and Kanode Gen'yu coins, coincide with the lead isotope ratio of the Keicho Tsuho coins ascertained to have been minted in Japan. As the Keicho Tsuho coins are believed to have been minted during the Keicho era, we can learn that they existed

41 Hisao Mabuchi, Yoshimitu Hirao, Seiji Sato, Noriko Midorikawa and Kenzo Igaki, 1983, "Lead Isotope Ratios of Ancient Asian Coins", Archaeology and Natural Science, Volume 15. Hisao Mabuchi and Yoshimitu Hirao, 1987, "Lead Isotope Ratios of Lead

almost during the same period as the Kajiki-sen and Kanode Gen'yu coins, and that there was a material supply of lead for coins minted in Japan during this period. Despite there being an insufficient number of analyzed samples, however, the Kajiki-sen, Kanode Gen'yu and Keicho Tsuho coins show a diversified distribution of foreign lead, implying that the origin of imported lead may have varied according to the place of minting.

Next, the Iutsushi-sen coins, possibly older than the Kajiki-sen and Kanode Gen'yu coins. Of course, we cannot restrict the period of these coins, as Iutsushi-sen coins are believed to have been made during all the periods examined in this paper. Most probably, however, the majority of the Iutsushi-sen coins are older than the Kajiki-sen coins, or at least some of them are. Looking at Iutsushi-sen coins as a whole, like the Kajiki-sen coins, the data are somewhat scattered but they are mainly within the range of Japanese lead. On the other hand, they differ from the Kajiki-sen coins in that there are some coins with lead isotope ratios belonging to Central and South Chinese lead which are not observed among the Kanode Gen'yu coins. Of course, there may be coins among them which were copied in China, but in view of the case with the abovementioned mochu-sen of kocho-sen coins, it is appropriate to think that these mochu-sen coins were minted in Japan using materials obtained from China during the Medieval period.

In particular, most of the lead isotope ratios for the mochu-sen of Eiraku Tsuho（永楽通寶） coins, which were originally minted in the Chinese Ming Dynasty, points to Japanese lead. We can point out the same characteristics observed with the Kanode Gen'yu coins in that Chinese materials were not used when the Eiraku Tsuho

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Ores in East Asia", Journal of the Archaeological Society of Nippon, Volume 73, Issue.

coins were copied, that is, prior to 1408, when the Eiraku Tshuho coins were first minted. Assuming from this, in reverse, that Chinese materials were relatively widely used along with Japanese resources in the stages before the minting of the mochu-sen coins of Eiraku Tsuho.

We will next examine the Shima-sen coins which were mainly minted at an early stage (in the first half of 14th century) for mochu-sen coins. The mochu-sen coins of kocho-sen coins and the coins in the Chinese Tang and Song Dynasties, all analyzed in this study, can be estimated to have been minted during the 14th century, judging from their coin inscriptions. The lead isotope ratios of these types of coin all fall within the range of Chinese lead as discussed above. Although the possibility of the Shima-sen coins having been minted in China still remains, it is noteworthy that the Shima-sen coins, including those with the inscription of Kocho-sen coins, have ratios indicating Chinese lead. In this sense, we should perhaps consider the possibility that they were minted in Japan. This does not contradict the status of Iutsushi-sen coins prior to the above Ming coins, and strengthens the probability of many coins having been minted in Japan, which may well have been dependent on Chinese materials in the early 14th century.

The results of lead isotope analysis of the Shima-sen coins of Eiraku Tsuho, point to Chinese lead. It is characteristic of these Shima-sen coins that the outer edge on the reverse are dented in the opposite direction than the usual one. Thus they cannot be placed in the same category as those Shima-sen coins having the inscriptions of Kocho-sen coins and the coins of the Chinese Tang and Song Dynasties. This area deserves further examination.

We have summarized the above results chronologically concerning the supply

of material for coins from the Japanese Medieval period as below.

Stage 1: Chinese lead was used as the material for coins such as the Shima-sen coins (around the 14th century)

Stage 2: Both Chinese and Japanese lead was used as the material, for coins such as the Iutsushi-sen coins (around the 15th century)

Stage 3: Japanese lead was basically used as the material, for coins such as the Kajiki-sen and Kanode Gen'yu coins, though some foreign lead was also used in these (around the 16th –and early 17th centuries)

There has been little progress regarding the study of coins appearing since the Kan'ei Tsuho coins. Looking at the lead isotope analysis presented by Hisao Mabuchi, however, results mostly lie within the range of Japanese lead or, in the case of ratios falling outside this range, they point to the Kamioka mine in Japan which has an unique lead isotope ratio. Thus, it is unmistakable that these coins were minted with Japanese lead.[42] It has also been suggested that this coincides with the prosperity of the mining industry at the beginning of the 17th century.[43] Should this be the case, the above transition stages may be considered to be appropriate.

Now, if we are able to trace back the transition of the above three stages, we can predict the overall supply route of lead material, and most likely that of the accompanying copper as well. In Stage 1, copper and lead production was insufficient in Japan, which was dependent on China as the material source of its coins. In Stage 2, domestic production was revitalized and by Stage 3, domestic production was

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42 Hisao Mabuchi, Yoshimitu Hirao, Seiji Sato, Noriko Midorikawa and Kenzo Igaki, 1982, "Lead Isotope Ratios of Ancient Asian Coins", Archaeology and Natural Science, Volume 15.

established, eliminating Chinese lead as the material source.

Reviewing the development of copper production already known through historical documents, crude copper was exported to China. The first case of this is said to be that 4,300 pounds of crude copper were shipped to China[44] when the Japanese government sent diplomatic embassies to the Chinese Ming Dynasty in 1433. According to Boshi'nyuminki（戊子入明記）, copper from Tajima（但馬）, Mimasaka（美作）, Bicchu（備中） and Bingo（備後） was shipped to Ming Dynasty with the diplomatic embassies in 1467. Furthermore, it is explained in the distinguished historical document Daijoinjishazojiki (entry for December 21, 1480) by Kuzuha-nyudo-sainin（楠葉入道西忍） that raw silk was the most lucrative import item from the Ming Dynasty, and in return Japan exported copper collected from Bicchu and Bizen. These documents confirm that domestic production of copper prospered in the 15th century.

