

# Ronald Reagan Presidential Library Digital Library Collections

---

This is a PDF of a folder from our textual collections.

---

**Collection:** Barr, William: Files  
**Folder Title:** [Law of the Sea – Bob Keating] (1)  
**Box:** 10

---

To see more digitized collections visit:

<https://reaganlibrary.gov/archives/digital-library>

To see all Ronald Reagan Presidential Library inventories visit:

<https://reaganlibrary.gov/document-collection>

Contact a reference archivist at: [reagan.library@nara.gov](mailto:reagan.library@nara.gov)

Citation Guidelines: <https://reaganlibrary.gov/citing>

National Archives Catalogue: <https://catalog.archives.gov/>

December 15, 1980

File - LOS

THE LAW OF THE SEA TREATY

An Overall Assessment

with

Recommendations for Executive Action

Robert B. Keating

Member of President-Elect's  
Foreign Policy Advisory Council

and

Strategic Minerals Task Force

"Multilateral negotiations have thus far insufficiently focused attention on United States long-term security requirements. A pertinent example of this phenomenon is the Law of the Sea Conference, where negotiations have served to inhibit United States exploration of the sea-bed for its abundant mineral resources. Too much concern has been lavished on nations unable to carry out sea-bed mining, with insufficient attention paid to gaining early American access to it. A Republican administration will conduct multilateral negotiations in a manner that reflects America's abilities and long-term interest in access to raw material and energy resources."

#### The Republican Platform

--The Security of Energy  
and Raw Materials Access,  
page 75

## LAW OF THE SEA TREATY

### U.S. INTERESTS

#### SUMMARY ASSESSMENT

##### A. National Security Considerations

-- The proposed treaty would concentrate enormous economic and political power in an International Seabed Authority which would be dominated by the Third World. This single international agency would control the development and exploitation of deep seabed mineral resources covering two-thirds of the earth's surface.

-- The treaty would not provide American companies with assured, continuing, and non-discriminatory access to critical minerals needed for our industry and defense.

-- The treaty would contribute to the erosion of high sea freedoms of navigation and overflight. Furthermore, it would not fully protect freedoms of navigation-- commercial, military, and overflight -- in the proposed "exclusive economic zone" extending 200 nautical miles seaward from coastal countries, and through straits and archipelagic waters of major interest to the United States (e.g., Gibraltar, Hormuz, Malacca and Bab el Mandeb).

-- The treaty could postpone, or prevent entirely, the development of energy resources in the deep ocean and on the Antarctic continental shelf (e.g., oil, gas, steam, or hot water).

-- The treaty would require the transfer of our highly sophisticated, defense-related, ocean mining technology to a supranational ocean mining Enterprise and to developing countries (including Romania, a Warsaw Pact nation, which would undoubtedly provide the U.S.S.R. with American state-of-the-art technology).



## U.S. INTERESTS

### SUMMARY ASSESSMENT

#### A. National Security Considerations - continued

-- The treaty would legitimize and codify a system of extensive and unchecked coastal nation jurisdiction with respect to ocean scientific research that would severely curtail the free conduct of oceanographic research in the "exclusive economic zone" and possibly the deep seabed area.

-- The treaty surrenders major political and strategic advantages to the Soviet Union to the direct disadvantage of the United States. The Soviets are self-sufficient in the minerals found in seabed nodules, but we are not. They have successfully negotiated two sets of provisions that give them near-certain capability of limiting U.S. access to deep seabed mineral resources:

(i) The Soviet Union sought and gained a quota provision that limits any one country to a total of 2% of the unreserved seabed area. They also gained a general "anti-monopoly" provision that could be used to discriminate against the United States.

(ii) The Soviet Union would be virtually guaranteed a permanent seat on the Council (whereas the U.S. has no such guarantee), along with two additional proxy seats which would then give the U.S.S.R. control of at least three Council votes (whereas the U.S. has no such control).

#### B. Foreign Policy Considerations

-- The proposed treaty would establish dangerous precedents for the creation of other Third World and/or Soviet dominated international institutions and adds impetus to related Third World causes (e.g., the New International Economic Order, the New International Information Order, a Moon Treaty, Common Regimes for Outer Space and Antarctica).

## U.S. INTERESTS

### B. Foreign Policy Considerations -continued

## SUMMARY ASSESSMENT

-- The proposed political and judicial arrangements of the treaty would give the Third World a virtual monopoly over future development of deep seabed mineral resources. With 80% of the member representation from developing countries, the Third World nations would have effective control of the "supreme", one-nation, one-vote Assembly of the International Seabed Authority, as well as control of important subsidiary committees. They would also enjoy a clear numerical superiority in the Executive Council.

-- The Soviet bloc would be expressly guaranteed three seats on the Executive Council, with the United States forced to compete with its own allies, as well as its adversaries, for even a single seat.

-- The one-nation, one-vote Assembly dominated by the Third World would determine how financial and other benefits from ocean mining activities are to be shared not only with developing countries but also with so-called national liberation movements.

-- The provisions for settling of commercial and other disputes under the Authority are arbitrary, subject to political pressures, and provide no assurances of consistent, even-handed resolutions under predictable rules. Western countries are assured only 3 of 21 members in the Law of the Sea Tribunal, and the Assembly would decide the representation and distribution of membership for the Sea-Beds Dispute Chamber. Members of the Tribunal would be elected by a two-thirds majority vote of the countries present and voting on the basis of one-nation, one-vote. Under such circumstances, the arbitration of important disputes concerning interpretation of the many ambiguous treaty provisions would be controlled by judges from Third World countries.



B. Foreign Policy  
Considerations -continued

-- The economic principles embodied in the treaty provisions clearly indicate that the economic model that would be followed for international deep ocean minerals management would not be market-oriented, but rather that of the centrally-planned economic regimes of socialist governments.

-- The treaty stipulates that within twenty years of commercial ocean mining production, the entire system of seabed exploitation could be amended by a two-thirds vote of the member representation to the treaty. Such amendments could be made over our objections and to the further detriment of our national security, foreign policy, and domestic economy.

C. Domestic Economic  
Considerations

-- The proposed treaty fails to satisfy Title II of the U.S. Deep Seabed Hard Mineral Resources Act of June 28 1980, which directs the U.S. delegation to the Law of the Sea Conference to negotiate a treaty that will (1) guarantee U.S. citizens assured, continuing access to deep seabed minerals, and (2) provide "grandfather" rights that will permit American companies to continue with already existing ocean mining projects without significant new legal and economic burdens being imposed by the International Seabed Authority.

-- A major defect in the proposed treaty is the absence of any transitional arrangements pertaining to the protection of interim ocean mining investments made before the treaty enters into force. The Preliminary **Investment Proposal (PIP)**, which was submitted for Conference consideration by the U.S. Delegation without effective consultation with U.S. industry, only grants the American investor the right to stand first in line to apply for a contract to mine on a site that he had already invested in before the treaty came into being. PIP provides no assurance that he would not be dispossessed from his mining site, or that

C. Domestic Economic  
Considerations - continued

-- The proposed International Seabed Authority would have the power to set both general production controls and specific production limits for ocean mining sites. Mining contracts would be allocated on a discretionary basis and no American company could be certain of obtaining either a license or a rational, economically viable production quota. Despite an avowed "first-come, first-served" policy, there is a specific quota provision that would limit the number of contracts awarded to a particular country, and, more seriously, there is a general "anti-monopoly" provision that could be used to direct contracts toward particular countries and away from others.

-- The treaty would establish a globally-chartered "Enterprise" enjoying a series of competitive advantages relative to private corporations, including the probability of a tax-free status. These advantages would notably include the mandatory transfer of ocean mining technology to the Enterprise from private corporations when they have been awarded a mining contract. The limited nature of commercial arbitration and compensation in such technology transfers would not compensate American companies for the loss of their competitive advantage as the leading developers of ocean mining and minerals processing equipment and technology.

-- Another onerous condition to receiving a mining contract from the Authority is the requirement that the private company turn over to the Enterprise another mine site of equal commercial value, fully prospected at company expense, and for which the company would receive no compensation. Thus, at least one-half of all exploitable sites would be reserved for development by the Enterprise or by developing countries in association with the Authority. Additionally, neither the Enterprise nor the developing countries need be restricted to mining operations on reserved sites, but could exploit non-reserved sites as well.



## C. Domestic Economic Considerations -continued

-- The treaty provides that the member nations would finance the start-up of the Enterprise. This means that the United States would be required to contribute at least \$125 million in long-term, interest-free loans, and the same amount in loan guarantees. Moreover, we would be obliged to provide millions of dollars for the operation of the Authority until it became self-financing, which might never be realized.

-- The treaty would allow and encourage the development of future ocean mineral commodity arrangements that could be binding whether or not approved by the United States.

-- The treaty does not provide a reciprocal tax credit to U.S. ocean miners for taxes paid to the U.S. Treasury. Additionally, there is no U.S. law which allows credits for taxes paid to the Authority. This double taxation places an undue burden upon a pioneering industry.

-- The treaty gives the coastal nations sovereign rights for the purpose of "exploiting, conserving, and managing the natural resources, whether living or non-living" of their economic zones. These include rights to exploit such highly migratory species as tuna. Should this right be ceded to coastal nations, our distant water tuna fishing industry might be considerably reduced or even terminated. These provisions might also have an adverse effect upon our interests in protecting and conserving such marine mammals as the whales.



Executive Actions Required

The present Law of the Sea treaty contains provisions which are harmful to our national security, foreign policy, and domestic economy. Substantial changes and improvements in the negotiating text are urgently needed if we are to achieve a treaty consonant with our national interests and the objectives of the Reagan Administration.

Unfortunately, the Law of the Sea Conference has essentially concluded its negotiations on all but a few ocean mining issues and final clauses. Its schedule calls for the Conference to conclude a draft convention that could be open for signature in 1981.

