Wrecks of Narvik

Dieter von Roeder

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Underwater photography
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Ship photography
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NSA collection
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Michael Symes

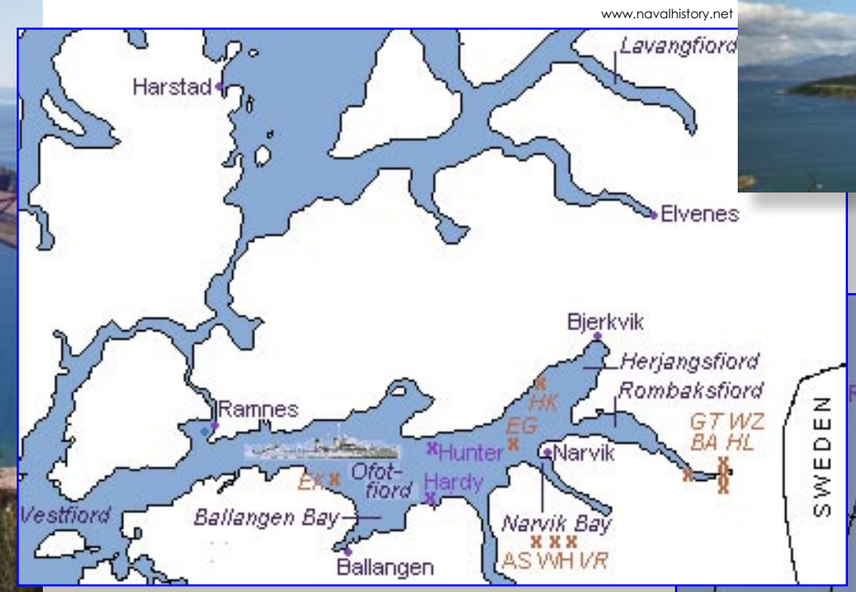
The port of Narvik in north Norway was established around the export of iron-ore from Sweden. This was due to the very good harbour and its ice-free conditions. At the outbreak of World War II, Narvik was a strategically important harbour, and during the first few days of the war a very intense battle was fought out here between German, Norwegian and British naval forces. During this fighting several ships were sunk, both warships and civil merchant ships. Narvik harbour was transformed into a great ship cemetery, with wrecks sticking up out of the water everywhere. Several of the ships were later salvaged, but many wrecks still remained. With its high density of wrecks, Narvik is an eldorado for wreck divers.

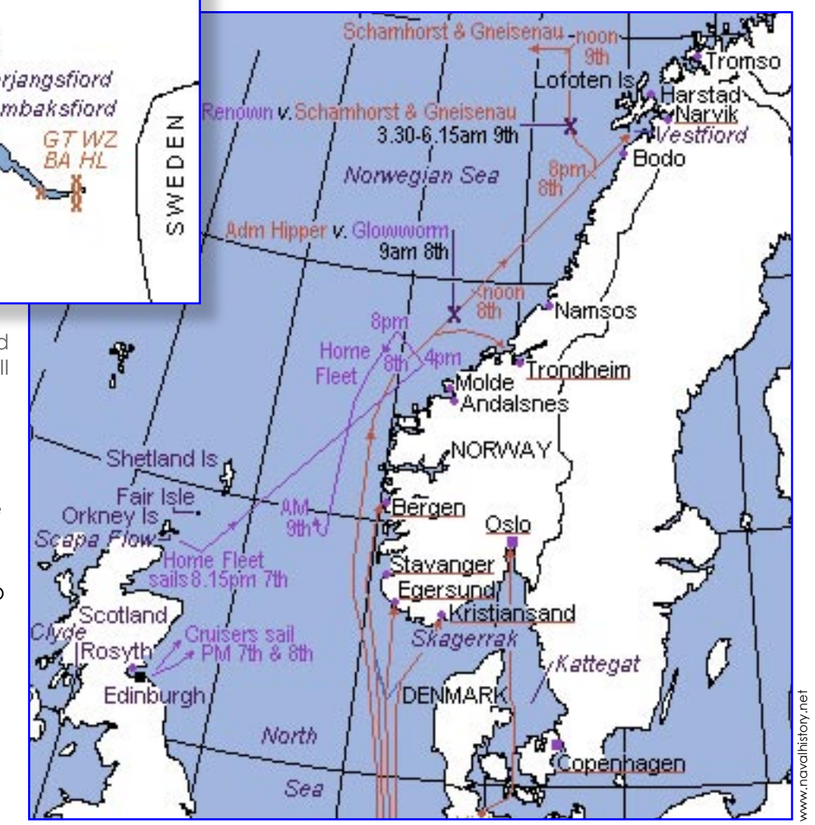
A diver explores the wreck of the German destroyer *Hermann Künne* in Trollvika

Narvik Wrecks

Narvik harbour

Narvik harbour





Maps outline battles in Narvik and around Norway during World War II

The importance of Narvik as a strategic harbour increased immediately at the outbreak of World War II. Germany needed large amounts of iron ore for their armaments industry, and had a big advantage, in that the ships carrying the ore could use neutral Norway and Sweden to get safely through, without the British navy being able to attack. The export from Narvik went ahead therefore, with ore ships from many countries. Due to the war between Finland and the Soviet Union, Norway had moved her largest warships to North Norway, and in April 1940 both the antiquated armoured warships were guarding Norway's neutrality in Narvik, in order to ensure that the traffic with the ore carrying ships was not disrupted by the warring nations.

Attack on April 9th

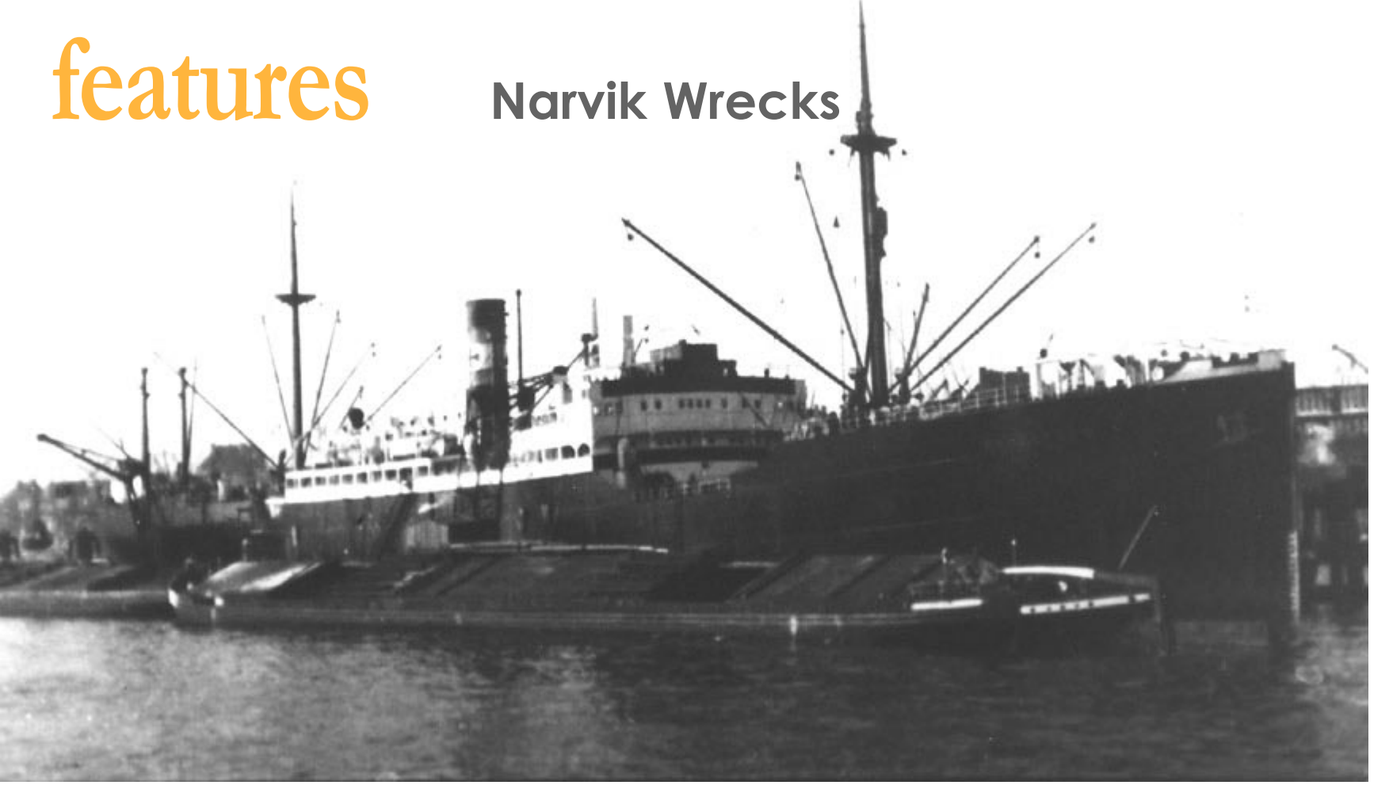
The German attack was a great surprise for Norway, and the forces in Narvik were quite unprepared for the attack. In the morning mist, the armoured warship *Eidsvold*, which was anchored outside Framnesodden, discovered that foreign naval vessels were on their way in to Narvik's harbour. Even with its forty years, the armament of the *Eidsvold* was a big threat to the much smaller German destroyer, *Wilhelm Heidkamp*, which stopped a few ship's lengths away. It must have seemed very strange for the commander of the *Eidsvold* to be requested to surrender to a German destroyer a long way in a Norwegian fjord. As the *Eidsvold* prepared to open fire the *Wilhelm Heidkamp* fired torpedoes, which sank the *Eidsvold* in just a few seconds. The German ships could thereafter sail into the harbour basin, partly hidden in a strong blizzard. On board the armour-plated *Norge*, it was clear that something was terribly wrong, and slipped its moorings. When the foreign warships were discovered in the harbour, the *Norge* immediately opened fire against them. Again, it went terribly wrong for the pride of the Norwegian navy. *Norge* was struck by a torpedo fired from the German destroyer *Anton Schmitt*, and capsized and sank in just two minutes. Out in the harbour basin, all was total chaos. The merchant ships launched lifeboats into the water, and thereby rescued a number of survivors from the *Eidsvold* and *Norge*. The captain of the German ore-boat *Bockenheim* thought that it was British forces that were attacking, as three torpedoes hit the ship. He therefore ordered the ship to be beached and blown up.

In the space of just a short time Narvik harbour was under German control. All the merchant ships that were not German were immediately put under German control, and the guns on the British cargo boats were demounted to be used as land-based artillery.

The British hit back

Even though the attack was surprising for Norway, the Royal Navy were already out in the Atlantic in a hunt for the German warships that were sail-

Narvik Wrecks



Neuenfels

ing north. Thus, the retreat of the 10 German destroyers in Narvik could be cut off. As the weather conditions were good for a surprise attack, the British second destroyer group was ordered into Ofotfjord in order to attack the German forces there, and to create the greatest possible damage to both the warships and the merchant ships there.

