Samuel Gutestrand Mandarić:
The History and Findings of Swedish Hydrographic Research: Insights from the Bohuslän Coast in the Late 1860s

Summary

This article explores the pioneering hydrographic research conducted by Fredrik Laurentz Ekman along the Bohuslän coast in the late 1860s. Using specially designed oceanographic instruments, Ekman systematically collected water samples from various depths, ranging from the surface to the ocean floor, across a study area extending from Vinga in the Gothenburg archipelago to Strömstad in northern Bohuslän. His investigations revealed significant salinity variations, with levels increasing with depth, contributing to a more detailed understanding of seawater composition. Ekman's meticulous methodology and innovative sampling techniques provided a foundation for future hydrographic research. By advancing measurement methods and deepening the understanding of salinity variations, his work influenced subsequent developments in marine science.

Early Hydrographic Research in Scandinavian Waters

The history of Swedish hydrography can be traced back to the summer of 1868, when Fredrik Laurentz Ekman (1830-1890) conducted specialized investigations on seawater salinity in the Bohuslän archipelago.[1] Mapping water characteristics was driven by both intra-scientific motivations and other justifications, with a primary objective of assessing the commercial viability of extracting salt from coastal seawater in Bohuslän.[2] Initial observations conducted in the archipelago revealed significant variations in salinity, which in turn spurred further explorations during the subsequent summer.[3]

In the summer of 1869, Ekman conducted chemical and physical oceanographic surveys at various locations along the coast, from Vinga in the Gothenburg archipelago to Strömstad in northern Bohuslän. Seawater was examined through sampling using oceanographic instruments specifically designed for this purpose, from the surface down to the ocean floor at each respective location. Prior to this, two salinity determinations had been conducted in the Skagerrak region, one by Adolph Strecker (1822-1871) in Sandefjord, Norway, and the other by Johan Georg Forchhammer (1794–1865) between Skagen and Hirtshals, Denmark.[4] Strecker's marine survey took place in the 1850s during his tenure as a professor of chemistry at the university in Kristiania (now Oslo). The chemical analysis of the surface water sample from Sandefjord, located slightly west of the estuary of the Oslo Fjord, indicated a salinity level approximately half of those obtained in the open waters of the North Sea.[5] Strecker's findings align with earlier experiments conducted by Forchhammer, a professor of mineralogy and geology at the University of Copenhagen, which demonstrated the existence of local variations in seawater salinity, particularly near the coast, accompanied by a clear percentage decrease. The chemical analyses conducted in Sandefjord provided evidence that the relative proportions of salts present in the seawater were essentially identical to those observed in the North Sea.[6]

The water sample from the coast of North Jutland was determined by Forchhammer and constituted a part of a systematic study on the chemical composition of seawater, which was published in the late 1850s.[7] The thesis was based on an analysis work spanning over fifteen years, involving surface water samples from various parts of the world's oceans, a significant contribution of which was collected during the Danish corvette Galathea's circumnavigation from 1845 to 1847.[8] The chemical analysis of the water sample taken between Skagen and Hirtshals revealed a higher salinity compared to the results obtained by Strecker in Sandefjord. By presenting a large number of determinations from other oceanic regions, Forchhammer was able to provide evidence that although the salinity varied to some extent, for example, due to runoff and evaporation, the composition of sea salt remained highly consistent.[9] In other words, the constituents of salt occurred in practically constant proportions.

Ekman's Oceanographic Surveys and Findings

Fredrik Laurentz Ekman's chemical and physical oceanographic survey in the late 1860s was the first conducted from the Swedish side of the Skagerrak.[10] The study was carried

[1] Ekman, 1870, p.3.

[2] Svansson, 2002, p.358; Svansson, 2006, p.22.

[3] Ekman, p.7; Ekman, 1870, p.3.

[4] Forchhammer, 1855, pp.177ff.

[5] Strecker, 1855, p.182.