If the Reagan Administration is not to be confronted with unacceptable treaty results and embarrassed by a Senate refusal to ratify the treaty, then steps must be taken immediately to reexamine our goals in the Law of the Sea Conference and provide necessary textual changes to our State Department negotiators. This Administration review of the treaty should include participation of Congress, industry, and labor, and should be directed toward providing the U.S. negotiating team with specific and binding instructions on our requirements for:

- Clear and unambiguous constraints on the degree of economic and political power to be accorded to an International Seabed Authority.
- The assurance of continuing and non-discriminatory access to seabed mineral resources with provision of "grandfather" rights to protect ongoing American ocean mining projects.
- The protection of high seas freedoms of navigation and overflight.
- The assurance of the development of energy resources in the deep ocean and on the Antarctic continental shelf.
- The protection of American ocean mining and minerals processing technology against mandatory transfer.
- The assurance of freedom of ocean scientific research.
- The clear establishment of the Council as the governing body of the International Seabed Authority with assurance that the United States would have equal representation on the Council with the Soviet Union.

- The establishment of a fair and equitable system of settling commercial and other disputes.
- The establishment of production policies based on market-oriented principles.
- The establishment of a fair, parallel system of ocean mining with the proposed globally-chartered "Enterprise".
- The provision of a reciprocal tax credit to U.S. ocean miners for taxes paid to the U.S. Treasury.

(The Review Committee should also examine Executive Actions necessary to promptly implement the Reciprocating State provisions of the Deep Seabed Hard Mineral Resources Act, (P.L. 96-283).)

To : Bill Barr  
From : Rob Heiting





To: Phil Barr  
From: Bob Keating

THE NEW YORK TIMES, SATURDAY, JUNE 26, 1982

## State Department

# Shock, Sadness and Puzzlement Greet Haig Move

By LYNN ROSELLINI

Special to The New York Times

WASHINGTON, June 25 — By 3:30 this afternoon, they had gathered, whispering in small groups in the hallways and in front of television sets in offices. Almost everyone had a theory about their former chief, Alexander M. Haig Jr., as well as their new one, George P. Shultz.

The talk went like this:

"It was Lebanon that did him in."

"They forced him to leave."

"He's had so many enemies."

"Who's the new Secretary?"

"Gonna be Shultz."

State Department employees gave a standing ovation to Mr. Haig after he bade them goodbye about an hour later in the crowded department auditorium.

"He is a good man," said Robert D. Hormats, an Assistant Secretary for Economic and Business Affairs, who announced his own resignation earlier this week. "He is highly respected."

That was the consensus at the department today as employees reacted with shock, sadness, puzzlement and in a few cases, bitterness, at the news that Mr. Haig had resigned. Some got the word at 3 P.M. on office "squawk boxes," tuned into the White House press room. Others picked it up along corridors and in elevators.

### Professionalism Respected

Despite his continuing controversies with the White House, Mr. Haig was highly regarded by many State Department employees. They said today that they respected his professionalism, as well as his refusal to succumb to pressures from the right.

"I think you're seeing a distinct shift to the right, with people like Meese emerging, and Judge Clark still in a good position at the White House," said Robert Cabelly, a special assistant to the Assistant Secretary for African Affairs, referring to Edwin Meese Jr., counselor to the President, and William P. Clark, the national security adviser.

"There's been problems with Haig all along," Mr. Cabelly continued. "The power thing. He wanted to take a softer stance on Begin, whereas Reagan and Clark wanted to slap him on the side of the head."

Other State Department employees had different ideas about the cause of Mr. Haig's departure. "We were speculating that it had something to do with the pipeline decision," said Ward Barmon, referring to the Administration's announcement last week that it would prevent American companies from permitting their foreign licensees from selling pipe-laying



The New York Times / Stan Baron

Secretary Alexander M. Haig Jr. leaving auditorium at State Department after his resignation. At left is John A. Scall, an ABC News correspondent who was chief representative to the United Nations under President Nixon.

technology or equipment to the Soviet Union.

Pilar Molnar, a Spanish translator, said, "My general feeling is that it had something to do with the Middle East," but added, "One thing is true: We are not going to find the real reasons this afternoon."

Still others declined the temptation

Democratic predecessors, Cyrus R. Vance and Edmund Muskie.

Another name mentioned almost as often as that of Messrs. Haig and Shultz today was that of the chief United States representative at the United Nations, Jeane J. Kirkpatrick. "Some people thought she was in line for the job," said Mr. Cabelly.

At 3:40 P.M., Mr. Haig's outer office on the seventh floor was quiet. Portraits of Henry A. Kissinger and other former Secretaries stared down on the empty expanse of green carpet. A receptionist chatted with a security guard.

"Yes, he's inside now," the receptionist said, gesturing toward the inner office.

Inside, the Secretary's top assistants had gathered to hear him say goodbye. When Mr. Haig entered the room, everyone rose and applauded. He asked them to give their "full support" to his successor, Mr. Shultz. Then he departed, and his staff applauded again.

"Everyone was extremely sad," said Mr. Hormats, one of those who left the Secretary's office shortly before 4 P.M.

About a half hour later, Mr. Haig emerged and, clutching a yellow file folder, made his way down to the modernistic Dean Acheson Auditorium on the second floor.

Bathed in bright television lights and looking tanned in a white shirt and gray suit, Mr. Haig was led to the rostrum by Dean Fischer, his press spokesman. There was continued ap-

plause for about a minute, and people began standing until almost everyone in the room was on his feet.

Then the audience grew quiet. Mr. Haig read his letter of resignation and then spoke of his "profoundest admiration" for members of the Foreign Service and State Department staff.

After just six minutes at the microphone, he left the auditorium, surrounded by a flying wedge of aides. Reporters hurried off to file their stories, and the employees headed for their car pools.

When it was all over, one employee sitting in the auditorium said to a colleague: "I bet the Embassy Row communicators will be busy tonight," a reference to the messages that will stream from Washington to foreign capitals as embassies assess the change.

But at least one Embassy apparently came late to the news.

At 3:31 P.M., more than a half hour after the White House announcement of Mr. Haig's resignation, a member of the Soviet Embassy staff called an editor and invited him to have a drink later in the afternoon.

"Haven't you heard the news?" said the editor, surprised.

"What news?" asked the Russian.

"Haig has resigned," the editor informed his startled listener.

"What? What?" he exclaimed.

"You're kidding me."

For years, the Federal Bureau of Investigation has maintained that the Soviet Embassy has sophisticated espionage equipment to stay on the inside track of Washington news.

**'I think you're seeing a distinct shift to the right.'**

—Robert Cabelly

to take part in the guessing game. "Secretary Haig had so many difficult situations," said Ruth Cline, another translator. "There is no way of telling. He has certainly faced a lot of interesting situations."

Despite their diverse speculations, most department employees seemed genuinely sorry to see Mr. Haig go.

"It's a shame that he felt he couldn't carry on," said William Bacchus, a personnel worker. "People in the department felt that Haig was a very strong individual to work for."

Mr. Cabelly said that Mr. Haig had "lifted the morale of the State Department," adding, "At the time he came in, it was in disarray after Vance and Muskie," he said, referring to his

Who is this guy, anyway?



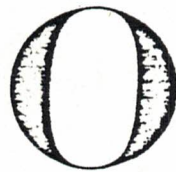
JLM- Didn't know if you've  
seen LSR's latest version of truth,  
wisdom & pragmatism. Leigh S. Ratiner  
7L.

## THE LAW OF THE SEA: A CROSSROADS FOR AMERICAN FOREIGN POLICY

6/30/82

To: Bill Brown

From: Goldwater



On April 30, the United States was the only Western industrialized country to vote against the final treaty adopted in New York by the Third United Nations Law of the Sea Conference. Venezuela, Turkey and Israel also voted no. The U.S.S.R. and most Soviet bloc countries abstained, as did a few highly industrialized Western nations. Most of the West, including France and Japan, joined the Third World and voted yes. Altogether, 130 nations voted to adopt the treaty and open it for signature.

The final treaty falls short of the goals sought by the Reagan Administration. It establishes a mixed economic system for the regulation and production of deep seabed minerals and, as a matter of principle, the Reagan Administration could not, consistent with its free enterprise philosophy, have done otherwise when the time came to vote.

Unfortunately, our strong and uncompromising defense of principle may have cost us a golden opportunity to convert the treaty into a better vehicle for commercial operators.

But that loss could be minor when compared with the prospect that the United States might now decide to exclude itself from a new global regulatory organization which may—sooner rather than later—count among its members all of our allies, the Third World and the socialist bloc. This new institution will safeguard the mining claims of our industrial competitors and reject rights claimed by American flag companies.

Moreover, if the United States stays out of the sea law treaty, and most major nations join it, we risk conflict over American assertions that we are entitled, without participating in the treaty, to rights embodied in the treaty related to navigational freedoms, exclusive economic zones, jurisdiction over our continental shelf,

---

Leigh S. Ratiner was Deputy Chairman of the U.S. Delegation to the final negotiating session of the Third United Nations Conference on the Law of the Sea, while on leave of absence from the Washington law firm of Dickstein, Shapiro & Morin in which he is a partner. He had served at the Law of the Sea Conference prior to 1977 in three previous Administrations, as a senior advisor and negotiator on seabed mining, energy and national security issues.

Foreign Affairs Summer '82



## THE LAW OF THE SEA 1007

fisheries, pollution control and the conduct of marine scientific research.

Should all this come to pass—and it seems likely it will—we will suffer a significant, long-term foreign policy setback with grave implications for U.S. influence in global economic and political affairs.

### II

The Law of the Sea Treaty has been under negotiation since 1966, when the United States and the U.S.S.R. agreed to consult all nations on the question of whether they would agree to a new global conference on the law of the sea. As initially envisaged, the aim of the conference would have been to fix the limit of the territorial sea at 12 miles and to provide for freedom of navigation through and over international straits which might be overlapped by the new 12-mile limit.

