The making and evolution of Hokusai's Great Wave

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Introduction

'Under the wave off Kanagawa' by Katsushika Hokusai (1760-1849), or 'The Great Wave' as it is commonly known, is the most famous Japanese woodblock print in the world. It was produced in the early 1830s and is part of the series *36 Views of Mount Fuji*, which depicts Mount Fuji from different places and in different weather conditions. In this print, a huge wave is about to engulf three fishing boats with their occupants crouching and hugging the deck (Figure 1). The main subject of the print, Mount Fuji, is present in the background but can easily be mistaken for another ocean crest.

Figure 1: *The Great Wave* by Hokusai (British Museum 2008,3008.1.JA)

The Great Wave was very popular in Japan when it was published in the 1830s and, although the exact number is unknown, many impressions were produced. The number of impressions made from a given set of woodblocks was generally not recorded but it has been estimated that a publisher had to sell at least 2,000 impressions from a design to make a profit [1]. For instance, some of the designs by Kunisada (1786-1865) are estimated to have been printed between 3,000 and 4,000 times [2]. Very popular prints could be issued in even greater numbers: *Fifty-three stations of the Tōkaidō* by Hiroshige (1797-1858) is thought to have been printed between 12,000 and 15,000 times [1]! Presently, experts believe that up to 8,000 impressions were made of *The Great Wave* [3].

There are usually small differences in impressions made from a given set of woodblocks, which are of great interest to collectors and curators of Japanese prints [4]. For instance, some prints in the *36 Views of Mount Fuji* series were initially printed as blue monochromes (*aizuri*) and later in other colour schemes (e.g. see the different impressions of 'Ushibori in Hitachi Province' in the collection of the Metropolitan Museum of Art – photographs are available on their website [5]). As impressions are not dated or numbered, the only way to determine the chronological evolution of a design is to compare

impressions of the same print and search for signs of woodblock wear. Ukiyo-e scholar Roger Keyes extensively studied prints by Hokusai and in particular *The Great Wave* [6]. Keyes' research included comparing surviving impressions of *The Great Wave* and deducing a sequence of numbered 'states'. He defined a new state as a change in an impression caused by woodblock damage, re-carving of a woodblock, or the use of a completely new woodblock. For instance, a break in the wave line on the right hand side of the design can be observed in many later impressions of *The Great Wave* (Figure 2) and corresponds to a new state. Keyes' task was not easy as he had to rely on postcards, illustrations from books and small black and white photographs. Based on his observations, he listed 21 states of Hokusai's Great Wave, see Table 1, and for each state he gave examples of corresponding impressions. However, when re-examining Keyes' photographs, variations corresponding to certain states have been found not to occur consistently. For instance, losses in the title cartouche corresponding to states 5 and 6 are not present in states 13 or 17 (Figure 3). Independently of Keyes, Forrer [7] also studied the evolution of *The Great Wave* and his findings are summarised in Table 2. Forrer described five signs of damage, with four of those corresponding to states defined by Keyes. Whereas Keyes listed 19 sequential breaks to the cartouche, Matthi Forrer noted only two. Forrer's study was much more concise than Keyes'; he did not illustrate his findings and gave no reference as to which impressions of *The Great Wave* he had examined to study the evolution of the print. This makes it difficult to assess the validity of his findings.

In the present research project, the evolution of woodblock damage in impressions of *The Great Wave* was examined using digital photographs. First, a census of surviving impressions was taken using various sources and photographs of 111 original impressions were gathered. Then, in order to understand how *The Great Wave* was made, the number of woodblocks used to produce it and how many printings were made using each woodblock for a typical impression was investigated. Finally, signs of woodblock damage and the use of newly-carved woodblocks were identified.

Figure 2: Break in the wave line caused by woodblock damage, as indicated by a red arrow (Metropolitan Museum of Art JP 10).

Table 1: The 21 states of *The Great Wave* defined by Keyes [6].

State	Description
1	Cartouche intact
2	Cloud block reduced
3	Cartouche breaks on inner border left of 裏 and outer border of 川
4	Cartouche breaks in left outer and right inner borders beside 十
5	Cartouche break in outer border right of 三
6	Cartouche break in outer border right of 神
7	Double cartouche break in borders below 裏; wear shows on double borders left of 神奈川
8	Break near peak in the upper right slope of Mt. Fuji; cartouche break in outer border left of 嶽
9	Cartouche break in outer border directly right of 沖
10	Narrow break in inner border above and to the left of 冨; long break in outer border below 裏
11	Long break in double borders left of 冨; 神奈
12	Wear in outer border right of 三十
13	Break in wave directly behind stem of boat at right; break in outer border near comer below 沖
14	Wide break in inner border above and to the left of 冨
15	Double break in borders at top left over冨; break in top inner border at right over 冨
16	Break in inner border left of 冨
17	Double break in borders at top to right of 冨
18	Break in outer border right of 奈
19	New light blue block for waves; new colour block for clouds
20	Blue block at lower right edge reduced
21	Break in inner border right of 景; light shading on horizon below peak

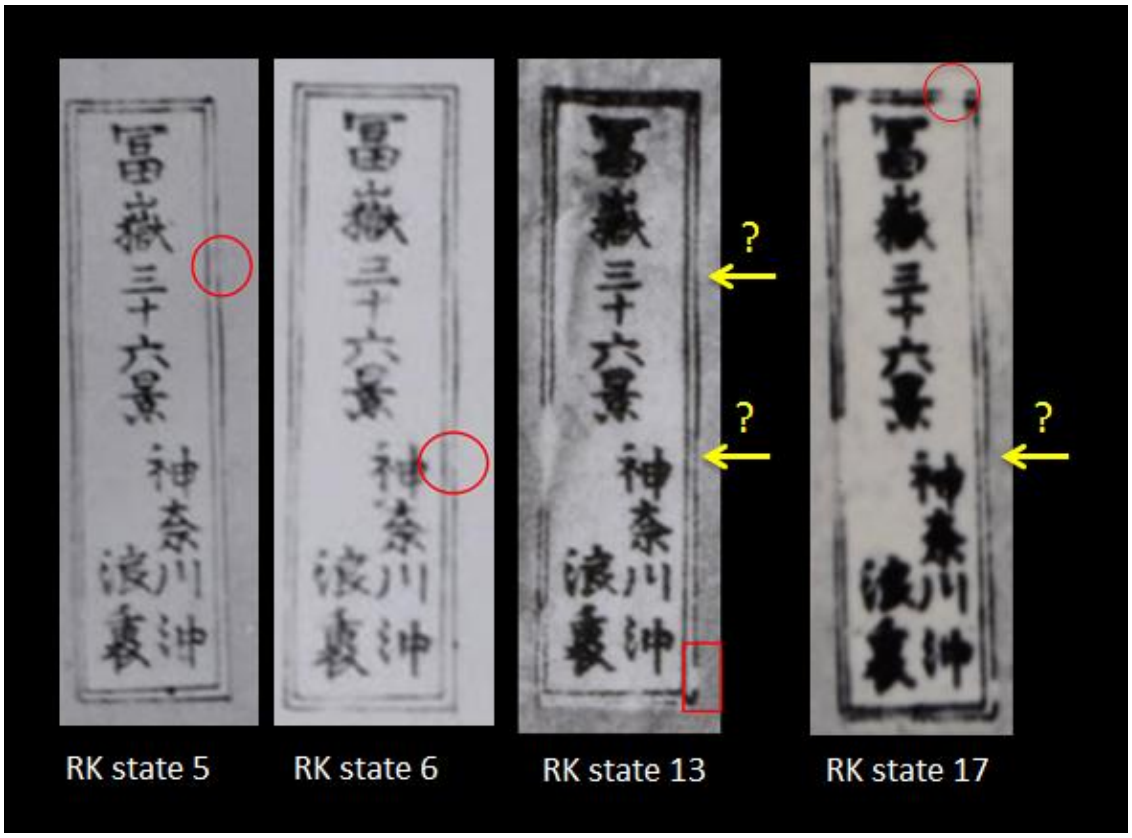


Figure 3: Damages to the title cartouche corresponding to states 5 and 6 defined by Roger Keyes [6] -- indicated in red -- do not consistently occur on impressions corresponding to later states, e.g. 13 and 17 (the photographs shown here are from Roger Keyes' notes).

Table 2: Evolution of damage in *The Great Wave* according to Forrer [7].

State	Description	Corresponding Keyes' state
A	Small cartouche break on the left hand side near the bottom on the inner border	3
B	Much larger cartouche break on both borders on the left hand side	4
C	Damage to the line of the wave at right behind the boat	13
D	Damage to the top of 'what can be called *The Great Wave*'s lower group of protruding fingers'	Not described by Keyes
E	New light blue block	19

Figure 4: Impression of *The Great Wave* in the collection of Blackburn Museum and Art Gallery. Differences, such as the shape of the clouds at the top of the print, show that this is a facsimile reproduction, not an original impression.

Locating impressions of *The Great Wave*

Keyes listed 62 impressions of *The Great Wave* and had 30 photographs of impressions in his notes. Many impressions of *The Great Wave* from museums and galleries were located for the present research thanks to Keyes' work. While his notes were extremely useful, they were not detailed or always accurate. For instance, Keyes referred to an impression as 'Manchester' but The Whitworth and the Manchester Art gallery, the only two institutions in Manchester known to have a collection of Japanese woodblock prints, do not hold an impression of *The Great Wave*. In another instance, Keyes listed a 'Blackburn' impression as an example of state 16 with a small black and white photograph of it. However, when a more recent photograph of *The Great Wave* from the collection of Blackburn Museum and Art Gallery was obtained, it did not match Keyes' photograph and further examination revealed that it was a facsimile reproduction, not an original impression (Figure 4). This was subsequently confirmed by consulting the records of Blackburn Museum and Art Gallery. The print in Keyes' photograph was eventually identified as the impression belonging to Bristol Museum

and Art Gallery. Finally, Keyes examined eight impressions of *The Great Wave* owned by private collectors, whom he did not always name in his notes; no attempt was made to locate these.

