

Assumptions on Techniques and Production Sites of the Dvaravati Glass Beads in the Central Region of Thailand¹

Putsadee Rodcharoen

*Department of Archaeology, Faculty of Archaeology,
Silpakorn University, Bangkok, Thailand
Corresponding author: putsadee_rod@yahoo.com*

Abstract

This article details the study of glass beads, which were found in 8 archaeological sites in the central region of Thailand. 11 total shapes were identified: 1) Annular 2) Cylinder Disk 3) Oblate 4) Spherical 5) Barrel 6) Cylinder 7) Tube 8) Square Cylinder 9) Collared 10) Faceted Hexagonal Sphere and 11) Fluted. Three manufacturing techniques were used to produce the beads, including drawn beads, wound beads, and beads made from multiple techniques. The most commonly found manufacturing method were drawn beads. Based on a study of the bead shapes, manufacturing techniques, chemical analysis and comparison with other beads, it is argued that the glass beads from the 8 archaeological sites were imported from India, Sri Lanka, South East Asia and the Middle East.

Keywords: Glass Bead; Central Region Excavation Sites; Dvaravati

¹ This research is a part of Ph.D. dissertation in Historical Archaeology entitle, "The Analysis of Glass Beads from Dvaravati Ancient Cities in Central Part of Thailand" Department of Archaeology, Faculty of Archaeology, Silpakorn University, granted by The Royal Golden Jubilee Ph.D. Program, Thailand Research Found (RGJ-TRF).

Introduction

Glass beads are an artifact found in Thailand about 2,000 years ago, during the late prehistoric period (Iron Age). There are many colors and various shapes. According to the data from many Archaeological sites, there are numerous artifacts from other areas, the glass beads are one of them in prehistorically communities. Much previous research has suggested that India was a centre of glass bead production about 3,000-4,000 years ago. Indian beads were exported and exchanged with others countries in the world, including South East Asia.

The production and exchange of glass beads occurred not only in The Iron Age period, but continued until the Dvaravati period. Glass beads are found at many archaeological sites, especially in the central part of Thailand. In this article, I will discuss examples from 8 excavation sites 1) Neoun Plab Pla, Tumbol U-thong, Supanburi province 2) Dhamma Sala, Nakhon Prathom province 3) Hor-Ek, Nakhon Prathom province 4) Ku Bua, Rachaburi province 5) Dong Lakorn, Nakorn Na Yok province 6) Phromtin Tai, Lopburi province 7) Kheed Khin, Salaburi province 8) Sri-thep, Petchabun province. Identifying the production techniques and the sources of glass bead production of Dvaravati period beads can be informative for discussion about the trade and manufacturing techniques of glass beads in Dvaravati period in central region of Thailand.

Glass Beads in Archaeological Studies

The most of archaeological analysis of glass bead in Thailand was the studies of stylistic attributes/surface attributes and formal attributes/shape attributes. The stylistic attributes, or surface attributes was the study to focus on colors and marks appeared on the surface of the beads. And formal attributes, or shape attributes was the study by applying Horace C. Beck's (Lois Sherr Dubin 2009 : 362-363) method stated in "the Classification and Nomenclature of Beads and Pendants". His method was based on measurement and mathematic calculation of the glass beads. The study of technological attributes or study of glass beads chemical elements was very rare. The study of glass

beads in Thailand was taken by both archaeologists and scientists who were interested in.