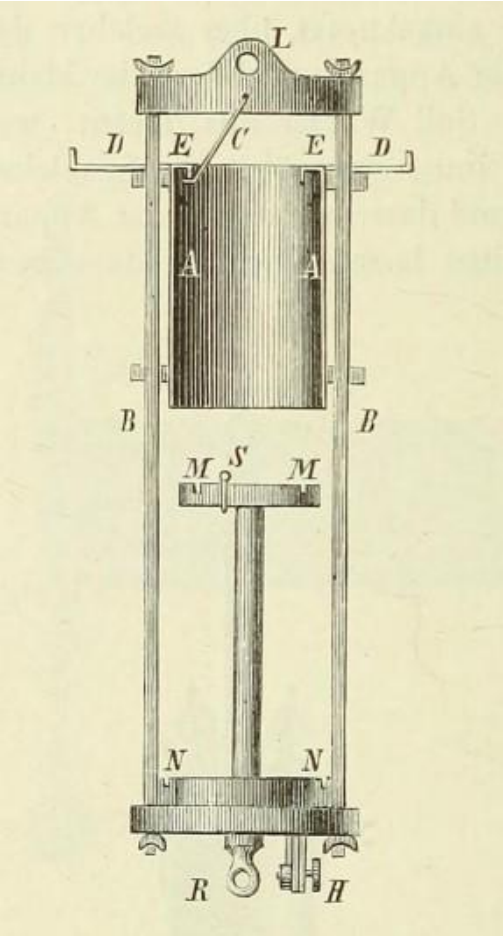
[6] Ibid., p.181f.

[7] Forchhammer, 1859, pp.1-48

[8] Ibid, p.5.

[9] Forchhammer, 1865

[10] Ekman, 1870, p.3; Gislén, 1929, p.20.



out using specially designed oceanographic instruments, adapted to enable sampling at various depths.

Based on preliminary investigations in the Skagerrak and Kattegat, which convinced Ekman of the rapid fluctuations in salinity at different depths, an uninsulated water sampler was constructed. Given the specific conditions along Sweden's west coast, Ekman recognized the importance of designing the sampler to minimize the transfer of water from upper layers to deeper strata.[11]

The water bottle consisted of a cylindrical structure open at both ends, smoothly gliding along two parallel rods with a ring-shaped disc positioned at the top, creating resistance against the water (see Figure 1).[12] Consequently, during the hoisting process, the cylinder was pressed downward, and its edges firmly engaged with grooves filled with a mixture of wax and tallow. This carefully designed configuration enabled the cylinder to form a complete seal, effectively isolating the water inside from the surrounding environment the moment the hoisting commenced.[13] Assuming a continuous and controlled lowering of the instrument, water could flow freely through the cylinder, ensuring that the collected sample provided a reliable result at the intended depth.[14]

Figure 1. Ekman's non-insulated waterbottle from 1869. From Wittmack, 1881

The collected water samples were determined for density, temperature, and salinity. A larger number of samples were taken to the Technical Institute in Stockholm, where Ekman worked as a lecturer, for precise determination of density through weighing.[15] In addition, a selection of samples underwent in-depth chemical analyses, such as determination of existing salt constituents and calculation of the total salt content in relation to the water's chlorine content.[16] This meant that Ekman's chemical investigations aligned with Forchhammer's previously conducted analysis work on the composition of seawater, which had shown, through analysis of a large number of water samples, that the chlorine content relative to the total salt content was practically constant. By titration with silver nitrate, the amount of chlorine could be determined, and then the total salinity was calculated using a coefficient derived from processing empirical data.[17] Forchhammer's chemical analysis work indicated that the general coefficient for the world's oceans was 1.812. This factor could then be used to multiply the chlorine amount in percent or parts per thousand, thus determining the total salinity.[18] Based on the results of four water samples: Hållö (surface sample), Pater Nosterskären (surface

[11] Ekman, 1893, p.7.
[12] Rubenson, 1880, p.52f.
[13] Ekman, 1876, p.4; Wittmack, 1881, p.34f.
[14] Ekman, 1875, p.8; Ekman, 1876, p.4f.
[15] Ekman, 1870, p.3.
[16] Ibid., p.3f, 43.
[17] Forchhammer, 1865, p.219ff.
[18] Ibid., p.221.

sample), Fjällbacka archipelago (10 fathoms), and Kosterfjorden (100 fathoms), Ekman determined the coefficient to be 1.811 (see Figure 2).[19]