The Ukiyo-e Search engine developed by John Resig [8] was also used to identify museums, libraries and galleries holding impressions of *The Great Wave*. Images of the impressions were then downloaded from the institutional websites or, if unavailable online, requested. However, the Ukiyo-e Search engine mostly lists impressions of *The Great Wave* from large national institutions and the websites of several art dealers -- many of these were reproductions, not original (i.e. out of 56 images of prints identified by the search engine, only 25 were original impressions). Photographs of additional impressions were obtained from online auction websites, books, art dealers and private collectors. Finally, several impressions were located using the Google Arts & Culture online platform, the image hosting service website Flickr and the social media website

Figure 5: (Left) Two small shapes in the sea are printed in the same colour (here dark grey blue) as the outlines in original impressions (RISD 20-1195), but (right) in light blue or medium blue in a reproduction (Library of Congress 02018u).

All the photographs of the impressions gathered were carefully examined to ensure they corresponded to original impressions rather than reproductions. Experience showed that most reproductions did not reproduce the colour of two small shapes in the sea accurately: whereas these shapes are of a dark grey blue or black in original impressions – the same colour used for the outlines, the cartouche and the signature -- these areas are of a lighter blue in reproductions, the colour used for the medium blue or light blue shapes in the sea (Figure 5). Also, in photographs of sufficiently high resolution, a small dark blue shape is present in a spot of sea foam in original impressions. According to David Bull, an experienced woodblock cutter, it most likely corresponds to a sliver of wood that the woodblock cutter did not remove during the carving of the woodblock at the time [9]. This imperfection was absent in all the reproductions examined (Figure 6).

In total, 77 impressions in the collections of national institutions were located worldwide (see Table 3) and photographs of 34 further impressions were gathered from auction websites, art dealers, books and private collectors. Not all photographs were of high resolution: high resolution images (jpeg file larger than 1 MB) were obtained for 67 impressions. These are listed in Table 4 and were useful to study woodblock damage in the cartouche and the summit of Mount Fuji. Of the rest of the images, 16 were of low resolution (jpeg file smaller than 200 KB).

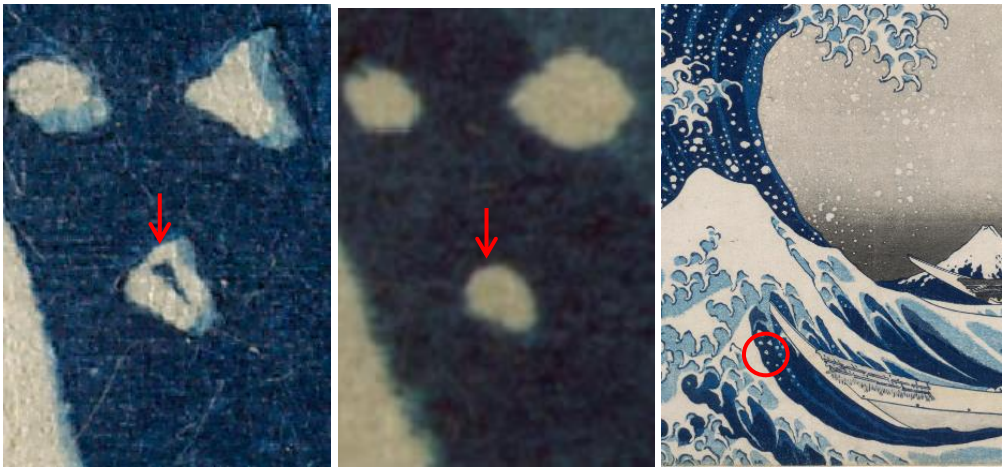


Figure 6: (Left) A small imperfection is visible on all the high resolution images of original impressions of *The Great Wave* (British Museum 2008,3008.1.JA) but (middle) missing from all the high resolution images of the reproductions examined in the present research (Library of Congress 02018u). (Right) Location of this small imperfection (British Museum 2008,3008.1.JA).

Figure 7: The clouds are absent in this impression (Rhode Island School of Design Museum). Have they faded or were they never printed?

Woodblock prints in the Edo Period were often made using light sensitive colourants, such as turmeric or orpiment [10-12], and many surviving impressions of *The Great Wave* have been affected by light. Typically, the most faded areas are the yellow parts of the boats and the pink clouds (compare Figures 1 and 2). In fact, out of the 111 impressions located, no clouds were discernible in 26 impressions, most probably because the ink had completely faded, although it cannot be excluded

that the clouds had not been printed. An example of a very faded impression is shown in Figure 7. It was found that one way to reveal whether the clouds are present but faded is to view an impression using ultraviolet (UV) light. For instance, the impression 1937,0710,0.147 from the British Museum has very little colour left in the sky, but clouds become visible under UV light (Figure 8).

Figure 8: (Left) The clouds are barely visible on the photograph, but (right) become apparent in the UV reflectance image (British Museum 1937,0710,0.147).

In the past, Japanese woodblock prints were sometimes retouched in an attempt to increase their value [13]. This involved filling in breaks, especially in the title cartouche, and applying colour to faded areas. The presence of retouches could impact on the study of woodblock damage and all the photographs obtained were carefully examined for signs of retouching. For instance, the impression JP 2972 in the collection of the Metropolitan Museum of Art shows retouching in the clouds (Figure 9), while the impression in the collection of Bristol Museum and Art Gallery had the break in the wave line filled in with blue ink (Figure 10). In total, signs of retouches were found on 16 impressions among the 111 impressions located. This included impressions from the Museum of Fine Arts (impressions 34.317 and 21.6765), the Keio University Library, the Yale University Art Gallery, the Hill-Stead Museum and the Metropolitan Museum of Art (impressions JP10 and JP1849). It is possible that other impressions had been retouched, but were not identified here because the resolution of the images available did not allow sufficiently detailed examination.

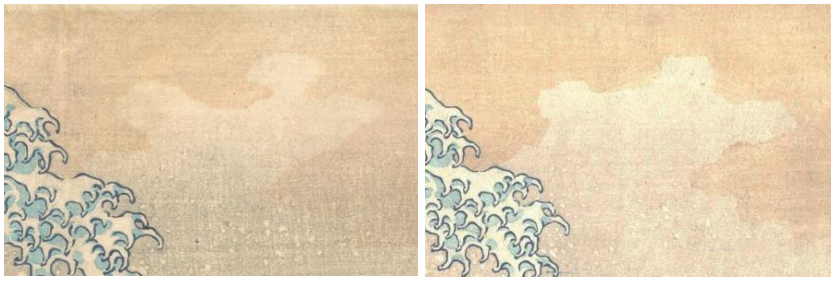


Figure 9: Evidence of retouching in the clouds. See how the shape of the clouds on the left (Metropolitan Museum of Art JP 2972) is different from the original design shown on the right (Metropolitan Museum of Art JP 1847). The clouds were most likely retouched after the original colour had completely faded, either using a brush or a new woodblock.

Table 3: Locations of original impressions of *The Great Wave*. Total: 77 impressions. (This table only lists national institutions.)

Locations	Institutions
Australia (1)	National Gallery of Victoria, Melbourne
Austria (1)	Museum of Applied Arts, Vienna
Belgium (1)	Royal Museums of Fine Arts of Belgium, Brussels
Canada (1)	Royal Museum of Ontario, Toronto
France (5)	Giverny Museum of Impressionisms French National Library, Paris (2) Guimet Museum, Paris (2)
Germany (4)	Dresden State Art Collections Grassi Museum of Applied Arts, Leipzig Museum of Arts and Crafts, Hamburg Museum of East Asian Art, Cologne
Israel (1)	Tikotin Museum, Haifa
Italy (4)	Chiossone Museum, Genoa (2) Civic Museum of Oriental Art, Trieste Museum of Oriental Art, Turin
Japan (16)	Edo-Tokyo Museum Hagi Uragami Museum, Yamaguchi Hokusai Museum, Obuse Isago no Sato Museum, Kawasaki Japan Ukyo-e Museum, Matsumato Keio University Library, Tokyo Museum of Art, Atami Ota Memorial Museum of Art, Tokyo (2) Shimane Art Museum, Matsue Sumida Hokusai Museum, Tokyo Tokyo National Museum (3) Tokyo Fuji Art Museum Yamatane Museum of Art, Tokyo
Netherlands (1)	Rijksmuseum, Amsterdam
Poland (1)	National Museum, Krakow
UK (6)	British Museum, London (3) Bristol Museum and Art Gallery Victoria & Albert Museum, London Maidstone Museum
US (35)	Art Institute of Chicago (3) Brigham Young University Museum of Art, Provo Chazen Museum of Art, Madison Cincinnati Art Museum D'Amour Museum of Fine Arts, Springfield Hammer Museum, Los Angeles Harvard Art Museums, Cambridge Hill-Stead Museum, Farmington Honolulu Museum of Art Legion of Honor Museum, San Francisco Los Angeles County Museum of Art Metropolitan Museum of Art, New York (4) Minneapolis Institute of Art Museum of Fine Arts, Boston (7) Nelson-Atkins Museum of Art, Kansas City Reading Public Museum Portland Museum of Art Rhode Island School of Design (RISD) Museum, Providence Saint Louis University Museum of Art Seattle Art Museum Spencer Museum of Art, Lawrence Toledo Museum of Art University of Michigan Museum of Art, Ann Arbor Yale University Art Gallery, New Haven

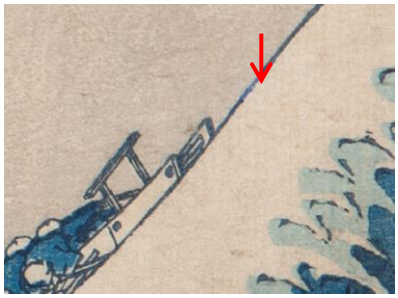


Figure 10: The break in the wave line (as shown in Figure 2) has been filled in on this impression (Bristol Museum and Art Gallery Mb4452).