Glass Bead Methodology

In this study I was applied many methods for classification the glass beads include:

1. Stylistic attributes and formal attributes by applying the Classification and Nomenclature of Beads and Pendants of Horace C. Beck (Figure 1)

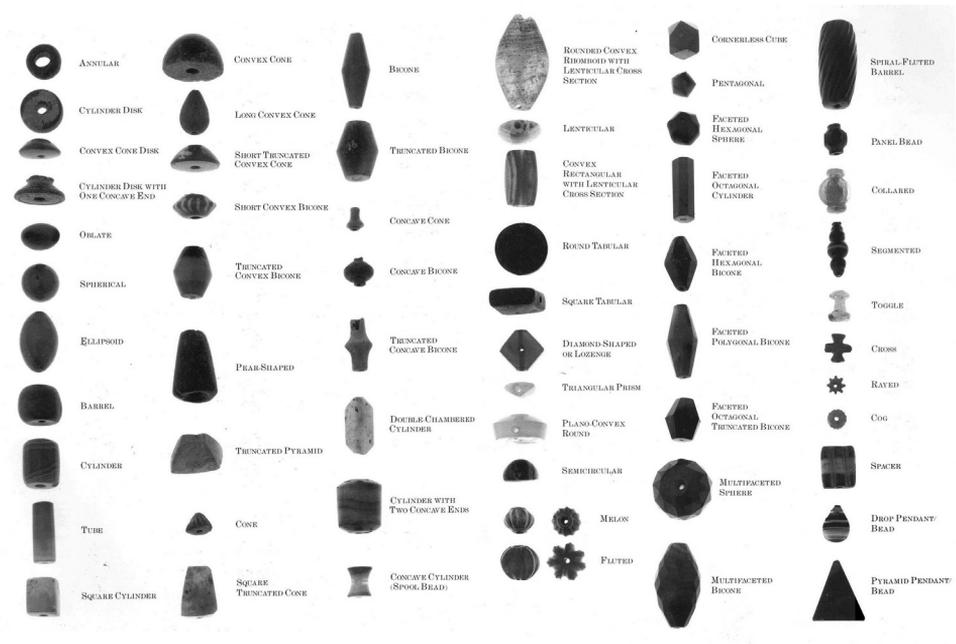


Figure 1: 59 Glass bead types by Horace C. Beck

Lois Sherr Dubin, *The worldwide history of beads: ancient ethnic contemporary* (London: Thames & Hudson, 2009), 362-363.

2. Colors classification by Munsell Bead Color Book. (Munsell Color 2012)

The Munsell Bead Color Charts are used for analyzing colors found in beads and very helpful for identifying the color of beads to

identify classification. (Figure 2)

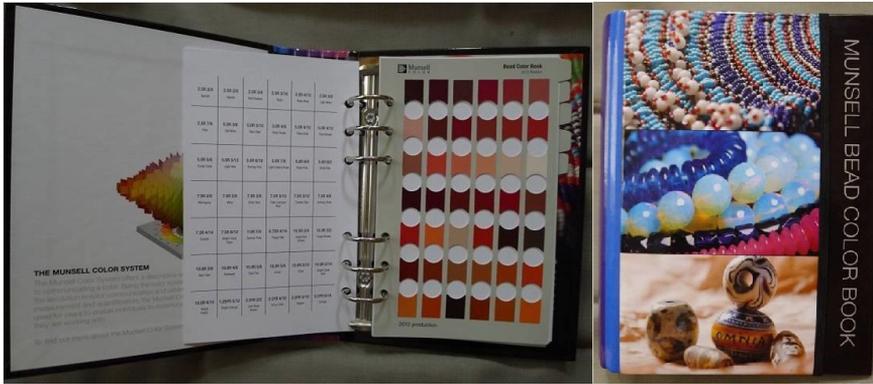
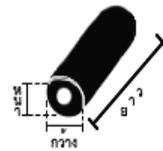
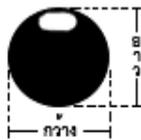
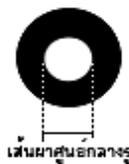


Figure 2: The Munsell Bead Color Book

3. The width, length and diameter calibration of glass bead for estimating the shapes.



Drawing 1: Spherical shape calibration **Drawing 2:** Tube shape calibration



Drawing 3: Diameter calibration

4. Weighing

5. Use the magnifier for surface analysis

6. Photographing

The analysis of glass bead from Dvaravati period excavation sites

Beads were studied from excavations at eight Dvaravati sites from Central Thailand. In addition to beads, these sites also contained artifacts such as kendi, kundika, lantern, flagon, pot shreds decorated by stamped technique in picture of elephant, lion, swan, a man riding the horse and flowers. These the decorations were auspicious motifs depicted on pottery during the Dvaravati period. Table 1 displays the quantity of different glass bead shapes found at the sites examined in this study.