In 1968 the United Nations began to expand the as yet unwritten agenda of the Conference to include the issue of deep seabed mining in areas beyond national jurisdiction. By the time the Law of the Sea Conference was formally created in 1973, its agenda included essentially all uses of the oceans. Between 1973 and 1980 over 150 countries including the United States agreed on treaty texts on all but four points: boundary delimitation, which was settled in the summer of 1981; participation in the treaty by entities which are not sovereign states; the composition and functions of the Preparatory Commission to set up the International Seabed Authority; and provisions for the protection of investment in deep seabed mining activities prior to entry into force of the treaty. After ten sessions of the Conference and 14 years of negotiating effort, the new Administration in Washington sought in the final Conference session this spring to renegotiate essential elements of a package that already commanded widespread support and near consensus.

How did this come about? In March 1981, the new Reagan Administration began a much-needed, soul-searching review of the draft convention on the law of the sea. It was clear that notwithstanding the treaty's many potential benefits, its deep seabed mining provisions were anathema to some elements of the Reagan Administration; moreover, the treaty was considered unratifiable in the Senate. The U.S. policy review lasted more than a year.

The policy review process, like many conducted through inter-agency groups regardless of which Administration may be in



power, was essentially an adversarial process in which initially all documents were prepared for the purpose of reaching preconceived objectives and prejudicing an ultimate decision. Pressure from the White House to reach consensus was intense and this produced even further, and in some cases devastating, compromise formulations describing fundamental issues in dispute. (As a result, at least one crucial point was destined to be ignored in the final decision-making process because of its obscurity, obfuscation and ambiguity.) Every effort was made by the Assistant Secretary of State who was in charge of this review to conduct a neutral and balanced process. The fact that he failed in this mission is not a reflection on his capabilities but rather on the interminable capacity of bureaucrats familiar with the intricate detail and complexity of the treaty to spend enormous amounts of time in meetings which precluded the active participation of any responsible Assistant Secretary of State.

There were two general points of view which emerged in the review process. The first was advocated by the Deputy Assistant Secretary of State for Ocean and Fisheries Affairs, the most senior official responsible for the day-to-day conduct of the review. In essence, this point of view held that the treaty was flawed because it created adverse precedents for other negotiations on economic issues between developed and developing nations—the North-South dialogue—subjugated American industry to an international regulatory and management system, and was incompatible with President Reagan's apparent desire to return the United States to a period of power and influence in world affairs in which its policies would simply be enunciated rather than sold to others through a process of diplomacy and negotiation. I think it is also fair to say that proponents of this view did not believe that it was possible for any American to participate actively in the negotiation of this treaty without being seduced by it; therefore, they saw great risks in any return to the bargaining table even for the purpose of making a best effort. These views were strongly supported by staff on the domestic side of the White House, the Interior Department and some civilians in the defense establishment as well as some members of Congress.

The opposite point of view was represented by other agencies and participants in the process and by this author, who at the time was serving as a contract adviser to the Assistant Secretary of State, James L. Malone. That point of view can best be summarized as a recognition that the treaty in its present form was unratifiable, accompanied by a belief that the treaty could be

renegotiated it. From the seemed no h ways, because recognition countless oth would be a viewpoint felt by returning would have resulting trea

Another p responsible A would not be the overall n eral conferen All of their debated on represented opposition to Therefore, t interests thro realistic to sa

The latter States decid return to th These object which were negotiated a participated opment of rejoining th the President to make the in which it w them.

The instru preliminary interpretatio more constr

<sup>1</sup> In addition mining groups w were organized to delegation accept



renegotiated and that significant improvements could be made to it. From the perspective of those who held this point of view, there seemed no harm in trying to improve the treaty in fundamental ways, because ultimately a good treaty which provided universal recognition of mining claims as well as universal acceptance of countless other important legal principles contained in the treaty would be a worthwhile goal. Moreover, the proponents of this viewpoint felt that U.S. interests could not be compromised merely by returning to the negotiations, since the President ultimately would have to decide whether the United States should sign the resulting treaty.

Another point was made with respect to resuming negotiations: responsible American negotiators, acting under strict instructions, would not be lured into accepting a treaty which was contrary to the overall national interest. American negotiators at a multilateral conference generally do not operate in a vacuum or in secret. All of their tactical and strategic movements are discussed and debated on a daily basis with the wide array of U.S. interests represented on the U.S. delegation.<sup>1</sup> Opportunities for the loyal opposition to change the direction of the negotiations are legion. Therefore, the risk perceived by some of compromising national interests through an effort to renegotiate did not seem sufficiently realistic to sacrifice the opportunity to improve the treaty.

The latter view prevailed, and the President of the United States decided on January 29, 1982, that the United States would return to the negotiations and would seek six broad objectives. These objectives were then supplemented by detailed instructions, which were not sent to the President for approval but were negotiated among the various agencies of government which had participated in the initial process. Perhaps inevitably, the development of detailed instructions became a surrogate forum for rejoining the original issue which had already been decided by the President. The basic dispute over the instructions was whether to make them so strict and so confining as to produce a situation in which it would be impossible for American negotiators to satisfy them.

The instructions, when finally issued on March 8, long after the preliminary negotiations in New York had begun, reflected an interpretation of the President's objectives which was considerably more constrained than the objectives themselves. It is for this

<sup>1</sup> In addition to government agencies, all of the representatives of the American ocean mining groups were invited to participate fully in the work of the delegation; special efforts were organized to obtain the views of companies not able to be in New York, in advance of the delegation accepting any compromises.



## 1010 FOREIGN AFFAIRS

reason that many delegations at the Conference frequently found it difficult to understand the U.S. negotiating posture, since the President's public statement appeared to a reasonable reader to permit a far more flexible stance by the United States than was actually being presented. Other delegations did not understand that the U.S. delegation was operating under instructions containing a restrictive interpretation of the President's objectives and was under pressure to adhere to those instructions as the sole guidance for interpreting the objectives.

One final point should be made in connection with the policy review process which turned out to be of utmost importance in the end. Since one of the principal U.S. objectives was to secure access to the raw materials of the deep seabed, the question necessarily arose whether there was any alternative to a comprehensive treaty on the law of the sea which would adequately protect claimed mining rights so as to provide a stable basis for major financial commitments in support of deep seabed mining.

The proponents of withdrawal from the Conference argued forcefully that an alternative mini-treaty regime among the genuinely concerned industrialized countries—outside the framework of the comprehensive treaty—would be an adequate basis for investment even if a treaty on the law of the sea were adopted by a very large number of countries and entered into force. Those who favored returning to the bargaining table were divided on this issue. Some felt that under certain conditions a viable alternative mini-treaty regime could be established, but that the United States should nevertheless seek the comprehensive treaty solution. Others felt that an alternative mini-treaty regime would be resisted by our Western allies in the face of a treaty adopted by the vast majority of nations, including virtually all of the developing countries. Moreover, if a comprehensive treaty on the law of the sea entered into force for 100 nations or more, it was felt that ultimately mining companies would choose that regime—which would give the best color of title to their mining claims—rather than a separate mini-treaty regime.

Because views were divided among those who supported returning to the bargaining table, doubts about the realistic prospects for establishing an alternative mini-treaty were not forcefully put forward at the highest levels of government, although the issue appeared in the relevant documents as one on which there was disagreement. Related arguments were presented to support particular points of view. As a result, to the best of my knowledge, no



authoritative statement was ever made to the President and his close advisers that, if they wished to preserve direct access to strategic raw materials through American flag operations, there could in the end be no viable alternative to an improved comprehensive treaty on the law of the sea.

Accordingly, when a final decision was made and detailed instructions for the delegation were negotiated, there was an assumption in the Administration that if the United States adopted a tough uncompromising stance and as a result lost the opportunity to improve the treaty, it could afford to stay out of the treaty because there was a viable alternative—a separate mini-treaty with our allies. This assumption may have been the Achilles heel of the U.S. strategy for the last session of the Law of the Sea Conference. (Moreover, the strong U.S. public posture to push ahead with mini-treaty negotiations even before the Law of the Sea Conference began in March was a major factor in convincing the developing countries that the United States did not have a serious interest in the comprehensive treaty and thus worsened the chances for successfully negotiating the President's objectives.)

One further comment should be made in connection with the policy review process. The Department of Defense had in previous Administrations been a strong unyielding supporter of the successful conclusion of the treaty. It had always felt that the stability of international law which would accrue from this treaty, which contains many provisions favorable to the mobility of its air and sea forces, was a significant national security benefit when compared with the uncertainty of potential arguments with coastal states which might exist in the absence of this treaty.

During the Reagan Administration, however, two things changed in the Department of Defense. First, there was a much greater emphasis, particularly on the civilian side of the Department, on the importance of American access to strategic raw materials as a national security interest and, second, there was a belief that if the treaty finally entered into force without U.S. participation, most of those provisions which were favorable to the security of the United States would be accepted as customary international law, and that therefore the treaty rights would be available to all states whether or not they became parties to the treaty. In combination, these two views produced significantly less enthusiasm for the treaty within the Defense Department than had been the case before. This shift markedly changed the balance of power in the intragovernmental adversarial process. The as-



sumption that the treaty provisions would become customary international law was never seriously questioned—it was taken for granted.

## III

Out of respect for our power and influence, the world waited for the U.S. decision. The Law of the Sea Conference went into neutral gear, avoiding final adoption of the text which had been virtually completed in 1980 with apparent U.S. agreement. By the time President Reagan announced on January 29 that the United States would return to the negotiating table, U.S. negotiating leverage was substantial.