Table 4: List of impressions for which high resolution images were obtained (total: 67 impressions). If high resolution photographs of several impressions were obtained, the number of those is indicated in brackets.

Art Institute of Chicago (3)
Auction websites (12)
Brigham Young University Museum of Art
Bristol Museum and Art Gallery
British Museum (3)
Chiossone Museum, Genoa (2)
Cincinatti Art Museum
Civic Museum of Oriental Art, Trieste
Giverny Museum of Impressionisms
D'Amour Museum of Fine Arts, Springfield
Edo-Tokyo Museum
French National Library, Paris
Guimet Museum, Paris (2)
Hammer Museum, Los Angeles
Harvard Art Museums, Cambridge
Hill-Stead Museum, Farmington
Honolulu Museum of Art
Keio University Library, Tokyo
Los Angeles County Museum of Art
Maidstone Museums
Metropolitan Museum of Art (3)
Minneapolis Institute of Art
Museum of Applied Arts, Vienna
National Gallery Victoria, Melbourne
National Museum, Krakow
Nelson-Atkins Museum of Art, Kansas City
Ota Memorial Museum, Tokyo
Private collections (4)
RISD Museum, Providence
Rijksmuseum, Amsterdam
Royal Museums of Fine Arts of Belgium, Brussels
Saint Louis University Museum of Art
Shimane Art Museum, Matsue
Spencer Museum of Art, Lawrence
Dresden State Art Collections
Tikotin Museum, Haifa
Tokyo Fuji Art Museum
Tokyo National Museum (2)
Toledo Museum of Art
Victoria & Albert Museum, London
Yale University Art Gallery, New Haven

The making of *The Great Wave*

None of the woodblocks used to produce *The Great Wave* in the 1830s have survived. Careful examination of all 111 impressions showed than at least seven separate woodblocks had been used for producing the early printings of *The Great Wave*. In practice, woodblocks were usually carved on both sides and four woodblocks (with three of them carved on both sidea) were most likely used to print The Great Wave. For the sake of clarity, when the term 'woodblock' is used in the text, it refers to one of the carved sides of the woodblock. These are listed in Table 5.

There are currently several publishing houses in Japan that produce modern reproductions of *The Great Wave* using traditional techniques. It is helpful to see how contemporary craftspeople produce these reproductions to understand how *The Great Wave* was produced in the 1830s. For instance, the Adachi Institute of Woodcut Prints is a publishing house attached to the Adachi Foundation for the Preservation of Woodcut Printing, which was established in 1994 to promote and preserve traditional woodcut printing techniques. The printing sequence used by the craftspeople at the Adachi Institute [14] to reproduce *The Great Wave* is shown in Figure 11. It consists of eight printing steps using seven woodblocks.

Table 5: Woodblocks used to produce the early impressions of *The Great Wave* print.

Colour	Areas printed	Notes
Dark blue	Outlines, cartouche, signature, body of Mt Fuji and sea	Probably 2 woodblocks
Light blue	Sea	Replaced by new block
Medium blue	Sea, body of Mt Fuji, fishermen garments	
Light grey/dark grey	Sky and boat furthest in the background	Used twice
Light grey	Two boats in the foreground	Replaced by new block
Yellow or beige	All boats	Replaced by new block
Pink or beige	Clouds	Not apparent on all impressions Possibly not always used

Four shades of blue can be distinguished on original impressions of *The Great Wave*. Three were produced using three individual blue shades (referred to in the text as 'light blue', 'medium blue' and 'dark blue'). They were applied using at least three separate woodblocks (corresponding to steps 1, 7 and 8 in Figure 11) while the darkest shade of blue was produced by overlapping dark blue and medium blue. The overlapping of these two shades of blue is visible, for instance, in the sea (Figure 12). Viewing one of the impressions using infrared light revealed that the outlines of the print, the cartouche title, the signature and the dark blue areas of sea were printed using the same ink (in this case an ink rich in indigo, which appears bright red in false colour infrared images, Figure 13). There are very few areas of the design printed in dark blue only, e.g. the area in the top left corner and some small areas in the centre of the impression, as highlighted in Figure 12 (and shown in Figure 5).

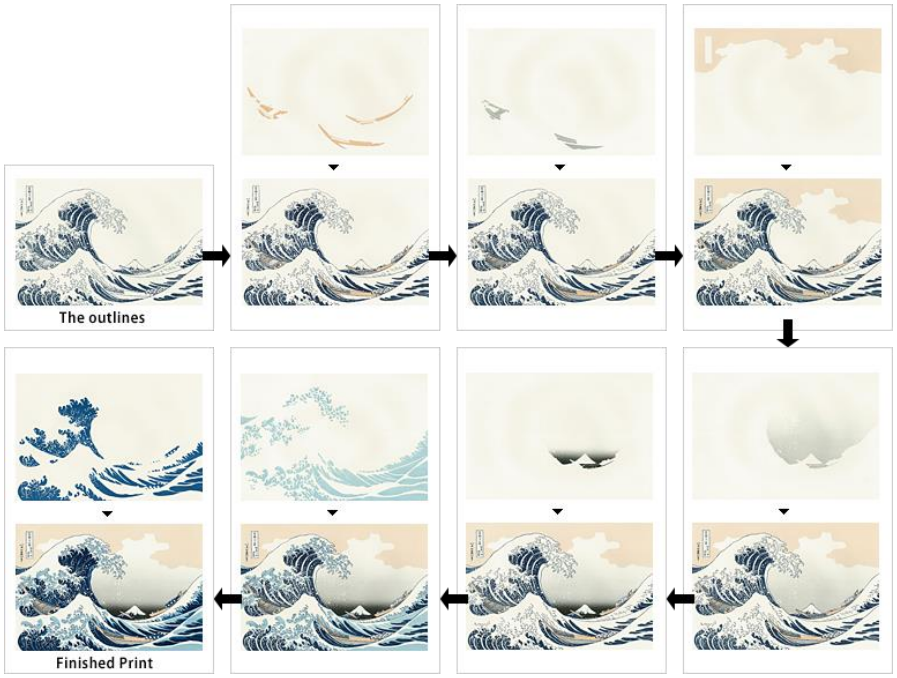


Figure 11: Printing sequence used by the Adachi Institute of Woodcut Prints of The Adachi Foundation for the Preservation of Woodcut Printing [14] for their reproduction of *The Great Wave*.

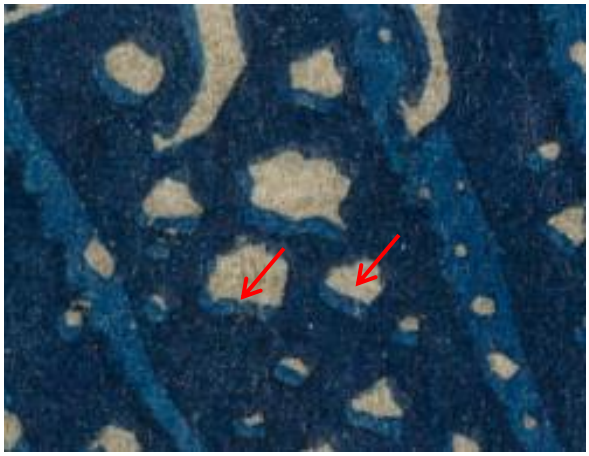


Figure 12: Evidence of overprinting (indicated by red arrows) showing that the darkest blue areas were produced by overlapping dark and medium blue inks (British Museum 1937,0710,0.147).

According to David Bull [15], the dark blue areas are more likely to have been applied on the paper using two woodblocks, rather than one: one woodblock for the solid areas and another one for the outlines. This is because more pressure is required to print a solid area than a line and the fine ridges in the woodblock that produce the lines in the print would get squashed by excessive pressure and be printed too wide. Using two separate woodblocks would also have reduced the risk of damage to the woodblock used to print the fine details. In fact, during a visit in March 2019 to the Takahashi Kobo Inc. publishing house in Tokyo that specialises in reproducing famous Edo prints using traditional methods, it was observed that the printer employed two separate woodblocks for the dark blue colour in their reproduction of *The Great Wave*: the keyblock for the outlines and another woodblock for the dark shadows of the sea (Figure 14).

Figure 13: Infrared reflectance false colour (IRRFC) image of *The Great Wave* (British Museum 1906,1220,0.533). Areas of the waves that appear dark blue-grey in visible light, but red in IRRFC images are shown by yellow arrows.

Figure 14: Impressions from *The Great Wave*'s keyblock of Takahashi Kobo Inc. (left) and from that of the Adachi Institute of Woodcut Prints of The Adachi Foundation for the Preservation of Woodcut Printing [14] (right). The Takahashi keyblock prints the outlines of *The Great Wave* only, while both the outlines and dark blue areas are carved on the Adachi keyblock.

It is difficult to determine whether the outlines and the dark blue areas were printed using two different woodblocks in Hokusai's *The Great Wave*. However, on late impressions the lines of the boat on the left hand side of the print are not worn out to the same extent as the line of a wave nearby (Figure 15). This strongly suggests that the lines of the boats with their fine details were not printed using the same woodblock as the lines of the waves and the dark blue areas.