Table 1: Glass bead shapes from 8 excavation sites

Sites	Shapes									Total
	Tube	Cylinder	Spherical /Oblate/ Barrel	Annular	Cylinder Disc	Square Cylinder	Collared	Faceted Hexagonal Sphere	Fluted	
1.Noen Plabpla	15	9	208	344	423	-	-	-	-	999
2.Dhammasala	-	1	7	2	10	-	-	-	-	20
3.Hor-Ek	3	2	13	9	17	-	-	-	-	44
4. Ku Bua	8	1	3	11	10	-	1	-	-	34
5. Dong Lakorn	14	4	50	42	233	-	1	1	-	345
6. Promtin Tai	29	5	50	49	66	-	-	-	-	199
7. Kheed Khin	16	3	21	10	15	-	-	-	-	65
8. Sri Thep	39	7	64	51	98	1	-	-	1	261
Total	124	32	416	518	872	1	2	1	1	1967

Table 2: The comparison of glass bead types from 8 sample sites with Horace C. Beck Classification

No.	Types	Figures
1	Annular	
2	Cylinder Disc	
3	Oblate	
4	Spherical	
5	Barrel	
6	Cylinder	
7	Tube	
8	Square Cylinder	
9	Collared	
10	Faceted Hexagonal Sphere	
11	Fluted	

Glass bead techniques

They are numerous techniques for producing monochrome and polychrome glass beads. In this study three techniques were identified.

1. Drawn Beads: This technique was first produced around 700 B.C. in Kopai site, Uttar Pradesh the north part of India (Kanungo & Brill 2009 : 11-25) and around 500 B.C. in Arikamedu, southeastern part of

India. And another source of glass is from Giribawa, Sri Lanka. (Dussubieux and Gratuze 2010 : 247-259) In the present day, Papanaidupet is still making drawn glass beads by the ancient technique. They brought some raw materials and craftsmen from Firozabad, Uttar Pradesh, which has been the glass capital of India for decades. (Francis Jr. 2002 : 19-30) and brought sand from Gudar. The glass beads from this present day are bigger than in ancient time. The methods of this technique are: (Sode 2003 : 47-58)

1.1 Put the 50 kg. glass chunk on the port of the furnace. When the glass chunk being soften put the iron cane into the glass. (Figure 3)

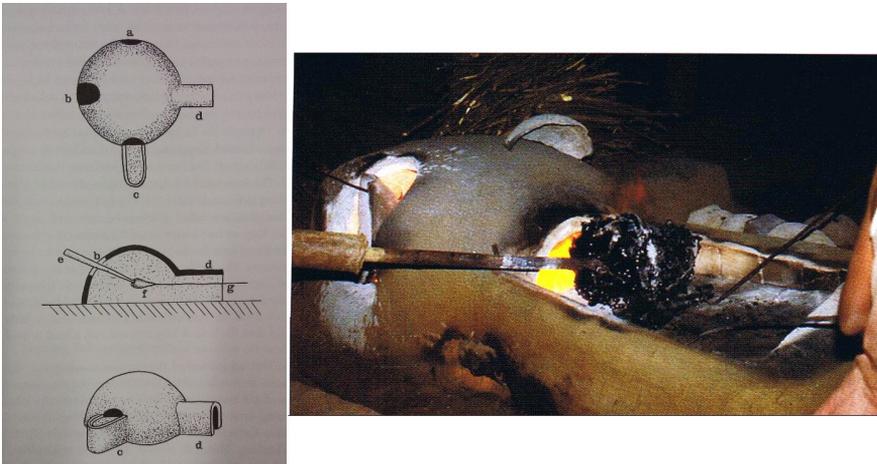


Figure 3: Tube-drawing furnace at Papanaidupet a: fuel port b: high port for the iron tube (lada) c: trough for melting glass d: port for drawing tube e: iron tube (lada) f: the cone of glass g: the tube being drawn out

Torben Sode, “Viking Age glass beads from Ribe Denmark in the light of ethnographic research,” in *Ornaments from The Past: Bead Studies after Beck*, (London: The Bead Study Trust, 2003), 47-58.

