

Boats from a Silesian coal mine

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Abstract: In January and April 2013 two unique boats were discovered in the layer of silt in a 200-year-old Adit in the area of Zabrze (Silesia, southern Poland). They lay in a disused gallery about 22 m underground. The boats are similar in size: 5 m in length and less than a metre in width. Probably they were not used to transport the coal, but to carry the miners, tools and materials, possibly also for inspections of the mine site. It is presumably one of the oldest galleries carved out in coal in the world. Author discusses the circumstances of the discovery of the boats, their construction and their utility details.

Keywords: boats, coal mining, x-ray, conservation, digitalization

For 62 years the National Maritime Museum (NMM) has been gathering and preserving objects pertaining to the maritime history of Poland. The cultural heritage of inland waters – rivers and lakes – is one of the more important aspects of our work. Our collections include a few dozen of traditional types of boats from all over Poland (Domżał 2017). Among the archaeological and restoration project we have been pursuing, there are two peculiar boats, discovered in a 200-years old mine adit in Zabrze (Silesia, Southern Poland).

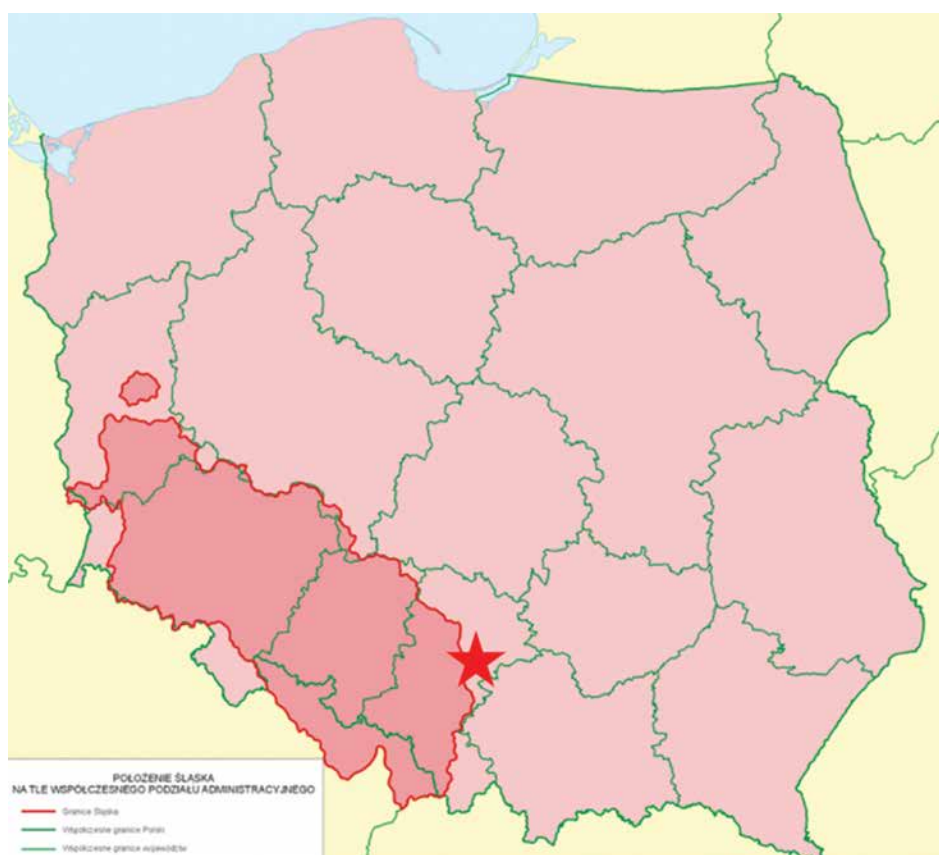


Fig. 1 Map with localisation of Silesian region and Zabrze city, where boats were found (author: R. Domżał, based on Wikipedia maps, https://en.wikipedia.org/wiki/Lower_Silesia)

In January and April 2013 two unique boats were discovered in the layer of silt in a 200-year-old adit in the area of Zabrze (Fig. 1). They lay in a disused gallery of the adit about 22 m underground. How did these vessels end up at such depth under the ground? At the end of the 18th century the construction of the Main Key Hereditary Adit began. It served as both a drainage adit and as an underground water canal between Zabrze and Królewska Huta in Upper Silesia. It is one of the longest hereditary adits in Europe and is the longest hydrotechnical construction in European coal mining. It is presumably one of the oldest galleries carved out of coal in the world (Kossuth 1965).