Two shades of grey are present on most impressions of *The Great Wave* and they were, most probably, each printed using a separate woodblock. A woodblock was used to produce the light grey areas for the two boats in the foreground (Figure 16) -- printing step 3 in Figure 11 -- and another one was used for the dark grey areas of the print, i.e. the straw mat of the boat the furthest at the back and the dark grey *bokashi* (i.e. the gradual shading) of the sky around Mount Fuji (Figure 17) -- printing step 6 in Figure 11. The shapes of the sea foam in the sky below *The Great Wave* were the same in all the impressions studied, showing this woodblock was used throughout the runs, even when the sky was depicted with rain (Figure 18). There is also evidence that this woodblock was used

for two printings in most impressions: to produce the dark grey *bokashi* surrounding Mount Fuji and the light grey wash in the sky (Figure 17) -- respectively printing steps 5 and 6 in Figure 11.

Figure 15: The outline of a wave has almost disappeared in late impressions, while the features of the adjacent boat are still apparent (left, British Museum 1937,0710,0.147). Compare with an early impression (right, British Museum 2008,3008.1.JA). This suggests the wave and the details of the boat were printed using two different woodblocks.

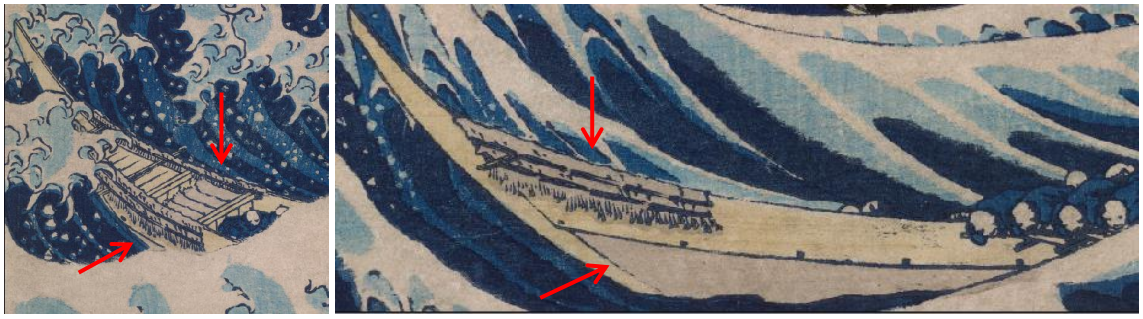


Figure 16: Light dark grey areas on the two boats in the foreground printed using the same woodblock. (British Museum 1937,0710,0.147.)

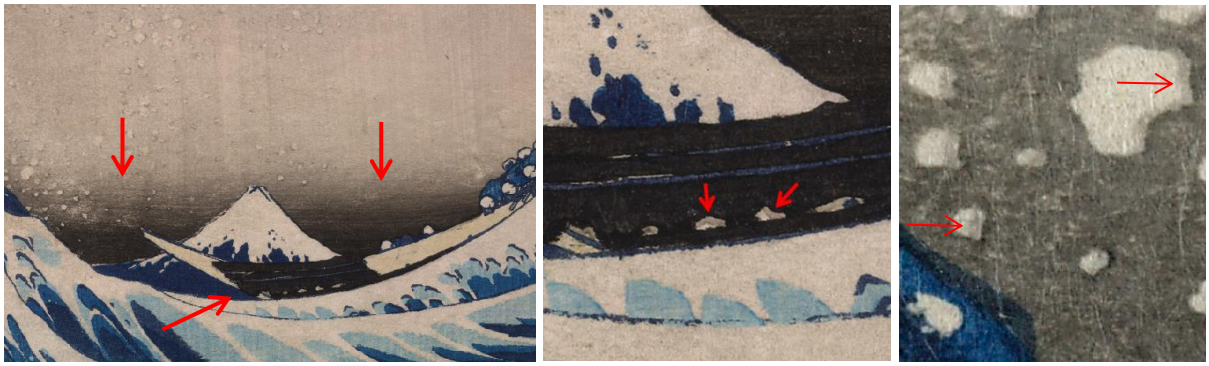


Figure 17: (Left) Dark grey areas on the boat furthest at the back and the sky around Mount Fuji, all printed using the same woodblock. (Middle) Evidence of overprinting on the straw mat on the boat and (right) on the sky. (Left and middle impressions: British Museum 1937,0710,0.147; right impression: British Museum 2008,3008.1.JA).

It is possible that a single woodblock was used for all the grey areas (i.e. the grey areas on the three boats and the sky around Mount Fuji), with separate areas of the design being produced through partial printing from this woodblock. However, as will be discussed in the next section of this article, the light grey areas in the two boats at the front were printed in very late runs using a completely different woodblock. This is not the case for the sky around Mount Fuji, which was printed using the original woodblock in all impressions. This suggests that the light and dark grey areas of the print

were carved on two separate woodblocks, the light grey woodblock being replaced by a new one at some point.

Many of the surviving impressions of *The Great Wave* have faded colours, especially in the sky and the boats (Figures 1, 7 and 8), but impressions with relatively bright colours have survived, for instance JP 10 from the Metropolitan Museum of Art (Figure 2), or the impressions in the collections of the Yale University Art Gallery and the French National Library. These impressions show the presence of yellow or beige areas on the boats, which were printed using a separate woodblock. Lastly, another woodblock was used for the pink or beige clouds in the sky as visible from Figure 18.

Figure 18: As shown by the shape of the sea foam below *The Great Wave* (red circle), the same grey woodblock was used for printing the sky around Mount Fuji in all impressions of *The Great Wave* located for the present study, even when the sky has a different appearance, such as a rainy sky. The colour of the clouds appears un-faded in this impression, but may have been re-applied during a restoration intervention (Art Institute of Chicago 1952.343).

Keyes [6] and Forrer [7] reported that very late impressions of *The Great Wave* were printed using a different woodblock for the light blue pattern in the white foam and this was observed in 16 out of the 111 impressions gathered for this study. As illustrated in Figure 19, the light blue areas in the sea have a more angular shape than in earlier impressions, especially in the bottom right corner of the print. Additionally, unnoticed by Keyes and Forrer, these late impressions were printed using a different yellow woodblock for the boats. This new yellow block was not a perfect replacement for the previous yellow woodblock as several sections of the boats were omitted from the new woodblock, i.e. all the yellow sections on the boat on the left hand side and the bottom of the bow of the boat in the foreground (Figure 20). It is possible that, rather than producing a new woodblock, sections of the original woodblock were scraped away, but this seems unlikely.

Figure 19: Light blue areas in late impressions (left: Art Institute of Chicago 1952.343) were not printed with the same woodblock as in early impressions (right: British Museum 2008,3008.1.JA).

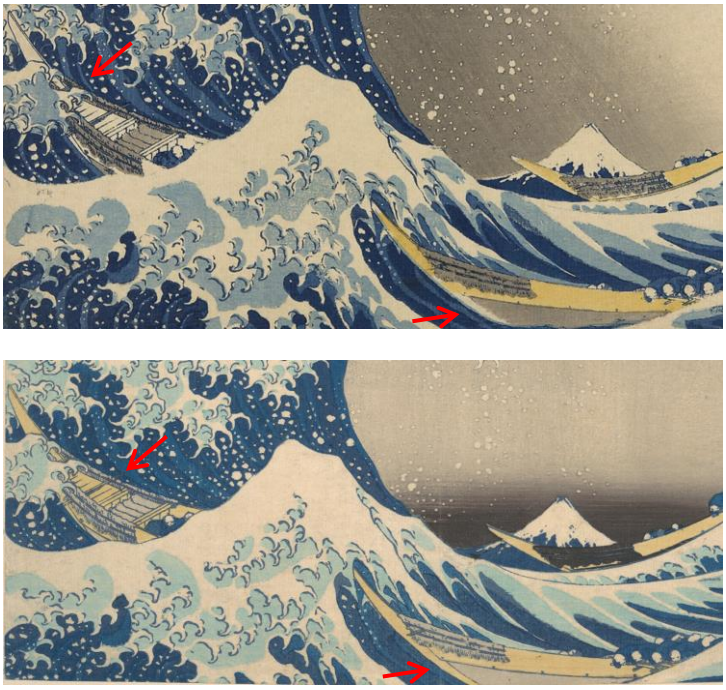


Figure 20: (Top) A different yellow woodblock was used in late impressions such as the impression of the Art Institute of Chicago 1952.343. (Bottom) Compare with the original yellow woodblock used in the impression of the Metropolitan Museum of Art JP 10.

There is evidence that the woodblock used for printing the clouds was re-carved at some point as a feature of the clouds changed from a rounded shape to a pointed one (Figure 21). Keyes noticed this change and believed that a new woodblock had been made for the clouds (c.f. ‘state 19’ in Table 1), but given the similarities in the shape of the clouds in all the impressions otherwise, this seems unlikely. Note that it is not always possible to state with certainty whether the woodblock on a given impression was used before or after re-carving as the clouds are often very faded or, as noted earlier, are sometimes not visible.