When the Conference resumed in March, the United States had its golden opportunity. The rest of the world was ready, willing and anxious to reshape important aspects of the treaty to attract U.S. support. Yet at the end, as has already been mentioned, the treaty was adopted over U.S. objections. The Soviet bloc abstention was prompted by a minor point, and the Soviets are likely eventually to sign the treaty. Two of America's closest allies, Japan and France, despite high-level pleas for solidarity, voted in favor—a startling and potentially powerful signal about Japanese postwar foreign policy development. West Germany, Britain and a handful of other Western allies abstained in support of the United States—but may well sign the treaty with or without the United States, for reasons which will be discussed later.

As described above, the United States returned to the bargaining table with instructions to fix every important defect in the seabed mining provisions—in short to convert the treaty into a “frontier mining code” in which the first company to stake a claim owns the resources and is not subjected to regulation or management except for the payment of taxes. This view was combined with a demand for overwhelming voting power for the United States and its closest allies in the proposed International Seabed Authority.

All of the improvements we sought were desirable and important. Some of them were fundamental to making the treaty commercially more workable. But the primary U.S. objective, in fact, was the eradication of ideological impurity. As a result, when the time came for compromise, the United States did not make ideological concessions to the Third World in exchange for pragmatic improvements. The Western allies maintained solidarity with the United States throughout the negotiations. In doing so, our allies, who in varying degrees share our ideological views—



but not our willingness to sacrifice concrete accomplishments for them—were deterred from negotiating more modest improvements on their own behalf.

Our strong stance on every issue (combined with public posturing in favor of an urgent separate mini-treaty) persuaded the bulk of Conference participants that the U.S. appetite was too great—no improvements were likely to satisfy us that could also be swallowed by the Third World. Many hoped up until the final hours that the United States would moderate its position on other issues, so as to create a fruitful negotiating climate. We did finally, but our concessions were small when measured against our remaining demands. Indeed, even the few concessions we offered brought cries of sellout from some in Congress, the mining industry, and elements of the Executive Branch.

The day-to-day negotiating process was monitored both within the delegation and back in Washington so closely by individuals who had supported the option of withdrawal from the Conference, that any negotiating move made by the American delegation was interpreted as a giant step down the slippery slope to compromise of principle and disaster. One of the individuals who held this view even believed that efforts at compromise which might ultimately fail and cause the United States to stay outside the treaty were in and of themselves dangerous precedents for other global negotiations. This particular individual alerted members of private industry (who also shared this perspective) to all U.S. delegation activities including new or contemplated U.S. proposals. Thus for every effort by the American delegation to find an accommodation that would help satisfy the President's objectives, there was a countereffort launched in Washington by those who had lost the battle to withdraw from the negotiations. These countermoves were executed as personal attacks on members of the American delegation, and as attacks on the process of negotiation itself, and were frequently marked by distortion and falsehood. The American delegation, meanwhile, was engaged in round-the-clock negotiations in New York and could not devote substantial attention to defending and explaining its actions in the face of increasing opposition in Washington which succeeded in obtaining a hearing at very high levels in the White House.

The American delegation was, therefore, held in check and did not make serious compromise proposals on many issues where genuine compromise might have produced far-reaching improvements in the treaty text. I would cite two examples: if the United States had not demanded virtually autocratic ruling powers over the Seabed Authority and had not sought the total elimination of



the so-called production ceiling (which in real economic terms is a cosmetic provision to reassure existing land producers of seabed metals that their production will not be wiped out by future seabed production), it would have been possible, perhaps easy, to have obtained major improvements in the practical effects of, and the principles contained in, the technology transfer provisions and the provisions which permit amendments to the treaty (after 20 years) without U.S. consent. When the U.S. position did reflect modest relaxation in some of these areas, the negotiators came very close to solutions for these latter two problems.

It should be borne in mind that those who did not want the United States to participate in the Conference may also have had as their underlying tactical objective a desire to ensure that the treaty was not improved, so as to make it more difficult for our Western allies to join the treaty and concomitantly to make it easier when the Conference ended in failure to obtain rapid agreement to an alternate mini-treaty regime.

The developing countries, however, sensed that these dynamics might be in process and virtually demanded an opportunity to negotiate the one issue on which they were prepared to make a concession so significant as to lure our allies into the treaty. Paralyzed by the rigidity of its instructions, the American Delegation had no choice but to play into the hands of the Third World strategy and negotiate the issue which the developing countries insisted be taken up first—the recognition of rights for mining companies who had already made investments in the seabed—"grandfather rights."

This was so because the issue of grandfather rights was considered by the entire Conference to be "outstanding" in that it had never been part of the 1980 package negotiated by Ambassador Elliot Richardson. Moreover, it was an issue on which significant progress could be made, while the issues the United States wished to renegotiate were among the most difficult. The developing countries hoped that if they made meaningful concessions on grandfather rights the U.S. mining industry would be pacified and would reduce its pressure on the U.S. government. In turn, they assumed the United States would reduce its demands.

The negotiations on the issue of grandfather rights resulted in a final Conference Resolution which successfully met some of our fundamental objectives—but more importantly may well have met the most central objective held by our closest allies. Under the Resolution, four existing mining consortia (each of which includes or is controlled by U.S. companies) plus projects sponsored by the governments of Japan, France, the U.S.S.R. and



India, would have guaranteed automatic access to the strategic raw materials of the seabed for the first generation of seabed mining. Altogether, ten seabed mining entities are entitled to all of the mineral production likely or possible from the seabed for the next 30 to 50 years: metal market projections indicate that demand for manganese, copper, cobalt and nickel from the seabed is unlikely to reach, much less exceed, the production capacity of these grandfathered miners during that period.

Thus—with the notable exceptions of mandatory technology transfer and the procedure for amending the treaty—the offensive ideological provisions of the treaty would not effectively apply before the middle of the twenty-first century. By that time there would have been a thorough treaty review and an opportunity to renegotiate.

Because the issue of grandfather rights dominated the negotiations, and because the negotiations were up against a deadline of April 30 (a consensus decision accepted by the Reagan Administration in 1981), opportunities to deal with issues other than grandfather rights did not arise until the final ten days of the session. Moreover, the procedure for the final session of the Conference was organized in such a way that between April 13 and April 30 the only amendments to the treaty which would have any chance of inclusion in the final draft would be those put forward by the president of the Conference, Ambassador T.T.B. Koh of Singapore, if he were satisfied that such amendments adequately enhanced the prospects for consensus.

Thus for a little over two weeks the president of the Conference held enormous power over the final treaty text. At the same time, it was his responsibility, and to his credit he took it seriously, to introduce amendments to the treaty only if they enhanced the prospects for consensus. He organized small groups for rapid, effective negotiations on other issues.

However, the atmosphere in this final stage was undoubtedly affected by an important exchange earlier in the Conference. Ambassador Koh had hoped that a set of proposed amendments put forward very early in the negotiations by a group of so-called "good samaritans"<sup>2</sup> would bridge the gap between the developing countries, on the one hand, and the United States and its Western allies on the other. He wanted both sides to accept these proposals—or at least not to reject them—so that at the end of the Conference he would be in a position to propose them for incor-

<sup>2</sup> Canada, Australia, New Zealand, Norway, Sweden, Denmark, Finland, Iceland, The Netherlands, Ireland, Switzerland and Austria.



poration into the final treaty text. For the United States, these papers moved significantly toward meeting the President's publicly announced objectives, although they fell far short of the American delegation's negotiating instructions. Verbatim acceptance of the good samaritan papers would have produced a treaty which on a fair reading of the President's objectives of January 29 would still have fallen short.

The crucial question was whether the United States was willing to send a strong signal that by and large these papers were on the right track, and with further negotiations and additional amendments might be acceptable. While the United States did not intend to reject these proposals out of hand, it stated its difficulties with these proposals in such strong terms as to lead Conference leaders to conclude that they had been rejected. In the vocabulary of diplomats, strong reservations to a proposal are generally considered to be a rejection. Thus, at a crucial halfway point in the Conference there may have been a tragic failure of communication.

After the United States apparently rejected the good samaritan papers as a basis for negotiations, the remaining weeks of negotiation were carried out by the president of the Conference in a desultory and pessimistic atmosphere, even though time permitted serious negotiation of the main issues of concern to the United States. Although the Group of 77 was maintaining a very tough posture in response to the U.S. stance, the job could have been done. But in an atmosphere where hope and optimism were lacking and U.S. commitment to the negotiation was doubted, it became virtually impossible for the president to pull a rabbit out of a hat.

He did, nevertheless, finally make a number of additional improvements to the treaty as a result of direct negotiations between the Western countries and the developing countries. For example, the United States is guaranteed a seat on the Executive Council of the new global institution, the Seabed Authority (assuming, of course, that the United States joins the treaty). The provisions for amending the seabed mining provisions of the treaty have been improved. The contract approval system for mining entities has less potential for abuse and discretion. The policy orientation of the Seabed Authority is slightly more favorable to mineral production, and the Seabed Authority must adopt rules and regulations for newly discovered seabed minerals once a nation capable of exploiting them makes a request—thus avoiding one of the fatal flaws in the previous draft treaty, a moratorium on these other minerals.



These achievements were modest, however, and did not rectify fundamental inequities and adverse precedents which the Administration quite properly opposed. Nevertheless, they may be sufficient to make the treaty very attractive to other Western industrialized countries who, while sharing our ideological views, are more interested in assured access to strategic raw materials and influence in global economic decision-making. Under the treaty, they will be guaranteed mineral access for a substantial period into the future and will play a large role in shaping the rules for seabed mining.

## IV

Perhaps the greatest irony for the United States is that, as a result of one further change in the last stages of the Conference, the treaty now authorizes, even commands, what the Third World had long vehemently opposed—a mini-treaty among those countries that wish immediately to resolve overlapping mine site claims and obtain global approval for their legal rights. But there is a catch. To obtain global approval, they must sign the treaty.