As for lead, on the other hand, there are cases of exports to Korea under Lee rule（李氏朝鮮） as far back as the 16th century. In the Chuso-daio-jitsuroku（中宗大王実録） (entry for February 1528), for instance, silver was extracted from Japanese lead in Korea. It is viewed as silver-contained lead, implying that lead production in Japan was not uncommon. The analytical results also show that Japanese lead was used in the excavated lead sheets from the Asakura Clan Ichijo-dani ruins in Fukui Prefecture.[45] From this we can gather that domestic production of lead had been

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43 Atsushi Kobata, 1967, Research on the History of Japanese Mining Industry.

44 Atsushi Kobata, 1943, History of Japanese Coin Circulation, Revised. Atsushi Kobata, 1969, Research on the History of Japanese Trade in the Medieval Ages.

45 Hisao Mabuchi, 1986, "Provenance Study on Materials Related to Firelock Using

revitalized by that time.

As for the Chikuzen Kobu and Heian Tsuho coins, not discussed earlier, it is highly possible that they were minted during the same time as the Kajiki-sen coins, but this largely contradicts the outline assumed above. The Heian Tsuho coins must be further examined before reaching a conclusion, giving due consideration to special circumstances including the fact that they were not minted in Japan. Assuming that the Chikuzen Kobu coins were minted domestically, one conceivable hypothesis is that they were made from imported lead, as indicated by the above lead isotope data, as we already know that lead was imported for military purposes from the 16th century onward.[46] Therefore, the analytical results of the Chikuzen Kobu coins can be easily accepted without hesitation, assuming that it emerged from another factor separate from the above transition stages. So the stages 3 can be accepted as representing the general trend of development.

As such, the transition process assumed from the lead isotope analysis of the coins does not contradict the trend of copper and lead production based on our piecemeal knowledge from existing historical documents, but on the contrary supports this assumption with actual research materials.

In this paper we have examined the material source of mochu-sen coins and the original Chinese coins minted during the Japanese Medieval period from an analytical perspective. We have also discussed the development of mochu-sen coins from the standpoint of material provenance and its implications. With this research, we have not only covered most of the representative coins of the Japanese Medieval period, but

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Lead Isotope Analysis", Bulletin of Museum in sites of Asakura Clan, 1985.

46 Atsushi Kobata, 1967, Research on the Japanese Mining Industry.

have also gained much new knowledge that could not have been obtained through mere observation in the past.[47] We hope this paper will contribute to research on coins and medieval history in the future. Lastly, we would like to note that study of Japanese coins of the Yedo period and ancient times will follow in separate papers.

We would like to thank the members of the Institute for Monetary and Economic Studies of the Bank of Japan for their continuous support and advice in compiling this research paper.

47 With some points of our theories not fully proven, there still remain more than a few topics facing us in the future. We must extend the scope of our discussion to include unearthed coins from excavation research, excavated items from domestic ruins related to mochu-sen coins and other bronze products. Excavated materials hold many possibilities of new success as their period and location of production can help us determine the place of mintage of unknown coins if we are able to clarify the lead circulation in Japan.

	Information						Measurements (Part1)			
No.	Classification	Coin Inscription	Characteristic	Analysis No.	BOJ Information No.	BOJ Classification	Vertical Diameter of Outer Circumference (mm)	Horizontal Diameter of Outer Circumference (mm)	Vertical Diameter of Inner Circumference (mm)	Horizontal Diameter of Inner Circumference (mm)
1	Kajiki-sen	Kobu Tsuho	hai-ka	B1301	Aカマa1-3-1-1	Kajiki-sen	22.90	22.89	18.44	18.36
2	Kajiki-sen	Kobu Tsuho	hotogi takara、hai-ji	B1302	-4	Kajiki-sen	23.03	23.13	19.30	19.69
3	Kajiki-sen	Kobu Tsuho	hai-ji	B1303	-5	Kajiki-sen	23.24	23.31	19.64	19.81
4	Kajiki-sen	Kobu Tsuho	hai-ji	B1304	-6	Kajiki-sen	23.29	23.24	19.53	19.65
5	Kajiki-sen	Kobu Tsuho	hai-ji	B1305	-7	Kajiki-sen	23.31	23.18	19.76	19.85
6	Kajiki-sen	Kobu Tsuho	tsuchi-bu、hai-ji	B1306	-8	Kajiki-sen	23.32	23.25	19.47	19.84
7	Kajiki-sen	Kobu Tsuho	tsuchi-bu、hai-ji	B1307	-9	Kajiki-sen	23.53	23.56	19.20	19.73
8	Kajiki-sen	Kobu Tsuho	tsuchi-bu、hai-ji	B1308	-10	Kajiki-sen	23.17	23.13	19.38	19.55
9	Kajiki-sen	Kobu Tsuho	yama-bu、hai-ji	B1309	-135	Kajiki-sen	23.21	23.07	17.44	17.47
10	Kajiki-sen	Kobu Tsuho	yama-bu、hai-ji	B1310	-136	Kajiki-sen	23.08	23.07	17.85	17.88
11	Kajiki-sen	Kobu Tsuho	hai-ki	B1311	-173	Kajiki-sen	24.04	24.08	19.15	19.44
12	Kajiki-sen	Kobu Tsuho	hai-ki	B1312	-175	Kajiki-sen	24.86	24.83	19.31	19.06
13	Kajiki-sen	Kobu Tsuho	hai-ki	B1313	-177	Kajiki-sen	23.49	23.51	19.05	18.95
14	Kajiki-sen	Kobu Tsuho	hai-ki	B1314	-178	Kajiki-sen	23.81	23.83	19.00	18.56
15	Kajiki-sen	Daichu Tsuho	hai-ji	B1317	-188	Kajiki-sen	22.95	22.95	18.74	18.92
16	Kanode Gen'yu	Gen'yu Tsuho		B1601	Aカマa1-3-2-2	Nagasaki-sen	23.95	23.92	20.17	20.04
17	Kanode Gen'yu	Gen'yu Tsuho		B1602	-6	Nagasaki-sen	23.44	23.37	20.05	20.07
18	Kanode Gen'yu	Gen'yu Tsuho		B1603	-10	Nagasaki-sen	24.00	24.01	19.42	19.55
19	Kanode Gen'yu	Gen'yu Tsuho	hai-ichi	B1604	-76	Nagasaki-sen	23.36	23.39	19.39	19.59
20	Kanode Gen'yu	Gen'yu Tsuho	hai-ichi	B1605	-78	Nagasaki-sen	23.02	23.09	19.73	19.59
21	Kanode Gen'yu	Gen'yu Tsuho	hai-ichi	B1606	-80	Nagasaki-sen	22.98	22.96	19.74	19.75
22	Kanode Gen'yu	Gen'yu Tsuho	hai-hidari	B1607	-112	Nagasaki-sen	23.30	23.31	19.64	19.42
23	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1608	-114	Nagasaki-sen	23.57	23.60	18.79	18.68
24	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1609	-115	Nagasaki-sen	23.17	23.09	19.28	19.25
25	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1610	-118	Nagasaki-sen	23.18	23.22	19.38	19.23
26	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1611	-124	Nagasaki-sen	22.94	23.00	18.71	18.41
27	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1612	-128	Nagasaki-sen	23.73	23.64	19.69	19.50
28	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1613	-133	Nagasaki-sen	23.32	23.18	19.36	19.32