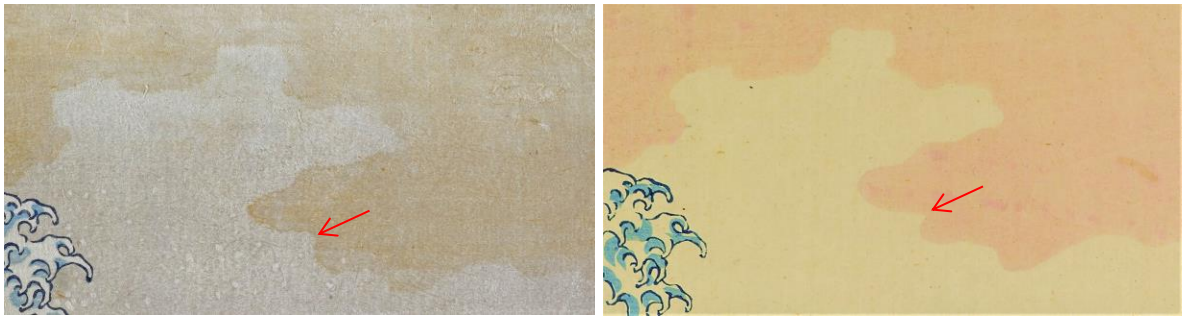
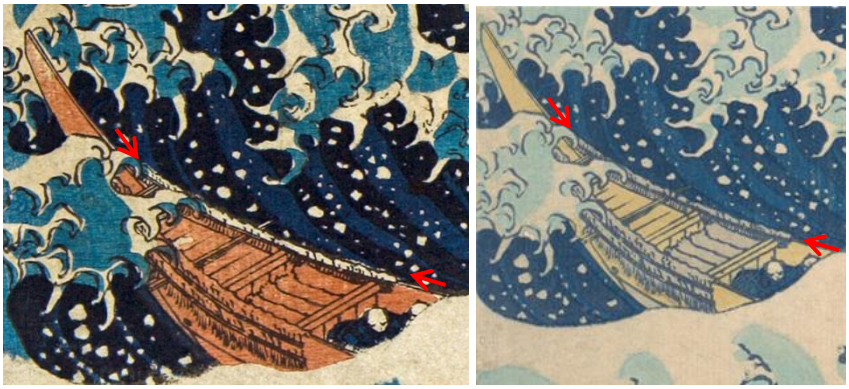
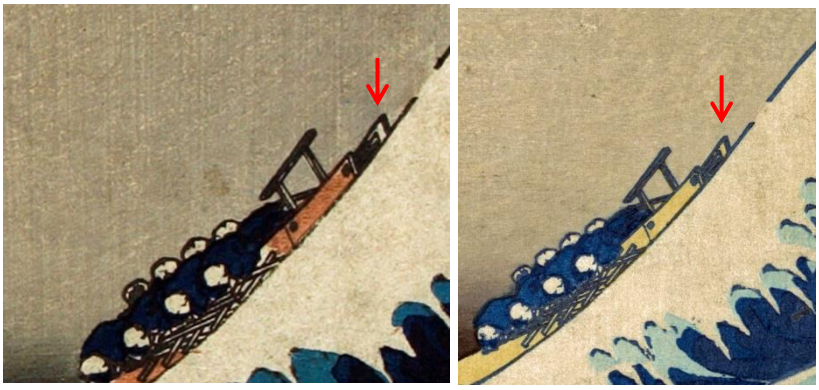


Figure 21: As indicated by red arrows, a feature of the clouds on *The Great Wave* print changed from a rounded shape to a pointed one: (left) before re-carving (Minneapolis Institute of Art 74.1.230) and (right) after re-carving (Chiossone Museum). Note that the contrast in the images was enhanced using the Photoshop software.

Finally, four impressions were found to have the whole of the boats printed in one colour, i.e. a brownish pink instead of grey and yellow (Figure 22). This printing could not have been done using the light grey and yellow woodblocks one after the other with brownish pink ink because the areas printed in brownish pink do not match exactly the areas printed in grey and yellow (Figure 23).Therefore, a new woodblock was used to colour the bodies of the boats in those four impressions. The use of this new woodblock has never been reported before. Also, at the same time this new woodblock was used, the woodblock for the dark grey areas was re-carved: as can be seen by comparing Figures 17 and 23, the grey mat of the boat furthest in the background was not printed, and probably scraped away from the woodblock.

Figure 22: Impression printed with a different woodblock for the bodies of the boats (Harvard Art Museums 1916.685).

a) 

b) 

c) 

Figure 23: Differences in the bodies of the boats, as indicated by red arrows on: (left) an impression with pink boats (Harvard Art Museums 1916.685) compared with (right) two other impressions (a) and (b): Metropolitan Museum of Art JP 10 and (c): British Museum 1906,1220,0.533. a) A section of the boat on the left hand side has been left white while it is light grey on other impressions. b) A section of the boat furthest in the background has been left white while it is printed yellow on other impressions. c) Other sections of the boat furthest in the background have been printed brownish pink while these are not covered by the dark grey ink in other impressions.

Evolution of *The Great Wave*

Woodblock damage

Woodblocks deteriorate with time. This typically results in breaks and in lines becoming faint or losing sharpness. There is some controversy regarding the mechanism of woodblock damage. It has long been assumed that woodblocks deteriorate through the repeated inking and pressure applied during the printing process, but Hedges [16] showed the woodblocks used to print medieval European books degrade mainly through the natural ageing of the wood under ambient conditions and there is little effect from the printing process. The printing technology was different in Japan from that in Europe and the main cause of the deterioration in Japanese woodblocks is unclear.

In order to study the evolution of *The Great Wave*, all the photographs of the impressions gathered for this research were carefully examined for signs of woodblock deterioration and compared. As noted by Keyes [6], evidence of woodblock damage was found to appear first in the borders of the title cartouche, which was produced by very narrow ridges. Only three breaks were found to occur systematically in the cartouche and in the following order (Figure 24):

- **Break 1**: single break on bottom left
- **Break 2**: double break on the left
- **Break 3**: single break on the right, at the bottom.

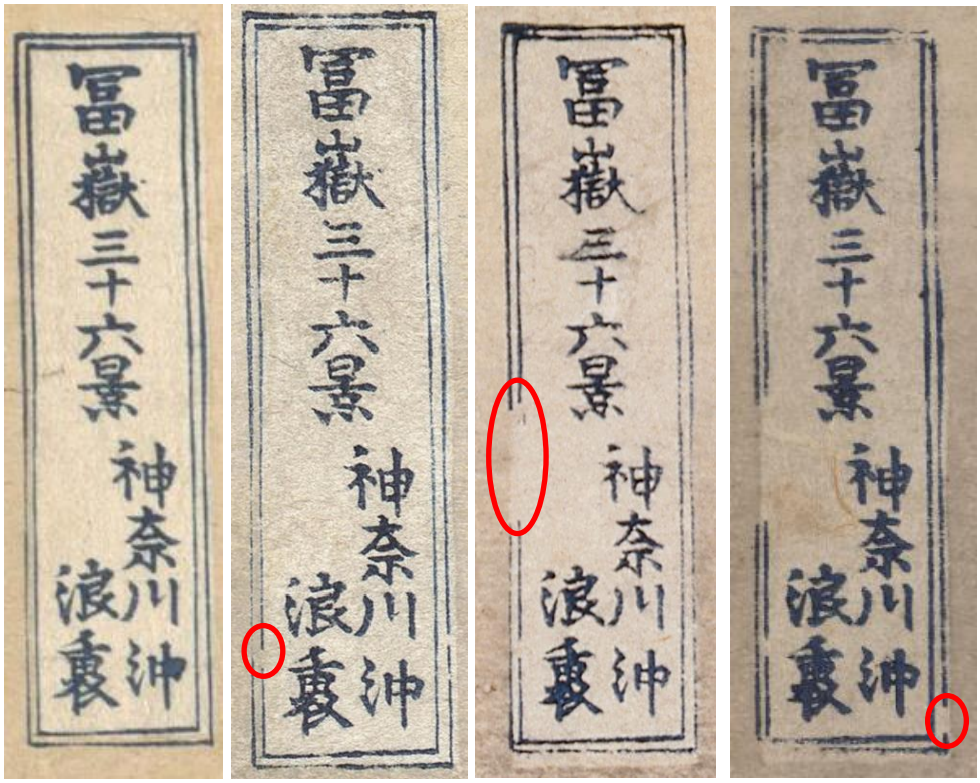


Figure 24: Breaks in the cartouche. From left to right: pristine cartouche (Metropolitan Museum of Art JP1847), break 1 (Tokyo Fuji Art Museum), break 2 (British Museum 1906,1220,0.533) and break 3 (British Museum 1937,0710,0.147).

Two other breaks listed by Keyes occur systematically: a break near the peak of Mount Fuji in the upper right slope (‘state 8’ in Table 1) and a break in the wave line (‘state 13’ in Table 1). The break in the slope of Mount Fuji occurs after break 1, but before break 2 as evident from some impressions (Figure 23). The wave line was damaged after the cartouche was damaged in break 2 but before break 3 as some impressions exist with breaks 1 and 2 and the break in the wave line, but not break 3 (Figure 24). Also, the break in the slope of Mount Fuji is generally much larger in early impressions than in later ones and even disappears in very late impressions (Figure 25). This could be due to the shape of the defect in the ridge causing the break: if the indent is wider at the top of the ridge than within the ridge, the corresponding break would become smaller as the ridge gets worn off as illustrated in Figure 26.

The new light blue and yellow woodblocks mentioned earlier were introduced after the occurrence of the three cartouche breaks and the break in the wave line. The new yellow woodblock was used alongside the new light blue woodblock, at least for the 12 impressions identified for this study produced using the light blue woodblock. These two new woodblocks could have been used because the original light blue and yellow blocks, possibly carved on the recto and verso of the same

woodblock, had been lost. Nevertheless, it is intriguing that the new blue and yellow woodblocks are considerably different from the original ones since it would not have been difficult to reproduce the latter more faithfully. This seems to indicate a lack of care, inconsistent with the high reputation of the publisher of *The Great Wave*, Nishimuraya Yohachi. Indeed, according to Binyon [17], Nishimuraya Yohachi was an important publisher 'remarkable for the high standard of engraving and printing'. However, according to a letter dated 1836 he experienced economic difficulties in the mid-1830s [18]. Could the woodblocks of *The Great Wave* have been sold to another publisher who would have had new woodblocks carved less meticulously?