If nations fail to sign, and instead sign an *alternative* mini-treaty regime, they will provoke global disapproval of the lawfulness of their mining claims. The President of the Conference has vowed to challenge any alternative mini-treaty before the U.N. General Assembly and to seek an opinion of the International Court of Justice. The resulting protracted litigation would have a chilling effect on seabed mineral investment.

For this reason among others, in my judgment Japan, France, West Germany, Britain and most other potential seabed mining nations ultimately will sign the Law of the Sea Treaty and a mini-treaty *among themselves* which will dovetail with the treaty. In any event, our allies will surely make certain that any such mini-treaty preserves their option to sign the Law of the Sea Treaty. They will do so because the Law of the Sea Treaty creates unchallengeable rights, superior to those created by a mini-treaty. Absent U.S. ability to persuade our allies to sign a permanent mini-treaty as an alternative to the treaty, the United States ultimately will be abandoned by its allies, who would be prohibited from recognizing U.S. mine site claims once they have signed the treaty.<sup>3</sup>

This point is crucial, because I believe the U.S. decision not to compromise ideological issues was founded on an assumption that

<sup>3</sup> Article 137, paragraph 3, of the treaty prohibits states from recognizing seabed mining claims which are not derived from the treaty and its rules and regulations. Under customary international law principles of treaty interpretation, a state which signs a treaty is bound not to act incompatibly with it pending its ratification and entry into force.



after the Conference ended, the Western industrialized countries would ignore the Law of the Sea Treaty and set up an alternate mini-treaty. This approach presumably assumed that a mini-treaty would include all potential seabed mining countries and therefore would provide sufficient legal security to attract the billions of dollars of private capital necessary to set up commercial mining operations. I suspect that if William Safire had understood that this outcome was, at best, improbable and unworkable, he would not have suggested in *The New York Times* on April 9, 1982, that the United States should shelve the treaty negotiations. I believe that if President Reagan understood the realistic prospects for an alternative mini-treaty regime, he too would have had second thoughts about the pursuit of principle over pragmatism.

U.S. policymakers may have also made another assumption which could prove dangerously false: that the United States could stay outside the treaty but claim and enjoy its numerous beneficial provisions (which, among other things, establish rights to the 200-mile economic zone, guarantee to every coastal state broad jurisdiction over its continental shelf, and provide for freedom of military and commercial navigation within the economic zone and through and over international straits)<sup>4</sup> and that these claimed benefits would be accepted by other nations because the treaty reflects custom—an accepted way of formulating international law.

I do not believe that serious consideration was given to the possibility that the contrary argument could be made—that the Law of the Sea Treaty only creates rights for those who are parties to it and who assume the treaty's obligations. Let us look at just a few examples.

The Strait of Gibraltar is critical to the passage of surface and submerged vessels and to overflight by aircraft of the United States. Spain, which is the relevant coastal sovereign, might argue that the 12-mile territorial sea has become part of customary law (a view very widely held in the world community). At the same time, Spain might argue that the regime of enlarged "transit

<sup>4</sup> In addition, coastal state rights to control offshore pollution as well as shipping state rights within coastal waters are covered by the treaty. Similarly the rights of marine scientific researchers and coastal states are set forth in the treaty. Space does not permit an exhaustive listing of the hundreds of legal rights and obligations which create the overall balance of sea law in the treaty. Suffice it to say that virtually all uses of the oceans are affected by the legal rights and obligations set out therein.

*Editor's Note:* The many issues considered by the Third Law of the Sea Conference have been the subject of a number of articles in *Foreign Affairs* from varied standpoints. See, most recently, Elliot L. Richardson, "Power, Mobility and the Law of the Sea," Spring 1980, pp. 902-919; Richard G. Darman, "The Law of the Sea: Rethinking U.S. Interests," January 1978, pp. 373-395; Jonathan I. Charney, "Law of the Sea: Breaking the Deadlock," April 1977, pp. 598-627; John Temple Swing, "Who Will Own The Oceans?," April 1976, pp. 527-546.



passage" through international straits is new to international law—that it is found only in the Law of the Sea Treaty and is thus a contract among the parties to it. Thus Spain would argue that the old rule permitting only "innocent passage" in the territorial sea would apply—which prohibits submerged navigation. This is not the time or place to attempt to prejudge the outcome of such an argument. What is dangerous for the United States is the existence of the argument and the potential uncertainty of its military rights in narrow seas during times of crisis.

A second example could be that coastal states may choose to impose stricter regulations on oil tankers flying a U.S. flag, arguing that they have a right to discriminate against non-parties to the treaty. Third, in a Middle East crisis Arab countries might be tempted to seize on U.S. non-participation in the treaty as an excuse to attempt to limit our activities within their economic zones.

Thus, for those nations who eschew the treaty obligations, while treaty rights may be claimed as a matter of customary law, they may also be contested (even by obstructive action) and in any case challenged in protracted litigation before the International Court of Justice. That Court may one day resolve America's rights to freedom of navigation, with the possibility that the successful ten-year negotiating effort to gain these rights could conceivably be lost in a single court decision.

v

One final point remains. The totality of the seabed mining provisions of the treaty are hard to defend on the merits. I am a conservative who sympathizes with the Reagan Administration's criticisms of the Law of the Sea Treaty. Presumably that is why the Reagan Administration asked me to join the effort at renegotiation. While I am certain that the final treaty would have better satisfied U.S. interests had the Administration been less ideologically rigid in its approach, I also would be the first to acknowledge that the best that could have been done would have involved important compromises of principle.

But the dilemma for the United States now goes far beyond the specific flaws in this treaty. In time—probably sooner rather than later—our allies, the Soviet bloc and the Third World will sign and ratify the treaty. They see a long-term future in the treaty, and they will want to be part of it. They will want to protect "grandfather rights" for their companies, secure international approval for broad jurisdiction over their continental shelves, have a voice in organizing, staffing and drafting the rules of the new



Seabed Authority, and lay to rest numerous other potential disputes about varying uses of ocean space and resources.

If the Western industrialized powers, minus the United States, join the Soviet bloc and the Third World, they will create an historic global organization—one which for the first time regulates, manages and produces globally shared resources. One day this institution could use its taxing power to become self-financing. Should all this occur without American influence, participation and leadership, our nation will suffer a much more serious adverse precedent than any of the adverse precedents we fought against in the treaty negotiation itself. We will stand as the emperor without clothes—for the entire world will see that it can do amazing and stupendous things without American money, leadership or technology. If the United States is not part of the treaty system, American companies will have to go to other countries to be able to conduct business in the seabed. As a result, the United States will lose direct access to strategic raw materials from the seabed, a goal it has sought consistently throughout the ten-year law of the sea negotiations.

In short, the guardians of pure conservative ideology may have won a battle when the United States stood alone at the Law of the Sea Conference, but the United States may lose a very important war.

## VI.

If one accepts the thesis that our Western allies will join the Law of the Sea Treaty and refuse to create a mini-treaty with us; that our companies will flee to other flags so as to operate under the treaty and gain universal acceptance of their mining claims; and that vitally important freedoms of the seas will now be subject to legal argument and potentially will be decided by the International Court of Justice adversely to our interests, then the United States is compelled to examine any remaining option to improve the treaty and sign it, and should not simply walk away from the treaty in the misguided hope that it will evaporate.

In September 1982 the Law of the Sea Conference will convene in New York to approve the final recommendations of its drafting committee. If the United States were willing to mount a major diplomatic initiative between now and then to obtain consensus approval for a few amendments relating to discrete issues—such as the process for amending the treaty, the mandatory transfer of private technology, and clearer provisions for the separation of powers between the one-nation, one-vote Assembly and the Executive Council (on which we now have a guaranteed seat)—I



believe there is a chance for success, and I also believe there would be a good chance to persuade the Senate to advise and consent to the treaty.

This approach is conditioned on the proposition that during the same time period the wider business community—not just a handful of mining companies, but scores of American corporations with far-flung global interests and a direct concern with the risks presented by isolationism and worsening U.S. relations with the Third World—will enter this policy debate and make their views known forcefully.

In a recent appearance before the Association of the Bar of the City of New York, the President of the Conference, in response to a question whether additional amendments would be admitted in September, replied that he was a "servant of the Conference" and would, of course, not impede a consensus decision to make further amendments.

In any event the United States should avoid premature breaking of ties with the Conference. We should attend the drafting committee meeting this summer (where incidentally the United States serves as Chairman of the English Language Group), we should attend the signing session in Caracas in December 1982, and we should sign the final act of the Conference, a step which has no legal significance except that it gives us the right to attend the Preparatory Commission as observers when it writes the rules and regulations of the new global Seabed Authority.

If, finally, the President decides that the United States should not sign the treaty after making one last effort to improve those of its provisions which are true impediments to its ratification—so be it. But my prediction is that eventually a future U.S. President will sign it, and its content will be worse than if we had compromised a little now on principle to gain additional benefits.

If my political analysis is correct, this or some future Administration will come to understand that the costs of isolation are far higher than the costs of accepting some of the rhetoric and principles of the North-South dialogue. And when the United States does eventually join, the rules of the game will already be set and our industrial competitors will be operating in the seabed and will have gained by then major political and economic advantages in the work of the new institution.

Our senior foreign policy makers should understand that once leadership is abdicated and the world finds that it can proceed without us, it will not be easy for the United States to reclaim its influence.



6/30/82  
To : Bill Barr  
From : Bob Keating

SUBMARINE HOT SPRINGS AND METAL SULFIDE DEPOSITS  
ON THE SOUTHERN JUAN DE FUCA RIDGE

By

Randolph A. Koski  
William R. Normark  
Janet L. Morton

U.S. Geological Survey, Menlo Park, CA

and

John R. Delaney

University of Washington, Seattle, WA

OCEANUS, in press.