	Information						Measurements (Part1)			
No.	Classification	Coin Inscription	Characteristic	Analysis No.	BOJ Information No.	BOJ Classification	Vertical Diameter of Outer Circumference (mm)	Horizontal Diameter of Outer Circumference (mm)	Vertical Diameter of Inner Circumference (mm)	Horizontal Diameter of Inner Circumference (mm)
29	Kanode Gen'yu	Gen'yu Tsuho	hai-kuchi、hai-ju	B1614	-137	Nagasaki-sen	23.59	23.52	19.52	19.02
30	Kanode Gen'yu	Gen'yu Tsuho	hai-ue	B1615	-140	Nagasaki-sen	23.81	23.80	18.89	18.92
31	Kanode Gen'yu	Gen'yu Tsuho	hai-ue	B1616	-141	Nagasaki-sen	23.72	23.54	18.98	18.70
32	Kanode Gen'yu	Gen'yu Tsuho	hai-ue	B1617	-148	Nagasaki-sen	23.48	23.53	18.71	18.96
33	Kanode Gen'yu	Gen'yu Tsuho	hai-∩	B1618	-153	Nagasaki-sen	23.12	23.11	19.28	19.03
34	Kanode Gen'yu	Gen'yu Tsuho	hai-∩、hai-ichi	B1619	-155	Nagasaki-sen	23.41	23.32	18.97	18.90
35	Kanode Gen'yu	Gen'yu Tsuho	hai-∩	B1620	-156	Nagasaki-sen	23.42	23.41	19.38	19.04
36	Kanode Gen'yu	Gen'yu Tsuho	hai-shin	B1621	-170	Nagasaki-sen	24.67	24.51	20.48	20.32
37	Kanode Gen'yu	Gen'yu Tsuho	hai-shin	B1622	-183	Nagasaki-sen	23.98	23.86	19.66	19.75
38	Kanode Gen'yu	Gen'yu Tsuho	hai-shin	B1623	-205	Nagasaki-sen	23.61	23.60	19.24	19.26
39	Kanode Gen'yu	Gen'yu Tsuho	hai-shin	B1624	-209	Nagasaki-sen	23.22	23.22	19.05	19.06
40	Kanode Gen'yu	Gen'yu Tsuho		B1625	-230	Nagasaki-sen	23.63	23.99	20.26	20.27
41	Kanode Gen'yu	Gen'yu Tsuho		B1626	-231	Nagasaki-sen	23.25	23.37	19.44	18.99
42	Kanode Gen'yu	Gen'yu Tsuho		B1627	-232	Nagasaki-sen	24.10	24.15	19.50	19.72
43	Chikuzen Kobu	Kobu Tsuho		B2001	Aカマａ1-3-3-172	Shima-sen	21.97	22.03	18.87	18.56
44	Chikuzen Kobu	Kobu Tsuho		B2002	-174	Shima-sen	22.20	22.12	18.55	18.46
45	Chikuzen Kobu	Kobu Tsuho		B2003	-176	Shima-sen	21.58	21.60	18.99	18.38
46	Chikuzen Kobu	Kobu Tsuho		B2004	-178	Shima-sen	22.41	22.40	18.27	17.65
47	Chikuzen Kobu	Kobu Tsuho		B2005	-196	Shima-sen	21.94	21.96	18.47	18.48
48	Chikuzen Kobu	Kobu Tsuho		B2006	-197	Shima-sen	21.53	21.86	18.48	18.86
49	Iutsushi-sen Type A	Kobu Tsuho		B1315	Aカマａ1-3-1-179	Kajiki-sen	23.91	23.83	18.99	18.88
50	Iutsushi-sen Type A	Kobu Tsuho		B1316	-180	Kajiki-sen	22.58	22.49	19.13	18.78
51	Iutsushi-sen Type A	Kobu Tsuho	hai-setsu	B1326	-182	Kajiki-sen	23.07	23.10	19.27	19.19
52	Iutsushi-sen Type A	Kobu Tsuho	hai-fuku	B1327	-185	Kajiki-sen	22.69	22.65	19.50	19.16
53	Heian Tsuho	Heian Tsuho		B1901	Aカマａ1-3-3-1	Shima-sen	22.82	22.89	18.79	18.65
54	Heian Tsuho	Heian Tsuho		B1902	-2	Shima-sen	23.42	23.09	18.36	17.80
55	Heian Tsuho	Heian Tsuho		B1903	-18	Shima-sen	23.55	23.54	17.33	17.12
56	Heian Tsuho	Heian Tsuho		B1904	-19	Shima-sen	23.45	23.42	18.71	18.72
57	Heian Tsuho	Heian Tsuho		B1905	-21	Shima-sen	23.57	23.57	17.56	17.27
58	Shima-sen	Jingo Kaiho		B1501	Aカマａ1-2 -300	Shima-sen	23.75	23.72	18.52	19.12
59	Shima-sen	Wakai Chinpo		B1502	-526	Shima-sen	24.09	24.03	19.60	19.98
60	Shima-sen	Wakai Tsuho		B1506	-527	Shima-sen	24.62	24.94	20.00	20.63
61	Shima-sen	Kaigen Tsuho		B1503	-7	Shima-sen	24.68	24.70	20.64	20.70
62	Shima-sen	Genpei Soho		B1504	-155	Shima-sen	24.36	24.59	20.28	20.34
63	Shima-sen	Junka Genpo		B1505	-285	Shima-sen	23.36	23.55	18.52	18.68
64	Shima-sen	Eiraku Tsuho		B2201	-1	Shima-sen	21.03	20.76	17.65	18.04
65	Shima-sen	Eiraku Tsuho		B2202	-3	Shima-sen	24.59	23.94	19.28	19.56

