The Discovery of Hydrothermal Vents

25th Anniversary CD-ROM

Sea Research—Ceaseless But Exciting

Reprinted from the San Francisco Chronicle
March 18, 1977

by

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Aboard the R/V Knorr
Over the Galapagos Rift Zone

It may be 4 in the morning, or noon or midnight, but on this oceanographic research vessel the work never stops and people sleep in snatches.

In the ship's main laboratory John Denver or a Bach fugue plays over the tape player while above the music a clattering HP-2116 computer plots our precise position every 30 seconds.

The lab is crowded. Someone watches over the fathometer; someone else the computer. The heat flow team worries the circuitry of its balky electronic gear while the chemists from the hydro lab prepare their plexiglass water filters for tomorrow's dive in the submarine Alvin.

On deck, just outside, two weary figures bend over the steel-trap lids of the sampling bottles that will go down to the bottom in a Kamikaze cast, while two others slice a 20-foot plastic-clad core sample of sea floor sediments into five-centimeter sections.

Topside the stars are wheeling above the radar mast, brilliant in the equatorial night. The ship's wake stirs only a gentle phosphorescent trail, for we're moving through calm waters at less than two knots.

This oceanographic cruise is sounding Pacific waters east of the Galapagos islands, 650 miles southwest of Panama. Here is one of the planet's most exciting spots: a rift in the earth's crust where new molten rock from the deep interior is spreading the sea floor apart to re-shape the oceans and move the continents. The Knorr is sailing over the heart of the rift zone's spreading center.

The research vessel Knorr is a floating laboratory for exploration of the Galapagos rift

It's a long night now. We're on an ANGUS run for 16 hours, and it won't end until the sun is high and until the submarine Alvin — safely tethered for the night in its cradle aboard the twin-hulled tender Lulu — is ready for its daily dive to the sea floor.

The letters ANGUS stand for Acoustically Navigated Underwater Survey System. But like every other device streamed from this ship by winch and cable into deep water, it's called "the fish" while it's working.

This fish, the ANGUS, is a plumber's nightmare: 3000 pounds of cage welded from massive steel pipes to carry a fish-eye camera, stroboscopic lights, two heat-sensing thermistors and a pinger to send out a chirping acoustic signal with its own identifying frequency.

The "fish" trails 300 yards behind the Knorr, and nearly 9000 feet down at the end of its cable. But its camera must stay as close as possible to an exact two fathoms — 12 foot — above the sea floor if its pictures are to be clear as the programmed shutter snaps off a shot every 14 seconds.

The scientists and technicians who spell each other keeping vigil over the fathometer must read the bottom topography closely as echo-soundings are recorded second by second on a continuous strip of wide paper.

They must tell exactly how deep the ocean bottom is trending as scarps and faulted uplits warp the sea floor: they must predict how far above that bottom the fish will fly each instant, and they must signal the winch operator one deck above when to pay out cable and when to winch it in, meter by meter, swiftly.

"Down one!" the depth watcher calls over the intercom to the winch driver, and the cable slacks off by a meter as the bottom dips away from the sledge. "Up two," he calls an instant later as the fathometer shows the bottom terrain is rising abruptly. The winch reels in two meters of cable, and the fish has just missed a hazardous crash into an upthrusting lava cliff.

Hour after hour the calls continue on the intercoms: "Up three!" "Down one!" "Up one!" "Christ, we crashed — up four!" "Hell, now I can't see bottom!" "Down three!" And on and on.

The ship is roiling just a bit, but the computer clicks its messages steadily: the printout shows good position fixes for both the ship and the fish. Tiny pinpoints of green light flash on the video display tube to show the Knorr's track and the fish swinging behind it obediently — most of the time.

Captain Emerson Hiller, the Knorr's master, cons the ship directly from the main lab instead of the bridge at critical moments. He keeps his eyes on the video screen, checks the orange and red lights that show time and position in digital numbers, and gently alters the direction of the ship's two cycloids by manipulating two prosaic levers.

Cycloids are a far cry from the conventional propellers of most ships: They're like giant Mixmasters mounted at the ship's bow and stern, and the variable pitch of their blades can drive the ship forward, backward or even sideways.

It's a strange sight to watch a 245-foot ship slip smoothly at right angles to its own wake, or spin in a full circle within its own length.

Everywhere inside the hull of this ship you can hear the high-pitched ping of the sonar sending out its singnals to a network of acoustic beacons that were explaced around the rift zone with great precision on the sea floor at the start of the expedition.

There are seven such beacons in two networks less than ten miles apart. The beacons are called transponders. They pick up the ship's signals on one frequency, then send out their own distinctive replies on other frequencies so the shipboard computer can calculate their range and bearing.

Our scientists have named the borren transponders to identify them: Dopey, Bashful, Sleepy and Grumpy form the northern net or the rift zone axis where the fresh lava lies and hot water gushes from vents and fissures to nourish unsuspected colonies of deep-sea life.

Doc, Sleepy and Happy are the southern net, among the curious sounds of sediment where our submarine divers have found fragile crusts and spires of manganese and iron.

During this two-month cruise, unfortunately, Grumpy grew stubborn and refused to answer his signals; the navigators disabled him with an acoustic message, and commanded him to drop his weights and float to the surface.