Figure 23: Break 1 and the break in the slope of Mount Fuji are present on this impression (see inserts), but not break 2 in the cartouche (Rijksmuseum RP-P-1956-733).

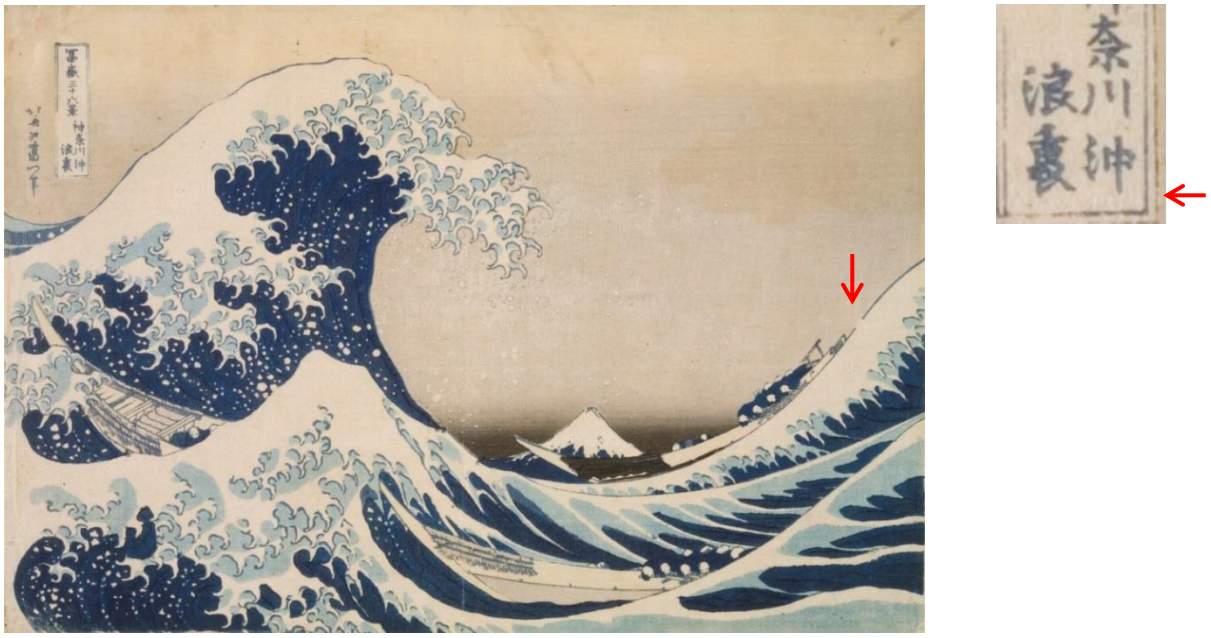


Figure 24: The break in the wave line is present on this impression but not break 3 in the cartouche (see insert) (Spencer Museum of Art).

No impression was found that was printed with the new light blue woodblock and the woodblock for the clouds before it was re-carved. This indicates that the clouds were re-carved around the same time the new light blue and yellow woodblocks were introduced.

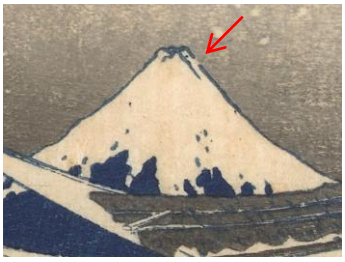
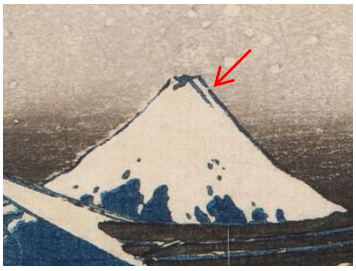
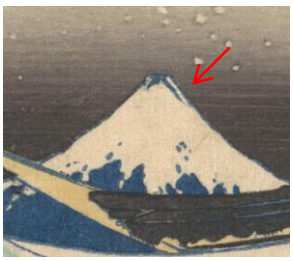
(a)  (b)  (c) 

Figure 25: Break on Mount Fuji: (a) present in state 3 (Rijksmuseum), (b) present but smaller in state 4 (British Museum 1906,1220,0.533) and (c) absent in state 6 (Metropolitan Museum of Art JP10).

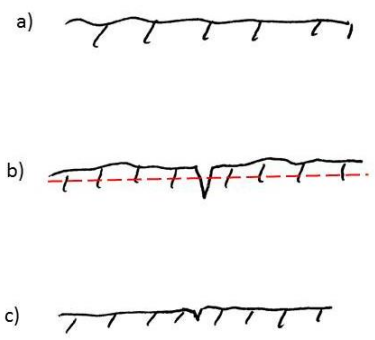


Figure 26: Schematic representation as to how a break in a woodblock could become smaller with time: a) pristine ridge; b) loss in the ridge, wider at the top of the ridge than within the ridge and c) as the woodblock wears down, the loss in the ridge narrows.

Finally, the latest impressions of *The Great Wave* were printed with a new colour woodblock for the body of the boats, which replaced the light grey and yellow woodblocks and was used with a brownish pink ink (Figure 20). The reason for producing the new woodblock is unknown. Maybe the woodblocks for the grey and yellow parts of the boats were lost or badly damaged or it was an aesthetic decision. The clouds in these very late prints look very different from early impressions as they were produced with a dark brownish pink colour using the *bokashi* technique. Also, the four late impressions with brownish pink boats identified in this study have black, not blue, outlines. Black ink was used for the outlines in the impressions of the *36 Views of Mount Fuji* series when 10 additional prints were added to the series at a later stage as a result of its popularity [19]. However, the use of black ink for the outlines was not limited to the impressions with the brownish pink boats as some impressions printed with black outlines and with grey and yellow boats exist, e.g. the impressions in the Chazen Museum of Art and the Cincinnati Art Museum.

In total, eight states could be defined as summarised in Table 5. Examples of impressions for each state are given in Table 6. Interestingly, when examining the 111 impressions of *The Great Wave* in chronological order, there was no sign of gradual woodblock damage preceding a break: for instance, the sections of the two lines in the cartouche corresponding to break 2 did not become gradually thinner in state 3 impressions, before completely disappearing in state 4 impressions. This suggests that the breaks in the woodblocks happened suddenly, possibly between printing events, which supports Hedges' claim that printing is not the main factor causing woodblock damage [16].

Table 5: States of damage of *The Great Wave*. (Note that 26 impressions of the 111 impressions gathered for this study are not included here as it was not possible to see clearly breaks in the cartouche or retouches on these. However, none of them had been produced using the new woodblocks corresponding to state 7 and so they were state 6 or earlier.)

State	Description	Number of impressions
1	No breaks in the cartouche	7 (8%)
2	Break 1	7 (8%)
3	Break in right slope of Mount Fuji	11 (13%)
4	Break 2	19 (22%)
5	Break in wave line	3 (4%)
6	Break 3	22 (26%)
7	Introduction of new light blue and yellow blocks, possibly alongside the re-carving of the woodblock for the clouds	11 (13%)
8	Introduction of a new woodblock for the boats' brownish pink bodies replacing the light grey and yellow woodblocks, possibly alongside the re-carving of the woodblock for the dark grey areas	5 (6%)

Table 6: Examples of impressions of each state (the object number is given when available).

State	Impressions
1	Minneapolis Institute of Art 74.1.230, Hammer Museum Los Angeles, National Gallery of Victoria 426-2, Metropolitan Museum of Art JP1847, British Museum 2008,3008.1.JA, Metropolitan Museum of Art JP 2569
2	Tokyo Fuji Art Museum, Guimet Museum EO3285, Museum of East Asian Art Cologne, Museum of Arts and Crafts Hamburg IE1896.395-1, Edo-Tokyo Museum
3	Rijksmuseum RP-P-1956-733, Los Angeles County Museum of Art M.81.91.2, Victoria & Albert Museum E.4823-1916, Legion of Honor Museum 1969.32.6, Chiossone Museum S 2583-13, Museum of Fine Arts 06.1283, Shimane Art Museum, D'Amour Museum of Fine Arts
4	Tikotin Museum, British Museum 1906,1220,0.533, Guimet Museum EO174, Ota Memorial Museum of Art, Art Institute of Chicago 1925.3245, Museum of Fine Arts 11.17652, Museum of Fine Arts 06.2548, Giverny Museum of Impressionisms, Brigham Young University Museum of Art
5	Portland Museum of Art, Spencer Museum of Art
6	National Museum Krakow 06-000486, Yale University Art Gallery 1973.42.39, British Museum 1937,0710,0.147, Museum of Applied Arts Vienna KI 10988, Bristol Museum and Art Gallery Mb4452, Maidstone Museum 122, French National Library, Isago no Sato Museum of Kawasaki, Art Institute of Chicago 1928.1086, Museum of Fine Arts 06.1153, Metropolitan Museum of Art JP 2972, Tokyo National Museum 10564-3574, RISD Museum 20-1195
7	Honolulu Museum of Art 13695, Cincinnati Art Museum, Art Institute of Chicago 1952.343, Chazen Museum of Art 1980.2386, Tokyo National Museum 10569-685
8	Harvard Art Museums 1916.685, Museum of Fine Arts 21.6764

While Keyes [6] reported the occurrence of other cartouche breaks beside breaks 1-3, those are most likely due to changes in the pressure applied to the woodblocks or the inking during the printing process and therefore cannot be used to define a new state of *The Great Wave*. Evidence of woodblock damage was found in other areas of the print. The locations of these areas are shown in Figure 27 and the corresponding woodblock damage illustrated in Table 7. Woodblock damage is very gradual in these areas, is more or less visible depending on inking and cannot be used to define a new state. However, these signs of woodblock damage indicate that an impression was produced in later runs and can be helpful to detect whether a given impression has been retouched or not. For instance, the cartouche of impression JP10 from the Metropolitan Museum of Art is almost intact, which is not consistent with the signs of woodblock damage elsewhere in the impression (Figure 28). This indicates that the cartouche was retouched, which was confirmed when the impression was examined using a magnifier at the Metropolitan Museum of Art.