	Information						Measurements (Part1)			
No.	Classification	Coin Inscription	Characteristic	Analysis No.	BOJ Information No.	BOJ Classification	Vertical Diameter of Outer Circumference (mm)	Horizontal Diameter of Outer Circumference (mm)	Vertical Diameter of Inner Circumference (mm)	Horizontal Diameter of Inner Circumference (mm)
66	Shima-sen	Eiraku Tsuho		B2203	-4	Shima-sen	23.87	23.90	19.55	19.57
67	Shima-sen	Eiraku Tsuho		B2204	-5	Shima-sen	22.84	22.98	18.31	17.40
68	Iutsushi-sen Type A	Wado Kaichin		B1318	Aカマａ1-3-1-189	Kajiki-sen	22.20	22.15	19.05	19.08
69	Iutsushi-sen Type A	Wado Kaichin		B1319	-190	Kajiki-sen	23.83	23.77	19.87	20.18
70	Iutsushi-sen Type A	Wado Kaichin		B1320	-191	Kajiki-sen	23.21	23.34	20.08	19.60
71	Iutsushi-sen Type A	Wado Kaichin		B1321	-192	Kajiki-sen	21.85	21.74	18.76	18.44
72	Iutsushi-sen Type A	Jingo Kaiho		B1322	-193	Kajiki-sen	24.10	24.05	19.10	19.31
73	Iutsushi-sen Type A	Jingo Kaiho		B1323	-194	Kajiki-sen	23.67	23.55	20.32	20.37
74	Iutsushi-sen Type A	Kaigen Tsuho		B1324	-196	Kajiki-sen	24.08	24.07	19.01	19.24
75	Iutsushi-sen Type A	Kaigen Tsuho		B1325	-197	Kajiki-sen	23.64	23.62	17.73	17.81
76	Iutsushi-sen Type A	Eiraku Tsuho		B1334	-287	Kajiki-sen	23.65	23.72	20.02	19.79
77	Iutsushi-sen Type A	Eiraku Tsuho		B1335	-288	Kajiki-sen	23.28	23.49	19.72	19.98
78	Iutsushi-sen Type A	Eiraku Tsuho		B1336	-289	Kajiki-sen	22.96	22.91	19.69	19.72
79	Iutsushi-sen Type A	Eiraku Tsuho		B1337	-290	Kajiki-sen	23.41	23.44	19.36	19.56
80	Iutsushi-sen Type A	Eiraku Tsuho		B1338	-291	Kajiki-sen	22.55	22.82	19.51	19.56
81	Iutsushi-sen Type A	Chosen Tshuho		B1339	-292	Kajiki-sen	21.80	21.69	18.71	18.78
82	Iutsushi-sen Type A	Chosen Tshuho		B1340	-293	Kajiki-sen	22.64	22.62	18.63	18.62
83	Iutsushi-sen Type A	Chosen Tshuho		B1341	-294	Kajiki-sen	22.04	22.29	17.90	18.36
84	Iutsushi-sen Type A	Chosen Tshuho		B1342	-295	Kajiki-sen	22.47	22.57	19.20	18.78
85	Iutsushi-sen Type A	Chosen Tshuho		B1343	-296	Kajiki-sen	24.91	24.74	18.01	17.69
86	Iutsushi-sen Type A	Genpo Tsuho		B1344	-218	Kajiki-sen	23.98	23.99	19.40	19.20
87	Iutsushi-sen Type A	Genpo Tsuho		B1345	-225	Kajiki-sen	23.66	23.76	19.80	19.56
88	Iutsushi-sen Type A	Daijo Tsuho		B1346	-275	Kajiki-sen	23.75	23.43	20.17	20.14
89	Iutsushi-sen Type A	Seiryu Genpo		B1347	-283	Kajiki-sen	23.83	23.75	19.28	19.01
90	Iutsushi-sen Type A	Shisei Tsuho		B1348	-286	Kajiki-sen	23.79	23.98	20.92	20.91
91	Iutsushi-sen Type B	Wado Kaichin		B1401	Aカマａ1-1 -1	Iutsushi Bitasen	22.69	22.80	19.84	19.94
92	Iutsushi-sen Type B	Wado Kaichin		B1402	-2	Iutsushi Bitasen	22.99	22.93	20.05	20.05
93	Iutsushi-sen Type B	Wado Kaichin		B1403	-3	Iutsushi Bitasen	23.52	23.60	19.38	19.18
94	Iutsushi-sen Type B	Wado Kaichin		B1404	-4	Iutsushi Bitasen	23.04	23.14	19.41	19.48
95	Iutsushi-sen Type B	Wado Kaichin		B1405	-5	Iutsushi Bitasen	23.23	22.99	19.14	19.57
96	Iutsushi-sen Type B	Wado Kaichin		B1406	-6	Iutsushi Bitasen	23.19	23.13	19.71	20.01
97	Iutsushi-sen Type B	Wado Kaichin		B1407	-7	Iutsushi Bitasen	23.20	23.32	19.71	20.01
98	Iutsushi-sen Type B	Wado Kaichin		B1408	-8	Iutsushi Bitasen	22.37	22.34	18.95	18.97
99	Iutsushi-sen Type B	Wado Kaichin		B1409	-9	Iutsushi Bitasen	22.44	23.86	19.89	19.87
100	Iutsushi-sen Type B	Man'nen Tsuho		B1410	-10	Iutsushi Bitasen	23.70	23.41	20.67	20.42
101	Iutsushi-sen Type B	Man'nen Tsuho		B1411	-11	Iutsushi Bitasen	24.03	24.03	19.20	19.23
102	Iutsushi-sen Type B	Man'nen Tsuho		B1412	-12	Iutsushi Bitasen	23.15	22.94	18.45	18.22
103	Iutsushi-sen Type B	Jingo Kaiho		B1413	-13	Iutsushi Bitasen	23.86	23.99	20.84	21.17
104	Iutsushi-sen Type B	Jingo Kaiho		B1414	-14	Iutsushi Bitasen	23.56	23.67	19.92	19.48