Then they sent down a replacement named Snow White. Bashful, too, fell silent, and so did Dopey. Transponders named Prince Charming and the Wicked Witch replaced them.

This complex navigation system is a far cry from years past, when oceanographers were content to know where they were within a quarter-mile when they took their fuzzy black-and-white pictures of the bottom, or when they sampled water or dredged the sea bed for rocks.

The scientific operations of today's oceanographers are equally impressive:

The ANGUS team, working under Robert D. Ballard of Woods Hole, Mass., the expedition's chief scientist, has now covered more than 70 miles of continous terrain with 75,000 photographs in brilliant color.

They show the rift zone's varying geologic formations — its fresh rock newly quenched from molten magna to form pillows and ropy wrinkles and flat lava lake beds with glassy spires, its milky, shimmering plumes of hot water rising from vents whose edges are crowded with life; its crusted mud mounds and barren sediment flats.

The deep-diving submarine Alvin, carrying a pilot and two scientists to the bottom on each daily mission, has made 25 dives to photograph the sea bed; recollecting live crabs, limpets, snails, crabs, tube worms, sediment cores and lava boulders, and to sample water temperatures as warm as 62 degrees.

A camera emplaced by a National Georgraphic Society team directly over one hot water vent and baited with mackerels and herring, has photographed a riot of color: Orange starfish, pink shrimp, yellow crabs, green sea urchins, purple sea cucumbers, two gray species of eel-like fish and another with huge blue eyes.

Probes have recorded heat flowing from the interior at rates nearly 25 times higher than normal.

Other instruments have analyzed the deep water's salinity, its dissolved oxygen content, and its acidity.

Still other devices lowered from the Knorr have brought back hundreds of liters of water from every depth level of the sea — from the surface to the deepest cleft.

Here on the ship, day or night, the scientists take those samples and in one of the Knorr's four jam-packed laboratories they analyze them within 24 hours for their chlorine, phosphate, silica, nitrate, ammonia, sulfide, calcium, magnesium and radioactive radon.

Plastic-meshed sediment traps, emplaced on the sea bottom nine months ago by the research vessel Melville out of the Scripps Institution at La Jolla, have been recovered by our expedition's sonar locators.

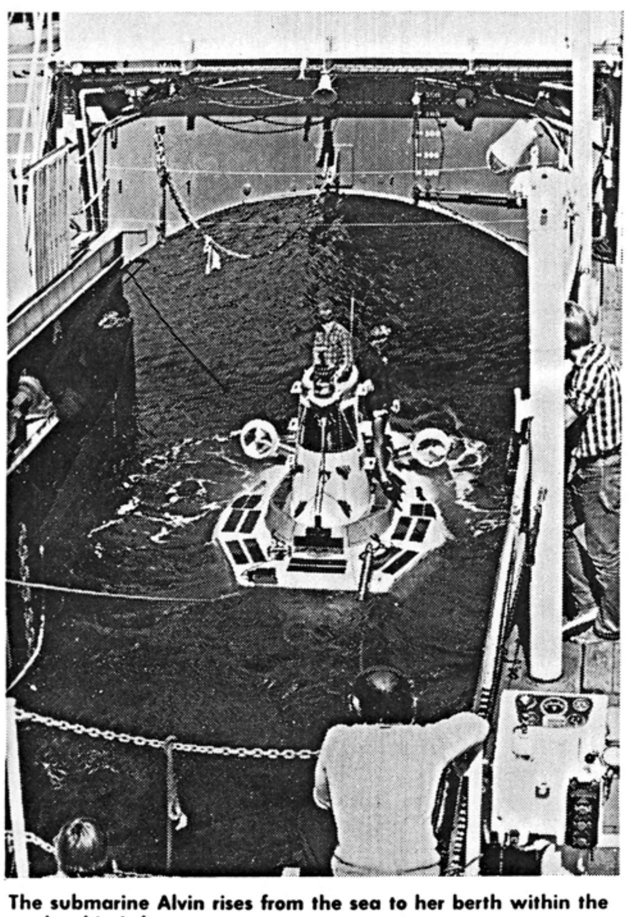
The traps yield precise information that can help tell our scientists how this region of the sea can build up sediments on the bottom ten times more rapidly than any other known deep-ocean rift.

The sediment comes from plankton skeletons and shells, from solids washed down by continental rivers, from dusts in the atmosphere, and even from minerals precipitating out of the brine that flows up through the vents in the rift zone's fresh lava.

There are nearly 20 scientists and 30 technicians aboard the Knorr and the Lulu, and the scientists range in rank from professor to graduate student.

They are here to learn new facts about some of the planet's most fundamental processes: how the earth's crust forms; how the chemistry of the seas where life began changes; how precious mineral resources are created in the volcanic turmoil of the dynamic planetary crust; how the molten matter and the radioactive elements far beneath the crust dissipate their awesome heat into the oceans.

For every day this expedition spends at sea the scientists will spend ten in their laboratories ashore puzzling out answers from their mountains of data. The voyage is yielding surprising discoveries already; their meaning, and the insights, will come later.



The submarine Alvin rises from the sea to her berth within the mothership Lulu.