Hafsvatten från	A. Paternoster-skären, hafsytan.	B. Hafvet ½ mil vester om Hållö fyr, ytan.	C. Hvalösundet i Fjellbackaskär-gården, 10 famnar.	D. Kosterfjorden 100 famnar.
Vattnets salthalt	2.094 %	2.587 %	2.999 %	3.501 %
Vattnets chlorhalt	1.1569 %	1.4284 %	1.6614 %	1.9374 %
Saltcoefficienten eller saltmängden relativt till en vigtsdel chlor	1.817	1.815	1.805	1.807

Figure 2. Displays the water's salinity and chloride content, as well as the salinity coefficient at Hållö, Pater Nosterskären, Fjällbacka archipelago, and Kosterfjorden. From Ekman 1870

The hydrographic surveys conducted along the Bohuslän coast revealed significant salinity variations within the Skagerrak, with salinity levels increasing with depth. The water exhibited a salinity range from approximately 1.5 percent near Gothenburg to 3.5 percent in the deep waters of Kosterfjorden.[20] Ekman divided his study area into a southern part, Kattegat, and a northern part, Skagerrak. The boundary between these marine regions can be illustrated by a transverse line approximately aligned with Marstrand in southern Bohuslän and Skagen at the northern tip of Jutland.[21] Surface salinity ranged from about 2.5 percent in Skagerrak to an average below 2 percent in Kattegat. The study also revealed that variations in salinity ceased at a depth exceeding 30 fathoms. This conclusion was based on measurements taken from geographically diverse areas such as Gullmarsfjorden, Pater Nosterskären, and Kosterfjorden, all of which indicated values between 3.3 and 3.4 percent at approximately 30 fathoms depth.[22] Ekman explained these findings by noting that the seawater in Skagerrak, along the coast of Bohuslän, experiences a significant influx of fresher water while also being subjected to a stronger current from the ocean.[23] Ekman proposed that a current from the North Sea flows along the northern coast of Jutland and then turns toward southern Bohuslän, reaching the coast north of Marstrand. From there, the current follows the Swedish coast in a northerly direction, merging with the incoming southerly current from Kattegat. Together with the Göta River, these currents contribute to the dilution of seawater. The current then turns southwest along the Norwegian coast, influenced by water from Norwegian rivers and mountains, before ultimately returning to the North Sea.[24] Ekman emphasized that this pattern is generally prevailing, but he also noted that the current direction is not constant and can occasionally be reversed due to the influence of wind.[25] Local impacts on seawater salinity through the inflow of fresher water were primarily assessed to occur from the surface down to a depth of two fathoms.

The marine survey conducted along the Bohuslän coast revealed that wind exerted an influence on the salinity of the Skagerrak. Ekman believed that fjord water exhibited

[19] Ekman, 1870, p.32.
[20] Ibid., p.16ff.
[21] Ibid., p.22.
[22] Ibid., p.16ff, 22f.
[23] Ibid., p.23.
[24] Ibid., p.22f.
[25] Ibid., p.23.

higher salinity when the wind blew from the land compared to when it blew from the sea. This was explained by the fact that the landward wind contributed to the movement of surface water out of the fjord, while the seaward wind enclosed it within the fjord.[26] Similar circumstances were deemed applicable to the open sea in Skagerrak. Consequently, the longer the landward wind persisted, the deeper layers of fresher surface water could be present. As wind direction exhibited seasonal variations, periodic changes in salinity could be established.[27]

In conjunction with the marine survey, two winter observations were conducted in Gullmarsfjorden. The fjord was covered by ice during these periods, with thicknesses of approximately 0.5 and 1.5 feet, respectively.[28] The measurements demonstrated a significant increase in salinity in the upper water layers between the different sampling occasions. However, the salinity at a depth of ten fathoms remained almost the same. According to Ekman, one contributing factor to this observation was the ice cover, which protected the surface water from the influence of wind and wave movement, thus preventing a substantial mixing of the upper water layers in Gullmarsfjorden.[29]

Conclusion: The Legacy of Ekman's Research

Fredrik Laurentz Ekman's pioneering hydrographic research along the Bohuslän coast in the late 1860s stands as a landmark contribution to oceanographic science, both within Sweden and in the broader global scientific community, significantly advancing the understanding of seawater composition. Ekman's investigations revealed the complex variations in seawater salinity and chloride content, which both confirmed and broadened the scope of earlier studies conducted by scientists such as Adolph Strecker and Georg Forchhammer. By developing and employing specialized instruments specifically developed for oceanographic sampling, Ekman gathered valuable data on the distribution of salinity in both the Skagerrak and Kattegat regions. His work laid the foundation for future hydrographic studies, advancing marine science through more precise and systematic methodologies for measuring and analysing seawater composition.