	Information						Measurements (Part1)			
No.	Classification	Coin Inscription	Characteristic	Analysis No.	BOJ Information No.	BOJ Classification	Vertical Diameter of Outer Circumference (mm)	Horizontal Diameter of Outer Circumference (mm)	Vertical Diameter of Inner Circumference (mm)	Horizontal Diameter of Inner Circumference (mm)
105	Keicho Tsuho	Keicho Tsuho			Aｴﾄﾞｃ1 -1	Keicho Tsuho	22.99	23.01	19.59	19.65
106	Keicho Tsuho	Keicho Tsuho		B2301	-2	Keicho Tsuho	22.49	22.41	19.04	19.41
107	Keicho Tsuho	Keicho Tsuho		B2302	-4	Keicho Tsuho	23.23	23.36	19.99	19.93
108	Keicho Tsuho	Keicho Tsuho		B2303	-8	Keicho Tsuho	23.60	23.61	20.15	19.52
109	Keicho Tsuho	Keicho Tsuho		B2304	-10	Keicho Tsuho	23.36	23.28	20.05	19.81
110	North Song Dynasty coin	Gen'yu Tsuho		B1701	Bﾁｳm1-44 -1	North Song Dynasty coin	23.87	23.91	18.85	18.86
111	North Song Dynasty coin	Gen'yu Tsuho		B1702	-9	North Song Dynasty coin	24.25	24.23	19.74	19.68
112	North Song Dynasty coin	Gen'yu Tsuho		B1703	-11	North Song Dynasty coin	24.68	24.75	20.48	19.91
113	North Song Dynasty coin	Gen'yu Tsuho		B1704	-21	North Song Dynasty coin	23.59	23.61	18.60	18.49
114	North Song Dynasty coin	Gen'yu Tsuho		B1705	-31	North Song Dynasty coin	24.16	24.36	19.12	19.13
115	North Song Dynasty coin	Gen'yu Tsuho		B1706	-42	North Song Dynasty coin	24.62	24.55	20.03	20.26
116	North Song Dynasty coin	Gen'yu Tsuho		B1707	-51	North Song Dynasty coin	24.00	24.02	18.21	18.60
117	North Song Dynasty coin	Gen'yu Tsuho		B1708	-61	North Song Dynasty coin	24.55	24.69	20.07	20.61
118	North Song Dynasty coin	Gen'yu Tsuho		B1709	-71	North Song Dynasty coin	24.51	24.03	20.32	19.88
119	North Song Dynasty coin	Gen'yu Tsuho		B1710	-81	North Song Dynasty coin	24.76	24.68	20.43	20.52
120	North Song Dynasty coin	Gen'yu Tsuho	hai-kyo	B1711	-328	North Song Dynasty coin	23.55	23.53	19.08	18.60
121	North Song Dynasty coin	Gen'yu Tsuho	hai-kyo	B1712	-329	North Song Dynasty coin	23.10	23.22	19.22	18.90
122	North Song Dynasty coin	Gen'yu Tsuho	hai-kyo	B1713	-330	North Song Dynasty coin	23.45	23.40	18.52	18.49
123	North Song Dynasty coin	Gen'yu Tsuho		B1714	-163	North Song Dynasty coin	23.83	23.56	19.16	19.26
124	North Song Dynasty coin	Gen'yu Tsuho		B1715	-164	North Song Dynasty coin	24.37	24.47	19.85	19.70
125	North Song Dynasty coin	Gen'yu Tsuho		B1716	-165	North Song Dynasty coin	24.14	24.25	19.34	19.38
126	North Song Dynasty coin	Gen'yu Tsuho		B1717	-166	North Song Dynasty coin	24.02	24.30	19.10	19.15

	Information						Measurements (Part1)			
No.	Classification	Coin Inscription	Characteristic	Analysis No.	BOJ Information No.	BOJ Classification	Vertical Diameter of Outer Circumference (mm)	Horizontal Diameter of Outer Circumference (mm)	Vertical Diameter of Inner Circumference (mm)	Horizontal Diameter of Inner Circumference (mm)
127	North Song Dynasty coin	Gen'yu Tsuho		B1718	-168	North Song Dynasty coin	24.25	24.08	19.11	19.24
128	North Song Dynasty coin	Gen'yu Tsuho		B1719	-235	North Song Dynasty coin	24.93	24.98	20.26	20.68
129	North Song Dynasty coin	Gen'yu Tsuho		B1720	-237	North Song Dynasty coin	24.22	24.28	19.04	19.05
130	North Song Dynasty coin	Gen'yu Tsuho		B1721	-238	North Song Dynasty coin	24.63	24.59	20.44	20.26
131	North Song Dynasty coin	Gen'yu Tsuho		B1722	-239	North Song Dynasty coin	24.79	24.76	19.47	19.24
132	North Song Dynasty coin	Gen'yu Tsuho		B1723	-240	North Song Dynasty coin	23.19	23.20	18.78	18.72
133	Ming Dynasty coin	Kobu Tsuho		B1328	Bチウp1-6 -2	Ming Dynasty coin	24.14	24.06	19.85	19.56
134	Ming Dynasty coin	Kobu Tsuho		B1329	-3	Ming Dynasty coin	24.08	23.67	20.89	20.90
135	Ming Dynasty coin	Kobu Tsuho	hai-setsu	B1330	-285	Ming Dynasty coin	24.42	24.16	20.71	20.40
136	Ming Dynasty coin	Kobu Tsuho	hai-setsu	B1331	-286	Ming Dynasty coin	24.64	24.80	20.43	20.41
137	Ming Dynasty coin	Kobu Tsuho	hotogi takara、hai-fuku	B1332	-232	Ming Dynasty coin	24.53	24.27	20.16	20.03
138	Ming Dynasty coin	Kobu Tsuho	hotogi takara、hai-fuku	B1333	-233	Ming Dynasty coin	23.15	23.21	19.92	20.34
139	Ming Dynasty coin	Kobu Tsuho	hotogi takara、hai-fuku		-234	Ming Dynasty coin	23.45	23.71	20.12	20.69
140	Ming Dynasty coin	Kobu Tsuho	hai-setsu		-287	Ming Dynasty coin	24.47	24.69	20.12	20.10