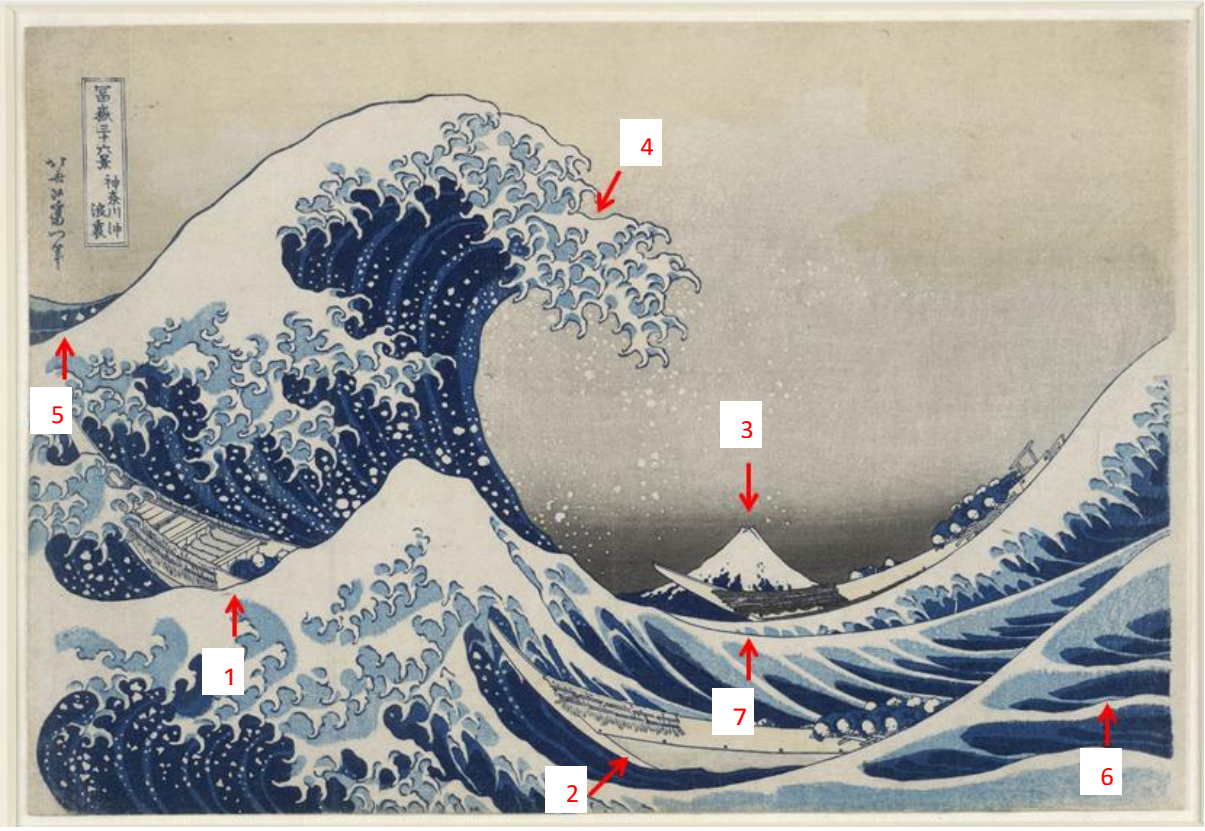
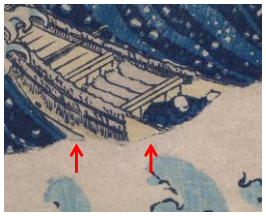
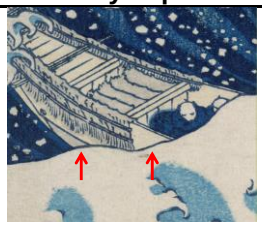
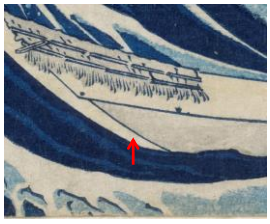
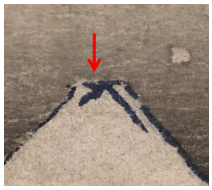
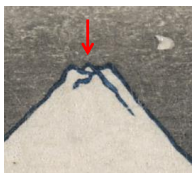
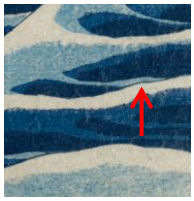
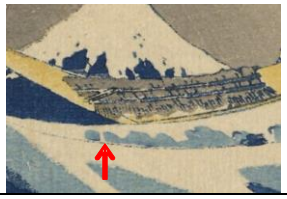
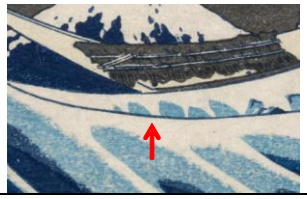


Figure 27: Areas where there is evidence of woodblock wear in late impressions of *The Great Wave* (British Museum 2008,3008.1.JA).

Other line breaks can be observed on some impressions, but again not systematically. For instance, break 'D' defined by Forrer [7] as a loss to the top of 'what can be called *The Great Wave*'s lower group of protruding fingers', which corresponds to area 4 in Figure 27, is present in most late impressions. However, it does not occur consistently in states 3 and 4 and a small gap is even present in several state 1 impressions (Figure 29). This break only occurs systematically in state 5 and later impressions and cannot be used to define a new state.

Table 7: Evidence of woodblock damage in late impressions (British Museum 1937,0710,0.147 for rows 1-5 and Art Institute of Chicago 1952.343 for rows 6-7), compared to a state 1 impression (British Museum 2008,3008.1.JA).

Area	Late impression	Early impression
1		
2		
3		
4		
5		
6		
7		

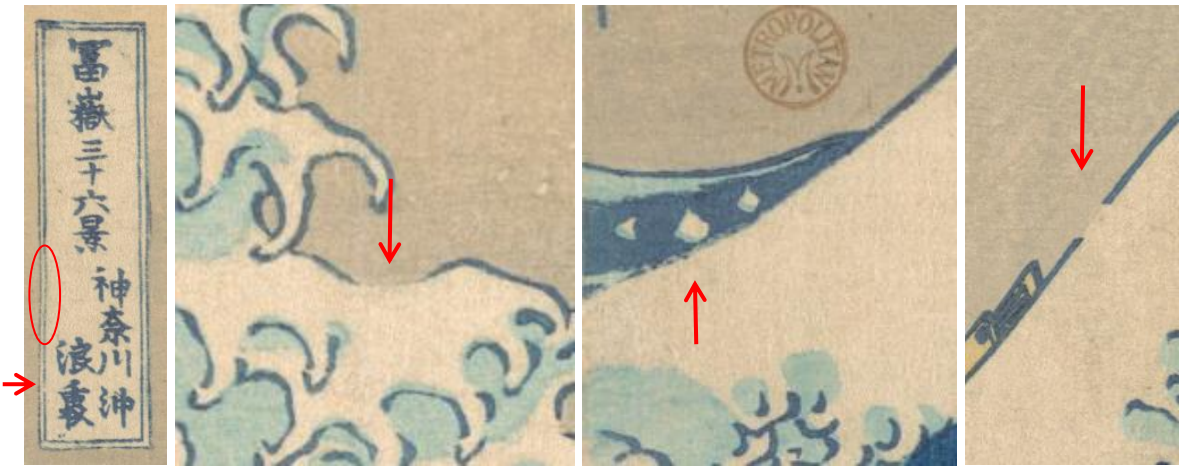


Figure 28: Only break 1 is present in JP 10 impression from the Metropolitan Museum of Art (a) while there is woodblock wear in areas 4 (b) and 5 (c) and the break in the wave line is present (d). This indicates that break 2 in the cartouche (double break on the left circled in (a)) has been retouched.

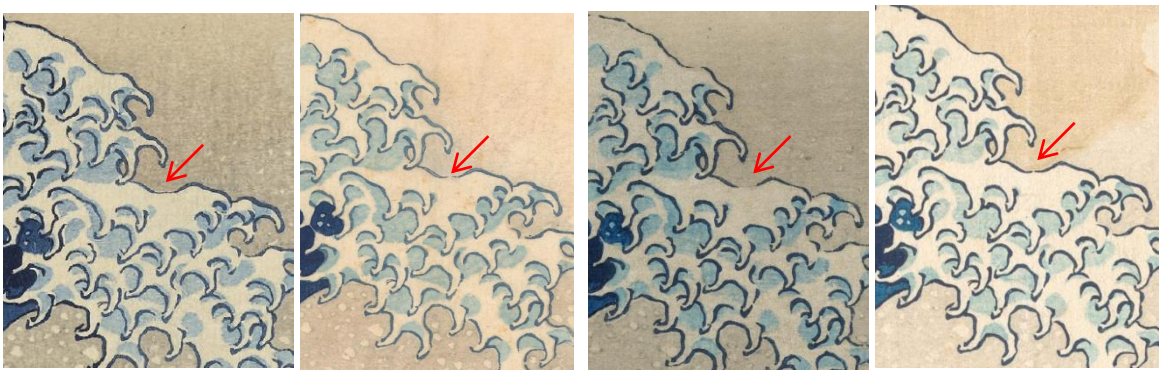


Figure 29: Damage 'D' does not occur consistently in impressions. From left to right: it is absent in a state 4 impression (Art Institute of Chicago 1925.3245), but present in a state 3 impression (Rijksmuseum RP-P-1956-733) and a state 4 impression (British Museum 1906,1220,0.533) and present, although as a much smaller gap, in a state 1 impression (Metropolitan Museum of Art JP2569).

