An evaluation on Scientific Investigation of Bronze Tara image from Sri Lanka at the British Museum: A critical evaluation on controversy of its provenance

Arjuna Thantilage
Senior Lecturer, Coordinator, Laboratory for Cultural Material Analysis (LCMA),
Postgraduate Institute of Archaeology, University of Kelaniya, Sri Lanka

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The life size gilded Tara image exhibited at the British Museum (acc. no. OA-1820-6-12-14, see photograph 5) which had been found in 1800s somewhere between Trincomalee and Batticoloa on the eastern coast of the Sri Lanka. The then governor Sir Robert Brownrigg later donated it to the British Museum. The metallurgical study on South Indian bronze images by Sharadha Srinivasan analyzed this Tara image by means of stable lead isotope and trace element analyses (Sirinivasan 1999 (a): 95). By comparing stable lead isotope ratio values and also trace element values of this Tara image with some other South Indian values she argues the possibility of it having a possible South Indian origin. She further states that the trace element trends of the Tara image fit the Pallava trend and suggests perhaps the re-use of Pallava metal (Sirinivasan 1999 (b): 204). The aim of this paper is to discuss the scientific results of the Tara image in comparison with the lead isotope and trace element results of Sri Lankan bronze images and address the existing controversy regarding the provenance of this Tara image and open up a discussion.

Tara is a female Bodhisattva Deity of Mahayana Buddhism. Archaeological evidences show the wide spread flourishing of Mahayana Tradition in the island with the existing Theravada Tradition after 5^{th} – 6^{th} Century AD probably through the intense maritime trade activities Sri Lanka had with China, India and South East Asia. The Mahayana influence can be clearly identified by the addition of Mahayana Bodhisattvas and other architectural features to the existing Theravada monasteries, as well as building of new ones throughout the country. There are hundreds of Bodhisattva images found throughout the island, most of them are of stone or carved on rock faces, varying from small to life size to huge (30 -40 feet high). Numerous metal Mahayana Bodisattwa images including Tara images specially made out of copper alloys such as bronze which were dated to 7^{th} – 9^{th} Century AD have been found from different parts of Sri Lanka.

Lead Isotope analysis method

There are four stable isotopes of lead metal. i.e. lead-206, lead-207, lead-208 and lead-204. It is a known fact now that the isotopic composition of lead in minerals from different parts of the world have distinct values and is the basis for lead isotope geochronology and lead isotope geochemistry. Generally, the minerals contain minute amounts of lead as an impurity. The isotopic composition of lead varies in nature over a range of up to 5 percent (Gale et el.1982: 12) were much higher than the analytical precision of the scientific methods used to measure the isotopic compositions in the minerals, enabling the isotopic composition of lead to be used as an indicator of provenance of the ore sources. The advantage of looking at the isotopic composition of an element rather than at abundances, or the abundance pattern, of minor and trace elements is that the isotopic composition of an element does not change from ore to artefact, regardless of the metallurgical processes used. (Begemann et el.1987: 269) The isotopic compositions of the four stable isotopes are usually expressed as abundance ratios of $Pb^{208/206}$, $Pb^{207/206}$ and $Pb^{204/206}$.

Lead isotopic composition of unalloyed copper gives isotopic characteristics of the copper source (Gale et el.1982: 12) The isotopic matching of leaded artifacts may be due to the lead coming from a single common source or due to the objects having been made from the same batch of metal containing lead from mixed sources which may have archaeological significance for shared geography or chronology. (Sirinivasan 1999(a): 93)

The thermal ionization mass spectrometry (TIMS) method was used for the lead isotopic analysis of this study. The lead isotopic analysis was carried out using the facilities at the lead isotopic laboratory, Natural History Museum, Stockholm.

Stable Lead Isotope ratio analysis of Sri Lankan images

By analyzing over fifty Sri Lankan later Anuradhapura Buddhist images representing 6^{th} – 9^{th} Century and Hindu images found from Plonnaruwa (11^{th} - 13^{th} Century AD) and plotting their stable lead isotope ratios values in the scatter plot of Pb 207/206 Vs Pb 208/206 it was possible to identify that the Sri Lankan historical bronze images were grouping into six different lead isotope groups (MLG1 to MLG6, see graph 1) and these same groups were also confirmed by the scatter plot of Pb 207/206 Vs Pb 206/204 (Thantilage 2008 (a): 62). For the ease of reading, lead isotope group boundaries of the Sri Lankan images are shown with other images as required later.