Measurements (Part2)							Lead Isotope Ratio				
Vertical Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Vertical Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Thick-ness 1 (mm)	Thick-ness 2 (mm)	Weight (g)	207 /206	208 /206	206 /204	207 /204	208 /204
7.29	7.10	6.18	6.03	1.27	1.37	2.81	0.8496	2.0971	18.355	15.594	38.491
7.20	7.35	6.09	6.27	1.11	1.02	2.55	0.8469	2.0882	18.383	15.569	38.389
7.27	7.27	5.81	6.07	1.43	1.36	3.41	0.8366	2.0829	18.672	15.621	38.892
7.19	7.23	5.83	6.23	1.31	1.23	3.19	0.8341	2.0758	18.719	15.614	38.857
7.34	7.63	5.74	6.11	1.25	1.20	2.59	0.8470	2.0936	18.415	15.598	38.554
7.38	7.53	6.07	6.30	1.26	1.24	2.97	0.8473	2.0951	18.398	15.589	38.546
7.14	7.29	5.96	6.19	1.37	1.28	3.45	0.8483	2.0944	18.415	15.618	38.563
6.82	6.87	5.95	6.28	1.25	1.19	2.88	0.8450	2.0895	18.454	15.594	38.561
6.76	6.60	5.86	5.77	1.26	1.09	2.99	0.8453	2.0946	18.436	15.584	38.615
7.15	6.99	6.14	6.04	1.43	1.35	2.99	——	——	——	——	——
6.49	6.50	5.47	5.41	1.16	1.22	2.03	0.8528	2.1136	18.300	15.604	38.679
6.42	6.41	5.92	6.16	1.40	1.47	3.35	0.8463	2.0944	18.452	15.615	38.647
6.82	6.62	5.62	5.54	1.53	1.46	2.78	0.8498	2.1026	18.347	15.592	38.576
6.66	6.73	5.96	5.95	1.28	1.29	3.47	0.8439	2.0865	18.470	15.586	38.537
7.43	7.43	6.32	6.33	1.32	1.31	2.72	0.8499	2.1000	18.383	15.624	38.573
8.21	8.26	6.16	6.04	0.93	0.89	2.43	0.8587	2.1115	18.192	15.622	38.411
8.03	8.07	6.08	6.09	0.89	0.90	2.20	0.8447	2.0894	18.470	15.602	38.592
8.08	7.94	5.98	6.00	1.10	1.06	2.84	0.8337	2.0872	18.859	15.725	39.368
7.74	7.65	5.78	5.88	1.21	1.21	2.97	0.8502	2.1028	18.315	15.572	38.513
8.68	8.50	6.33	6.39	1.12	1.12	2.63	0.8496	2.1013	18.347	15.588	38.553
7.89	7.76	6.04	6.08	0.98	0.95	2.42	0.8476	2.0934	18.371	15.572	38.459
7.85	8.03	5.38	5.89	1.22	1.12	3.04	0.8497	2.1000	18.354	15.595	38.544
7.54	7.55	6.18	6.20	1.07	1.17	2.87	0.8476	2.0934	18.376	15.575	38.467
8.40	8.37	6.37	6.51	1.16	1.09	3.01	0.8481	2.0967	18.385	15.591	38.546
8.02	8.25	6.53	6.68	0.95	0.95	2.39	0.8477	2.0926	18.391	15.589	38.485
7.90	7.95	6.69	6.62	1.06	1.05	2.35	0.8489	2.0954	18.390	15.615	38.525
8.71	8.38	6.64	6.77	1.11	1.12	2.69	0.8466	2.0884	18.401	15.579	38.429
8.27	8.24	6.79	6.29	1.13	1.08	2.92	0.8472	2.0906	18.397	15.586	38.462