1.2 Melting the glass chunk until soften like fluid then put the 2 meters iron tube (lada) into the glass and forming the glass in shape of cone. (Figure 4)

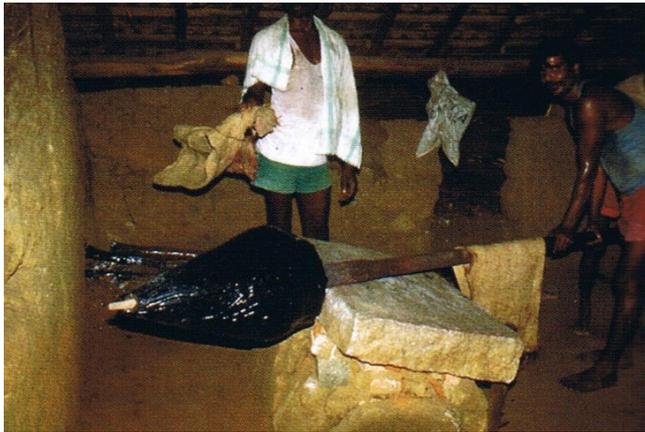


Figure 4: Forming a cone of glass on the lada (iron tube)

Torben Sode, “Viking Age glass beads from Ribe Denmark in the light of ethnographic research,” in *Ornaments from The Past: Bead Studies after Beck*, (London: The Bead Study Trust, 2003), 47-58.

1.3 Blowing in to the iron tube for making the bubble in the glass cone. When the glass cone was drawing into tube its will has the complete hole and ready for cutting into beads.

1.4 Put the glass cone into the high port. The cone is places entirely within the furnace. Opposite the high port is the low port with the tunnel opening. The craftsman inserts the long handled iron hook through the tunnel into the heart of the furnace and grabs at the open tip of the cone and walk backward about 6-8 meters, then drops the hook and grabs the glass tube.(Figure 5)

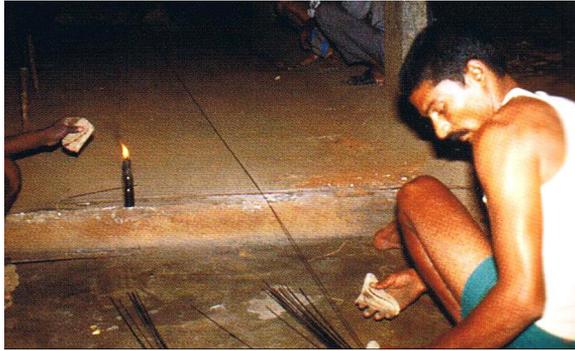


Figure 5: Drawing of a continuous glass tube from the furnace

Torben Sode, “Viking Age glass beads from Ribe Denmark in the light of ethnographic research,” in *Ornaments from The Past: Bead Studies after Beck*, (London: The Bead Study Trust, 2003), 47-58.

1.5 Checking the hole of glass tube by blowing smoke through the hole. After the glass tube was cool and setting craftsman will holds a dozen of tube in one hand over the blade. With the other hand, he brings a second blade down onto the fixed blade, chopping small segment from the tube.(Figure 6) For remove the sharp edges resulting from the cutting, another craftsman will put the glass segments into dung ash to prevent the beads from sticking together and the hole from collapsing, stirs with a large wooden paddle for twenty to thirty minutes. When the beads are rounded, they are placed in a large mortar to remove the ash from the beads. (Figure 7)



Figure 6: Cutting the glass tubes into short segments



Figure 7: Re-heating the glass beads

Torben Sode, “Viking Age glass beads from Ribe Denmark in the light of ethnographic research,” in *Ornaments from The Past: Bead Studies after Beck*, (London: The Bead Study Trust, 2003), 47-58.