Graph 1 shows the distribution of Sri Lankan Anuradhapura and Plonnaruwa period Buddhist images (7^{th} – 11^{th} Century AD) in the scatter plot of Pb 207/206 Vs Pb 208/206. It clearly indicates a majority of the images grouped in MLG1 lead group. Apart from that there are four images closely grouped in MLG2 lead group, and one image in MLG4 group. The trace element studies of these images show that 95% of the images in MLG1 group had used copper from the local copper deposit situated at Seruwila (near Trincomalee) at the eastern coast of the country.

Lead isotope ratio value of British Museum Tara over Lead ingots and lead coins from Tissamaharama

When we plot the lead isotope ratio values of Gajalakshmi lead coins and lead ingots found from Tissamaharama from soil layers dated parallel to the latter part of the Anuradhapura period (7^{th} – 9^{th} Century AD) one pure piece of lead ingot exactly matched with the MLG2 group. Graph 2 shows the lead isotope distribution of Tissamaharama leaded artefacts and the British museum Tara over Sri Lankan lead isotope groups (for the ease of comparison only the Tissamaharama lead artefacts are shown in the graph)

The grouping of Tissamaharama lead piece and the Tara image undoubtly indicates that during the contemporary period of the Tara image, Sri Lanka had definitely obtained lead from that particular source of lead for local productions from which same source the lead had also been obtained for the production of the Tara image.

Anuradhapura period images lead isotopically group with the Tara image

In the lead group MLG2 there are four other images belonging to the latter part of the Anuradhapura period (7^{th} – 9^{th} Century AD) which are contemporary to the Tara image, have closely grouped together with the Tara image. (see Photographs 1 – 4). The Buddha image in the photograph no1 had been found from Batticoloa the same place where the Tara image had been found. The author elsewhere had identified that these images may represent a different school of image production during the Anuradhapura period, especially considering their resource utilizations and other image features, with the majority of images grouped with MLG1 lead group (Thantilage, A. 2010 (b))

Reasons for assigning the latter Anuradhapura period images into two schools of image productions are briefed below

MLG1 school:

Only use copper from local Seruwila source.

Only use one particular lead source MLG1 throughout.

Found mainly in and around Anuradhapura.

Image features (casting/gilding etc..)

MLG2 school:

Use copper from a particular source, other than the local Seruwila source.

Only use one particular lead source MLG2 throughout.

Found outside Anuradhapura area.

Image features (casting/gilding etc..)

When taken into consideration, the above criteria in each group the Tara image satisfies the all main criteria in its lead group, Of course, the stylistic and iconographic features would also be definitely more powerful as in the case of technological features.

Comparison with Indian images

The Graph 3 shows chronologically parallel South Indian images to the Tara over the Sri Lankan lead groups (MLG1 – MLG6). Their boundaries are determined by the mean values of closely grouping Sri Lankan images in each group.

In the Indian context the Tara image is closely matched with only one gilded Buddha image from Nagapattainam (Sirinivasan 1999 (b): 202 – 204). (see graph 3). In the Sri Lankan context when we compare lead isotope ratio values of the Tara image with Sri Lankan lead isotope groupings, the Tara image closely matches with the Sri Lankan MLG2 group icons as a group, than the above mentioned Buddha image from Nagapattainam which has fallen outside the boundaries of the MLG2 lead isotope group. This emphasizes that the Tara image is more closely incorporated with Sri Lankan lead isotope group MLG2. Further in the Indian context, there is only one later Pallava period image (which may be more or less chronologically parallel to the Tara) that had grouped with the Sri Lankan lead isotope group MLG2 in comparison to the five Sri Lankan images including the Tara which closely match within the group. Interestingly out of those five images there are three images found from the same area (Eastern coastal area of the island).