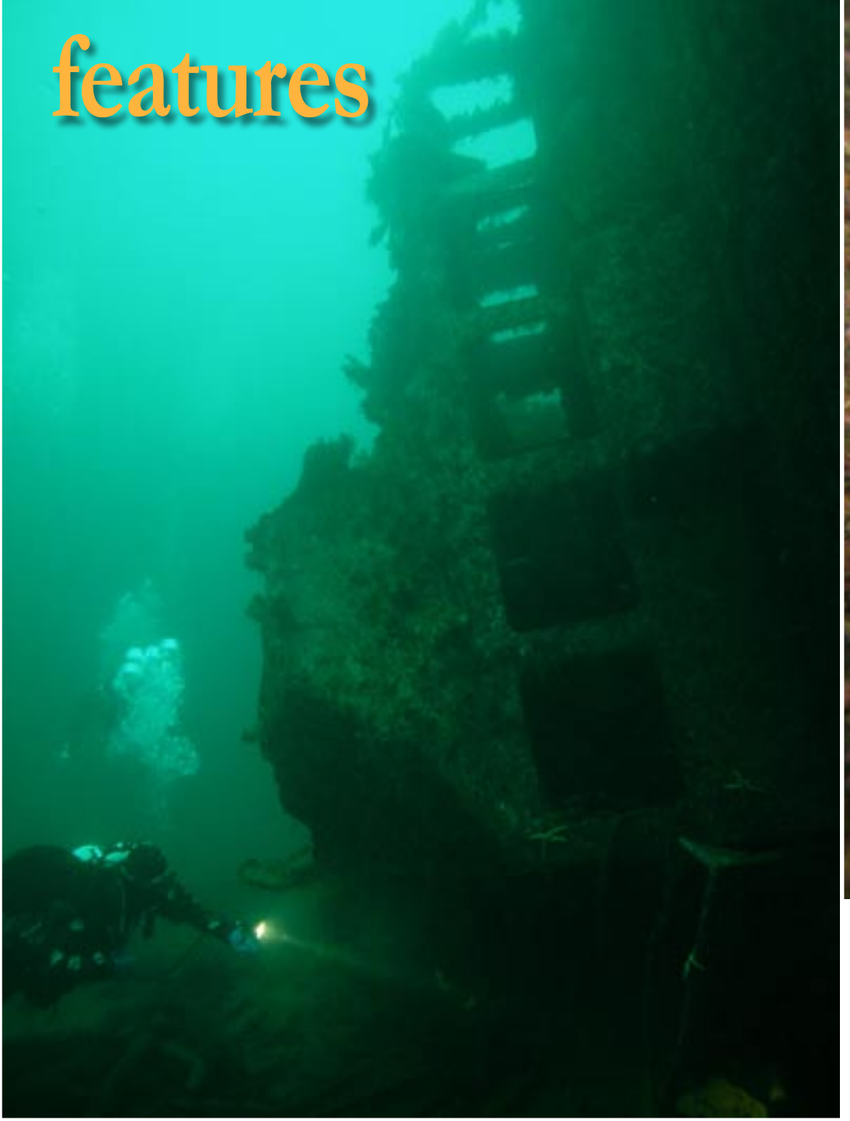
The attack was a total surprise, as the German destroyers at the mouth of the fjord had not observed the British attackers. The British could therefore fire their torpedoes straight into the harbour basin without meeting any serious resistance. The results were overwhelming. Two German destroyers and several cargo boats were sunk after being hit by torpedoes. In addition, many ships were damaged, and the German naval leadership in Narvik was nearly totally wiped out when the *Wilhelm Heidkamp* was hit by a torpedo. The retreat of the British ships was, however, not quite so easy, as the German destroyers guarding the fjord threw themselves into the fray. The British destroyers *HMS Hardy* and *HMS Hunter* were thus sunk in Ofotfjord. The remaining British forces also discovered the German supply ship *Rauenfels*, which was beached and blown up. Essential supplies of ammunition, weapons and provisions were thereby lost for the Germans.

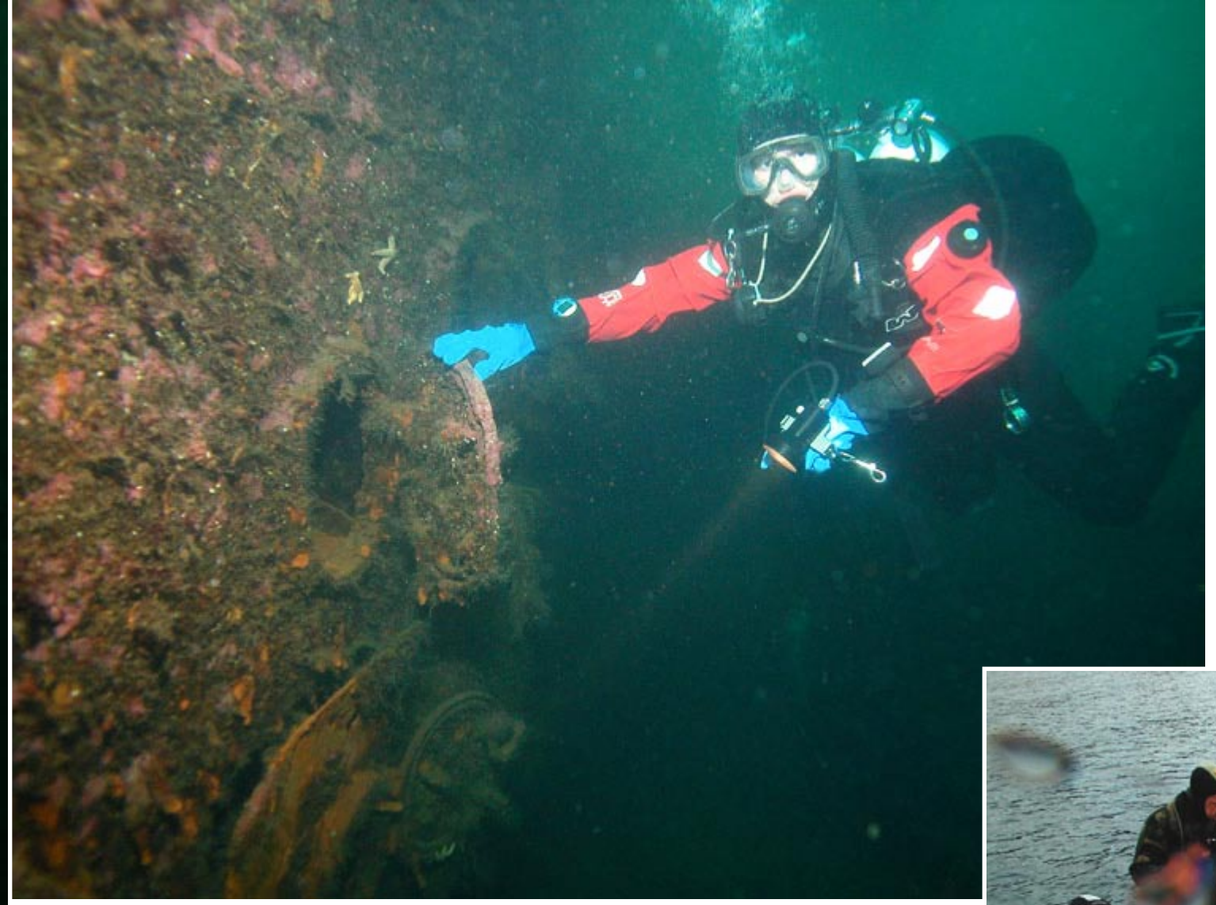
After this there were some quieter days. Planes from British aircraft carriers attacked the harbour, but caused only limited damage.

On April 13th, the great battle of Narvik harbour took place. Under command of the British battleship *HMS Warspite*, a large British force sailed into Ofotfjord to annihilate the German destroyers. German submarines attempted to attack but the torpedoes didn't work! Thus, all the remaining German destroyers could be destroyed. This time the British losses were small. Only the destroyer *HMS Eskimo* had its bows destroyed by a German torpedo. Most of the German destroyers were beached, emptied of ammunition and blown up. The merchant ships were not spared.

When the British forces pulled out, all the merchant ships were either sunk or destroyed. Narvik harbour was transformed into an enormous ships' cemetery with wrecks sticking up out of the water everywhere.

View of the great damages in Narvik Harbour after it was attacked on April 9, 1940, World War II





◄ A diver explores the bridge of the wreck of the German destroyer *Anton Schmitt*

▲ Close up of a porthole on the destroyer *Anton Schmitt*

► Captain Terje Seiness with divers on the way to the wrecks of the German destroyers

Other shipwrecks

Narvik was a quiet place for the rest of the war. The most dramatic event that otherwise occurred was when the German ore-boat *Odin* sailed into the German anti-mine boom at the entrance to the harbour, and immediately sank. Apart from this, it was only minor ships sinking due to collisions, overloading, etc.

There are several wrecks of aircraft to be found in the area around Narvik, both in the sea, in fresh water, and in the mountains. During the fighting in 1940, German bombers also sank several allied ships in this area. The most well known of these is the Norwegian fast-route ship *Dronning Maud* in Gratangen.

Clearing up

The big work of salvaging the sunken ships in Narvik was started already in the Spring of 1940. Norwegian and German salvage boats worked at top speed, and in just a short time most of the wrecks which were blocking the quays were lifted and sent overseas for repair. In addition, the wrecks out in the harbour basin were blown up so that the ore-boats could pass over them. After the war, the salvaging work continued on the remaining ships. From 1949 until 1956 most of the cargo boats were lifted and broken up for scrap. Only the most damaged and heavily loaded were allowed to remain, and today they make a fine and exciting diving site for wreck divers. In 1964, three German destroyers were lifted from the harbour basin and moved out to Framnesodden, where they are out of the way of shipping traffic. Thus the totally destroyed armoured vessel *Eidsvold* lies in the company of its slayers.