Measurements (Part2)							Lead Isotope Ratio				
Vertical Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Vertical Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Thick-ness 1 (mm)	Thick-ness 2 (mm)	Weight (g)	207 /206	208 /206	206 /204	207 /204	208 /204
8.34	8.46	6.35	6.40	1.07	1.03	2.69	0.8476	2.0913	18.394	15.590	38.466
8.14	7.91	6.63	6.63	1.20	1.16	2.80	0.8489	2.0951	18.344	15.572	38.433
8.41	8.09	7.05	6.85	1.15	1.10	2.57	0.8490	2.0977	18.396	15.617	38.589
8.11	8.15	6.78	6.80	1.11	1.06	2.65	0.8488	2.0984	18.373	15.595	38.554
8.25	8.19	6.69	6.43	1.34	1.32	2.82	0.8467	2.0881	18.402	15.580	38.425
8.10	8.22	6.73	6.66	1.25	1.23	2.83	0.8489	2.0952	18.351	15.576	38.443
7.59	7.62	6.65	6.57	1.12	1.12	2.40	0.8476	2.0950	18.389	15.587	38.524
8.36	8.61	6.48	6.53	1.26	1.29	3.48	0.8496	2.1024	18.351	15.591	38.582
8.60	8.91	6.63	6.81	1.04	1.11	2.98	0.8481	2.0986	18.470	15.665	38.761
8.90	8.94	6.49	6.85	1.05	1.01	2.63	0.8496	2.1027	18.354	15.594	38.593
8.68	8.69	6.64	6.77	1.07	1.08	2.94	0.8499	2.1032	18.364	15.607	38.721
8.69	8.46	6.06	6.39	0.88	0.87	2.27	0.8501	2.1036	18.358	15.606	38.716
8.74	8.53	6.86	6.68	0.92	0.85	2.22	0.8468	2.0947	18.503	15.668	38.858
8.55	8.56	6.48	6.71	1.08	1.09	2.97	0.8476	2.0951	18.449	15.638	38.751
7.43	7.60	6.51	6.53	0.89	0.85	1.57	0.8570	2.1093	18.337	15.715	38.678
7.72	7.73	6.41	6.46	1.04	1.20	2.19	0.8490	2.0969	18.403	15.625	38.590
7.42	7.45	6.35	6.45	0.92	0.92	1.94	0.8573	2.1123	18.312	15.700	38.681
7.67	7.70	6.45	6.46	1.01	0.99	2.36	0.8519	2.1011	18.424	15.696	38.711
7.14	7.19	5.80	5.84	0.93	1.03	1.93	0.8556	2.1159	18.317	15.672	38.758
7.30	7.20	5.97	6.01	0.86	0.92	1.74	——	——	——	——	——
6.63	6.75	5.52	5.61	1.27	1.31	3.21	0.8236	2.0606	19.006	15.653	39.162
7.17	7.14	6.61	6.38	1.04	1.06	2.42	0.8545	2.1161	18.367	15.694	38.864
6.88	6.88	5.83	5.76	1.33	1.24	3.10	0.8528	2.1078	18.384	15.679	38.751
7.50	7.49	6.11	6.08	0.97	0.97	2.46	0.8518	2.1076	18.422	15.691	38.825
7.39	7.53	6.68	6.53	0.84	0.89	2.05	0.8538	2.1111	18.363	15.678	38.766
7.58	7.84	6.39	6.11	1.04	0.96	2.56	0.8538	2.1106	18.357	15.673	38.744
7.58	7.65	6.61	6.74	1.00	0.98	2.79	0.8549	2.1134	18.342	15.680	38.763
7.96	7.99	6.63	6.68	0.97	1.05	2.29	0.8540	2.1116	18.360	15.680	38.769
7.48	7.93	6.40	6.16	1.03	1.00	2.92	0.8542	2.1118	18.358	15.681	38.768
7.72	7.46	6.65	6.50	1.03	1.05	3.23	0.8532	2.1083	18.305	15.617	38.590
7.91	7.44	6.65	6.99	1.00	0.96	2.95	0.8220	2.0582	19.062	15.666	39.232
7.60	8.11	6.62	6.39	1.04	1.12	3.28	0.8625	2.1300	18.125	15.633	38.605
7.46	7.40	6.75	6.78	0.94	0.86	2.56	0.8538	2.1099	18.347	15.664	38.710
7.87	8.39	6.36	6.42	1.01	0.95	2.85	0.8536	2.1036	18.318	15.636	38.533
8.70	8.83	7.14	7.56	0.97	0.87	1.97	0.8523	2.1086	18.376	15.663	38.747
9.05	9.53	5.87	5.87	0.80	0.83	1.76	0.8525	2.1082	18.359	15.650	38.703
7.67	7.95	6.04	6.48	0.95	1.03	2.75	0.8551	2.1151	18.321	15.667	38.750

Measurements (Part2)							Lead Isotope Ratio				
Vertical Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Vertical Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Thick-ness 1 (mm)	Thick-ness 2 (mm)	Weight (g)	207 /206	208 /206	206 /204	207 /204	208 /204
7.69	7.45	6.02	5.93	0.95	1.04	2.83	0.8552	2.1153	18.323	15.670	38.759
7.73	7.57	5.54	5.56	1.06	1.04	2.57	0.8553	2.1149	18.304	15.656	38.711
7.65	7.46	6.32	6.32	1.05	1.09	2.92	0.8496	2.1029	18.366	15.605	38.622
8.08	8.40	6.20	6.32	1.55	1.60	4.01	0.8473	2.0907	18.418	15.606	38.507
7.99	7.98	6.40	6.23	0.98	1.05	2.89	0.8496	2.1027	18.392	15.626	38.673
7.43	7.42	5.89	6.11	1.01	0.96	2.45	0.8382	2.0830	18.625	15.610	38.794
7.90	7.81	6.25	6.34	1.09	1.08	3.22	0.8476	2.0919	18.436	15.626	38.565
7.94	7.96	6.27	6.48	1.37	1.26	3.50	0.8487	2.1013	18.368	15.588	38.597
7.76	7.48	6.67	6.79	0.91	0.94	2.39	0.8464	2.0895	18.438	15.606	38.527
7.03	6.96	6.16	6.38	0.93	1.04	2.88	0.8499	2.1049	18.358	15.603	38.642
6.60	6.81	5.84	5.88	0.97	1.00	2.54	0.8489	2.0957	18.383	15.605	38.491
6.72	6.79	6.05	6.18	0.96	0.93	2.13	0.8501	2.0936	18.385	15.629	38.495
7.14	7.13	6.21	6.31	1.03	1.07	2.16	0.8503	2.0992	18.359	15.610	38.508
6.65	6.69	5.69	5.72	1.08	1.07	2.35	0.8470	2.0944	18.440	15.618	38.588
7.14	6.86	5.44	5.73	1.32	1.27	2.99	0.8472	2.0908	18.415	15.602	38.471
7.05	7.01	5.97	5.91	0.97	1.01	1.82	0.8389	2.0843	18.606	15.610	38.750
7.03	6.84	6.02	5.93	1.12	1.14	2.72	0.8482	2.0927	18.452	15.650	38.579
6.63	6.69	5.89	6.06	0.83	0.91	1.79	0.8552	2.1068	18.321	15.668	38.564
7.40	7.59	6.69	6.75	1.08	1.04	1.97	0.8435	2.0526	18.594	15.683	38.133
6.93	6.89	5.80	5.80	1.56	1.77	5.12	0.9244	2.1814	16.697	15.435	36.421
7.82	7.81	6.68	6.84	1.14	1.16	2.98	0.8505	2.1002	18.339	15.598	38.515
9.09	8.90	6.80	6.71	0.82	0.82	2.55	0.8521	2.1081	18.354	15.640	38.692
6.76	6.72	6.03	5.90	0.85	0.91	2.82	0.7993	2.0594	19.884	15.893	40.947
7.22	7.17	6.47	6.51	1.22	1.12	3.18	0.8326	2.0834	18.789	15.644	39.145
7.37	7.42	6.09	5.78	1.23	1.22	3.76	0.8552	2.1152	18.318	15.665	38.745
7.03	7.35	6.00	6.22	0.96	1.00	2.38	0.8484	2.0998	18.360	15.578	38.650
7.40	7.21	6.00	5.89	1.14	1.21	3.28	0.8491	2.0946	18.398	15.588	38.632
7.90	7.28	5.79	5.86	1.01	1.07	2.82	0.8491	2.1013	18.427	15.646	38.818
7.59	7.60	6.27	6.26	0.82	0.85	1.93	0.8550	2.1148	18.335	15.676	38.873
7.25	7.43	5.69	5.75	1.50	1.44	3.07	0.8467	2.0896	18.433	15.606	38.614
7.68	7.68	6.53	6.40	0.77	0.88	2.02	0.8493	2.0989	18.403	15.634	38.722
7.56	7.58	6.21	6.28	1.06	1.06	2.89	0.8468	2.0943	18.427	15.605	38.593
7.43	7.44	5.95	5.89	1.23	1.20	3.40	0.8488	2.0972	18.374	15.596	38.533
8.03	7.78	6.29	6.27	1.15	1.09	2.75	0.8523	2.1061	18.317	15.612	38.579
7.52	7.86	6.24	6.30	1.24	1.31	3.68	0.8489	2.1016	18.397	15.618	38.663
7.34	7.72	6.61	6.45	0.94	1.11	2.61	0.8477	2.0921	18.414	15.609	38.523
7.67	7.16	5.97	6.07	0.97	1.00	2.69	0.8538	2.1134	18.339	15.658	38.758
7.65	7.94	6.26	6.39	1.17	1.01	3.31	0.8487	2.0994	18.367	15.589	38.560
8.31	8.25	6.81	6.47	0.75	0.80	2.31	0.8445	2.0933	18.479	15.607	38.686