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[26] Ibid., p.26.

[27] Ibid., p.27.

[28] Ibid., p.18.

[29] Ibid., p.34.

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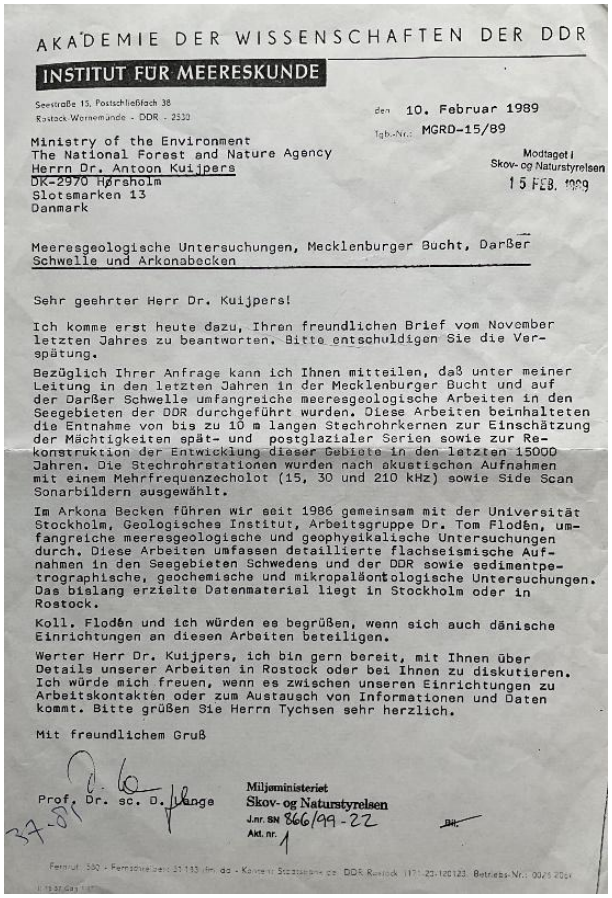
Antoon Kuijpers, Dieter Lange & Wolfgang Matthäus: *Joint Danish-East German (DDR) marine geological investigations in the Baltic Sea during the years 1989-1991*

Background and cooperation start-up

With this contribution we will present a review of the history of Danish-East German joint seabed investigations in the Baltic Sea, a project which started in early 1989. Later that year the timing of this initiative turned out to immediately precede a historical breakup of the existing 'East-West' political situation in Germany and elsewhere in Europe. Our contribution will focus solely on activities in the field of marine geology during the period 1989 - 1991, and not refer to other marine research in Denmark or in the German Democratic Republic (Deutsche Demokratische Republik, DDR) at that time. It is further emphasized that, apart from mentioning a few historical milestones, this review does not present a complete overview of the DDR marine research history, for which may be referred to other publications (e.g. Brosin 1996; Lange *et al*. 2011; Matthäus 2019, 2023). It should be noted, however, that closer contacts between Danish and DDR marine institutions had started already in the 1980s. Within that context, in 1983, the Danish Minister of the Environment, Christian Christensen, had visited Warnemünde. Later, in 1987, from the 10 members of the expert panel for evaluation of the environmental effects caused by the Danish 'Fixed Great Belt Link Project' (1988-1998) only one expert had been invited from 'behind' the 'Iron Curtain', and this was a scientist from the Warnemünde Institute of Marine Research (Storebaelt, 1994).