## INTRODUCTION

Oceanic ridges are submarine mountain ranges formed at the boundaries between oceanic plates by the process of seafloor spreading. Since 1978, active hot springs and metal-rich sulfide deposits have been discovered and sampled at several localities where the rate of spreading at the ridge crest is medium to fast, for example, the East Pacific Rise, the Galapagos Rift, and the Juan de Fuca Ridge (Figure 1). The mineral deposits are forming where heated seawater carrying large amounts of dissolved metals and sulfur exits from the seafloor, frequently with enough force to produce particle-filled clouds or "black smokers" above the vents. The metals, mainly zinc, iron, copper, lead, silver, and cadmium, combine with sulfur and precipitate from solution as metal sulfide deposits. The precipitated sulfide minerals accumulate in platforms and mounds that are commonly topped by towering chimneys composed of sulfide and sulfate compounds.

Under the sulfide deposits are newly formed volcanic rocks or sediment that form in the axis of the spreading center. In addition to concentrations of valuable minerals, the deep-sea hot springs support remarkable animal communities including clams, crabs, and tube worms. A description of hydrothermal vents and associated sulfide deposits on the southern Juan de Fuca Ridge is presented here; other discoveries along the East Pacific Rise and Galapagos Rift are described elsewhere in this volume by Malahoff.

The Juan de Fuca Ridge is a 500-kilometer-long medium-rate spreading center that separates the Juan de Fuca and Pacific oceanic plates off the coast of Oregon and Washington (Figure 2). The southern end of the ridge is



terminated by the Blanco Fracture zone, a transform fault that displaces the southern extension of the ridge approximately 350 kilometers to the east, where it is known as the Gorda Ridge. In September 1981, a research team with members from the U. S. Geological Survey and the University of Washington successfully located hydrothermal vents and dredged samples of sulfide mineral deposits from a water depth near 2200 meters at the southern end of the Juan de Fuca Ridge. This southern segment of the ridge was chosen for the survey because it is geologically uncomplicated and has a relatively fast spreading rate (the plates are separating at a rate of 6 centimeters per year) similar to that at other ridges known to have hydrothermal vents and sulfide deposits. Furthermore, a previous seafloor survey by the University of Washington revealed evidence of recent volcanic activity, and the presence of small bottom dwelling organisms called benthic siphonophores that are also known to inhabit hot spring sites at other places.

During the 1981 cruise to the southern Juan de Fuca Ridge, normal navigational methods for the USGS research vessel S. P. Lee were augmented by an acoustic transponder array placed along the axial valley. This additional instrumentation assured tight fixes on locations of the ship and deep tow apparatus, and provided accurate ship positions for bathymetric mapping during each crossing of the ridge. A bathymetric map of the study area with a contour interval of 25 meters was compiled from echo sounder data recorded during the 1981 cruise and from a prior USGS cruise to the area in the fall of 1980.

The vent sites were discovered by photography accomplished by a camera mounted on a sled and towed behind the ship. The camera system, built at the University of Washington, uses two 35-millimeter cameras housed in a tube steel cage designed to be towed about 5 meters above the seafloor. The



cameras operate individually and consecutively; approximately 7300 black and white and 900 color photographs were taken during a series of 12 four and one-half hour deeptows across the study area. A pinger device mounted in the camera sled provided a continuous record of the height of the camera above the seafloor as well as a fine-scale trace of bottom topography.

Samples of volcanic rock and hydrothermal deposits were recovered with a circular-frame chain-bag dredge equipped with a relay transponder and pinger to fix its position relative to the ship and the seafloor. At dredge stations over vent sites, the dredge was towed near the seafloor to the vent site where it was quickly dropped to the bottom and dragged across the vent area before being pulled clear of the bottom. During the cruise, eleven dredge stations recovered fragments of fresh, glassy basalt. The twelfth successful station recovered several hundred kilograms of basalt and 12 kilograms of massive metal sulfide.

#### GEOLOGIC SETTING

The southern Juan de Fuca Ridge has a simple profile (Figure 2): a smooth and flat, 1-kilometer wide axial valley enclosed by symmetrical steep valley walls and ridges; the relief between ridge top and valley floor is 80 to 100 meters. The valley walls and a low terrace about 30 meters above the valley floor are related to steep normal faults formed during pull apart of the two adjacent plates.

Bottom photographs and pinger records show that the planar valley floor has a narrow and sharply defined medial depression that is nearly continuous in the northern part of the study area (Figure 2). This topographic feature is 50 to 200 meters in width, has a maximum depth of 25 meters, and may have formed by collapse of a lava lake or by faulting.



Bottom photographs also show that the flat axial valley floor is made up largely of thin sheet flows of basaltic lava. Sediment cover is minimal in the current-swept trough. The sheet flows are flat lying with a ropy surface texture referred to as pahoehoe lava. Dredged samples of fresh basalt have unaltered glassy surfaces indicating that the volcanic rocks are less than a few hundred years old. Alteration is limited to coatings of iron and manganese oxides on exposed surfaces and fractures. Pillowed lavas are not abundant on the valley floor, but are present in the valley walls. Away from the central depression, collapse pits and open cracks or fissures in the valley floor are uncommon. The surficial appearance of the axial valley of the southern Juan de Fuca Ridge contrasts with the axial zone of the East Pacific Rise at 21°N latitude and the Galapagos Rift where a complex fault-block terrane and pillowed lavas are typical.

#### HYDROTHERMAL VENTS

Five hydrothermal vent sites were observed in bottom photographs taken within the axial valley in the northern half of the study area (Figure 2): four are within or along the edges of the axial depression and the fifth occurs at the base of the eastern valley wall. An additional hydrothermal discharge, or hydrothermal plume, was indicated by high amounts of dissolved manganese in water samples taken at a location near the center of the study area where no vent deposits were observed on photographs. Visible photographic evidence of a vent site consists of multicolored crusts, ledges, and mounds of hydrothermal material and concentrations of bottom-dwelling organisms such as clams, worms, and crabs.



The hydrothermal material is easily identified in black and white photographs (Figure 3). It consists, in part, of a light-colored, easily dispersed precipitate that forms a loose surficial cover over volcanic rock or older hydrothermal deposits. Low-lying ledges and small mounds of darker, stony-looking sulfide make up the bulk of the hydrothermal deposits. Chimney structures constructed of sulfides are not abundant, and no black smokers were observed. However, in a few photographs (for example, Figure 3) the bottom water has a cloudy appearance suggesting that the camera was positioned near an active hot spring.

Within the vent sites, small-diameter worm tubes occur in clusters or as solitary individuals that extend upward in the water column from depressions and cracks in the hydrothermal deposits (Figure 4). An abundant, but unidentified fauna(?) seen in many photographs including Figure 4 is commonly concentrated in low areas around small sulfide mounds. Small clams and scattered clam shell debris are also present in many photographs.

The ledges and mounds of light and dark hydrothermal precipitates with abundant tall worm tubes are probably located in close proximity to the actual vents of hydrothermal discharge. Clam shells, crabs, and thin coatings of the light-colored hydrothermal precipitate are common features near the periphery of the vent areas. The worm tubes, clams, and other organisms from the Juan de Fuca study area appear to represent less robust life forms than those associated with hot springs on the East Pacific Rise.



## COMPOSITION AND FORMATION OF SULFIDE DEPOSITS

The sulfide samples recovered from the southern Juan de Fuca Ridge are porous crystalline aggregates of zinc, iron, copper, and lead sulfide. Two types of sulfide were recovered: (1) angular slabs of somewhat friable and granular dark-gray zinc sulfide with an upper crust and interlayers of iron sulfide (Figure 5A); and (2) rounded fragments of hard spongy-textured light-gray zinc sulfide (Figure 5B). The dark-gray sulfide samples consist largely of the minerals sphalerite (cubic  $\text{ZnS}$ ), wurtzite (hexagonal  $\text{ZnS}$ ), and pyrite (cubic  $\text{FeS}_2$ ), with minor marcasite (orthorhombic  $\text{FeS}_2$ ), galena ( $\text{PbS}$ ), and chalcopryrite ( $\text{CuFeS}_2$ ). Minor nonsulfide minerals include anhydrite ( $\text{CaSO}_4$ ), gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ), barite ( $\text{BaSO}_4$ ), and amorphous silica ( $\text{SiO}_2$ ). These minerals generally occur as thin films or clusters of elongate crystals in cavities.

Sphalerite is the most abundant sulfide mineral and has two forms. It is present as globular or "colloform" crystals with an internal construction of delicate growth bands, and as angular overgrowths that project into open space (Figure 6A). Wurtzite, in contrast, forms shiny six-sided crystals with broad growth bands (Figure 6B), and is abundant in cavities. The two zinc sulfide minerals are present because one of them (wurtzite) is only temporarily stable (metastable) or because slight variations in the composition of the mineralizing solution favored the crystallization of one mineral and then the other. Sphalerite and wurtzite are also abundant minerals in the sulfide mounds and chimneys at  $21^\circ\text{N}$  latitude on the East Pacific Rise.

In dark-gray sulfide samples, the iron sulfide minerals pyrite and marcasite occur as lenses, clusters, and discontinuous layers of globular crystals enclosed by zinc sulfide. Galena and chalcopryrite form small angular inclusions in zinc sulfide minerals. The iron sulfide crusts have a thin



orange-red film of oxidation suggesting that these surfaces were in contact with oxygen-rich seawater on the seafloor. The opposite surfaces of dark-gray sulfide slabs are jagged and free of alteration; the fragments probably were broken away from the seafloor along these surfaces during the dredging operation.

Several samples of dark-gray zinc sulfide contain numerous closely-spaced, 1-centimeter-wide tubes (Figure 5C) left behind by burrowing organisms, probably the larger wormlike animals observed in bottom photographs. Although no organic material remains, the tube walls have a consistent zonation: outer and inner walls of pyrite enclose a flaky layer of silica. The tubes may be empty or partly to completely filled with zinc and iron sulfides. Sulfide crusts within tubes suggests that the tubes were channels for mineralizing fluids after abandonment by organisms.