Drainage adits were used to transfer boats already in 1766 in Worsley, England, and from 1794 in the Fox Adit in Waldenburg, Germany (currently Wałbrzych, Poland). Based on these examples a plan was conceived to build the Main Key Hereditary Adit (*Hauptschluselerbstollen*) in order to drain the coalfields between Królewska Huta (Königshütte) and Zabrze, and, by means of the Gliwice Canal, to connect the Queen Luise Mine with the iron works in Gliwice and the river port on the Odra river in Koźle (Jurkiewicz 2002). The Main Key Hereditary Adit underground canal was dug in 1799–1863, which runs a few dozen metres below ground for 14 km, connecting Chorzów and Zabrze (Fig. 2). The canal was used to drain the local coal mines and as a route for coal-laden boats to the entrance of the adit, located in the current centre of Zabrze. From there the boats passed into an over ground canal leading to Gliwice (Jaros 1991). In 1951 the entrance to the adit was walled up.



Fig. 2 One of the boats covered with mud found in the adit (photo: courtesy of Coal Mining Museum in Zabrze)

The construction of the Main Key Hereditary Adit began on June 23, 1799. The exit of the adit was located in Zabrze, in the valley of the Bytomka, at the point located 231.4 m above sea level, or in one of the lowest points in the whole Upper Silesian Coal Region. The work on the Kłodnicki Canal joining the coalfields with the rest of the country began in 1792. A new stretch of the Gliwice Canal up to the exit of the Main Key Hereditary Adit was built in 1801–1806 (Jaros 1965).

The Main Key Hereditary Adit became an important waterway for transporting coal to the Royal Iron Works in Gliwice and further on to the Odra River. The first transports of coal went through the adit most probably in 1806. After making coal seams accessible, ports were built, from which mining roads were carved. The coal was loaded into wooden crates reinforced with flat bars and girdles, capable of holding about 370 kg of coal. These crates were in turn loaded onto rail carts and pulled by horses or men up to the bank of the adit (Frużyński 2007).

The crates used to transport freshly dug coal were detachable from the rail chassis. Then cranes lifted the crates into special compartments in the boats. The boats conveyed the coal through the 8.5 km long canal to the iron works in Gliwice. There the crates were hoisted onto rail carts, which transported the fuel where needed. A small port was built on the grounds of the iron works to load the coal from the crates onto river barges. An interesting aspect of this system is that the adit canal had no locks, but two inclined planes – one in Sośnica (10.6 m high), and the other within the iron works (5.1 m high). In another port a small crane was used to service a pier, to which the coal carts were lowered by means of a windlass.

The first of the ports described above was most probably the main underground loading port in the adit. It was connected to the rest of the mine not with a drift, but a gallery, which allowed the use of horse transport. The horses pulled carts loaded with three coal crates placed transversely. The man-operated windlasses at drifts could lower only one box at a time. The length and the width of the wharf sufficed for building the necessary track sidings, allowing to manoeuvre the horse-pulled carts as needed. The rotating crane between the tracks could, with one rotation, hoist an empty crate from the boat and lower a laden crate onto it. To accommodate the workhorses, a small stable was built right next to the port. Regardless of the economical aspect, the Main Key Hereditary Adit was undoubtedly one of the most profound achievements of mining and hydro-technical engineering in late 18th early 19th century Upper Silesia (Jurkiewicz 2002).

The coal transport boats used in the Adit were made of wood reinforced with iron bars. Each of the boats had two iron rings mounted on the bow and two plug-ended chains on the stern, which were used to attach the boats to each other. Each boat was divided into 10 or 11 compartments, each for one coal crate, which amounted to four tons of cargo.