Previously, during a number of years in the 1970s the Danish 'Belt Project' had been run and conducted multi-disciplinary oceanographic studies in the Belts and Sound. At the end of that decade this was followed by a national plan of systematic seabed mapping in the inner Danish waters east of Jutland. The organization made in the 1980s responsible for this mapping was the Danish Nature and Forest Agency, Ministry of the Environment, with its department for seabed research ('Havbundsundersøgelser'). The investigations aimed, among others, on studying the distribution of marine resources such as sand and gravel. At the end of 1988 the work planning for the next year envisaged mapping of an area in the Baltic Sea south and southeast of Denmark, bordering DDR territory. Although at that time the 'cold war' was slowly getting 'milder', the military 'East-West' pacts (Warsaw, NATO, resp.) were in practice still existing. With the aim of getting a better understanding of seabed structures and processes when looking also beyond national boundaries, the seabed mapping group in Denmark decided to contact the 'Institute of Marine Research' in Warnemünde, officially the 'Institut für Meereskunde Warnemünde', Akademie der Wissenschaften der DDR' (in short 'IfM Warnemünde'). Late 1988 a letter was sent to 'IfM Warnemünde' with the proposal to join forces and organize together marine geological research cruises in selected Danish and DDR Baltic Sea areas. A few months later, in February, a positive response from the Director was received (Figure 1), soon followed by a successful meeting in Warnemünde for the start-up of joint research activities. Within this context, border procedures when entering the DDR in those years can be characterized as 'unforgettable', and also a few other experiences

made in early spring 1989 outside the meeting in Warnemünde were highly memorable. Practically, contacts between Copenhagen and Warnemünde at that time were, however, excellently facilitated by a well-functioning, direct train connection between Copenhagen and East Berlin. In the 1990s this was replaced by a public traffic solution in Denmark depending for part of the journey on time-consuming, local bus service. Moreover, at the same time the ferry terminal in the center of Warnemünde close to the location of 'IfM Warnemünde' was moved away from the town to the Rostock industry harbor east of Warnemünde.



AKADEMIE DER WISSENSCHAFTEN DER DDR

INSTITUT FÜR MEERESKUNDE

Seestraße 15, Postschließfach 38
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den 10. Februar 1989
Tgb.-Nr.: MGRD-15/89

Ministry of the Environment
The National Forest and Nature Agency
Herrn Dr. Antoon Kuijpers
DK-2970 Hørsholm
Slotsmarken 13
Danmark

Modtaget i Skov- og Naturstyrelsen 15 FEB. 1989

Meeresgeologische Untersuchungen, Mecklenburger Bucht, Darßer Schwelle und Arkonabecken

Sehr geehrter Herr Dr. Kuijpers!

Ich komme erst heute dazu, Ihren freundlichen Brief vom November letzten Jahres zu beantworten. Bitte entschuldigen Sie die Verspätung.

Bezüglich Ihrer Anfrage kann ich Ihnen mitteilen, daß unter meiner Leitung in den letzten Jahren in der Mecklenburger Bucht und auf der Darßer Schwelle umfangreiche meeresgeologische Arbeiten in den Seegebieten der DDR durchgeführt wurden. Diese Arbeiten beinhalteten die Entnahme von bis zu 10 m langen Stechrohrkernen zur Einschätzung der Mächtigkeiten spät- und postglazialer Serien sowie zur Rekonstruktion der Entwicklung dieser Gebiete in den letzten 15000 Jahren. Die Stechrohrstationen wurden nach akustischen Aufnahmen mit einem Mehrfrequenzecholot (15, 30 und 210 kHz) sowie Side Scan Sonarbildern ausgewählt.

Im Arkona Becken führen wir seit 1986 gemeinsam mit der Universität Stockholm, Geologisches Institut, Arbeitsgruppe Dr. Tom Flodén, umfangreiche meeresgeologische und geophysikalische Untersuchungen durch. Diese Arbeiten umfassen detaillierte flachseismische Aufnahmen in den Seegebieten Schwedens und der DDR sowie sedimentpetrographische, geochemische und mikropaläontologische Untersuchungen. Das bislang erzielte Datenmaterial liegt in Stockholm oder in Rostock.

Koll. Flodén und ich würden es begrüßen, wenn sich auch dänische Einrichtungen an diesen Arbeiten beteiligen.

Werter Herr Dr. Kuijpers, ich bin gern bereit, mit Ihnen über Details unserer Arbeiten in Rostock oder bei Ihnen zu diskutieren. Ich würde mich freuen, wenn es zwischen unseren Einrichtungen zu Arbeitskontakten oder zum Austausch von Informationen und Daten kommt. Bitte grüßen Sie Herrn Tychsen sehr herzlich.