The light-gray sulfide samples consist of pale-gray to colorless sphalerite in a spongy aggregate of branching and dendritic growth forms. Abundant irregular cavities result in a high porosity, 30-35 percent. The cavities appear to result from the mineral growth pattern rather than the presence of organisms. A few scattered grains of pyrite are embedded in the sphalerite; copper and lead sulfide minerals are absent. Unlike the dark-gray sulfide where cavities contain clusters of wurtzite crystals, the cavities in light-gray sulfide samples contain spherules or thin coatings of silica, scattered prisms of barite, and rare patches of iron oxide.

Microscopic studies reveal that the dendritic sphalerite is locally colloidal with delicate internal growth banding (Figure 6C). The color variation in the bands is the result of variations in the ratio of iron to zinc and the amount of intergrown silica in the zinc sulfide mineral. The light color of this sphalerite indicates a lower iron content than the sphalerite and wurtzite in dark-gray sulfide samples.



The bulk chemical compositions of dark- and light-gray sulfide samples are shown in Table 1. Both types of sulfide are rich in zinc, silver, and cadmium; on land these deposits would be considered to have ore-grade concentrations of these metals. The copper concentrations of both dark-gray and light-gray sulfide are lower, and the lead concentration of dark-gray sulfide is higher than the amounts of these elements in sulfide deposits from the East Pacific Rise and the Galapagos Rift. The zinc-rich sulfide samples from the Juan de Fuca Ridge may have been recovered from the lower temperature top or edge of the massive sulfide deposit; higher temperature copper-rich sulfide may be present at the base of the massive sulfide deposit, closer to active vents, or in fractures within the underlying volcanic rock.

The presence of hydrothermal deposits on the Juan de Fuca Ridge results from the large-scale circulation of seawater through the oceanic crust along the tectonically active axis of spreading (Figure 7). The movement of fluid within the circulation cell is related to high heat flow emanating from a nearby heat source, presumably a body of basaltic magma emplaced at a shallow level (1 to 2 kilometers) below the ridge. This magma also supplies the lava extruded as sheet flows on the axial valley floor. The fluid circulation begins on the flanks of the ridge where normal oxidizing seawater penetrates into the cooling basaltic oceanic crust. As the fluid becomes heated and chemically interacts with the basaltic wallrock, it evolves into a reducing and somewhat acidic solvent capable of extracting and transporting sulfur, iron, manganese, and other metals. Near the ridge axis, the high temperature, metal-rich fluid is quite buoyant and rises along permeable zones, probably normal faults or rock fractures that crosscut the volcanic rocks of the axial valley floor. Metal sulfides may be precipitated along channelways below the seafloor as the ascending fluid cools during mixing with cooler seawater.



However, vigorous fluid flow through the shallow linear depression results in discharge of hot fluid onto the seafloor and deposition of massive sulfide deposits. Further mixing of the hydrothermal solutions with seawater has produced accumulations of iron and manganese oxide on basalt surfaces surrounding the sulfide deposits.

#### RESOURCE POTENTIAL AND IMPLICATIONS FOR FUTURE RESEARCH

The resource potential of hydrothermal sulfide deposits on the Juan de Fuca Ridge and other spreading centers is made uncertain because of short- and long-term economic, political, and technological questions. The problems are addressed by other authors in this issue of OCEANUS. Even more fundamental, perhaps, is the need for more information regarding the distribution, occurrence, and composition of deposits elsewhere on the oceanic ridge system.

At least five vent sites were observed in the northern half of the 12-kilometer-long USGS study area of the Juan de Fuca Ridge during the 1981 cruise. The deposits appear to form shallow ledges less than 1 meter high, with occasional mounds of somewhat greater thickness. The width of the deposits traversed is 25 to 50 meters, but their dimension parallel to the valley is uncertain. However, their presence in all traverses in the northern part of the area suggests the sulfide deposits have a nearly continuous distribution along the linear depression. These rough dimensions and the composition of the samples recovered imply that approximately 100,000 cubic meters or 250,000 metric tons of zinc- and silver-rich sulfide may lie within the study area. Because of the similarity in spreading rate and ridge morphology, it is reasonable to believe that additional deposits are located along the segment of ridge axis north of the study area.

Metal sulfide deposits along oceanic ridges may be analogous to massive sulfide deposits found in basaltic rock sequences (ophiolites) on land. Ophiolites are layered sequences of mafic and ultramafic rocks that have lithological, structural, and geophysical characteristics similar to modern-day oceanic crust. Ophiolites are thought to be fragments of ancient oceanic crust and upper mantle that formed during seafloor spreading and were subsequently uplifted onto and incorporated into the margins of continental land masses.

The upper parts of ophiolite sequences, especially the pillow lavas, host massive iron-copper-zinc sulfide deposits. Deposits of this type have been mined for copper, gold, silver, iron, and sulfur in Cyprus, Turkey, Oman, the United States, and many other countries. The deposits in ophiolites range in size from a few thousand to 20 million tons of ore containing 0.5 to 10 percent copper, 0.5 to 3 percent zinc, and a few ounces of gold and silver per ton. Ore-grade concentrations of cobalt may also be present. The sulfide mineral assemblage is characteristically simple: abundant pyrite with minor chalcopyrite and sphalerite.

Massive sulfide deposits in ophiolites may represent hydrothermal mineralization at ancient oceanic spreading centers. The massive sulfide orebodies are commonly underlain by a network of sulfide veins, referred to as stockwork mineralization, that may extend to depths of one kilometer or more. The massive and stockwork zones are thought to represent mineralization on the seafloor and in the underlying hydrothermal feeder system, respectively.

Geological and geophysical investigations of the active hydrothermal vents and sulfide deposits on modern spreading centers such as the Juan de Fuca Ridge, will provide valuable information on the origin, occurrence, and



distribution of mineral deposits in ophiolites. For example, the spacing and distribution of sulfide deposits on ocean ridges appear to be related to deep-seated normal faults that form during the spreading process. This association has already been recognized at mining districts in the Troodos Ophiolite Complex in Cyprus (Figure 8), and should be applicable during mineral exploration programs in other ophiolite terranes.

The discovery of hot springs presently depositing metal sulfide deposits on volcanically and tectonically active segments of seafloor presents an especially unique opportunity to apply the Uniformitarian Principle of Geology--"the present is the key to the past"--to several disciplines within the earth sciences. Continued research on the mid-ocean ridge system will stimulate and improve our concepts in such diverse fields as volcanology, evolutionary biology, ore genesis, mineral exploration, and deep-seabed mining.

## SELECTED READINGS

- Adamides, N.G., 1980, The form and environment of formation of the Kalavassos ore deposits--Cyprus, in Panayiotou, A., ed., Ophiolites: Proceedings of the International Ophiolite Symposium, Cyprus, 1979, p. 117-127.
- Bonatti, Enrico, 1981, Metal deposits in the oceanic lithosphere, in Emiliani, Cesare, ed., The Sea, v. 7: John Wiley and Sons, New York, p. 639-686.
- Coleman, R. G., 1977, Ophiolites: Springer-Verlag, New York, 229 p.
- Francheteau, J., Needham, H. D., Choukroune, P., Juteau, T., Seguret, M., Ballard, R. D., Fox, P. J., Normark, W., Carranza, A., Cordoba, D., Guerrero, J., Rangin, C., Bougault, H., Cambon, P., and Hekinian, R., 1979, Massive deep-sea sulfide ore deposits discovered on the East Pacific Rise: *Nature*, v. 277, p. 523-528.
- Haymon, R. M., and Kastner, Miriam, 1981, Hot spring deposits on the East Pacific Rise at 21°N: Preliminary description of mineralogy and genesis: *Earth and Planetary Science Letters*, v. 53, p. 363-381.



Hekinian, R., Fevrier, M., Bischoff, J. L., Picot, P., and Shanks, W. C.,  
1980, Sulfide deposits from the East Pacific Rise near 21°N: Science, v.  
207, p. 1433-1444.

Le Pichon, Xavier, 1968, Sea-floor spreading and continental drift: Journal  
of Geophysical Research, v. 73, p. 3661-3697.

Macdonald, K. C., and Luyendyk, B. P., 1982, The crest of the East Pacific  
Rise: Scientific American, p. 100-116.

Riddihough, R. P., 1978, The Juan de Fuca plate: EOS, v. 59, p. 836-842.

Table 1.

Results of bulk chemical analysis by atomic absorption spectroscopy.

| <u>Sample No.</u> | <u>WF-22-D-1</u> | <u>WF-22D-3</u> |
|-------------------|------------------|-----------------|
| <u>Element</u>    |                  |                 |
| Zn (wt%)          | 54.0             | 59.2            |
| Fe (wt%)          | 8.0              | 1.8             |
| Cu (wt%)          | 0.32             | 0.07            |
| Pb (wt%)          | 0.25             | 0.06            |
| Ag (ppm)          | 290              | 230             |
| Cd (ppm)          | 490              | 1060            |
|                   |                  |                 |

WF-22D-1: Dark-gray massive zinc sulfide with minor pyrite.

WF-22D-3: Light-gray spongy zinc sulfide.



## FIGURE CAPTIONS

Figure 1. Pacific Ocean spreading centers and locations of massive sulfide deposits (solid dots). DSDP locations refer to Deep Sea Drilling Project drill holes that intersected sulfide deposits below the seafloor.

Figure 2. Oblique map of the southern Juan de Fuca Ridge showing the central depression, hydrothermal vents, and probable hydrothermal plume indicated by water sampling. The USGS study area is shown on the inset regional map.

Figure 3. Bottom photograph of hydrothermal vent fields, showing shallow ledges of light and dark hydrothermal deposits. The light material is a loose surficial precipitate; the dark material is a thicker deposit of stony zinc-rich metal sulfide. The cloudy appearance of the water in the left side of the photograph may indicate an active hot spring. The scale represents approximately 1 meter.