The marks on the Drawn Glass Beads

Drawn Glass Beads producing the marks visible on the surface as follow;

1. Bubbles in the glass beads appear in the process of heating the materials. While the melting, in the glass will made gas, when the glass getting cool and setting into glass, this gas will appear the spaces in the glass. Normally, the bubbles are round shape. Shapes of bubbles will change follow the technique of the producing e.g. Long and narrow shape bubbles, happen when the melted glass is stretched. So the bubbles in the glass beads suggest the bead was made using a drawing technique. For opaque glass beads, linear striations appear on the surface of the beads. (Figure8-9)



Figure 8: Bubbles in the glass bead **Figure 9:** Long stripe on the bead surface

2. Cutting edge: This cutting edge can show the manufacturing of drawn glass beads after cutting glass tube into tiny beads. From the process of re-heating for removing the sharp edges if the beads slight heating the sharp edges cannot be remove.(Figure 10-11)

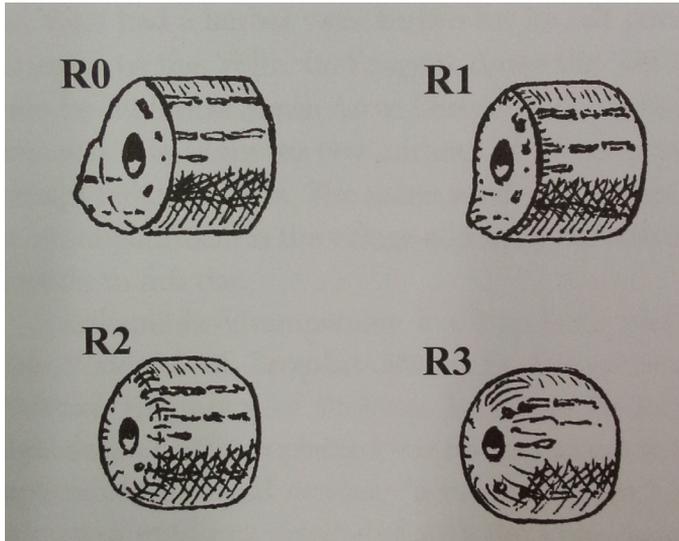


Figure 10: Sketch of the roundness factor used to describe small drawn beads
R 0: A bead with slight heating that barely changes
R 1: More heating will bevel the edges of the beads
R 2-3: A bead heated enough to round off the profile is designated



Figure 11: Many types of cutting edges

3. When removing the sharp edges if the fire is too hot, the beads are left too long, or insufficient ash is used. Two or more beads may melt together into a clump. (Figure 12)



Figure 12: A clump of glass beads from Neoun Pub Pla excavation site.

2. Wound Beads: This technique was earlier found around 700 B.C. in Kopai site, Uttar Pradesh the north part of India (Kanungo & Brill 2009 : 11-25). In this technique, glass beads are produced by twisting glass around a metal rod or mandrel in a crucible. The craftsman can decorate the bead with other colors or shape it with a paddle or other tool. When the iron rod cools down the beads can be knocked off. This technique is also often associated with Chinese manufacturing methods. In present day, Purdalpur in Uttar Pradesh still makes the glass beads by this technique. (Francis Jr. 2002 : 11) (Figure 13)



Figure 13: Furnace-winding beads in Purdalpur, India

The marks on the Wound Glass Beads

Wound glass beads producing, will appear the marks as bubbles that visible on the surface of the glass. The bubbles arrange in vertical line of the beads, and hole of the beads of each side is not equal. (Figure 14)