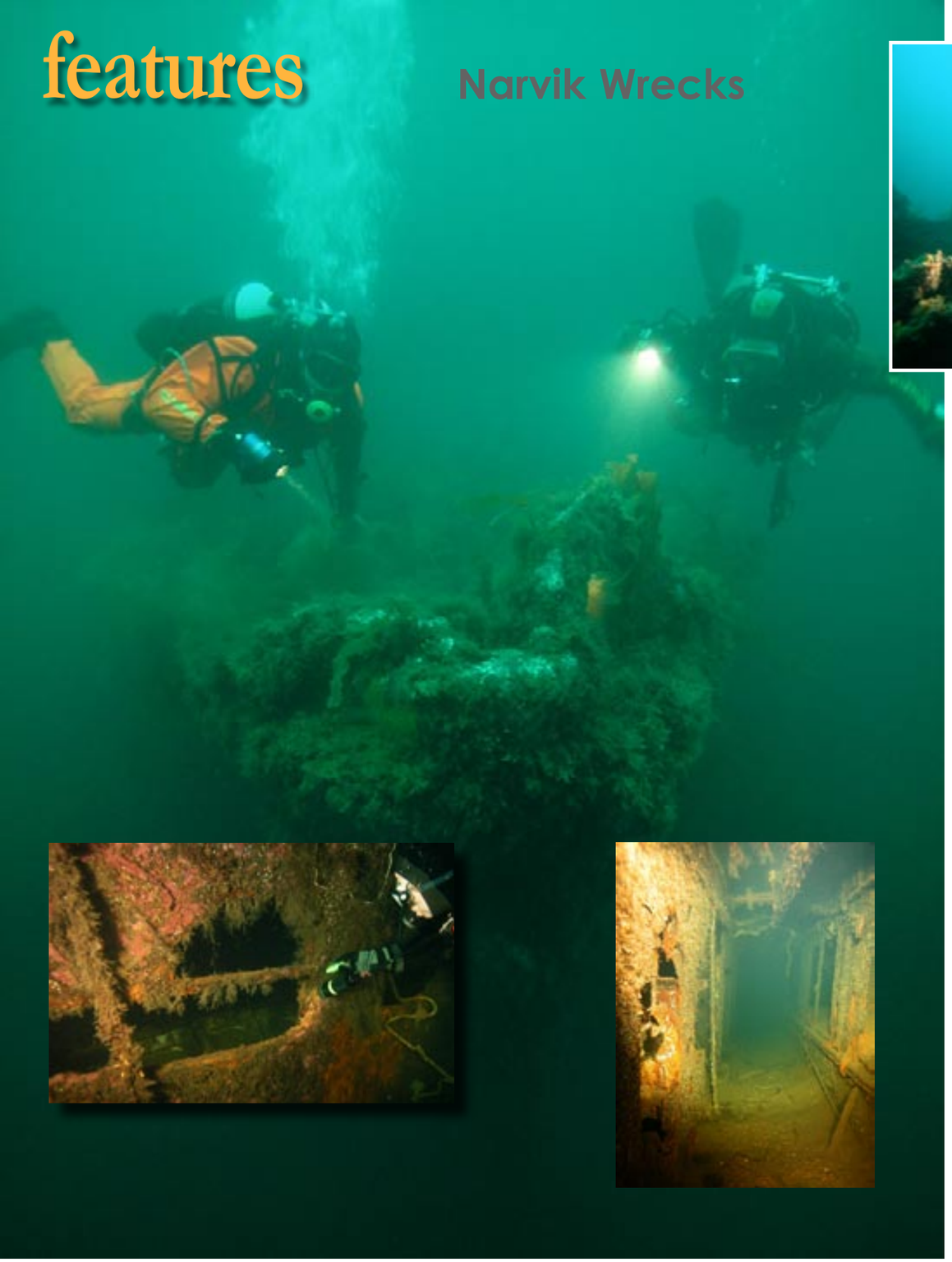
Diving to the wrecks

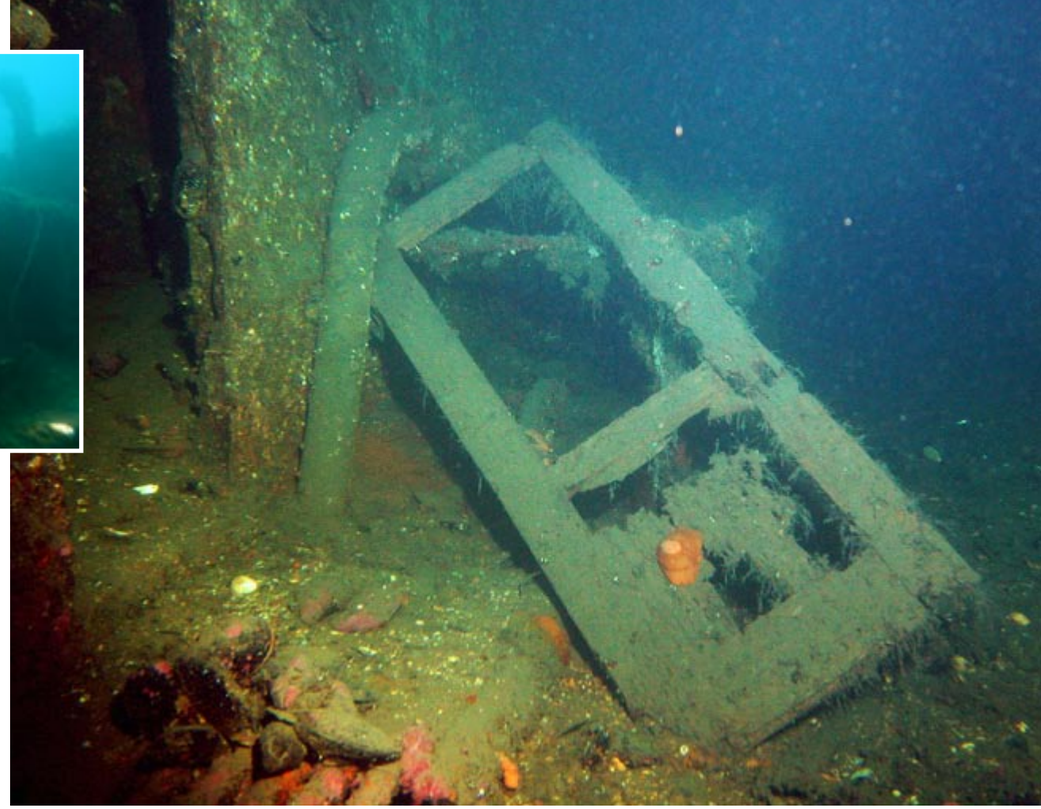
All diving in Narvik is controlled by the Harbour Authorities. Anyone wishing to dive must register with the Narvik Harbour board, and sign a declaration regarding diving to the wrecks. These rules and regulations, and self-declaration can be found on the internet at **www.narvik.kommune.no/havnetj/dykking.html**

When one has registered, a dive permit can be obtained for NOK 50.00 per week. The dive permit is valid for the wrecks: *Martha Hendrik Fisser, Strråssa, Romanby, Neuenfels, Anton Schmitt, Wilhelm Heidkamp, and Diether von Roeder.*

It is totally forbidden to dive down to some of the other wrecks that lie in the Narvik area. This is because they have either not been cleared of ammunition, or that they are preserved as a historic site. Among others, it is forbid-

Narvik Wrecks





◄ Divers explore the wreck of the German destroyer *Wilhelm Heidkamp*. INSET LEFT: Gunnery holes. INSET RIGHT: Corridor of the wreck
▲ A diver gets up close and personal with artifacts still visible on the wreck of the German destroyer *Wilhelm Heidkamp*
►A door blown from the wreck of the British cargo boat *Romanby*

den to dive down to *Eidsvold, Norge, Odin, Erich Giese* and all the German destroyers in Rombaks fjord.

Three German destroyers in one dive!

Imagine diving down to three German destroyers from World War II in one single dive! It is possible in Narvik. The destroyers *Anton Schmitt, Diether von Roeder* and *Wilhelm Heidkamp* lying outside Framnesodden, were opened for diving a few years ago. The destroyers make a fine and well preserved diving site, with a dive depth of 12 - 24 meters. The wrecks lie close together, so that if you are a practiced diver with lots of air, you can visit all these three wrecks in the same dive without the need for decompression.

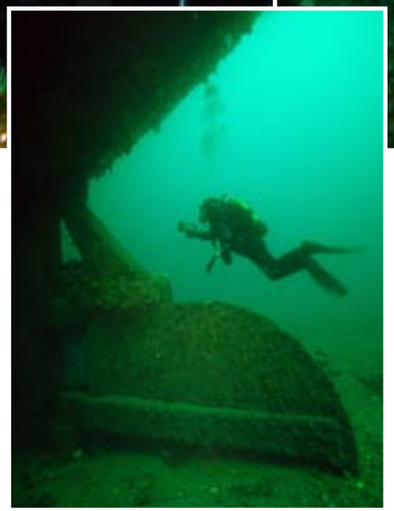
Normally, there is a small plastic buoy attached to the *Wilhelm Heidkamp* to which the dive boat can be moored. Following the down-line, one arrives at the roof of the control room of the *Wilhelm Heidkamp*, which is the middle one of the three destroyers. The vessel lies on its keel, with its stern blown off. It is recommended that one swims straight out from the starboard of the *Wilhelm Heidkamp*, to arrive at the *Anton Schmitt*, some 7 meters away.

Anton Schmitt lies leaning on its starboard side. Up at the highest part (the port side) it is about 15 meters deep, and it is 24 meters at the deepest. Most of the ship's stern has been blown away, but the wreck is otherwise fairly intact. Among other things, there is the wheelhouse with its many details. A good route, is to swim forwards to the bows and continue down towards the keel, thereafter swinging slightly towards the starboard where one will meet the bows of the *Wilhelm Heidkamp*. The bows of the destroyer stand up from the sea bottom, and it is a fine sight, to be remembered. This vessel could do 35 knots at its fastest. On the portside af the wheelhouse below the first deck, there is a hole straight into the crew's laundry. Otherwise, there is a lot of detail that should be studied.

To get over to the *Diether von Roeder* you should swim straight out from the the port side of the *Wilhelm Heidkamp*, that is, in the opposite direction from the *Anton Schmitt*. It is about a 30 meter swim. Of the *Diether von Roeder*, just about only the mid-section remains. The stern and the bows were blown away, and much of the remaining ship shows the ravages of time. But there are still a number of details that are worth taking back with you. Outside Framnesodden, it is also not as muddy as it is in the harbour basin.

Wrecks of merchantships in the harbour

The wreck of the British cargo boat



◄ Diver reveals the reserve propeller blades of the German cargo ship *Neuenfels*

▲ Colorful corals decorate the walls of the ship wreck *Neuenfels*

► Jarles checks out the propeller blade of the *Neuenfels*

◄ INSET: Jarles with the rudder of the *Neuenfels*

Narvik Wrecks

Romanby lies in the harbour basin. The boat was being loaded on 9th April and sank after being hit by a torpedo on 10th april. Of the wrecks in the harbour, the *Romanby* is probably the best to dive down to. The wreck is fairly complete, and it is easy to swim through the corridors and down into the engine room, which lies completely open. It is recommended, though, that inexperienced divers should not swim down into the engine room.

Behind the rear cargo compartment, you can see, among other things, a folded stock anchor. Swimming further back towards the stern, and letting oneself glide out from the railing, you will see the fine rudder of the wreck together with the propeller axle that is sticking out. Being 130 meters in length, the *Romanby* is a big wreck to explore. Beautiful growths of sea anemones and sea carnations can be seen many places on the wreck. The depth along the deck is about 12 meters, and the maximum depth to the bottom outside the wreck is 28 meters. *Romanby* lies on its keel on a flat bottom. There are normally buoys on the wreck.

Neuenfels

Further in, lies the German cargo ship *Neuenfels*. This is the biggest wreck remaining in the harbour, and it is an imposing sight, with its 143 meters length and 18 meters breadth. Here, too, there is a maximum depth of 28 meters to the flat sea bed outside the wreck. Along the deck the depth is about 12 meters, which gives a long bottom-time and thereby good time to explore.

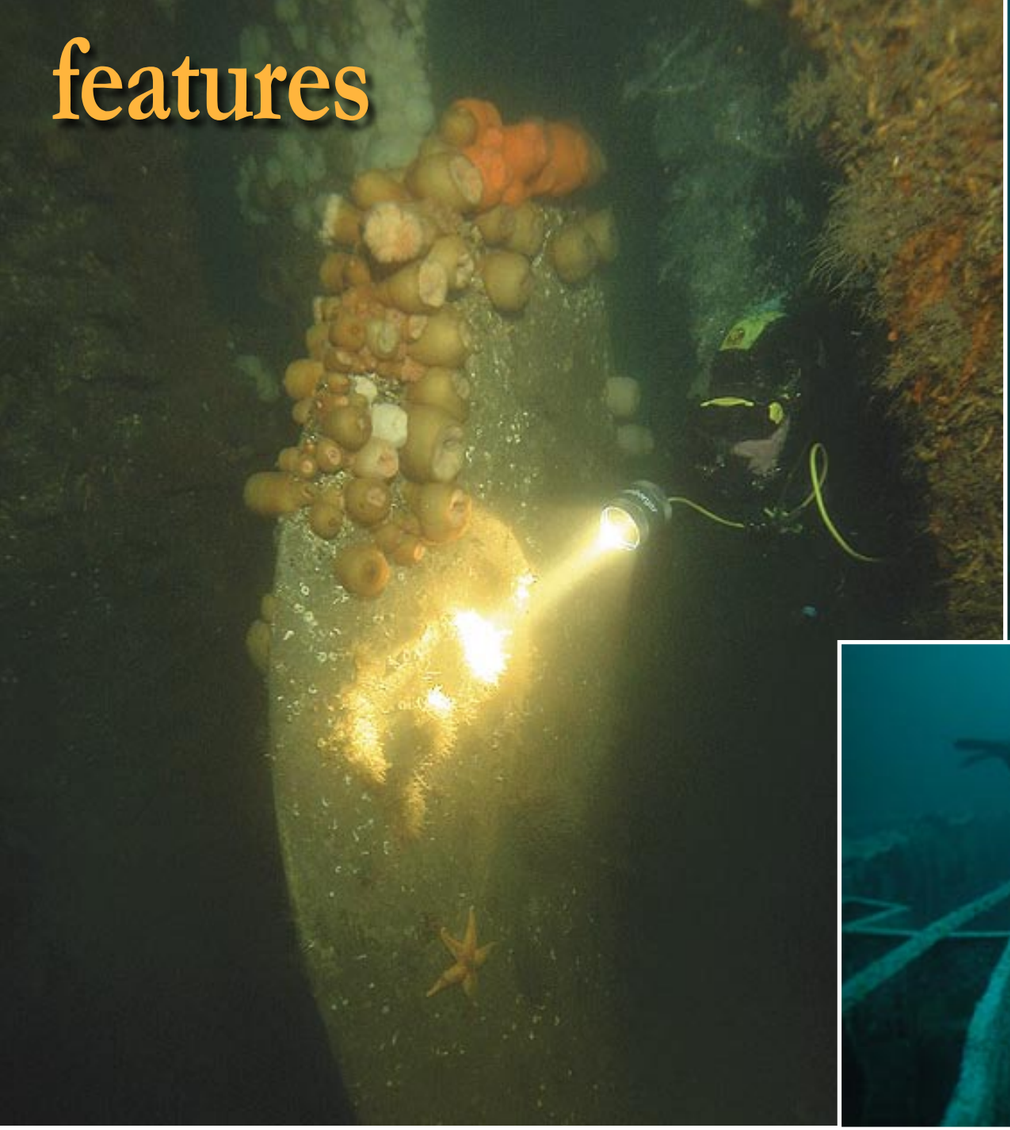
After being sunk, the *Neuenfels* lay with its masts and some superstructure above the surface, although they later had to be blown up in order not to be a danger for the shipping traffic. The remains of the blown up superstructure lies on the bottom beside the wreck.