Figure 4. Bottom photograph showing solitary worm tubes attached to depressions or cracks in underlying hydrothermal deposits. An unidentified fauna (?) is concentrated in low areas around small dark sulfide mounds. The scale represents approximately 1 meter.

Figure 5A. Cross-section of dark-gray zinc sulfide slab with interlayers and crust of iron sulfide. Iron sulfide crust has thin film of oxidation.

Figure 5B. Spongy-textured rounded fragment of light-gray sulfide composed mainly of dendritic sphalerite.

Figure 5C. Dark-gray sulfide sample crosscut by numerous worm tubes partly to completely filled with zinc sulfide.

Figure 6A. Microscopic view of delicately-banded colloform sphalerite overgrown by angular crystalline sphalerite in dark-gray sulfide sample. Field of view is approximately 1 millimeter across.

Figure 6B. Microscopic view of broadly zoned hexagonal wurtzite crystals in dark-gray sulfide sample. Field of view is approximately 0.5 millimeter across.

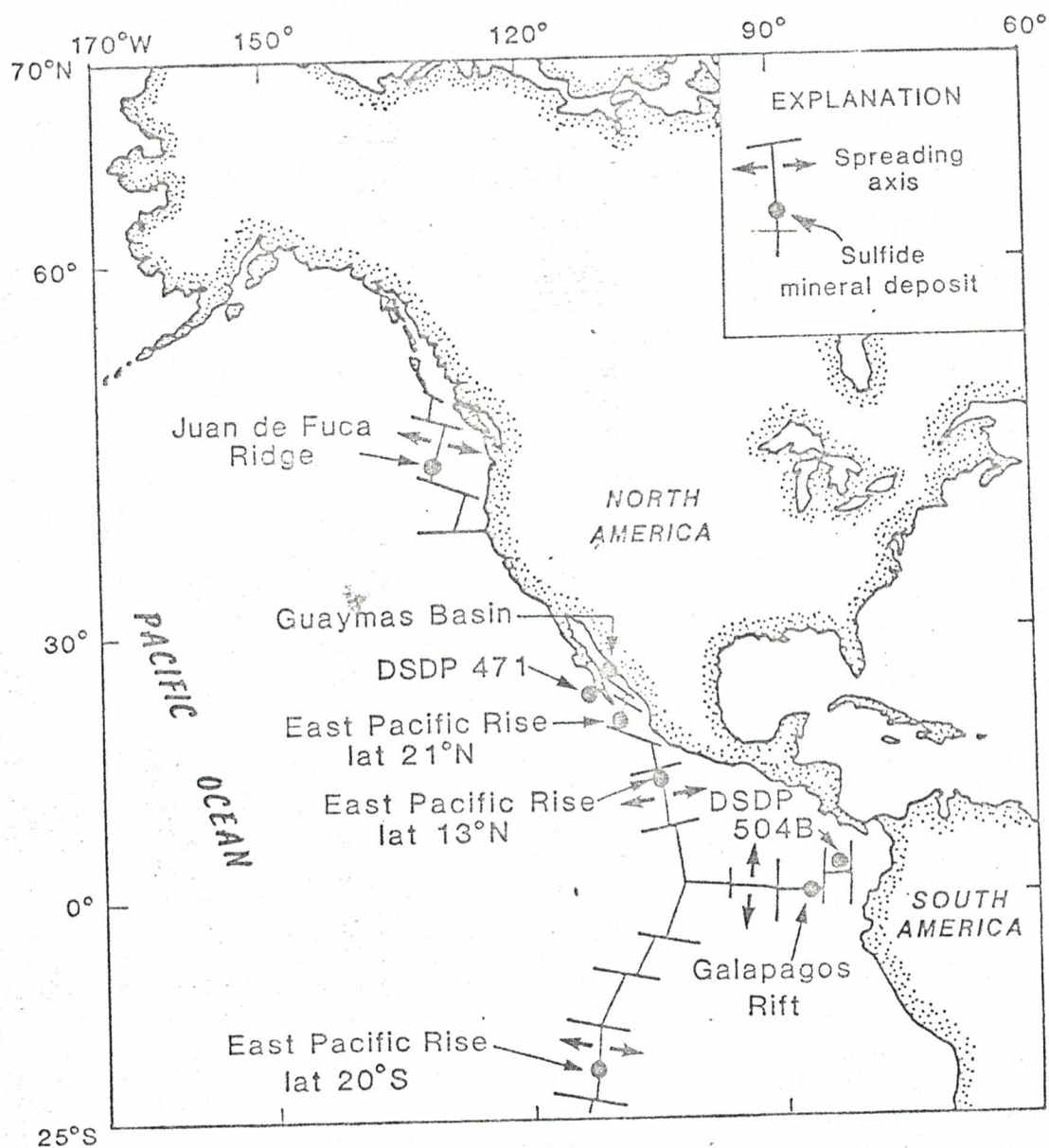
Figure 6C. Microscopic view showing low-iron colloform sphalerite in light-gray sulfide sample. Field of view is approximately 1 millimeter across.

Figure 7. Model showing circulation of seawater through oceanic crust at a spreading center, and deposition of massive sulfide and oxide deposits on the seafloor. The circulation is driven by a heat source at depth, presumably a body of magma emplaced below the axis of spreading.

Figure 8. This simplified diagram shows the relationship of massive sulfide deposits in Cyprus ophiolite to faults created at an ancient spreading center. Adapted from N.G. Adamides (1980).



Figure 1



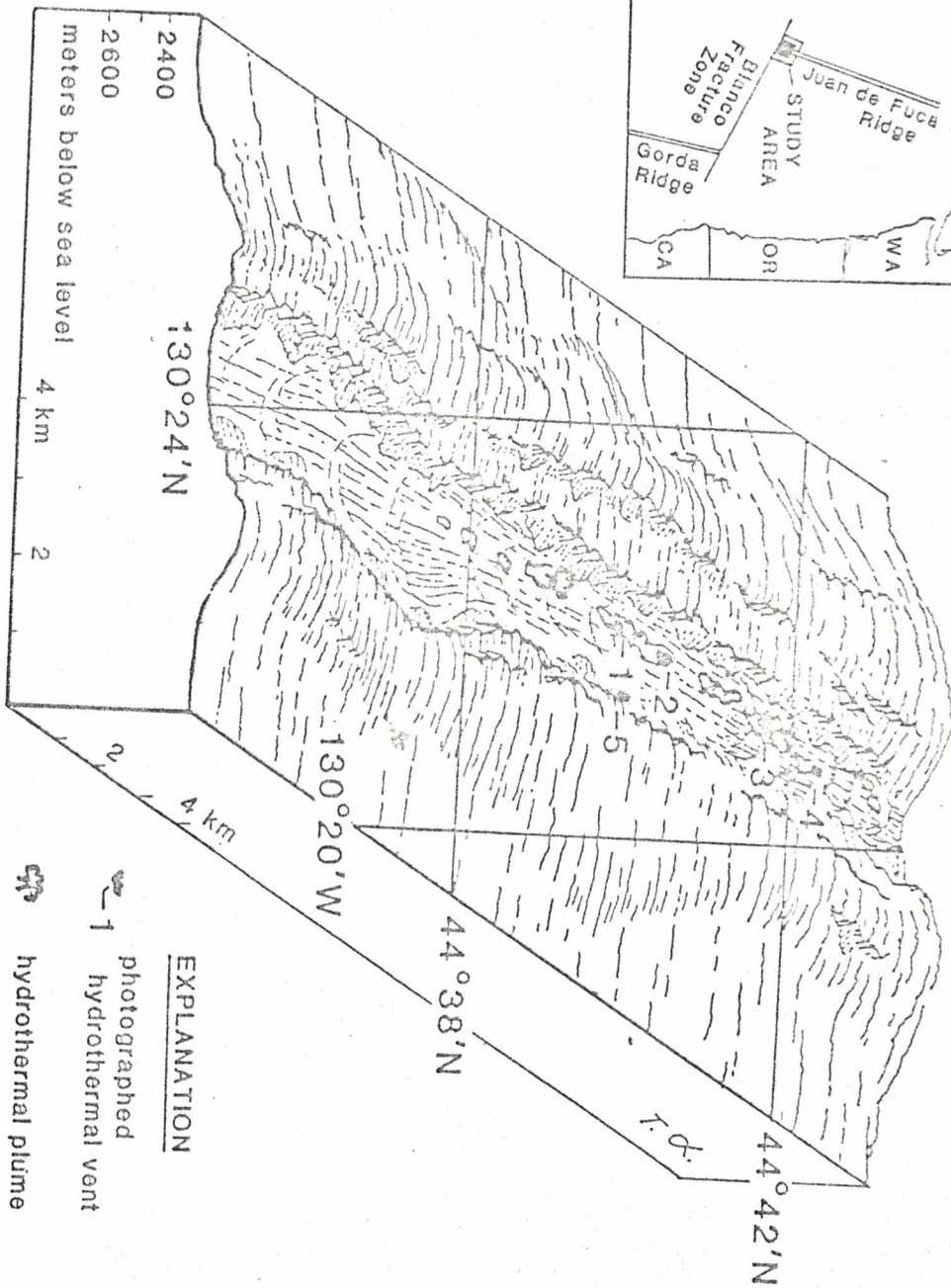
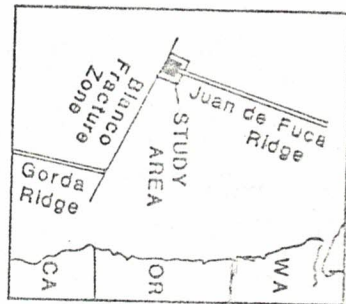




Figure 3





Figure 4