In addition, Keyes [6] stated that the clouds' woodblock was larger in very early impressions ('state 2' in Table 1) but no evidence for this was found (Figure 30). Also, no evidence was found for a reduction of the new light blue woodblock at lower right edge ('state 20' in Table 1).

Figure 30: The shape of the clouds is the same in impressions of different states. From left to right: state 1 (Minneapolis Institute of Art 74.1.230), state 6 (Yale University Art Gallery 1973.42.39) and state 7 (Art Institute of Chicago 1952.343). Note that contrast has been enhanced using Photoshop in these images to help visualise the clouds.

Evolution of colours

Unlike some of the other prints in the *36 Views of Mount Fuji* series, there is not much variation in the colour schemes of *The Great Wave* print. All the impressions examined in this study use three shades of blue in the sea. The lightest blue can be very pale (e.g. National Gallery of Victoria and Giverny Museum of Impressionisms) or a deeper shade (e.g. Museum of East Asian Art Cologne or Harvard Art Museums), but this does not appear to be correlated with how early an impression is.

In general, early impressions tend to have more subtle colours in the boats and the clouds than later ones. For instance, only impressions in states 6 and 7 have vivid pink or brown clouds (e.g. Figures 15 and 21). However, it is possible that the subtle colours in the early impressions are a result of exposure to light and that they used to be more vivid when initially printed. Scientific analysis might help to elucidate this point.

The dark grey *bokashi* surrounding Mount Fuji goes slightly above the top of the mountain in almost all the states 1 and 2 impressions encountered in this study, but remains below the summit in later impressions (Figure 31). The dark grey colour used for this *bokashi* was also used for the boat furthest in the background. In some impressions, black is used. The use of black is unlikely to have been the original intention of the artist as it obstructs the details of the boat (Figure 32). In fact, all the states 1 and 2 impressions identified in this study had the *bokashi* printed in dark grey and not black.

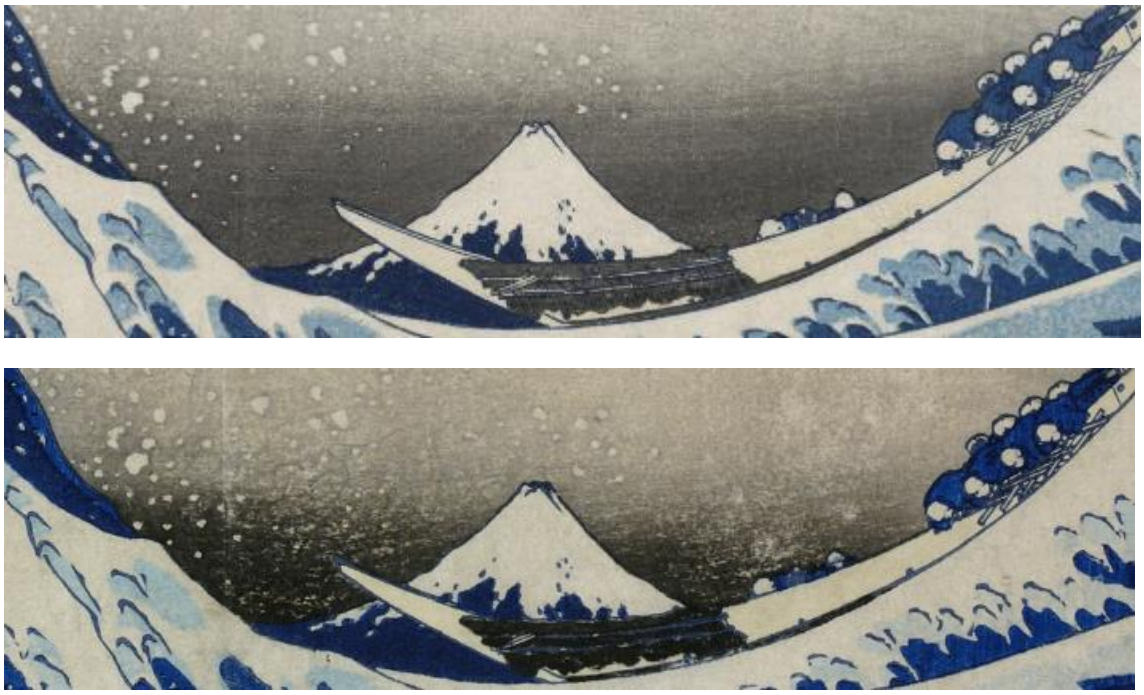


Figure 31: The dark grey *bokashi* surrounding Mount Fuji goes above the top of the mountain in most states 1, 2 and 3 impressions encountered in this study (top: British Museum 2008,3008.1.JA, state 1), but below in later impressions (bottom: British Museum 1906,1220,0.533, state 4).

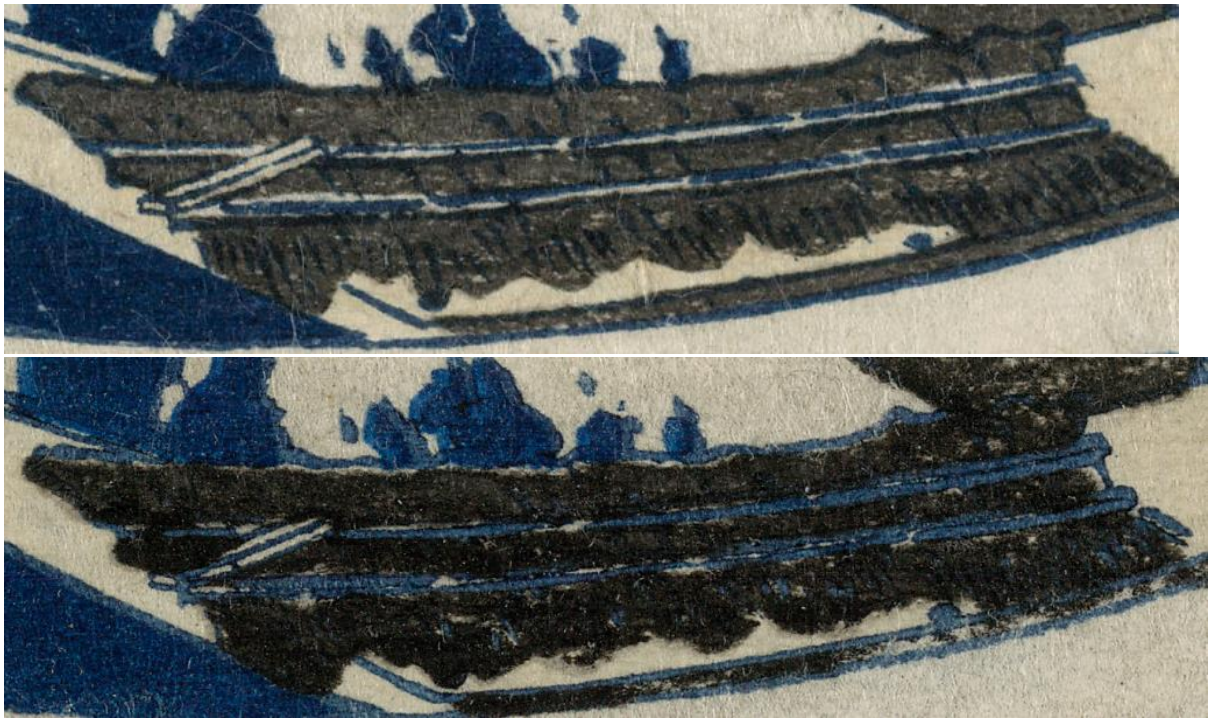


Figure 32: Details printed in dark blue in the third boat are still visible under the dark grey colour in all states 1 and 2 impressions encountered in this study (top: British Museum 2008,3008.1.JA, state 1), but often obstructed by black ink in later impressions (British Museum 1906,1220,0.533, state 4).

Conclusions

Small differences in impressions made from the same set of woodblocks allow the evolution of a print to be followed and are of great interest to ukiyo-e scholars and collectors of Japanese prints. Many impressions of the famous *The Great Wave* print by Hokusai were produced in the 1830s and Keyes [5] and Forrer [7] have previously described how the print changed as a result of woodblock damage. However, their approaches were not entirely systematic and documented and inconsistencies were discerned. In the present research, the evolution of *The Great Wave* print was investigated by examining digital images of 111 impressions gathered from museums, galleries, libraries, books and other sources. It was determined that *The Great Wave* print was originally produced using at least seven woodblocks, with two of them being replaced by new ones in later impressions. While Keyes listed 19 breaks in the cartouche of *The Great Wave* [5], careful examination and comparison of impressions showed that only three of these breaks occurred systematically. The other breaks reported by Keyes were probably due to a difference in the pressure applied on the woodblocks or an uneven inking of the woodblocks by the printmaker. Together with a break in the slope of Mount Fuji and a break in the wave line, the three cartouche breaks were used to define states 2-6 of *The Great Wave* (state 1 corresponds to very early impressions with no evidence of woodblock damage). Later impressions of *The Great Wave* were printed using a new light blue woodblock for the sea and a new yellow woodblock for the boats (state 7). This new yellow woodblock was then replaced by a brownish pink woodblock to print the entire body of the three boats (stage 8). In total, eight states were defined to describe the evolution of *The Great Wave* as the woodblocks became damaged or were replaced. To illustrate this, examples of impressions of each state were also given.

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