Notably, in the Indian context the images that are more or less chronologically parallel to that of the Tara image (i.e. Later Pallava and Early Vijayala Chola images)have been exactly grouped with the MLG1 group in which lead isotope group that 90% of the Sri Lankan Anuradhapura period images have been grouped. This indicates a very interesting fact that until about 9th Century AD Sri Lanka and India had obtained lead from a common source. It has been shown elsewhere by comparing the lead isotopesvalues from the ancient mines and artefacts that this lead may have been probably from the Mediterranean region and obtained through ancient Roman long distance trade (Thantilage 2008 (a):86).

The matching of South Indian Images to late Anuradhapura period images of the Sri Lankan image group exactly in MLG1 indicate resource utilizations for the production of those images may have, seems plausible. But this trend seems to have changed after the early Calukya-Chola period (1070 -1125 AD) since later South Indian images do not match the Sri Lankan groupings.

In the Sri Lankan context there are four late Anuradhapura images which closely match in the MLG2 group together with the Tara image. All these four Sri Lankan images match both with lead isotopically and trace elementally showing they may have a common origin.

In the Indian context only one middle Pallava image, more or less chronologically parallel to the Tara, matches with the Sri Lankan lead group MLG2. It seems with the available results that the use of MLG2 lead source would have been more intense in the Sri Lankan context during the latter part of Anuradahpura period, as five images are closely matched with that group.

Later Polonnaruwa Hindu bronzes

Four Polonnaruwa period Hindu Bronzes which are later than the Tara image (12 – 13th Century AD) in which one image made with local Seruwila copper are grouped in MLG2 group further in parallel Indian context, there are three matching Chalukya Chola images which grouped in MLG2 (Sirinivasan, S. 1999 (a) 95 – 97). This might show that both Sri Lanka and India may have used lead from this source until 12th – 13th Century AD. (graph 4). It seems Polonnaruwa Hindu bronzes have some distinct lead isotope signatures showing uniqueness as there are no South Indian contemporary images in MLG3 and MLG5 lead groups in which a considerable number of Polonnaruwa Hindu bronzes were present. Further there are two South Indian later Chalukya chola images grouped in Sri Lankan lead isotope group MLG4 but notably no Sri Lankan Polonnaruwa period Hindu bronzes have fallen within that group.

Conclusion

In the Sri Lankan context, the Tara image is more closely matched lead isotopically with another four images of which three of them have been found from the same area as that of the Tara image in contrast to the Indian context, where shown only one Buddha image from Nagapattinam could be matched . But it is important to pay an attention to the fact that this particular Nagapattinam Buddha image does not match with the Sri Lankan lead isotope group MLG2 in which the Tara image is closely grouped with four other Sri Lankan images. Nevertheless, the exact matching of a piece of pure lead (possible piece of an ingot which had been found from the soil layer along with the leaded Gajalakshmi coins made in the same Tissamaharama area) with the MLG2 group would undeniably indicate that this MLG2 lead source would have been known to Sri Lanka during the latter part of the Anuradhapura period, contemporary to the Tara. The Gajalakshmi coins were well dated to the latter part of the Anuradhapura period. In other words this indicates that the lead from this particular lead source that had been taken to make the Tara image was also known and utilized during the contemporary time in Sri Lanka.