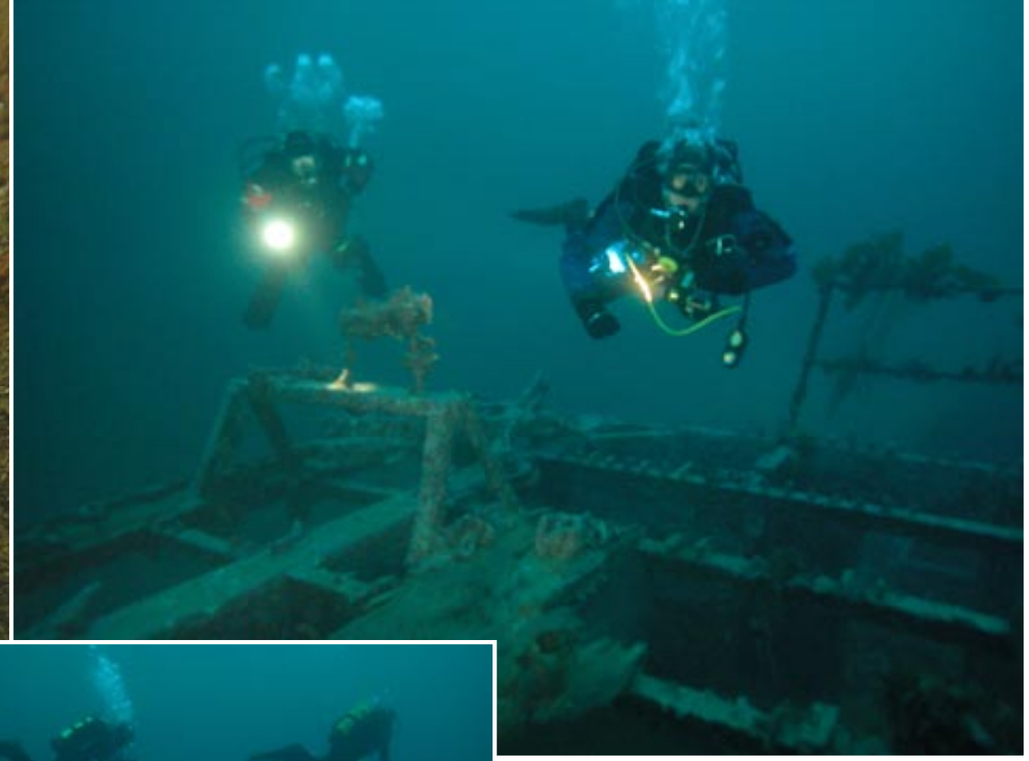
If you swim through the first cargo compartment from the stern you can see one of the reserve propeller blades. Down at the bottom, under the stern, both propellers can be seen sticking up from the seabed, and also the rudder which is half sunk into the mud. Looking out from here, one can really get an idea of the imposing size of the wreck. The hole in the hull after the torpedo hit 10th April is also an imposing sight. Normally, there are buoys on this wreck too.

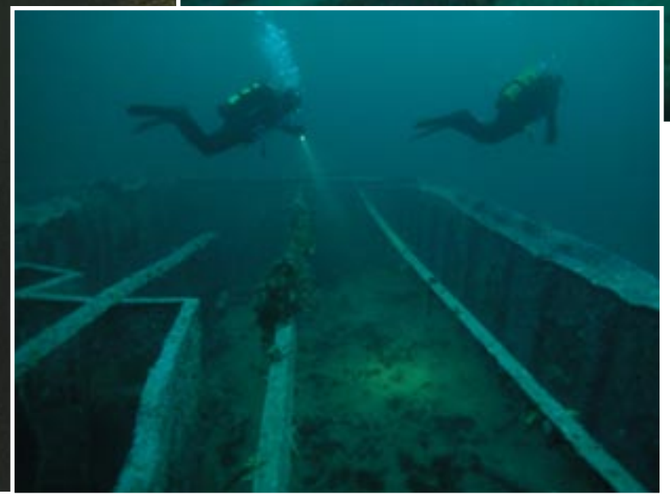
About 4-5 years ago the whole deck was covered with 30-50 cm of mud. All the mud has now gone after Narvik Urban Council extended the industrial area, which caused a greater flow between high-water and low-water. This should be taken into consideration when planning dives to the wrecks in the harbour. The surface current can often be extremely strong.

Stråssa and *Martha Hendrik Fisser*

Further out in the harbour basin lie the wrecks of the Swedish cargo boat *Stråssa* and the German cargo boat *Martha Hendrik Fisser*. There is only about 30 meters between the two wrecks, so it is quite possible to visit them both in a single dive as long as one just wants a general overview. If you just want to dive







CLOCKWISE FROM TOP:
▲ A diver checks out the rudder of the German cargo boat *Martha Hendrik Fisser*
► Divers explore the wreck of the Swedish cargo boat *Strråssa*
▼ *Strråssa* in its glory days
◄ The *Strråssa* is a wreck with lots of details to discover

down to the *Martha Hendrik Fisser*, one usually does so via a descent/ascent from the *Strråssa*. One can then follow a rope that is stretched between the two wrecks. Both vessels have been affected by work with explosives, but the hulls and parts of the superstructures remain.

Strråssa was kept partly afloat after the attack, but was finally blown up by the Germans in May. Today, the *Strråssa* is a fine wreck with lots of detail. The wreck lies upright on its keel on the flat seabed. The depth is about 28 meters to the bottom outside the wreck and 15 meters along the deck. Parts of the wheelhouse are still relatively intact, and one can look down into an open engine room with the ship's big motor in place. There is also a workshop here with, among other things, a lathe and other machines. Unfortunately, due to the stagnant water, the visibility is generally not very good here. The wreck is well decorated with colonies of dead man's fingers, and there is a rich animal life.

The rope between *Strråssa* and *Martha Hendrik Fisser* stretches between the sterns of both ships. On *Strråssa* this rope is fastened beneath the railing at the front edge of the stern on the portside. On *Martha Hendrik Fisser*'s stern the rope is fastened to the starboard side.

Over on *Martha*...

Martha Hendrik Fisser was the victim of a British torpedo 10th April. This wreck, too, lies upright on its keel on the 28 m deep, flat bottom. The depth along the deck of this wreck is 10-12 meters. If you get to this wreck using the rope from the *Strråssa*, you will arrive at the stern of the *Martha Hendrik Fisser*, where, among the first things you will see, is a curved staircase down to the rooms that were in the stern. In front of the stern lies the rear cargo compartment, where one can see a 4-bladed reserve propeller.

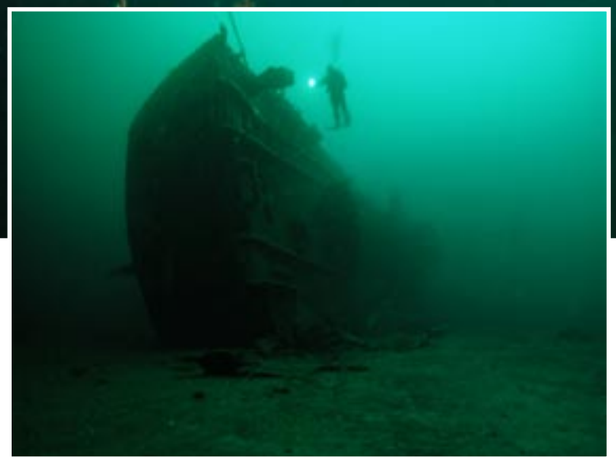
One can easily swim down into the after cargo compartment, towards the remains of the superstructure of the midship section, where the engine room, among other things, is to be found. The engine room of this wreck is not open from above, but it is relatively easy to swim through. Look out for possible divers behind you, as it can easily become cloudy. Penetration here should not be carried out by inexperienced divers. The wreck is otherwise easy for everyone to get around on. Remember to turn back in good time if you started your dive from the *Strråssa*, and must get back to the down-line on this wreck. If the visibility is not so good you should give yourself good time for the return.

With depths down to some 28 meters (at the seabed), the most sensible is to use at least two dives to expore these two wrecks, as there are so many different things to see. If you keep to the deck, an overview of both wrecks can be obtained in a single dive.

Common to all wrecks in the harbour basin, is that the parts that have been blown away lie on the bottom just beside the wrecks. With a little planning, one can therefore also visit masts and superstructures, but visibility can be bad.

Hermann Künne in Trollvika

With regard to the German destroyer *Hermann Künne*, which lies in Trollvika in Herjangs fjord, the wreck can be reached both by car and by boat. Either way, it takes about 30-40 minutes to travel the 30 km from the centre of Narvik. If you intend to go by car, it is important first to contact some of the local divers from Narvik Sports Divers Club or Bjerkvik Divers Club. In order to be able to get down to the water where the *Hermann Künne* lies, you have to pass the boom which closes off the the final stretch of the old national road to Harstad. The wreck of the *Herman Künne* starts at the low-water line and goes down to 40 meters depth. It is a fine subject for photography, and a wreck which is suitable



Divers explore the wreck of the German destroyer *Hermann Künne*, which lies in Trollvika in Herjangs fjord

for divers at all levels of experience. Many details from the ship are to be found everywhere. The propeller has disappeared but the gigantic rudder is still there, sticking majestically out to the side. Many fish live in and around the wreck. Those who just want a relaxing time can study the many different things that they had on board. It is still forbidden to remove anything that lies in and around the wreck.

Plane wrecks too...

Not only is Narvik *favoured* with the wrecks of many ships, but there are also plane wrecks. In Rombaks fjord some kilometers north-east of Narvik, lies a German *Dornier 26* seaplane, also from the wartime. Relatively intact (one can actually see that it is a plane ...), it lies at a depth of 22 meters. The fuselage stands upright but the wings broke off when it sank and are now lying over the fuselage.

Another German plane from World War II is a *Junker 52*, which lies east in Hartvikvannet about 3 miles from Narvik. The plane is quite intact at a depth of 2 to 9 meters, and there is easy access to the plane in the summer. It is a good photographic subject.

Diving in Narvik?

As previously stated, a dive permit must be obtained from the Harbour Authorities (telephone 76- 95-03-75) in order to be able to dive in Narvik. Information, regulations og conditions for diving in Narvik, together with a self declaration for a dive permit can be found on the Narvik Harbour board's website: **www.narvik.kommune.no/havnetj/dykking.html**

• Narvik Dyk & Äventyr (Narvik Dive and Adventure) are currently the only tour operators who have a complete presentation with dive boats (live-aboard), overnighting and diving. The firm runs week tours from weeks 13 to 45. See website: **www.narvikdykaventyr.nu**

• Narvik Dykkerklubb (Narvik Diving Club) can assist with tips about diving and overnighting, and also boat trips. Contact Frank Bang on telephone 957-56-450. See also Bang's website: **http://home.online.no/~f-bang/**

• Tore Lie and Torje Løvgren provide boat trips with a 23 ft RIB. Contact telephone 911-94-960 (Torje)

• Kristoffersen Dykk (Kristoffersen Dive and leasing) fill air, give service and sell equipment. Contact telephone 907-211-05 ■

Technical data for the most relevant wrecks in Narvik:

***Wilhelm Heidkamp* – Z-21** Built: 1939
Shipyard: Deschimag, Bremen #923
Owner: German Navy
Weight: 2411 tons displacement
Dimensions: 125.1 x 11.8 meters
GPS: 68°26.086"N 017°22.643'E

***Anton Schmitt* – Z-22** Built: 1939
Shipyard: Deschimag, Bremen #924
Owner: German Navy
Weight: 2411 tons displacement
Dimensions:125.1 x 11.8 meters
GPS: 68°26.058"N 017°22.588'E

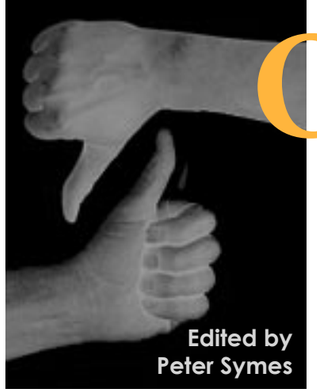
***Diether von Roeder* – Z-17** Built: 1938
Shipyard: Deschimag, Bremen #919
Owner: German Navy
Weight: 2411 tons displacement
Dimensjon:125.1 x 11.8 meters
GPS: 68°26.083"N 017°22.682'E

Romanby Built: 1927
Shipyard: W. Gray & Co, West Hartlepool #987
Owner: Ropner Shipping Co, West Hartlepool
Weight: 4887 tons
Dimensions:127.9 x 18.0 meters
GPS: 68°25.533"N 017°22.629'E

Neuenfels Built:1925
Shipyard: AG Weser, Bremen #397
Owner: DDG Hansa, Bremen
Weight: 8096 tons
Dimensions:143.2 x 18.6 meters
GPS: 68°25.230"N 017°23.601'E

Strässa Built: 1921
Shipyard: AB Götaverken, Göteborg #356
Owner: Trafik AB-Grängesberg-Oxelösund, Stockholm
Weight: 5602 tons
Dimensions:120.1 x 16.3 meters
GPS: 68°25.142N 017°24.032'E

Martha Hendrikk Fisser Built: 1911
Shipyard: Ropner & Sons, Stockton #456
Owner: Hendrik Fisser AG, Emden
Weight: 4879 tons
Dimensions:118.2 x 15.9 meters
GPS: 68°25.207"N 017°24.220'E



Letters & Opinions

All perspectives expressed in this section are those of the individual author and do not necessarily reflect the views of X-RAY MAG or its associates

Edited by Peter Symes

Open Letter to Disney

Attention: Mr. Michael Eisner
Chief Executive Officer, Disney World

Dear Mr Eisner,

Since Sylvia Hui's editorial in The STANDARD on 18 May 2005 - "Disneyland weddings for the young and wealthy..The menus feature traditional Chinese banquet delicacies such as roast suckling pig, shark's fin soup and sliced abalone", you would have received hundreds of pleas at a global level to remove the gruesome item from the menu.