Each coal transport was usually composed of three or four linked boats. One worker stood on the bow of the first boat, grabbed on handles protruding from the ceiling of the adit and pushed the boats forward using his legs. When he found himself on the last boat, he walked to the fore boat and repeated the procedure. Pushing a train of boats from the underground pier to the exit of the Adit (1.6–2.5 km) took six to seven hours. Joining the boats was more economical, as it shortened the operation. However, due to the difficulties with long trains of boats passing each other in the Adit, only occasionally would more than four boats be linked. The introduction of a wooden pole, with which the driver would push the boats against the roof and sides of the Adit, shortened the transport time to three to four hours. The boats leaving the Adit moored in the transfer port, where a crane hoisted the crates onto larger barges, capable of taking 18 crates. During a single workday a few workers operating the crane could offload about 100 crates, which means that daily two or three 3–4 boat trains would leave the adit. The barges, pulled by men walking along the canal, would then be taken to Gliwice and on to Koźle (Frużyński 2000).



Fig. 3 Both objects examined in the Shipwreck Conservation Centre in Tczew, branch of the National Maritime Museum in Gdansk (photo: P. Jozwiak)

The two boats found in the Main Key Hereditary Adit in Jan and April 2013 were called Z1 and Z2 (Fig. 3), and soon after discovery were stored in special tanks with water. Both artefacts are the property of the Coal Mining Museum in Zabrze. Due to the lack of specialised conservation laboratory in Silesian region, NMM in Gdansk was asked to take care of the conservation process. In result, both boats were transported to the Shipwreck Conservation Center in Tczew, 50 km from Gdansk. This branch of the NMM was opened in 2016. The boats are similar in size: 5 m in length and less than 1 m in width. Z1 was made from the Douglas fir wood and Z2 from pine wood. None of the boats was used to transport coal, as one might assume, but rather to carry the miners, tools and materials, and possibly also for inspections of the mine site. Vessels of this kind might have been used in mining from the middle of the 19th century until the second half of the 20th century. Despite numerous distortions, the condition of the boats can be considered to be good (Fig. 4).



Fig. 4 Boat no. 1 after cleaning, prepared for scanning (photo: P. Jozwiak)