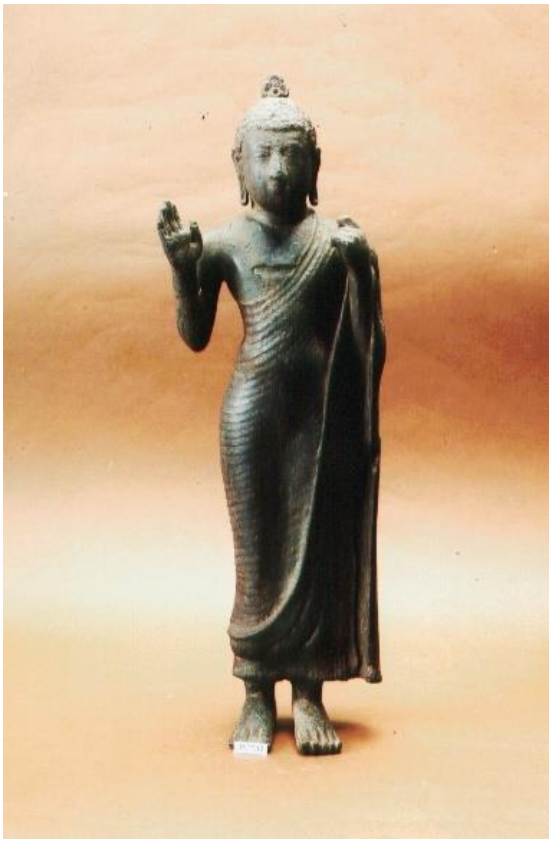
Trace elementally none of the MLG2 group images were matched with the trace element trends of local Seruwila copper source. This has been pointed to an existence of a possible second school of image production during the Anuradhapura period (**Thantilage, A. 2010 (b)**). Unfortunately the trace element results of the Tara image published in the study by Schroeder (Schroeder 1990: 551) was giving very unusual value of Cobalt/Nickel elemental ratio of 2.65 which is not even consistent with the South Indian image values. So the accuracy of those results for conducting any comparison is questionable.

When the five images in MLG2 are considered, out of these five images there are three images including the Tara image have been found in the same Eastern coastal area. All the four images that the author was able

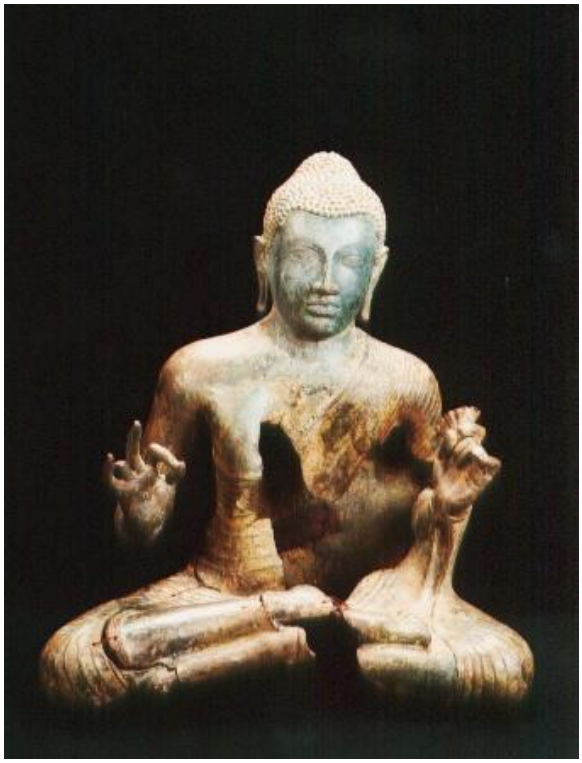
to analyse and so attributed to MLG2 group, matched each other very closely not only lead isotopically, but also trace elementally. Because of this closely matching in different dimensions, we may strongly argue the possibility of that these four images could have a common origin. Considering the fact that the two images in the MLG2 have been found from the same area where the Tara imagewas discovered and also they have matched very closely with two other images which were discovered from different parts of the country namely Badulla and Kurunegala (Photographs 2 & 4), we may conclude that this school of image making may have been known to other parts of the country.

So according to the above findings, it is clear that the Tara image has closely matched and forms a group with some Sri Lankan Buddhist icons, unlike in the Indian context which had only grouped with one image and even that image does not match with the Sri Lankan MLG2 image group.

Finally as concluding remarks we may argue that there is a good possibility of having all the five images in the lead isotope group MLG2 share a same common origin. Hence in the Sri Lankan context, there is not enough evidence to suggest that the Tara image may have a different origin than the closely matching others in the same group. It is extremely essential to take into account all these five images together in MLG2 group before any provenance attribution is made in future. Further stylistic and Art historical studies on these five images would also be helpful in this endeavor.