We are disappointed at the response or lack there of to the issue; it is apparent that shortsightedness or plain ignorance from your banquet and PR staff. By promoting and offering shark fins soup, DISNEYLAND is seen as supporting the culling of sharks, eventually causing their extinction in the world's oceans.

Imagine shark fins to be the hand and legs of Mickey Mouse; chop them off and throw the lame struggling body of Mickey on the side walk to die a slow painful death! That is how sharks are harvested from the world's oceans.

SAVE OUR SHARKS CAMPAIGN 2003

Please consider the following:

1. In the minute it takes you to read this letter almost 200 sharks will have their fins removed while still alive and thrown back into the sea to die. Shark experts estimate that 100 million sharks are slaughtered each year for their fins.
2. Shark fin is tasteless and has no nutritional value - they are cartilage, just like your fingernails and hair.
3. It is Cruel to consume shark fin. It is akin to chopping legs off a cow and throwing them back into the field and allowing them to bleed to death.
4. Because of the demand from Asia, fishermen from Galapagos are now pushing for wholesale revisions to the fishing statute by demanding a year-round fishing calendar, use of long-line fishing, a lifting of the prohibition on shark fishing. In this respect, the Asian culture is threatening to destroy one of the most unique and fragile eco-systems remaining on this planet.
5. Sharks reproduce very slowly and we are killing them faster than they can replace themselves. Sharks have slow growth rates and do not reach sexual maturity for years. It takes a whaleshark 25 years to reproduce. For Hammerheads and Tiger sharks it takes 15 years. Once sexually mature, sharks have long gestation periods with the embryo developing in the mother for up to two years.
6. Sharks are vanishing from our world's oceans very quickly. The demand for shark fin soup in Singapore, Malaysia, Hong Kong and China is primarily responsible for the peril of sharks globally — some 100 million animals are killed every year just for their fins.

> *Instead of supporting conservation, DISNEYLAND HONG KONG is now contributing to the extinction of sharks, promoting cruelty and wastefulness to children and young adults*

To conserve sharks and the preserve the species, we must address the issue at the heart of the problem. We must reduce the demand for shark fins in Asia. Since 2001, Ocean N ENvironment and Asian Geographic have launched the 'Say No to Shark Fins" campaign on an annual basis targeting young couples and children.

Instead of supporting conservation, DISNEYLAND HONG KONG is now contributing to the extinction of sharks, promoting cruelty and wastefulness to children and young adults. Since many shark species are protected, DISNEY is therefore seen as encouraging the sale and consumption of endangered species. In this aspect, DISNEY is promoting to children and young people a message that cruelty and exploitation of animals is acceptable.

THIS IS UNACCEPTABLE

We respectfully suggest the following actions: Admit the shortsightedness of current policy, and instead, support the conservation of sharks by removing shark fins soup from wedding banquets and replace it with other more sustainable delicacies.

Since 2002, Ocean N Environment and Asian Geographic have produced a card/letter package " WHY WE ARE NOT SERVING SHARK FIN SOUP TONIGHT" for couples to distribute at their wedding dinner. Perhaps you may wish to consider this as an option. By doing this, DISNEYLAND and prospective wedding couples will be seen as intelligent, eco-savvy, and most importantly, contributing to the preservation of our ocean environment.

I trust that you will respond expediently. Imagine the next edition of Asian Geographic with Mickey Mouse struggling in agony without his arms and legs on the cover. Get the picture?

PHOTO COURTESY OF BIMINI BIOLOGICAL FIELD STATION

This guy is cutting the fin off a great hammerhead shark. Most shark finners dump the carcasses or live sharks back into the sea to die a horrible slow death of suffication. A surfboard-sized fin from a basking shark can get USD 5,000 on the market. Studies show that, since 1986, Hammerhead populations in the North Atlantic have decreased by 89%.

Submitted by:
Michael AW, Chairman
Ocean N Environment Australia
Publisher of Asian Geographic, Scuba Diver Australasia and Underwater Channel
www.asiangeographic.org
www.scubadiveraustralasia.com

Hydrothermal Vents

Ephemeral Underwater Oases of the Ocean Depths

Text by Michael Symes
Photos by Peter Batson (**www.exploretheabyss.com**)

PETER BATSON

Tevnia plume

Hydrothermal vents are places in the Earth's crust where very hot water arises from vents in the cold, deep-sea floor. This hot, mineral-laden water is a rich environment for the development of an exotic marine life, previously unknown before the discovery of hydrothermal vents. This marine life uses a quite different chemistry from other animal life, be it marine life in the upper sea levels, or terrestrial life. Thus, hydrothermal vents are not only very interesting geologically speaking, but even more so from the biological point of view.

Their discovery

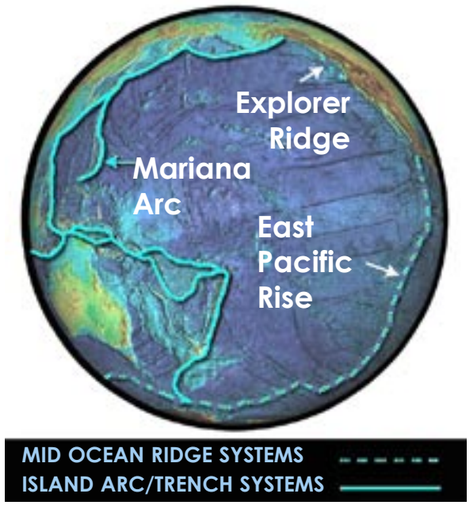
Prior to the 1970s, hydrothermal vents were an unknown phenomenon, but certain observations had led marine geologists to hypothesize that vents existed. Rocks had previously been recovered from the sea floor containing minerals known to form when volcanic rocks react with seawater. Such rocks are to be seen on Iceland and other volcanic islands today. And sediments with unusually high amounts of iron, manganese, and other metals are found near mid-ocean ridges. There are also large chunks of ocean crust, kilometers thick, known as *ophiolites*, that have been lifted up onto land by tectonic forces. These ophiolites show evidence of hot seawater circulation through fissures in the rocks in the distant past.

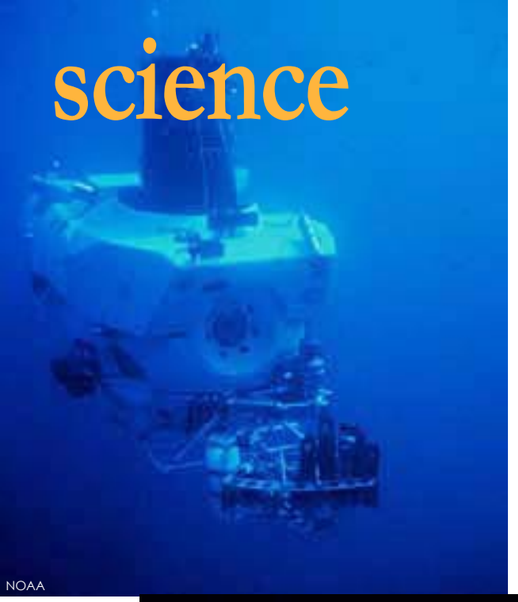
Furthermore, heat flow anomalies indicated that the crust near a mid-ocean ridge crest was cooler than expected. It was infered that the crust was cooled by circulation of seawater through cracks and fissures in the rock. There were also deep-tow temperature anomalies. An instrument package towed at about 2500 meters depth near the East Pacific Rise, a geologically active zone betwen the Pacific tectonic plate and the Nazca plate, measured an average temperature of ca 2°C, but detected warmer water temperature peaks of 0.1°C to 0.2°C.

This then led geologists, in 1977, to organize an expedition to an area of the East Pacific rise near the Galapagos islands, some 2500 meters below the surface. They took a deep tow instrument and Cousteau's research submersible *Cyana*. They first found slightly warm water with the deep tow, then dived on that spot in *Alvin*. As they hoped, they found 20°C warm water seeping from fissures. But more importantly, they found a strange alien landscape littered with what looked like chimneys expelling clouds of black smoke.

The greatest surprise, however, was that there were very numerous, large animals living around the vents.

Global View: Pacific Ring of Fire

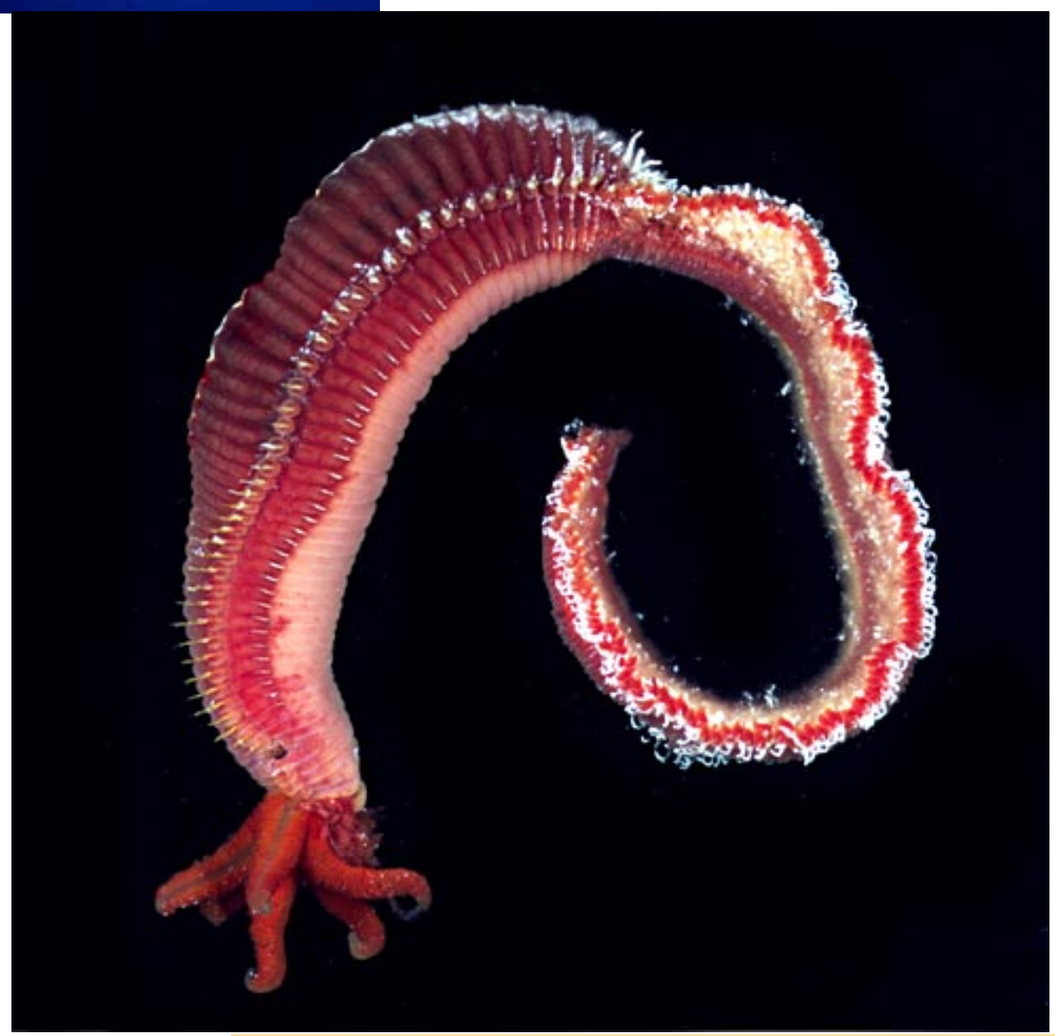



NOAA

Hydrovents

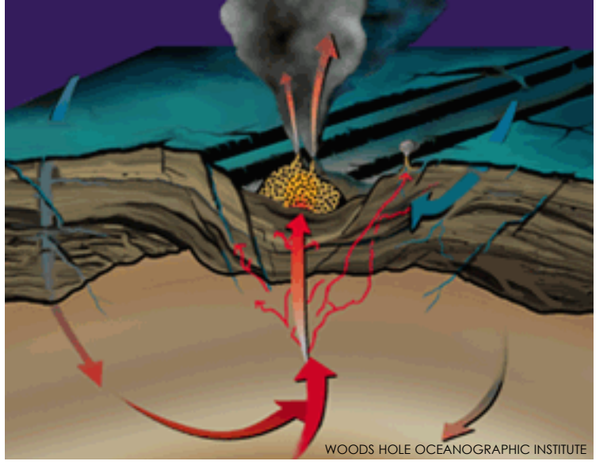
TOP LEFT: *Alvin* submersible
BOTTOM LEFT: Alvinellacaudata
FAR RIGHT: Black smoker
BELOW RIGHT: Map of Active Sites

Surrounding these chimneys was a unique type of ecosystem that had never been seen before. These animals turned out to be completely new species, often new Families or Orders, and even one new Phylum. Until then, it had always been assumed that all life on Earth obtained its energy from the sun. Using a process called photosynthesis sunlight is converted into energy by plants which, in turn, provide food for countless species of animals in a complex web of life. But here was a sight that challenged those assumptions. Here was proof for the first time that life could be sustained by the earth itself, totally cut off from the world of sunlight.


