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# The New York Times

...Southern New York... breezy. Midwest, variable cloudiness with some snow likely. South, partly sunny, some thuderstorms. West and Southwest, mostly sunny with rain in the north. Details on page 40.

VOL.CXXXI .... No. 45,208

NEW YORK, FRIDAY, JANUARY 29, 1982 Y 50 CENTS

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# Divers Find Natural 'Oil Refineries'

By WALTER SULLIVAN

Natural "oil refineries" have been discovered in a series of nine dives along the centerline of the Gulf of California. The oil is being formed from the unusually rapid breakdown of organic debris by extraordinarily intense heat flowing through the sediments, offering scientists a singular opportunity to see how petroleum is formed.

It is possible that important oil deposits were produced in this manner millions of years ago as continents split apart, forming narrow seas like the Gulf of California. A better understanding of how oil is formed could aid in finding new deposits.

Making this new find even more exciting is that the oil deposits are in an area of volcanic activity that is also generating metallic deposits. These are of a type familiar to geologists on land, where they have been of great commercial value. Their manner of formation has never been witnessed before.

The divers also observed, as have others on similar expeditions, bizarre life forms. Biologists on the expedition have come home on the submarine Alvin with what they say are the largest bacteria ever observed, so large they are visible to the naked eye. Near geysers of superheated, sulfurous water these bacteria have formed white matting over much of the terrain.

### Significance of Discovery

But the real significance lies in the ability of geologists to observe side by side two of the processes that have made possible modern industry: the formation of ores and the production of petroleum from the remains of oceanic life.

The economic potential of the metallic formations, assumed to consist of copper and other metals in combination with sulfur, will remain uncertain until their depth and composition are determined. Nevertheless observation of the ore-forming process is expected to arm geologists with important clues in their search for similar ore bodies on land.

Ordinarily oil has been thought to form over millions of years, whereas in this instance the process is probably occurring in thousands of years. As noted editorially in the current issue of the British journal Nature, it may now be possible to observe what temperatures and time durations are needed to bring about the conversions of various sedimentary materials into petroleum.

The activity is not only manufacturing petroleum at relatively high speed but also, by application of volcanic heat, breaking it down into the constituents of gasoline and other petroleum products, as in a refinery.

### Different From Other Sites

The area explored by the expedition, which returned to San Diego Jan. 21, differs basically from the regions of sea floor eruption discovered on the Pacific floor in the last few years.

The others, including a five-mile series of submarine geysers or "smokers" discovered in recent weeks by a French-American expedition off Central America, are far from any sources of abundant sediment. Hence there is little accumulation on top of the recently erupted rock.

It is rapid sedimentation (more than three feet per thousand years) that is believed to account for the remarkable features of the newly discovered area. It now appears that such special circumstances explain the so-called Besshi ore deposits found in many parts of the world. They take their name from Besshi, Japan, a rich source of copper as well as some gold and silver.

As explained by Dr. Steven D. Scott of the University of Toronto, a specialist in ore deposits on land who took part in the dives, Besshi ore deposits are marked by alternate layers of volcanic and sedimentary rock with veins of metallic ore intruding the sediments.

### Deposited in Sediment

In the Gulf of California, because of heavy covering of sediment, hot waters laden with metallic compounds extracted from below the sea bottom are often unable to escape into the sea and disperse their load, as occurs in areas of sea floor eruption explored on earlier expeditions. Instead they deposit their metals in the sediment. This appears to be how the Besshi deposits were formed.

Nevertheless, according to Dr. Robert Ballard of Woods Hole (Mass.) Oceanographic Institution, who just returned from the French-American expedition, extensive metallic deposits were evident in the area it explored, where sediment accumulation was meager.

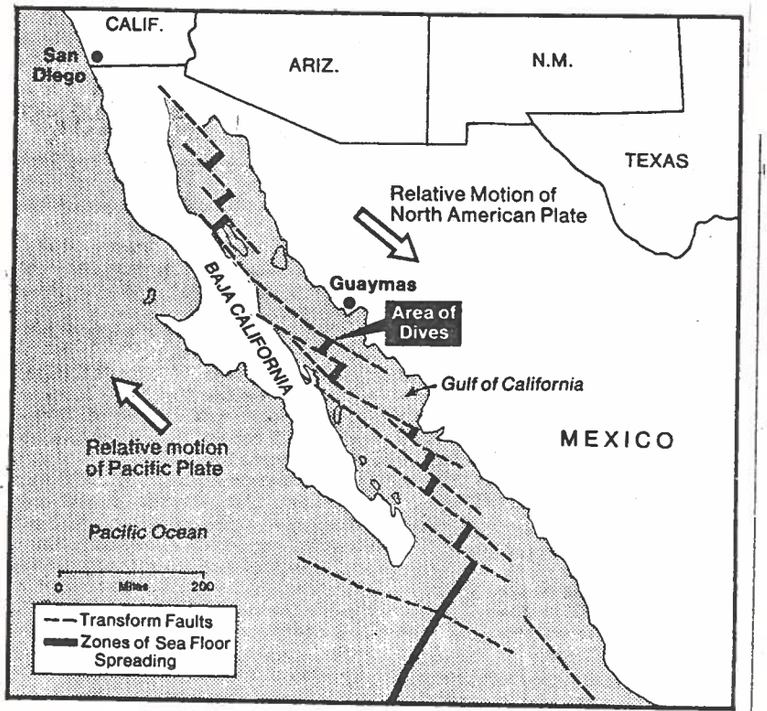
The expedition, financed by the National Science Foundation, consisted of the Research Vessel E. B. Scripps of the Scripps Institution of Oceanography in San Diego; the Alvin, operated by Woods Hole, and its mother ship, Lulu. Dr. Peter F. Lonsdale of Scripps was chief scientist.

In 1980, dredging the bottom from another Scripps ship, the Melville, Dr. Lonsdale and Dr. Bernd R. T. Simoneit of Oregon State University obtained petroleum in the area of the dives. Mounds 60 to 100 feet tall were observed and attributed to hot water eruptions. The dives also revealed spikes of volcanic rock, some 65 feet high and only a few feet thick, rising from the sea floor.

The volcanic activity there and at the other diving sites in the Pacific is a byproduct of steady northwest movement of the Pacific floor relative to the Americas. This tears open the sea floor along numerous rift valleys, including those running diagonally across the Gulf of California. These zones of spreading are linked by so-called transform faults.

Most remarkable among the forms of life observed were the carpets of filamentous bacteria, so large they are visible to the naked eye. According to Dr. J. Frederick Grassle of Woods Hole, they probably live on sulfurous material from the geysers. Water in some of the geysers was at 600 degrees Fahrenheit, close to the boiling point of water under the pressure at that depth of 6,500 feet.

Among factors accounting for the natural "oil refineries" are abundant life contributing much organic matter to the sea floor, heavy deposition of erosional sediment from the Colorado River and intrusion of that sediment by lava, producing a heat source.




The New York Times / Jan. 29, 1982

## Your morning smile

Sign on a TV commentator's desk: "Give me the facts straight. I can mix them up when I quote you."