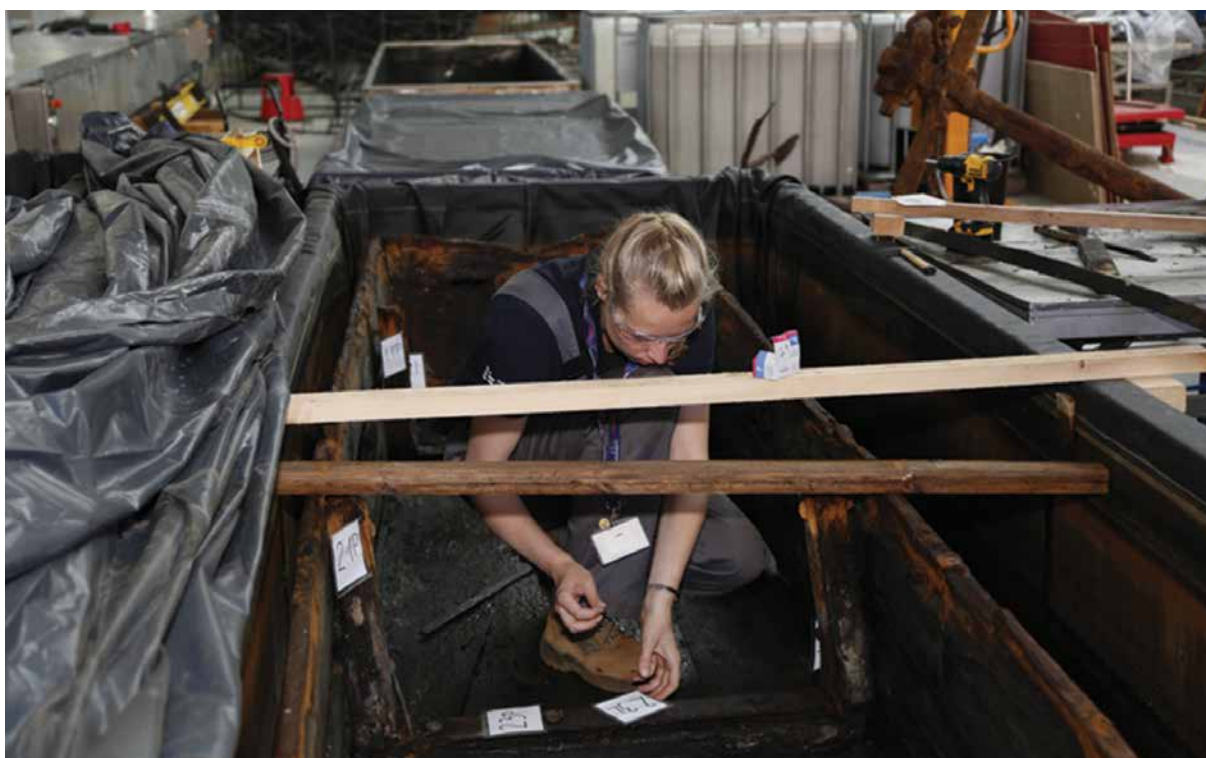


Fig. 5 Taking samples for the analytical research from both objects (photo: P. Jozwiak)

The Coal Mining Museum in Zabrze has tasked the National Maritime Museum in Gdańsk to conserve both objects. Prior to the beginning of the conservation proper tests were conducted to determine the deterioration of the wood and choose the appropriate conservation method (Fig. 5). The objects were x-rayed in order to check the condition of metal elements fastened to the wooden construction (Figs 7a and 7b). The chemical composition, both qualitative and quantitative, was determined by using a scanning electron microscope and X-ray spectroscopy.

Examination and conservation of the two boats found in the disused coal mine in Zabrze began in 2019. The microscopic testing was conducted to determine the type of wood used in the construction of boats Z1 and Z2. The physicochemical testing was conducted to determine the condition of the wood in both boats, which had remained in water for dozens of years. A number of standard tests were conducted: measuring the maximum humidity, the holocellulose, cellulose, cellucotton, and mineral content. The moisture content varied between 153–250% in Boat Z1 and from 71 to 250% in Boat Z2, which shows the large difference in the level of deterioration of the wooden construction. The side planks were found to be in much worse condition than the vertical elements of the frame and of the bottom. After the disassembly of the metal elements the process of removal of deleterious iron compounds began. A few dozens of the wooden and metal elements were submerged in coordinating complex solution, which has been replaced every few months. Former wreck conservation projects enabled assessment on the proper treatment methods (Jagielska 2015).

At the same time test conservations were performed on wood, first on samples, later on smaller elements of the boats. The samples were conducted by impregnation with various solutions of PEG and by freeze-drying. The best effects – largest increase in durability and decrease in shrinkage – were achieved by PEG 4000 impregnation and by lyophilisation.



Fig. 6 Boat no. 1 after cleaning, prepared for scanning (photo: P. Jozwiak)

In 2020 Boat Z2 was disassembled, while in 2021 it was decided to proceed with the disassembly of Boat Z1. Samples of the conserving agent are taken regularly to monitor the chloride ions content. After the removal of chlorides from the metal is completed, the elements will be cleaned mechanically. The final stage will be sealing the elements to protect them from harmful external factors. The investigation into the metal elements of Boat Z2 is still in progress. Published results of tests on Boat Z2 and the research into the professional literature will help in determining the best conservation method, including one option which is not very common, but has already been implemented in some research (Almkvist, Hocker, Sahlstedt 2013).

Based on the analysis of test results and conferring with conservators from a number of Polish museums, a decision was made to separate the metal and wooden elements and to conserve them separately. All the elements will be re-assembled after completing the conservation procedures. Before the boats were dismantled, they were photographed and 3D-scanned to provide documentation necessary for restoration process.