PETER BATSON

Hydrothermal vents and their formation

Hydrothermal vents occur in geologically active regions of the ocean floor where the planet's crustal tectonic plates are slowly spreading apart thus allowing magma to well up from below to form mountain ranges known as mid-ocean ridges. Vents are usually clustered in fields and normally found at a depth of more than a kilometer. Most have been discovered along the crest of the Mid-Oceanic Ridge, a 74000 kilometer-long chain of mountains that wraps around Earth like the seam on a tennis ball. A few vents have also been found at seamounts, underwater volcanoes that are not located at the intersection of the tectonic crustal plates.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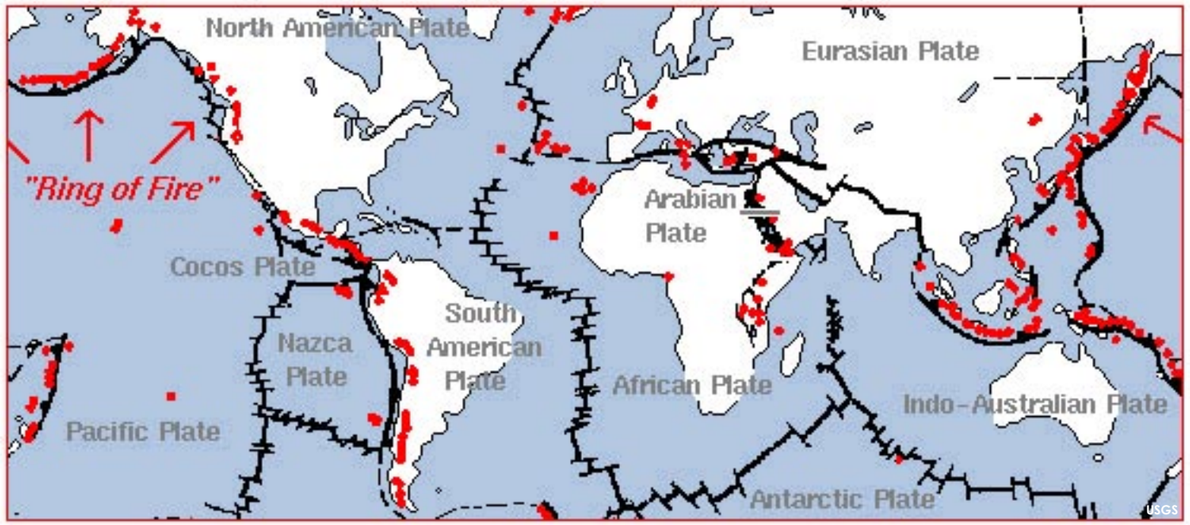
THE CHEMISTRY OF A "BLACK SMOKER" IS UNIQUE: AFTER SEA WATER SEEPS INTO THE CRUST, OXYGEN AND POTASSIUM AND THEN CALCIUM, SULFATE, AND MAGNESIUM ARE REMOVED FROM THE WATER. AS THE WATER HEATS UP, SODIUM, POTASSIUM AND CALCIUM DISSOLVE FROM THE CRUST. MAGMA SUPERHEATS THE WATER, DISSOLVING IRON, ZINC, COPPER, AND SULFUR. THEN THE WATER RISES BACK UP TO THE SURFACE, WHERE IT MIXES WITH COLD SEA-WATER, FORMING BLACK METAL-SULFIDE COMPOUNDS.

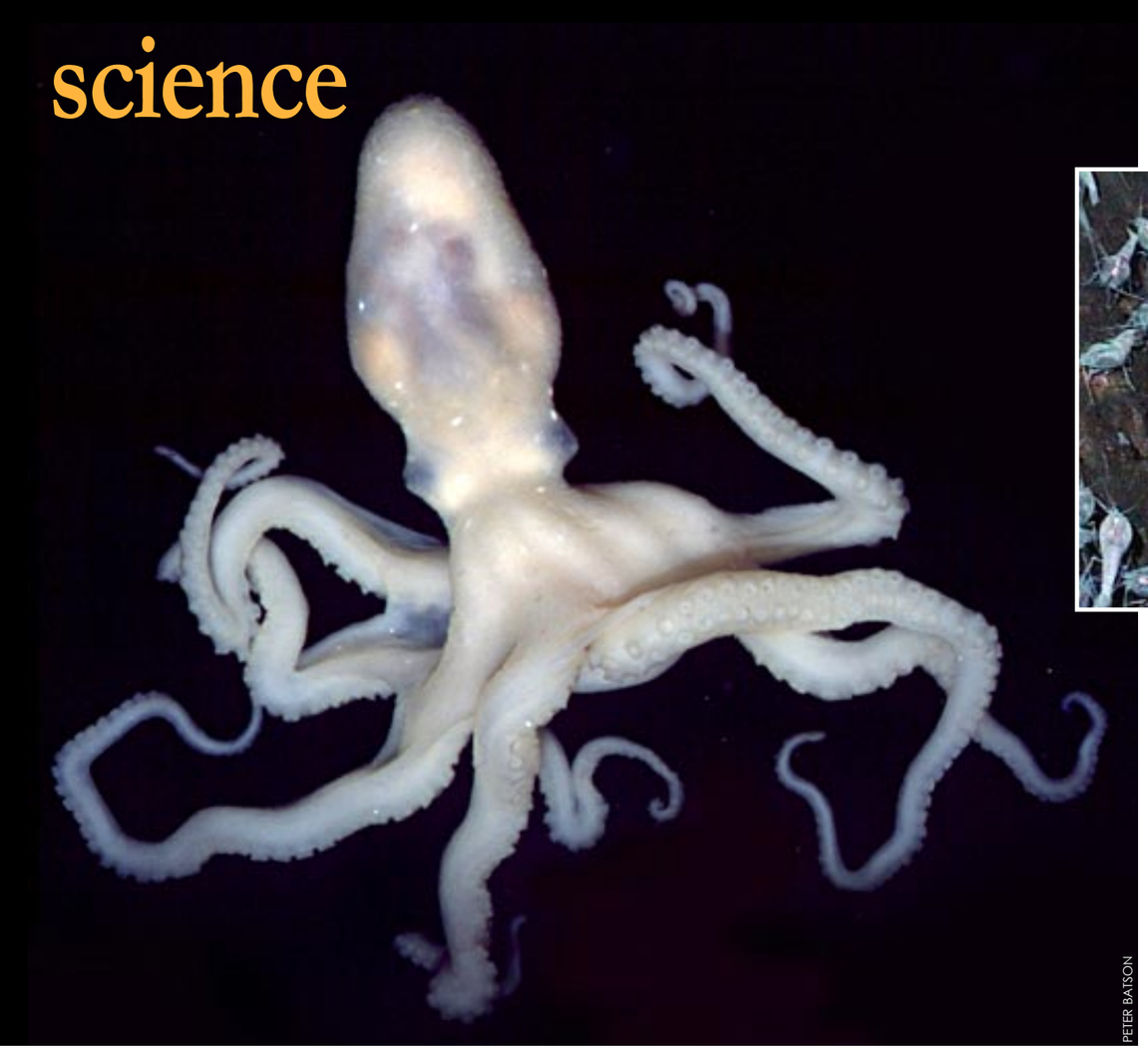
As cracks form in the ocean floor at these spreading centers, seawater seeps a kilometer or two down into the hot rock where it is heated by the intense heat of the magma. As the water is heated to boiling point, it expands and rises back to the surface, up through the cracks and fissures through which it dropped. On its way back up, the hot water dissolves minerals and other chemicals from the rock. When it reaches the ocean floor, the water is a rich, chemical soup. Some of the minerals precipitate out of the sea water and harden on the rim of the vent. Over time, the rim of the vent is built up into a tall, chimney-like structure. These chimneys are formed from dissolved metals that precipitate out when the super-hot vent water meets the surrounding cold deep ocean water. Individual vent openings typically range from less than a centimeter to more than two meters in diameter.


NOAA

Vent chimneys can grow very rapidly, up to 9 meters in 18 months. During a December 1993 dive to the Phoenix vent field, *Alvin* accidentally toppled a 10



Hydrovents



PETER BATSON

NASA

Strange and unique species develop in the ecosystem of the hydrothermal vents such as the vulcan octopus (ABOVE), shrimp and vent crabs (INSET).

meter-tall smoker. When the sub returned for a brief visit three months later, the chimney had already grown back 6 meters.

The dark colour of the water spewing forth from these vents has earned them the name *black smokers.*

As the vent water bursts out into the ocean, its temperature may be as high as 400°C. This water does not boil, however, because it is under so much pressure; for when the pressure on a liquid is increased, its boiling point increases. However, the intense heat is limited to just a small area. Within less than a couple of centimeters of the vent opening, the water temperature drops to 2°C, the ambient temperature of deep seawater.

Chemicals in hydrothermal vents

There is a very mineral-rich environment surrounding these vents. The water rising from the vents is acidic, with a pH of about 3.5, and contains up to 0.03% H_2S. It contains significant amounts of calcium, potassium, and sodium, together with silicon, barium, rubidium, iron and manganese.

The *black smokers* are the hottest of the vents. They throw out mostly iron and sulfide, which combine to form the black iron monosulfide. It is this compound which gives the smoker its black colour. There are also so-called *white smokers* which release cooler water, and which contain amorphous silica mixed with zinc- and iron-sulphide, and calcium- and barium-sulphate. These compounds are white.

However, important and commercially interesting as the chemicals in the vents might be, it is the creatures surrounding the vents that are the most interesting.

Creatures at these oases

Scientists once thought that no living thing could survive the harsh combination of toxic chemicals, high temperatures, high pressures, and total darkness existing at these vents. Similar communities have since been found at several hundred hot spots around the world. Hydrothermal vents are like underwater oases, providing a habitat for many creatures that are not found anywhere else in the ocean. More than 300 new species have been identified since the first vent was discovered in 1977.

These creatures are like nothing else on Earth.

Thickets of giant tube worms, some more than two meters tall, can be seen around

PETER BATSON

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TOP RIGHT: Stalked barnacles
RIGHT: Alvinella head

Hydrovents

PETER BATSON

NOAA PMEL VENT PROGRAM

ABOVE: Riftia on tevnia
RIGHT: Palm worms are one of the many species that live near hydrovents

the vents. The tail ends of the worms are firmly fixed to the ocean floor, while the red plumes at their heads look like a field of red poppy flowers. When *Alvin* had been at the same spot less than two years earlier none of these strange creatures had been observed. Measurements at the site have since shown that individual tube worms can increase in length at a rate of more than 80 cm per year, making them the fastest-growing marine invertebrates.

In addition to the giant tube worms, which have so far been found only in the Pacific, there are Jericho worms, bristley orange worms, small benthic worms living in the mud, and finger sized, red palm worms that stand upright, topped with fronds. A special class of small worms, called *Alvinellids* (named after the sub), live on the walls of mineral deposits that form around vents.

Mussels, shrimp, clams, and crabs are abundant at many vents, but these are not the same species we usually eat. The prawn-like shrimps that dominate vents in the mid-Atlantic, for example, have no eyes. Both clams and mussels reach enormous size near vents. They appear to live about 20 years and attain lengths of 20 to 30 cm. Like the tube worms they, too, have symbiotic bacteria that live within specially modified gills. Although the clams and mussels do have digestive tracts, it appears that the symbionts provide nearly all of their food.

It is still not fully known how shrimp and other vent creatures can cope with chemical-laden seawater that would kill ordinary shellfish.

While octopuses are at the upper end of the vent's food chain, bacteria are at the bottom. They are the first organisms to colonize newly formed vents, arriving as if in a blizzard and then settling to form white mats attached to the ocean floor. Bacteria have been found living beneath the ocean's floor, and it seems likely that they emerge from below when the conditions are right. Most of the creatures that congregate around vents live at temperatures just above freezing.

Thus chemicals are the key to vent life, not heat.

Incredible deep sea creatures had been known for quite some time, but these animals all depended on the regions above for their sustenance. They feed on small scraps of food and dead animals that fall from above. Here at the vents, though, something entirely different was taking place. These organisms were using another process to get their food directly from the vents themselves.