Measurements (Part2)							Lead Isotope Ratio				
Vertical Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Vertical Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Thick-ness 1 (mm)	Thick-ness 2 (mm)	Weight (g)	207 /206	208 /206	206 /204	207 /204	208 /204
6.51	6.58	5.37	5.89	0.99	1.02	2.32	——	——	——	——	——
8.03	8.06	7.04	7.31	0.85	0.82	1.81	0.8514	2.1004	18.410	15.674	38.668
6.72	7.01	5.98	6.02	0.94	1.02	2.40	0.8456	2.0866	18.493	15.637	38.586
6.82	6.47	5.73	5.76	0.98	1.00	2.70	0.8487	2.0686	18.457	15.663	38.179
7.23	7.18	6.52	6.46	0.56	0.61	1.62	0.8337	2.0294	18.822	15.693	38.197
7.46	7.44	6.41	6.43	1.32	1.53	3.76	0.8485	2.1058	18.523	15.717	39.005
8.11	7.84	7.10	6.83	1.12	1.13	3.46	0.8577	2.1218	18.259	15.661	38.742
7.88	8.09	6.63	7.12	1.30	1.35	4.10	0.8610	2.1235	18.157	15.633	38.556
6.59	7.11	6.04	6.14	1.31	1.18	3.49	0.8471	2.1013	18.588	15.747	39.059
8.14	7.94	6.98	6.97	1.23	1.28	3.81	0.8581	2.1210	18.236	15.649	38.680
7.47	7.61	6.66	6.67	1.02	1.06	3.11	0.8533	2.1103	18.380	15.684	38.787
7.23	6.79	5.89	5.88	0.95	1.00	3.10	0.8487	2.1026	18.509	15.709	38.918
7.57	7.80	6.26	6.71	1.05	1.03	3.42	0.8552	2.1146	18.313	15.662	38.725
7.59	7.58	6.55	6.51	0.95	1.04	2.95	0.8582	2.1187	18.278	15.687	38.778
7.65	7.86	6.47	6.42	1.17	1.26	3.63	0.8548	2.1141	18.343	15.680	38.778
6.37	6.51	6.42	5.50	0.99	0.97	2.90	0.8626	2.1292	18.118	15.628	38.879
6.31	6.60	5.24	5.31	1.25	1.27	2.58	0.8845	2.1728	17.540	15.513	38.110
7.21	6.92	6.16	6.20	1.08	1.11	3.25	0.8671	2.1486	17.981	15.592	38.634
8.11	8.10	7.08	7.12	1.07	1.31	3.12	0.8561	2.1176	18.315	15.678	38.779
8.42	8.17	7.03	7.02	1.39	1.35	4.05	0.8559	2.1168	18.306	15.674	38.752
7.85	7.96	6.97	7.04	1.13	1.05	3.44	0.8491	2.1037	18.535	15.738	38.991
8.25	7.58	7.01	7.02	1.25	1.28	3.58	0.8582	2.1211	18.227	15.642	38.661

Measurements (Part2)							Lead Isotope Ratio				
Vertical Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Outer Width of Outer Edge of the Inside Hole (mm)	Vertical Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Horizontal Diameter of Inner Width of Outer Edge of the Inside Hole (mm)	Thick-ness 1 (mm)	Thick-ness 2 (mm)	Weight (g)	207 /206	208 /206	206 /204	207 /204	208 /204
7.93	8.33	6.99	6.72	1.20	1.36	3.80	0.8567	2.1194	18.287	15.666	38.758
8.04	7.82	6.61	6.59	1.23	1.30	3.69	0.8596	2.1176	18.188	15.635	38.516
7.91	8.03	6.87	6.75	0.95	0.88	2.91	0.8553	2.1162	18.298	15.651	38.722
7.60	7.44	6.63	6.51	1.32	1.29	3.60	0.8593	2.1195	18.223	15.660	38.596
8.00	7.83	6.56	6.54	1.28	1.33	4.45	0.8563	2.1195	18.299	15.669	38.757
7.47	7.61	6.53	6.51	1.16	1.17	3.34	0.8524	2.1114	18.410	15.693	38.844
6.67	6.44	5.81	5.67	1.28	1.26	3.56	0.8527	2.1080	18.331	15.630	38.643
7.37	7.38	5.95	5.81	1.30	1.30	3.28	0.8511	2.1032	18.363	15.630	38.622
6.40	6.42	5.91	5.79	1.35	1.41	3.28	0.8530	2.1104	18.383	15.681	38.795
6.50	6.61	5.93	5.86	1.32	1.47	4.09	0.8543	2.1107	18.316	15.648	38.660
6.53	6.93	5.66	5.61	1.39	1.36	3.75	0.8572	2.1209	18.282	15.671	38.774
6.45	6.66	5.28	5.50	1.49	1.20	3.11	0.8546	2.1137	18.344	15.676	38.774
6.78	7.14	5.67	5.57	1.06	1.08	3.20	——	——	——	——	——
6.49	6.68	5.98	5.87	1.15	1.17	3.40	——	——	——	——	——