Scanning of two boats from Zabrze in the Shipwreck Conservation Centre in Tczew took one workday. Each of the boats was scanned along all the planes. Fifty scans were made, 20 for the first, and 30 for the second boat. The scanning was conducted using a handheld Artec Eva optic scanner, which uses structured light, i.e., projects narrow strips of light which fall on the surface of the scanned object; the cameras then analyse the distortion of the light. The scanner is able to detect the geometry and the texture of the scanned object. Artec Studio software was used to create the 3D models. The whole process took three workdays, used for processing the images, removal of artifacts and errors, merging the scans in order to create a 3D image, and finally, geometrical corrections and application of textures (Fig. 6).

In November 2021 the Digitalisation Department of the National Maritime Museum began the process of scanning the parts of the disassembled boats, which was done in the Conservation Workshop of the Maritime Culture Centre. Again, the Artec Eva optical scanner was used. Scanning over 100 parts took two weeks, during which about 500 scans were conducted. Overall, the creation of 3D models of the boats, including processing the scans, required three months of work. Similar 3D documentation projects of the objects from coal mines are known from Germany (Schmidt-Reimann, Reuter 2015).

This documentation has proved very helpful in the conservation and the disassembly of both boats. We believe that the conservation of both boats will require about four years. After that, we would be happy to share the results of this project.



Figs 7a and 7b Radiography as a tool to assess state of preservation of metal parts before the dismantling (photo: B. Galus)

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References

- Almkvist, G., Hocker, E., Sahlstedt, M. 2013. *Iron Removal from Waterlogged Wood*. Uppsala, Swedish University of Agricultural Sciences.
- Domżał, R. 2017. *Zabytkowe statki w Polsce*, [Studia i Materiały Narodowego Muzeum Morskiego w Gdańsku T. XVIII, seria B – Materiały Źródłowe 17]. Gdańsk, Narodowe Muzeum Morskie.
- Frużyński, A. 2000. *Główna Kluczowa Sztolnia Dziedziczna. Nasze Zabrze* 9.
- Frużyński, A. 2007. Zbiór planów i rysunków technicznych Wyższego Urzędu Górniczego z Wrocławia jako źródło do dziejów górnictwa na Górnym Śląsku na przełomie XVIII i XIX w. In S. Januszewski (ed.), *Górnictwo w czasie, przestrzeni, kulturze*. Wrocław, WPHU Pionier: 158–159.
- Jagielska, I. 2015. *Conservation of wooden wrecks from the Baltic Sea*. In K. Piotrowska, P. Konieczny (eds), *Condition.2015 Conservation and Digitalization. Conference Proceedings*. Gdańsk, Narodowe Muzeum Morskie w Gdańsku: 21–24.
- Jaros, J. 1965. *Historia górnictwa węglowego w Zagłębiu Górnos Śląskim do 1914*. Wrocław, Wydawnictwo PAN.
- Jaros, J. 1991. *Dwa wieki kopalni węgla kamiennego „Zabrze-Bielszowice”*. Zabrze, Wydawnictwo Stowarzyszenie Inżynierów i Techników Górnictwa.
- Jurkiewicz, J. G. 2002. Główna Kluczowa Sztolnia Dziedziczna – najdłuższa budowla hydrotechniczna w europejskim górnictwie węglowym. In *Materiały Szkoły Eksploatacji Podziemnej II*. Kraków, Wydawnictwo IGSMiE PAN: 773–781.
- Kossuth, S. 1965. *Górnictwo węglowe na Górnym Śląsku w połowie XIX wieku*. Katowice, Wydawnictwo “Śląsk”.
- Schmidt-Reimann, P., Reuter, T. 2015. Conservation and 3D-documentation of waterlogged wood from medieval mining. In *Condition 2015 Conservation and Digitalization. Conference Proceedings*. Gdansk, Narodowe Muzeum Morskie w Gdańsku: 125–130.