This process is known as *chemosynthesis*, with bacteria in the water actually feeding on what would otherwise be a lethal soup of noxious chemicals. Small animals feed on these bacteria, and these small animals again provide food for the larger animals. It is an entire ecosystem, totally separate from the world of light.

It should be noted, though, that not all vent animals have symbionts. Some are scavengers or carnivores that benefit from the rich food supply, for example, crabs and amphipods

SYMBIOSIS
Symbiosis is an association between two organisms that benefits them both. In the case of many of the vent animals, the animal has chemosynthetic bacteria as symbionts. The animal gets its food from the bacteria. The bacteria get an ideal location for growth, because the animal provides them with both oxygen and hydrogen sulphide.

Chemosynthesis

Chemosynthesis is analogous to photosynthesis but with a different energy source.

Photosynthesis, which is used by all terrestrial plants, and the great majority of the marine ones too, is exemplified by how phytoplankton produce their food. In this process, carbon dioxide and water react under the energy input of sunlight, with chlorophyll as a catalyst, to produce organic molecules such as sugars and starch, with oxygen as a biproduct.

$$CO_2 + H_2O \rightarrow \text{'}CH_2O\text{'} + O_2$$

THE TUBE WORM
A particularly remarkable type of vent animal is the tube worm. These can be 3 or more meters long. They live within a tough, white tube attached to the sea floor near a vent. A red "plume" protrudes from the top of the tube. This structure contains red haemoglobin, that absorbs oxygen, carbon dioxide, and hydrogen sulfide from the water surrounding the worm. The brown, spongy tissue filling the inside of a tube worm is packed with symbiotic bacteria - about 10 billion bacteria per gram of tissue. The bloodstream of the tube worm transports the absorbed chemicals to the bacteria, which are housed within a special organ called the trophosome. The bacteria then use these chemicals to grow and to produce organic substances that are absorbed by the worm for food. Having no digestive tract at all, the worm thus depends solely on the bacteria for its nutrition.

Tube worms reproduce by spawning: They release sperm and eggs, which combine in the water to create a new worm. Biologists don't know how the infant worm acquires its own bacteria. Perhaps the egg comes with a starter set.

At least 5 different species have been discovered.

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ABOVE: Colony of tube worms

Hydrovents

PETER BATSON

Stalked barnacles

where 'CH_2O' is the basic building block of sugars, lipids, etc.

For the production of a specific compound, sugar, we can write the following process.

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

i.e. six molecules of carbon dioxide plus six molecules of water produce one molecule of sugar plus six molecules of oxygen. Here the sugar can be glucose, for example.

However, due to the absence of light-energy from the sun to power photosythesis other energy sources must be used to drive food synthesis. Now, the most prevalent chemical dissolved in vent water is hydrogen sulphide, H_2S, which is produced when seawater reacts with sulphate in the rocks below the ocean floor. And it is that which supplies the energy to drive the chemosynthesis, for hydrogen sulphide is a highly reduced molecule, and therefore a great deal of energy can be obtained when it is oxidised. This ability to oxidize and release the energy in H_2S is restricted to certain types of bacteria containing the oxidising enzyme.

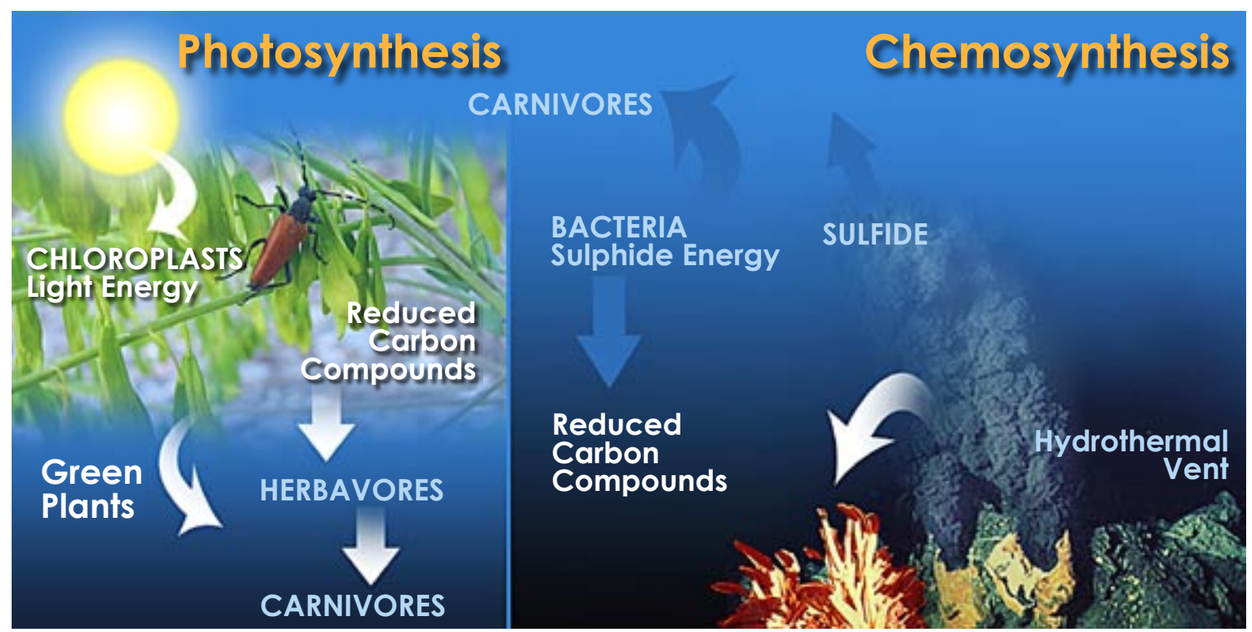
Chemosynthesis takes place in two stages, with the first stage being catalysed by bacteria such as *Thiomicrospira* and *Thiothrix*.

$$H_2S + 2O_2 \rightarrow SO_3^{--} + \text{chemical energy} + H_2O$$

The chemical energy produced here then facilitates the reaction between carbon dioxide and water to produce organic molcules.

$$CO_2 + H_2O \rightarrow \text{'}CH_2O\text{'} + O_2$$

As shown above, symbiotic chemosynthetic bacteria can use hydrogen sulfide as their energy source. However, methane-using symbiotic chemosynthetic bacteria also exist, especially at cold-seeps (see below). There are many varieties of chemosynthetic bacteria. Nearly all use a reduced chemical energy source, using oxygen to oxidize it to produce the energy they need.



Instead of photosynthesis, hydrothremal vent ecosystems get their energy from chemicals in a process called *chemosynthesis*. Both methods involve an energy source, carbon dioxide and water to produce sugars. Photosynthesis gives off oxygen gas as a byproduct, while chemosynthesis produces sulfur. Information source: NOAA

Hydrovents

Transience

Vent fields are tens of kilometers apart along ridge axes, and most vent fields are probably active only for about 20 years, although some can be active for 100-1000 years. The chimneys eventually become blocked as chemical precipitates plug up the cracks and fissures and flow ceases. The animals near such dead vents also die. However, new vent systems form fairly frequently, as forces of plate tectonics open new cracks and fissures.

Most of the animals that live near vents are sessile, and even animals like crabs can't move that far. So, how are new vents colonized? How do vent species survive when vents frequently die?


JOHN COLLINS

Hydrothermal vents may play a role in the regulation of ocean temperature which has a large affect on coral growth and health

Colonization of new vents

It is not known how tube worms and other organisms locate new vents for colonization. The vents are small, and they are separated, like islands. Most vent organisms have a free-swimming larval stage. But it is not known whether the larvae float aimlessly or purposely follow clues, such as chemical traces in the water, to find new homes. Many vent animals produce eggs with large yolk sacs. It seems that their eggs and larvae can survive for a long time, perhaps years. It is thought that the larvae drift with currents along the bottom, which may tend, at least slightly, to flow toward active vents. When the larvae find favorable conditions, they settle to the bottom and grow to adults. However, most die because they fail to find an active vent. When the flow of hot, sulphide-rich water slows to a trickle, death also comes quickly.

Cold Seeps

These are entirely different, geologically, from hydrothermal vents. They occur in situations where sediments are compressed, squeezing out the water between the mineral particles and causing it to seep out of the sea floor. Cold seeps are mentioned here because they have hydrothermal vent-like organisms that use a CH_4- or H_2S-based energy source.

Animals that don't live near vents

Some animals normally found in the deep ocean are not found, or are rare, near vents. These include sponges and anemones and echinoderms. Perhaps the conditions near the vents (hydrogen sulphide, high temperature, etc.) are harmful to them.


JOHN COLLINS

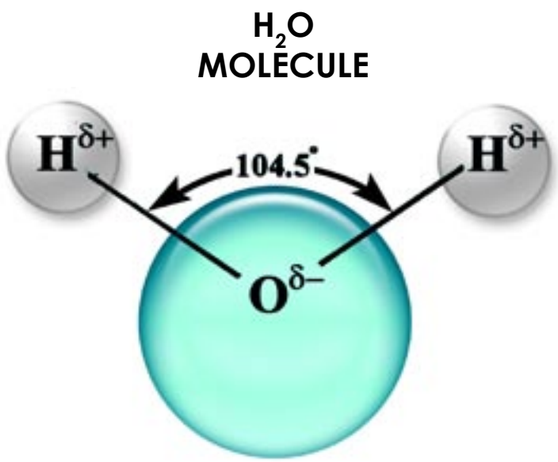
Sponges and soft corals do not grow near hydrothermal vents. It is thought that they cannot survive in this extreme environment

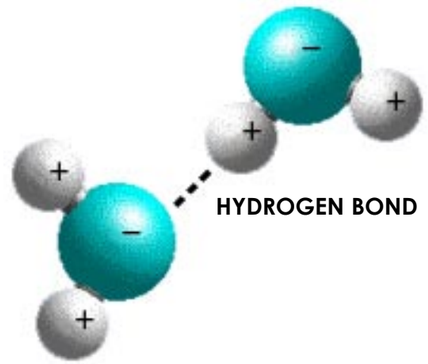
Hydrothermal vents are important sources of knowledge

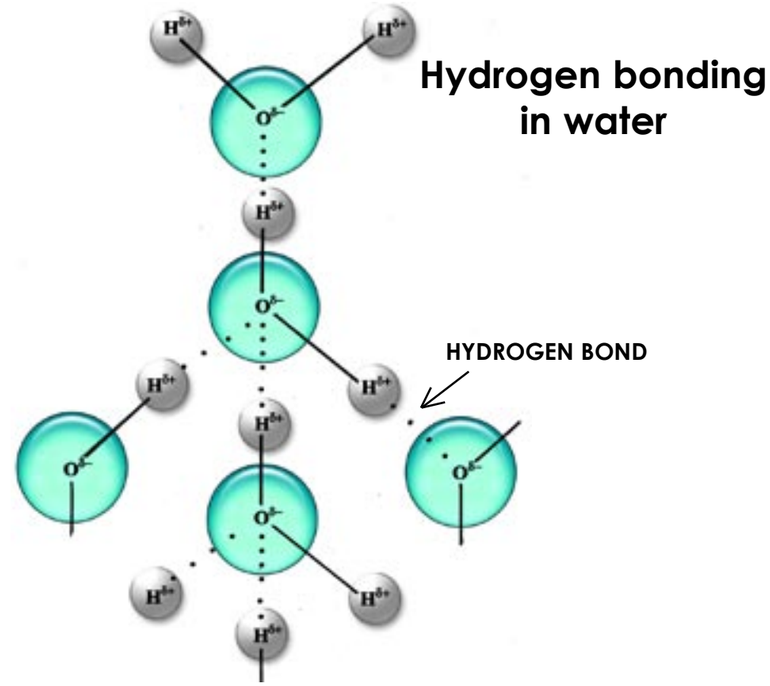
Interesting as it is in itself, the life surrounding hydrothermal vents is also an important source of knowledge. For example, vent bacteria can withstand higher temperatures than any other organism. That makes them attractive to researchers who are developing heat-stable enzymes for genetic engineering, and culturing bacteria designed to break down toxic waste. Also, these bacteria and tubeworms may show the way to the development of new drugs, industrial processes, and other products useful to us all.

Some biologists think that life, in the form of chemosynthetic bacteria, first evolved at vents. One reason is that such deep sea organisms would have been less affected by the harsh and highly variable conditions on the Earth's surface, where any photosynthetic organisms would have needed to live. Certain microorganisms have adapted to thrive on these vents and create rich underwater ecosystems that some scientists believe may represent some of the earliest life forms on Earth. Biologically, hydrothermal vents have a lot to tell us about the origins of life and the conditions in which life can be found, which is important to our continuing search for life elsewhere.