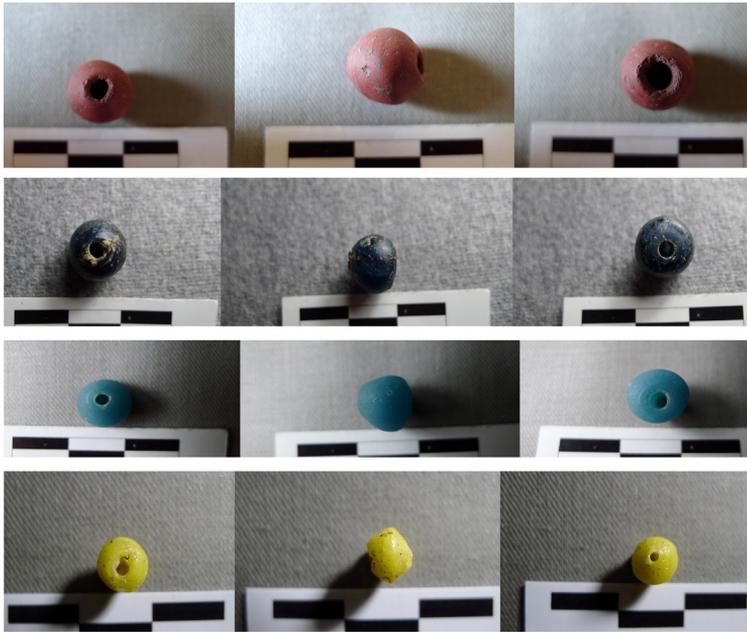


Figure 14: The marks on the Wound Glass Beads from Neoun Plab Pla, Kheed Khin and Dong Lakorn excavation sites.

3. Multi-Technique Beads

3.1 Drawn and Wound glass beads, information from the analysis found, and the glass beads that drawn yellow glass tube as the inner core, then wound around the tube by blue glass sheet and melt them together. After that, it was cut as size of the beads. (Figure 15)



Figure 15: Drawn and Wound glass beads from Hor-Ek excavation site

3.2 Square Cylinder glass bead made by drawn tube bead and reheating for forming the square shape (Figure 16)



Figure 16: Square Cylinder Glass Beads

3.3 Collar bead was making by put a glass tube for heating and stretched at both ends with pincer. Pressed at both ends for made the edge. After that flattened the body. But some beads didn't flattened. (Figure 17)

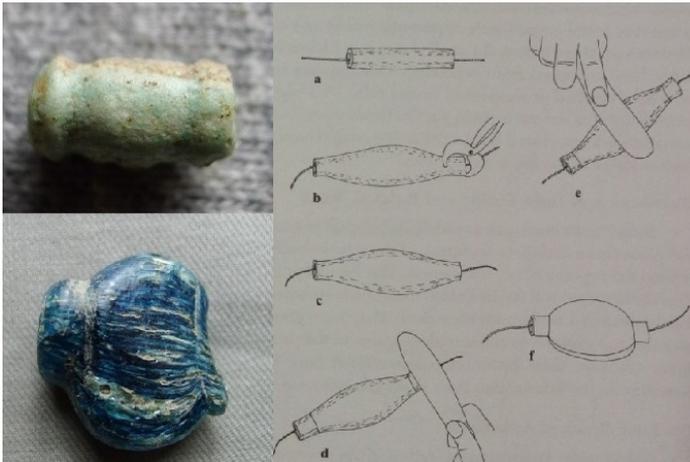


Figure 17: Collar beads from Dong Lakorn and Ku Bua excavation sites.