Mit freundlichem Gruß

Prof. Dr. sc. D. Lange

Miljøministeriet
Skov- og Naturstyrelsen
J.nr. SN 866/99-22
Akt. nr. 1

Figure 1. Correspondence from 'IfM Warnemünde' at the start-up of Danish-East German (DDR) joint seabed investigations, February 1989

In the early 1990s the marine geology group of the 'Nature and Forest Agency' was transferred to the Geological Survey of Denmark (DGU) and later integrated in the Geological Survey of Denmark and Greenland (GEUS). Within the framework of the planned cooperation, the main input provided by the Danish existed in acoustic and shallow seismic equipment (e.g. boomer). A relatively small vessel, MV 'Marie Miljø' (Figure 2), operated by the Ministry of the Environment with help of a crew from the Danish Navy, was used for shallow-seismic data acquisition, but had, however, no facilities to collect longer sediment cores.

The 'IfM Warnemünde' had 2 research vessels (Figure 3), of which the larger one was the RV 'A. v. Humboldt' built in 1967 and owned by the institute since 1970. Later, between 1992 and 2004, the vessel was an important research platform of the 'Institut für Ostseeforschung' (IOW, see further below). The second vessel was the RV 'Professor Albrecht Penck' built in 1951 and used by the 'IfM Warnemünde' since 1960. The latter vessel could likewise stay and continue its function as a research vessel under flagship of the 'IOW' (until 2010). The RV 'Professor Albrecht Penck' had initially played an important role in the early history of the 'IfM Warnemünde' as it had been used during the first Atlantic research cruise (Gulf of Guinea) organized by the institute in 1964 (Matthäus, 2007). In the following period between 1970 and 1979 the larger, ocean-going RV 'A. v. Humboldt' had acted as a research platform during several expeditions in the North Atlantic and tropical Atlantic, followed in 1980 by an expedition in the Indian Ocean, and in 1989 by a research cruise in the Eastern central Atlantic. Both vessels, but more in particular the RV 'A. v. Humboldt', were well-equipped to take longer sediment cores, and with this facility they provided an excellent contribution to the planned joint sea-going work in the Baltic. In particular, the vibro-corer developed on behalf of the 'IfM Warnemünde' in the 1960s and 1970s could be used to collect up to 9 m long sediment cores (Matthäus, 2019).

Since 1960 the 'IfM Warnemünde' had become an integrated institute of the 'Akademie der Wissenschaften der DDR'. However, for political and financial reasons during the 'cold war' international cooperation had not been easy (Matthäus, 2023). For details and a historical overview of marine geological and coastal research in Warnemünde in the

earlier period (1950 and 1970) of the DDR can be referred to 'IOW' Marine Science Report No 111 (Matthäus, 2019a). As one of the first pioneers having started marine

⇑ Figure 2. MV 'Marie Miljø', Danish Ministry of the Environment, operated with a crew from the Danish Navy (wikipedia.org)

⇒ Figure 3. 'IfM Warnemünde' emblem of RV 'A. v. Humboldt' and RV 'Professor Albrecht Penck' (courtesy W. Matthäus)

geological research in Warnemünde had been Otto Kolp (1918-1990) (Matthäus, 2019b). In the early 1970s the DDR achieved international diplomatic status as a state, which led to better political conditions for international cooperation. In 1973 the 'IfM Warnemünde' could join the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Soon after, in 1975, the DDR became also a member of International Council for the Exploration of the Sea (ICES) and became a member of the Helsinki Commission (HELCOM). The latter organization, in which the 'IfM Warnemünde' has played an active role, had been established in order to help protecting the environment of the Baltic Sea and improve collaboration of the Baltic member states.

Joint sea-going activities in the years 1989-1991

At the planning meeting in Warnemünde, early spring 1989, two joint sea-going activities had been agreed on for that year, whereas joint planning involved a further activity in the first part of 1990. The first campaign should include an extension of the grid of shallow seismic profiles south of Denmark into DDR waters off Warnemünde, and was planned for September 1989. The second joint research cruise of that year would take place in early October and would include acoustic investigations and sediment coring in the Danish-DDR border zone in the central Baltic between the Danish island of Bornholm and Danish mainland. After having sent a Danish notification for asking permission to work in DDR territorial waters, it took not more than a few months, i.e. a normal time span, until the Danish Embassy in East Berlin had received a positive response from the DDR authorities. This included permission to carry out shallow seismic investigations in the designated DDR waters off Warnemünde in the period applied for, i.e. September 1989. This permission did not have many restrictions, on condition that an 'observer' from the 'IfM Warnemünde' must be on board the Danish vessel while sailing in East German waters. After having successfully completed its shallow seismic data acquisition in Danish waters, MV 'Marie Miljø' with its crew from the Danish Navy crossed the borderline, and was about to start work in DDR waters, as on the bridge of MV 'Marie Miljø' an urgent message was received: sender was NATO Headquarters in