There are many other reasons why scientists want to learn more about hydrothermal vents. For example, these underwater geysers are believed to play an important role in the ocean's temperature, chemistry, and circulation patterns. Hydrothermal vents are central to the function of the Earth system and the life that is part of it; the vents at ocean ridges are an essential part of the chemical balance of seawater. ■







Text by Micheal Symes

Water Facts

THE HEAT CONTENT OF WATER

It has often been stated that life depends on the anomalous properties of water. More than 40 properties of water appear to be anomalous in some way or other, and among these is its large heat capacity.

The specific heat capacity of a substance is the amount of heat energy required to heat one gram of the substance one degree. The original unit of heat energy was the calorie, which was the amount of heat energy required to heat water one degree celcius. However, the relative unit of the calorie was later replaced by the absolute unit of the joule, where one calorie equals 4.18 joule. Water then has a specific heat capacity of 4.18 J g-1 K-1 , where K refers to the absolute temperature scale.

Water has the highest specific heat of all liquids except ammonia, and can thus retain and store large amounts of heat. This high heat capacity of water has as least two major impacts on our lives.

For the first, the large heat capacity of the oceans and seas allows them to act as heat reservoirs, so that sea temperatures vary only a third as much as land temperatures. This effect moderates and stabilises our climate, reducing extremes in temperature. That is also why coasts experience a milder climate than areas that lie more inland. The heat stored in water is also transported to other places around the globe through currents and will warm up colder water.

Secondly, and of more direct importance to humans, the high water content in organisms contributes to thermal regulation and prevents local temperature fluctuations. This allows us to more easily control our body temperature.

The high heat capacity of water is also the reason, for example, why hot water can cause such serious scalding. Hot water, when cooled from say 100°C to the temperature of skin, releases such a large amount of heat energy to the skin that it causes the damaging and very painful scald.

But why has this apparently simple substance such a high specific heat? The answer is *hydrogen bonding*, which also explains many of the other properties of water.

HYDROGEN BONDING

Water is a polar molecule, having a weak, partial negative charge d- at the oxygen atom and a partial positive charge d+ at the hydrogen atom. This is because the electron shell round a hydrogen atom is rather thin, and the positive charge on its nucleus shows through, thus giving the hydrogen atom a small but definite positive charge. On the other hand, the electron shell round an oxygen atom is rather thick, and so the oxygen atom has an extra bit of negative charge. These opposite charges attract, giving a relatively weak force called a hydrogen bond. Thus, when water molecules are close together, their positive and negative regions are attracted to the oppositely-charged regions of nearby molecules. This hydrogen bonding is shown by dotted lines in the diagram. Each water molecule has the potential to be hydrogen-bonded to four others. It is these hydrogens bonds that account for some of the essential and unique properties of water.

As water is heated, the addition of energy first causes the hydrogen bonds to bend and break. And, as water is a light molecule there are more molecules per gram than most simlar molecules to absorb this energy. Now, because the energy absorbed in these processes is not available to increase the kinetic energy of the water, and thereby raise its temperature, it takes a considerable input of heat to raise the temperature of water. Which is the same as saying that it has a high specific heat. ■

technical matters

Leigh Cunningham

Photos courtesy Craig Nelson
www.aquaimaging.co.uk

Configuration & Hose Routing

Two hotly debated subjects

Leigh Cunningham is the technical manager and TDI Instructor Trainer for Ocean College, Sharm El Sheikh.

Probably best known for his records - Leigh once held the record for the deepest dive in the Red Sea - and attempts of reaching extreme depths, he also has a wide range of teaching credentials to his curriculum:

TDI instructor trainer, DSAT Tech Trimix instructor, PADI MSDT IANTD Technical diver instructor CMAS 3 star instructor.

Since the introduction of Scuba diving in the mid 1950s, one of the most hotly debated subjects in the world of technical diving is that regarding the best type of gear configuration. Over the years, many experienced divers, instructors, and training agencies, have all claimed that their method and style of kit configuration is the best.

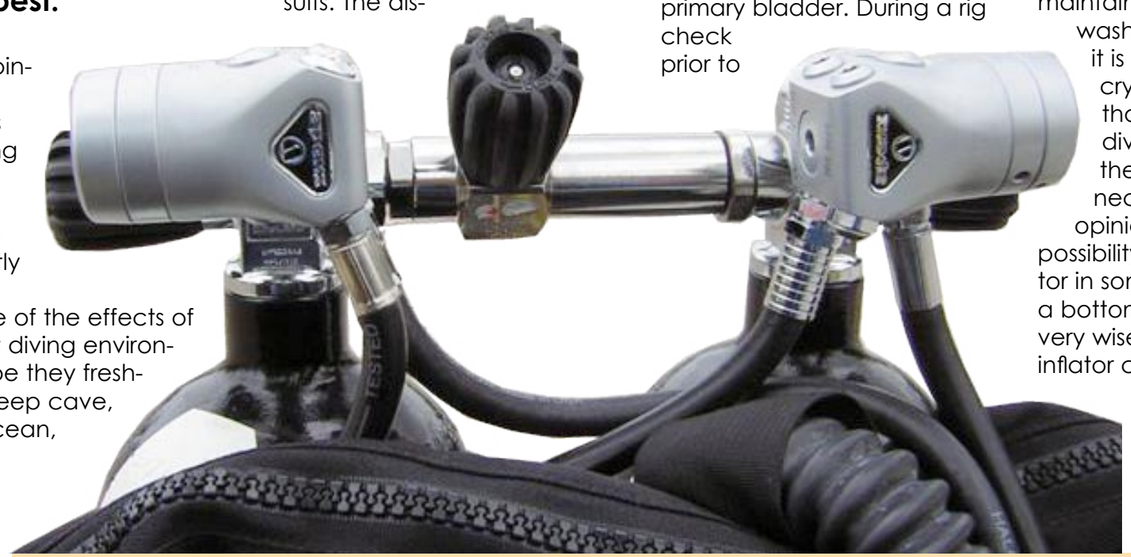
In my opinion, the specifics regarding kit configuration can frequently vary because of the effects of different diving environments, be they freshwater deep cave, open-ocean, or decompression diving. And there are also the personal experiences and preferences of the individual diver to consider. What might be a very logical, safe configuration in one environment, could lead to a multitude of difficulties in a very different environment. For example, I have had much discussion with many divers on the issue of whether or not to have the back-up inflator connected to the redundant wing. A redundant wing system is standard kit for divers using wet suits, and is also an option for those using dry suits. The disadvantage of having the back-up Low Pressure Inflator (LPI) connected would be the possibility of having a 'creeping' inflator.

But what is a creeping inflator? For those using wet suits, the tech wing (BCD) would have a redundant bladder to give independent back-up buoyancy. Divers using dry suits may consider the dry suit as a form of back-up buoyancy or opt for the redundant wing. Normally, divers would not use the back-up bladder unless there was a problem with the primary bladder. During a rig check prior to a dive, the back-up system should be checked along with everything else. For if this isn't done there is the possibility that salt crystals could form around the inflator mechanism. This would then cause the back-up inflator to fill only very slowly, i.e. creep, causing buoyancy problems. The diver would then have to vent gas from two bladders during the ascent, which can be very tricky.

Unless equipment is not maintained by cleaning and washing after every dive, it is highly unlikely salt crystals will form. I have, though, met numerous divers who do not have the back-up inflator connected to the LPI. In my opinion, because of the possibility of a creeping inflator in some environments, e.g. a bottomless wall, it would be very wise to have the back-up inflator connected to the LPI at all times..

In my opinion, the specifics regarding kit configuration can frequently vary

As stated, having a creeping inflator could cause buoyancy problems during the dive. When diving in environments where the bottom very close, or you are above your maximum depth, then there is no problem. In the event of losing buoyancy abruptly you can just sit on the bottom and connect the LPI to your back-up wing. However, in an environment where, for practical purposes, there is no bottom, it might be wise to have your LPI connected to your back-up wing. The questions you should ask yourself in this type of environment are (i), how long would it take to connect the LPI? and (ii), what depth might I be at by the time I get it connected and establish neutral buoyancy?



When hoses are routed down and behind, they don't snag on objects, and it is more streamlined

Gear Configuration

Many factors dictate the degree of negative buoyancy at depth. These can be the depth itself, the thickness of the wet suit, and how close you are to a perfectly weighted system (steel tanks all round make an over weighted diver).

Be safe! Have a neat and tidy, streamlined diving system.

Also, a diver may be able to maintain his depth at the bottom by lightly finning. However, finning too hard and for too long could lead to excessive CO_2 production. The breathing rate would then increase, and the flushing and exhaling of CO_2 would become less efficient. This would then cause the breathing rate to increase even more, producing more CO_2 and thus predisposing the diver to a heavy narcotic hit, together with a greater possibility of O_2-toxicity problems. This is the well known vicious circle of too much CO_2, leading to too much N2, leading to too much O_2.

Very deep diving for technical divers will have a different set of considerations for buoyancy compared to the average recreational diver, who may experience depth changes of only just a couple of atmospheres. At 200m there is a great deal of difference, with a pressure change of over twenty atmospheres. At these depths, an over-weighted diver runs the risk of reaching the point of no return, where the ability to inflate is exceeded by an increasing descent speed, as suit-compression and excess lead, or the addition of steel tanks, steel plates and unnecessarily heavy equipment, becomes overwhelming.

The secondstages are rigged on different first stages as is a source of bouyancy. This way, in case a first stage fails, i.e. it freeflows, it's valve can be closed and the diver will still have both breathing gas and buoyancy.

Example of a single bladder wing - the Gravity Zero 55lb seen at **www.abyssuk.com**

Bungee or not?

Another hotly debated subject is whether to have a bungeed or an un-bungeed wing system. Again, much like the Low Pressure Inflator issue, there is no one right or wrong answer. There is only the consideration of what should be used in a variety of environments or diving circumstances. For example, in confined or closed environments, such as cave or wreck penetration, the bungeed wing could result in snagging or entanglement, whereas in open water or ocean diving this problem would not generally occur. The advantage of a bungeed wing is that, if a diver found himself in an undesirable position where it was difficult to dump gas by adjusting his body to an optimum position, then the bungee would assist in self-deflating the wing by squeezing the gas out from any position. However, that advantage could also turn into a disadvantage in the event of a wing malfunction, such as a split or ruptured bladder. In this scenario, a rapid loss of gas would occur from both the split and by the bungee squeezing away badly needed gas. In the un-bungeed system there is always the option of turning sideways to trap some of the remaining gas inside. This is not for the faint-hearted but is an option none-the-less. So, there is no right or wrong answer, only what is best for the given environment.

Hose routing

This, too, is a subject that has had many a group of technical divers debating in open session for hours on end. In the caving community, a pioneer of configuration protocol is William Hogarth Maine, or Bill Main as this highly respected caving pioneer is called. The term Hogarthian was adopted due to Bill's philosophy. Originally, this philosophy was based on safety issues in caving, where, if divers used exactly the same equipment and configuration down to even the smallest detail, i.e. if one diver was a replica image of the other, then, in an emergency, other team members would be compatible with the diver in trouble

Incorporated in this style of configuration is a very rigid hose routing, the specifics of which include what side you have your primary first stage and back-up regulators, a 2m primary hose that would be wrapped once around the neck, and the location of additional equipment for the dive. Again, due to differing diving environments, this configuration may not always be the most suitable. For example, in open-ocean do we really need a 2m long hose when one of 1.5m may be sufficient?

In summary, what is fundamentally important is that, no matter what the environment, no matter where the hoses are located and their length, no matter whether your back-up LPI is connected, divers MUST know what they have and where it is situated. This is the only way to

Erh..no! Fine and orderly hoserouting but this is not quite what we had in mind

resolve a problem in a worst-case scenario, whether it be in a cave, in open water or inside a wreck. It therefore makes great sense to have a tidy, streamlined and neat configuration that is well suited to the given environment and the diver.

This discussion is by no means restricted to the technical diver. Recreational divers also need to consider their hose routings, many of which may have been learned or become a habit, good or bad, over many years of just taking such things for granted. I have seen some recreational divers stow their alternate second stages in various unsuitable places like BCD pockets and restrictive retainers, or even attached to nothing, where they dangle like a dog's tail!.

Nearly all recreational agencies have a general agreement that the alternate air source is usually stowed in the imaginary triangle between the chin and down and across the rib cage. However, I believe that in an out-of-air emergency, the stressed diver on the bottom will always prefer to take the regulator from his buddy that he can clearly see and knows that it is working. The alternate air-source in the triangular region may have flashing fairy lights on it, but I can guarantee that in most cases the out-of-air diver will always go for the one in their buddy's mouth. If I had my way, I would adopt the same philosophy in the recreational community as in the technical community, by breathing off the second stage that would be donated to the out-of-gas diver, and having the back up regulator on a bungee around the neck, where it can be located with ease. ■