Photograph 1: Buddha Image. Late Anuradhapura Period, Kankayanodai, North Batticaloa. National Museum, Colombo. Museum Reg. No.: 35.77.12

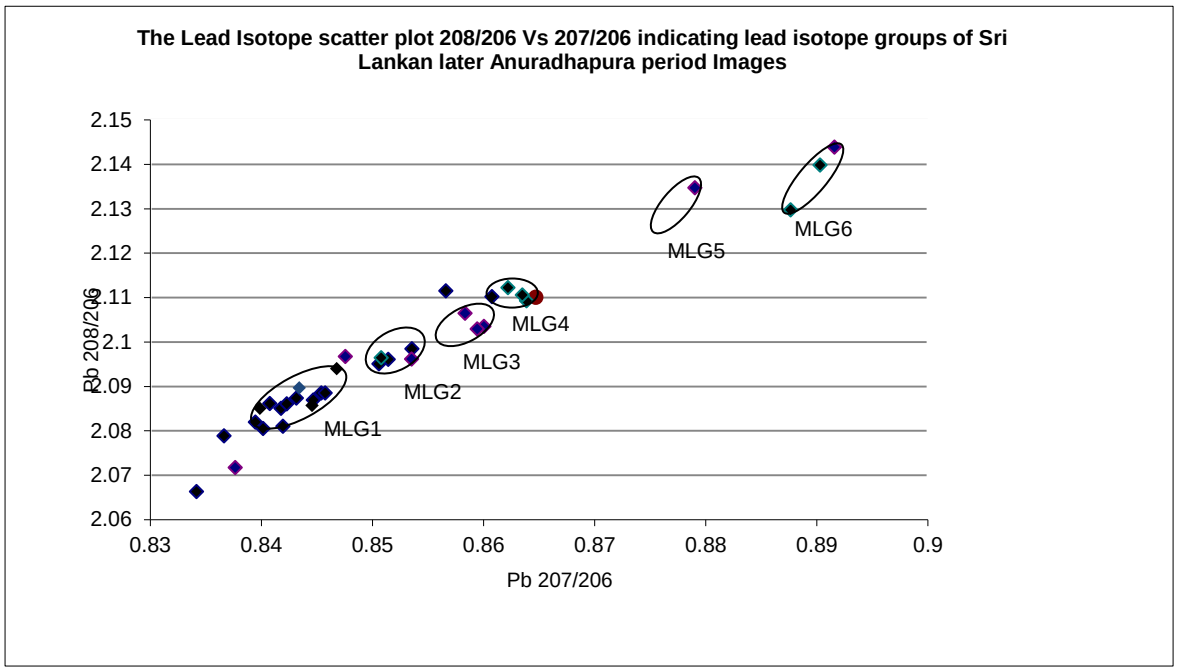


Photograph 2: Buddha Image 5th - 6th Century AD. Baddulla.
National Museum, Colombo. Museum Reg. No.:13. 11 . 289

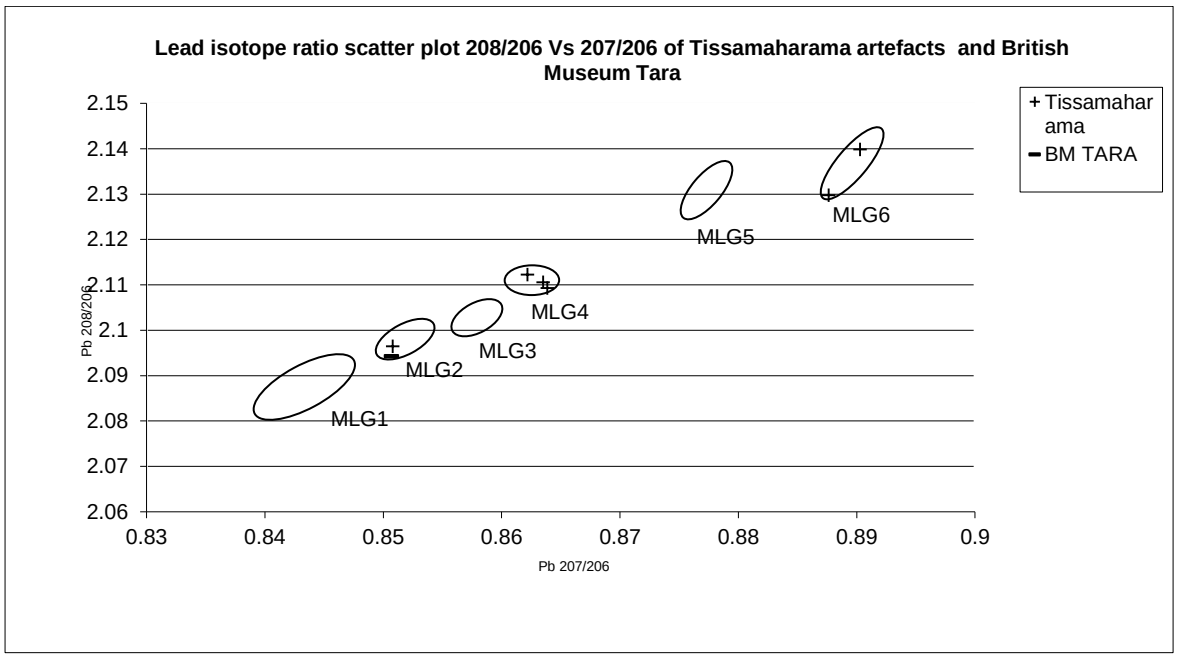
Photograph 3: Buddha Image 7th Century AD, Thiriyaya.
Archaeological Museum, Anuradhapura.