Brussels. The message included the order to immediately leave DDR territory, as one had realized that a NATO navy crew had been entering territory of the Warsaw Pact. In this way this first planned research activity came to an end; a second attempt was more successful (see below). Meanwhile the other, second planned campaign west of Bornholm with RV 'Professor Albrecht Penck' (Figure 4) could be carried out as scheduled. During this cruise on October 7th the participants on board had the opportunity to experience the 40th Anniversary of DDR, among others by listening to a radio speech by Erich Honecker and some additional words by the master of the RV 'Professor Albrecht Penck'. At this historical occasion, a few national drinks in the form of 'Anker Gold' and 'Rostocker' beer were of course not absent.

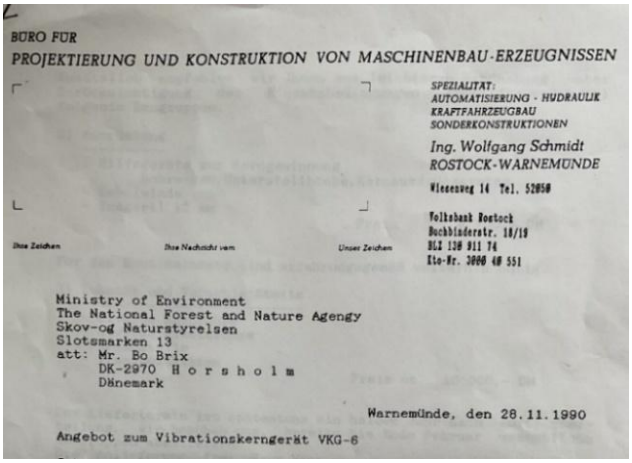
Figure 4. RV 'Professor Albrecht Penck' leaving Warnemünde harbor

Figure 5. Sediment retrieval from the VKG-6 vibro-corer on deck of the RV 'A.v. Humboldt'

For spring 1990 – meanwhile the Berlin Wall had fallen, November 9th 1989 – a major cruise activity had been planned which included, among others, the collection of 6 m long sediment vibro-cores with RV 'A. v. Humboldt' in Danish waters. As the DDR was still existing, the diplomatic procedure for handling the official notification was via the Danish Embassy in East Berlin. The cruise was scheduled for April to start in the week before the Easter Holidays, and should include also most of the following week. However, after having left harbor, until the Friday before Easter the RV 'A. v. Humboldt' had still no permission to enter Danish waters, and thus was forced to wait outside Danish waters. Repeated telephone and telegram contact attempts with the Danish Embassy in East Berlin remained unanswered, with the vessel still waiting over the Easter weekend. Finally, a (positive) response was received, and vibro-coring work (Figure 5) could start. After successful completion of the cruise, RV 'A. v. Humboldt' made a port call in Copenhagen (Figure 6) to deliver the many sediment cores taken during these days after Easter. At one of the coring sites an almost 5 m long core was retrieved, containing a few meters of glacial till overlying about half a meter of tertiary limestone, an astonishing and impressive sequence to retrieve with a vibro-corer. As a result, in Denmark it was decided to investigate the possibility of buying this highly effective sediment coring device which was realized shortly after (Figure 7).

Figure 6. Port call of RV 'A. v. Humboldt' in Copenhagen, April 1990

After the unsuccessful attempt in September 1989 to conduct shallow seismic investigations in DDR waters, a renewed notification was sent to East Berlin for asking DDR permission for another cruise with MV 'Marie Miljø', scheduled for June 1990. A positive response came soon, and planned shallow seismic profiling off Warnemünde with a representative from 'IfM Warnemünde' on board could finally be carried out. However, communication between DDR state institutions apparently did not well function anymore. Suddenly a DDR coast guard vessel appeared during the profiling work, starting to circle around MV 'Marie Miljø', and urgently asking what the Danish vessel was doing (Figure 8). Apparently, responsible regional authorities had never been informed by East Berlin. Fortunately, owing to intervention of the 'IfM representative' the profiling work could be completed without further problems (Figure 9).