3.3.3 Gold-glass beads were made from two tubes of clear glass. The one with the smaller diameter was cover with gold foil and slipped into the larger one. The combined tube was heated and crimped along its length, producing bulges to be cut into beads. The finished product is quit

bright, with gold layer. But gold glass-beads were expensive so false gold-glass beads were made instead with a small tube of semi opaque white and larger, outer tube of amber-colored glass. (Figure 18)



Figure 18: False Gold-Glass Beads from Hor-Ek, Dong Lakorn and Phromtin Tai

Glass Beads Producing Technique from Example Sites

After finished the physical attribute analysis of glass beads from 8 example sites can assumed the glass beads producing technique by this table;

Table 3: Glass Beads Producing Technique from Example Sites

Sites	Techniques			Total
	Drawn	Wound	Multi-technique	
1.Noen Plabpla	994	2	3	999
2.Dhammasala	20	-	-	20
3.Hor-Ek	42	-	2	44
4. Ku Bua	33	-	1	34
5. Dong Lakorn	339	-	6	345
6. Promtin Tai	195	-	4	199
7. Kheed Khin	60	5	-	65
8. Sri Thep	253	1	7	261
Total	1936	8	23	1967

The assumptions of glass bead production sites

The result from physical attribute analysis described above could be concluded that drawn glass bead was the most popular bead used among the Dvaravati ancient cities in the Central Region of Thailand. This type of beads with various colors was found abundantly in the 8 sample sites where they were believed to be the original manufacturing places as well as one of the trade routes of glass beads in Thailand. The widespread use of the drawn glass beads, which were originally from India and Sri Lanka could clearly describe the trade relationships between India and the Dvaravati ancient cities in the Central Region of Thailand.

Moreover, there were other artifacts from the sample sites that presented the Indian cultural influence, such as spouted pots and carinated pots. The spouted pots were significant in the Dvaravati culture, and were believed to be influenced by an Indian pottery called 'Kendi'. Kendi had been used in either daily life or religious ceremonies. The carinated pots were also used for both functions, but more popular for daily use.

In other Southeast Asian countries, kendis were found at many historical towns, such as OcEo in Vietnam (Dung 2006 : 223), Angkor Borei in Cambodia (Stark 2000 : 69-89) and Beikthano in Myanmar (Thaw 1968 : 43-44). In Thailand, there were many Dvaravati ancient cities in which kendi fragments (particularly spouts) had been found, such as Ku Bua in Ratchaburi Province, Noen Plabpla in Suphanburi Province and Kheed Khin in Saraburi Province. Those fragments from the excavations were dated around the 7th – 11th C.E. by the relative dating.

In addition, the comparison of the chemical elements between the beads from the Indian archaeological sites and those from Southeast Asia led to the clear conclusion that the drawn glass beads were truly widespread in South India and Sri Lanka, particularly during the 4th Century BC - 5th Century AD. They were also largely found at many sites in Southeast Asia, and had been used continually for many periods. Because Southeast Asia is one of the center of Maritime Silk Road many commodities were traded along this routes one of the most important was glass. They

traded both raw material and finished objects so some of glass beads were locally made. (Lankton and Dussubieux 2013 : 415-457)

The result of the study presented that the glass beads found at the archaeological sites near the Lopburi-Pasak River had more diversity than those found at the Mae Klong - Tha Chin River because they have various shapes and colors. It could be primarily assumed that the glass beads from India and Sri Lanka was very popular among the Davaravati ancient cities located nearby the Mae Klong – Tha Chin River while those located near the Lopburi-Pasak River consumed the glass beads from India and Sri Lanka as well as from the Middle East and China.

Incidentally, monochrome beads trading was starting around the Iron Age and continuing to Dvaravati period bead trading in this period between South India (Sri Lanka) and Southeast Asia, or between the Central Region and the Southern Region of Thailand was a part of the Maritime Silk Road, which had been flourished during the the 9th – 10th Century (Qingxin 2009 : 40-69). The Dvaravati southern sea ports did not only export beads, but they also traded the Tang pottery from China and the Arab-Muslim wares of the Abbasid Dynasty. The supportive evidence was foreign wares which were abundantly found on the Southern Region of Thailand, such as at Tung-Tuk and Lam Pho, Chaiya district in Surathani Province. There were dated in the 9th – 10th CE (Francis Jr. 2002 : 90-93).