Photograph 4: Vajrapani Bodhisattva 9th Century AD, Kurunegala District.
Department of Archaeology, Sri Lanka.

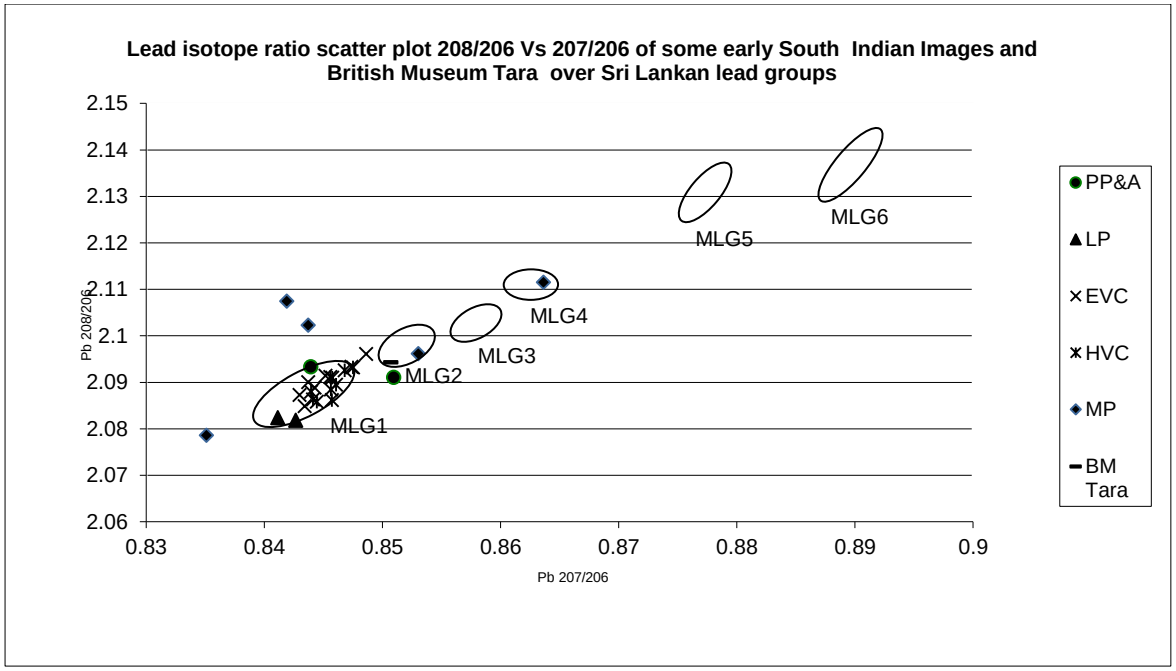
Photograph 5: Tara image. Found in Sri Lanka and now deposited at the British Museum.



Graph 1: Lead isotope scatter plot showing lead isotope groups (MLG1 – MLG6) determined by the lead isotope ratio distribution of the Sri Lankan later Anuradhapura period images.