BÜRO FÜR
PROJEKTIERUNG UND KONSTRUKTION VON MASCHINENBAU-ERZEUGNISSEN

SPEZIALITÄT:
AUTOMATISIERUNG - HYDRAULIK
KRAFTFAHRZEUGBAU
SONDERKONSTRUKTIONEN

Ing. Wolfgang Schmidt
ROSTOCK-WARNEMÜNDE

Volksbank Rostock

Ihre Zeichen Ihre Nachricht vom Unser Zeichen

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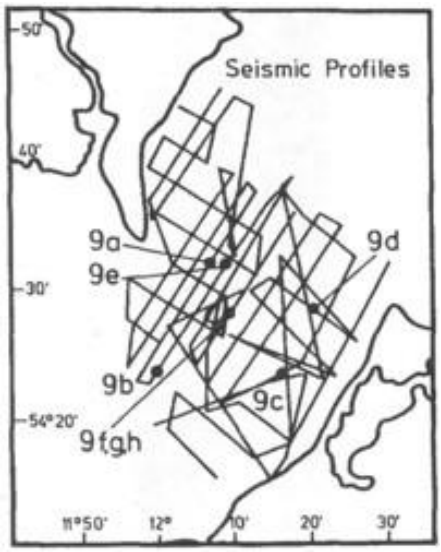
Warnemünde, den 28.11.1990

Angebot zum Vibrationskerngerät VKG-6

Figure 7. After having seen impressive coring results during the joint RV 'A.von Humboldt' cruise in April 1990, the Danish Ministry of Environment bought a VKG-6 vibro-corer in Warnemünde (for DM 125.400)

Figure 8. DDR coast guard vessel asking MV 'Marie Miljø' off Warnemünde what the Danish vessel was doing there, June 1990



In the following period until the end of 1991 further joint cruises with RV 'Professor Albrecht Penck' were made. A memorable experience during these cruises on board the DDR vessels was the wake-up procedure: at 05:15 h the cabin door was smashed open by the crew, and cabin light fully turned on with the words 'reise, reise' (get up), although work on deck with heavy gear of the vibro-corer normally did not start before 08:00 h. A compila-tion of results from all these joint cruises conduc-ted in the period 1989 to 1991 could be presented during the Second Marine Geological Conference 'The Baltic' held at the 'IfM Warnemünde' 21-26 October 1991. At the same time this conference represented the last major international scientific event arranged at the 'IfM Warnemünde' as a part of the 'Akademie der Wissenschaften der DDR' (Lemke *et al*. 1992).

Figure 9. Grid of shallow seismic tracks between Denmark and East Germany including profiling lines in DDR waters made during the cruise with M/V 'Marie Miljø', June 1990

New era with further cooperation

At a special and, for most of the attendants, a sad meeting held in the auditorium of the 'IfM Warnemünde' in December 1991 the official announcement was made that after December 31st 1991 'IfM Warnemünde' would not exist anymore, but that a new

institution would take over under the name of Institute for Baltic Sea Research (Institut für Ostseeforschung Warnemünde, IOW) which fortunately would employ most of the people having previously worked at the 'IfM Warnemünde'. Owing to a wise and clever strategy of the institute's director and management, both nationally and internationally, the status of a marine research institution thus was not lost, despite of some political attempts to stop institutional marine research in Warnemünde. For a detailed report of institute activities and developments during the final years of the 'IfM Warnemünde' and first years of the 'IOW' (1990-1994) see Fennel (2018). In the following decades Danish – (East) German marine geological cooperation in the Baltic continued, which after 1992 has resulted in a long series of peer-reviewed publications (e.g. Lemke *et al*. 1999, 2001). Later on, this close bi-lateral cooperation remained not restricted to the Baltic Sea only, but could occasionally be extended to marine geological research in tropical waters of the Atlantic (Yucatan Strait, US Virgin Islands Caribbean Sea) and to Arctic waters, where in 2002 during an expedition of RV 'A. v. Humboldt' marine geological investigations were carried out in West Greenland fjords around Nuuk, capital of Greenland.

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