There was a correlated record describing that in the 9th-11th CE, China imported the Chinese wares to sell along the Maritime Silk Road, but the expected destination actually was Arab, which was ruled by the Abbasid Dynasty at that time. Originally from the Middle East, the glass beads especially the false gold-glass beads were the clear evidence of the commercial connections between Davaravati ancient cities and Arab.

One of cultural factors that encouraged the Southeast Asia to trade overseas was the rise of the Srivijaya culture on the middle of the Sumatra Island in Indonesia, Malay Cape in Malaysia and the Southern Region of Thailand from the the 8th CE. Sri-vijaya had played a significant role on the maritime trade, with China, Indian and Arab until the 13th CE. Archaeological evidences that supported this assumption were the groups

of glass beads mentioned in the above subjects.

Conclusion

According to the research, glass beads from 8 Archaeological sites found, 11 types of beads are popular. Most of the technically productions are Drawn and Wound, and the multi-technics beads less than drawn and wound beads. These show the popularities of the patterns of the beads, and could assume that the sources of productions of the glass beads is imported from India, Sri Lan-ka, Southeast Asia country and Middle East country also. The glass beads are the part of trading of the Maritime Silk Road, because that area is a dominant connection of world beads trading along the Maritime Silk Road. This route, moreover the transport glass beads, and include huge glass products e.g. Glass utensils and vases also. From the result of the study, assumed that the glass beads are the important artifacts which help and support the information for archaeologists to study the story about the trading in the region and between the regions.

Acknowledgment

The author would like to thank The Royal Golden Jubilee Ph.D. Program, Thailand Research Found (RGJ-TRF), Professor Dr. Phasook Indrawooth (the RGJ advisor), Associate Professor Surapol Nathapintu, Dr. Laura L. Junker, Dr.Laure Dussubieux and Associate Professor Dr. Thanik Lertcharnrit for supporting this research.

References

- Cayron, Jun G. (2006) *Stringing the Past: An archaeological understanding of early Southeast Asian glass bead trade* Diliman. Quezon City: The University of the Philippine Press.
- Dubin, Lois Sherr. (1987) *The history of beads from 30,000 B.C. to the present*. New York: Harry N. Abrams, 1987.
- Dung, Nguyen Kim, Ian Glover and Mariko Yamagata. (2006) Excavation at TraKieu, and Go Cam, QuangNam Province, Central Viet Nam. In *Uncovering Southeast Asia's Past*, pp.216-231. NUS Press, Singapore.
- Dussubieux, Laure and Barnard Gratuze. (2010) Glass in Southeast Asia. In *50 years of archaeology in Southeast Asia: Essays in honour of Ian Glover*, pp.247-259. River Books, Bangkok.
- Dussubieux, Laure, Bernard Gratuze, and Maryse Blet-Lemarquand. 2010. "Mineral Soda Alumina Glass: Occurrence and Meaning." *Journal of Archaeological Science* 37:1646-1655.
- Francis, Peter Jr. (2002) *Asia's Maritime Bead Trade 300 B.C. to the Present*. Honolulu: University of Hawai'i Press.
- Lankton, James, and Laure Dussubieux. 2013. "Early Glass in Southeast Asia." Pp. 415-457 in *Modern Methods for Analysing Archaeological and Historic Glass*, edited by Koen Janssens. West Sussex: Wiley and Sons.
- Qingxin, Li. (2009) *Maritime Silk Road*. Translated by William W. Wang. China: China Intercontinental Press. 2009.
- Sode, Torben. (2003) Viking Age glass beads from Ribe, Denmark in the light of ethnographic research. In *Ornaments from The Past: Bead Studies after Beck*, pp.47-58. The Brad Study Trust, London.
- Stark, Miriam T. (2000) Pre-Angkor Earthenware Ceramics from Cambodia's Mekong Delta. UDAYA, 1 : 69 - 89.
- Thaw, Aung. (1968) *Report on the Excavations at Beikthano*. Rangoon : Ministry of Union Culture.