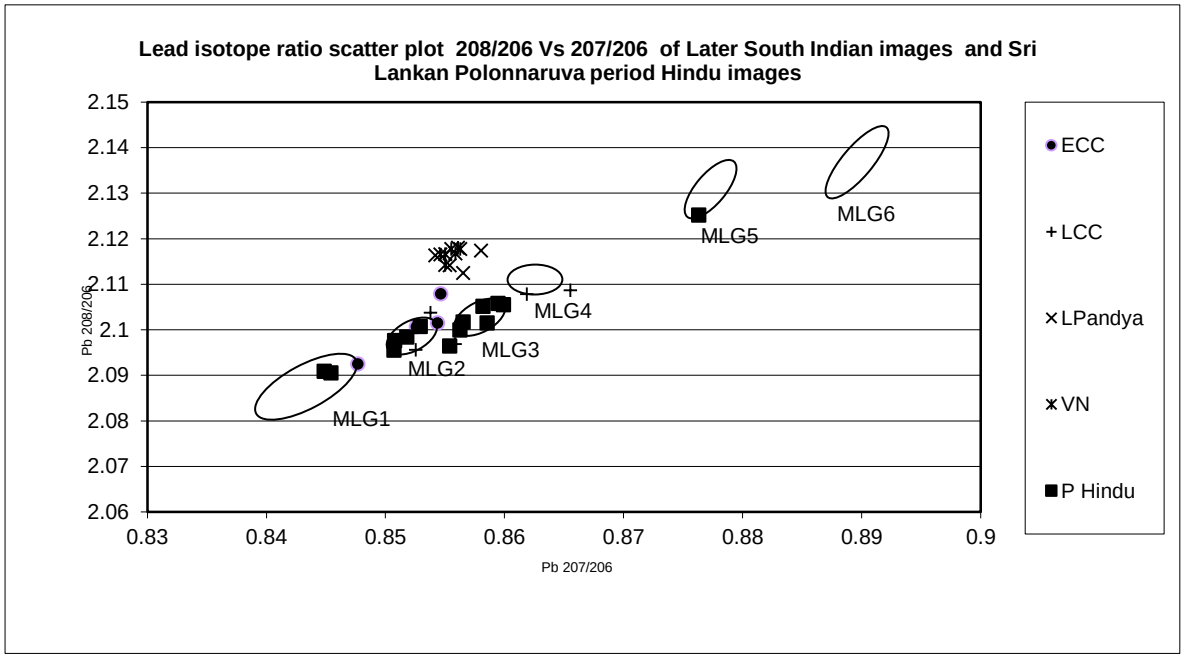


Graph 2: A piece of pure lead ingot from Tissamaharama closely grouped with the Tara image at the British Museum inside the Sri Lankan lead isotope group of MLG2. (Only the Tissamaharama artefacts in the graph1 are indicated in the graph 2 for convenience of studying)



Graph 3: Lead isotope ratio distribution of early South Indian images (**Sirinivasan 1999a**) contemporary to the latter Anuradhapura period, and British museum Tara image over Sri Lankan lead groups. Note that one middle Pallava image has grouped with MLG2.

PP&A – Pre Pallava and Andra (c. 200 – 600 AD), MP – Middle Pallava (c. 600 – 850 AD), LP – Later Pallava (c. 850 – 875 AD), EVC – Early Vijayala Chola (c. 875 – 940 AD, HVC High Vijayala Chola (c. 940 – 1070), BM Tara - British Museum (as in **Sirinivasan 1999b: 207)**



Graph 4: Lead isotope distribution of Plonnaruva period (12 – 13 Century AD) Hindu images and later South Indian images (**Sirinivasan 1999a**) over Sri Lankan lead isotope groups. Please Note that some later Chalukya-Chola images have grouped with the Sri Lankan lead isotope group MLG2

ECC – Early Chalukya –Chola (c. 1070 – 1125 AD), LCC – Later Chalukya – Chola (c. 1125 – 1279 AD), L Pandya – Later Pandya (c. 1279 – 1336 AD), VN – Vijayanagara (as in **Sirinivasan 1999b: 207)**

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