

REPORT ON DEEP SOURCE GAS WORKSHOP

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Division of Gravity, Geothermics and Geodynamics

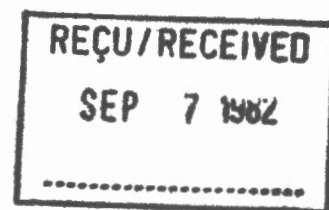
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Report on Deep Source Gas Workshop

May 3 - 4, 1982

Sponsored by U.S. Dept. of Energy, Morgantown Energy
Technology Center, Morgantown, WVa.

Purpose: To assess the possible existence of "deep" methane and to formulate a research programme to detect such gases, to determine where they may be concentrated, and to assess whether these concentrations may have economic potential, either currently or in the future.

Premise: Methane may exist at, or may be generated from, depths below those at which commercial production has been established. The petroleum industry considers "deep" to be in excess of 15,000 feet. Other definitions extend to the depths of the upper mantle.

Three processes may lead to deep gas formation:

- a) Primordial carbon exists in some form in the earth's mantle from the original planetary accretion. This carbon is available for combination with free hydrogen either in the mantle, or at shallow depths, for methane formation;

- b) In plate-margin subduction, large volumes of sediments are subducted to great depths, together with ocean floor basalts. Biogenic carbon in these sediments combines at elevated temperatures with hydrogen to generate methane or other hydrocarbons.
- c) Conventional, biogenic methane is produced and remains stable in the deepest sedimentary basins and may be retrieved from depths below 30,000 feet or more.

Workshop Format

The attached agenda and list of participants outlines the format of the two-day workshop and is an indication of the interest from various disciplines: academic, government and industry. Ten oral presentations outlined evidence, both theoretical and observed, for possible deep-source methane. Subsequently, four discussion groups assessed the data and ideas presented and formulated a series of recommendations for future investigations. The formally-presented papers and the recommendations will be combined and distributed in a workshop report. A brief summary follows:

No direct evidence for mantle-derived (abiogenic) methane has been conclusively demonstrated. Helium collected from deep ocean floor vents is significantly enriched in the ^3He isotope in comparison with atmospheric helium or crustal helium derived from

uranium decay. This high $^3\text{He}/^4\text{He}$ ratio is interpreted as indicating a primordial, or mantle source. These deep sea fissure gases also include methane. In many instances this methane is enriched in ^{13}C , which might be attributed similarly to a mantle carbon. However, in most cases the deep sea gases have been collected in sediment covered areas where the upward migrating methane has been "contaminated" by biogenic carbon. In one instance, the gases have been collected in an apparently sediment-free setting, the high ^{13}C values are retained, and this methane has been touted, therefore, as mantle-derived, or abiogenic.

There appears to be no evidence for subducted carbon methane, and this hypothesis is still based solely on plate tectonics theory and consideration of geothermal gradients. Apparently gas is being extracted from "back-arc" regions but no attempt has been made to determine whether an origin from subducted sediments is indicated, or whether a distinctive "signature" would exist.

The current thinking in the petroleum industry is that conventional, biogenic methane will still be encountered in the deep sedimentary basins to whatever depth is economical to drill and extract. This may

be erroneous as the stability of methane under the conditions expected at 40,000 feet or more, is apparently not entirely known.

It was recommended that these studies be continued and that a coordinating body be established or selected (such as the Gas Research Institute). Among the suggestions for future studies are:

1. Examination of drilling records on file for analysis of gases;
2. Routine examination of gases from current wells;
3. Studies of rocks in archived collections which are believed to be from the mantle (kimberlites and the included xenoliths). In particular compositions and isotopic ratios of fluids in inclusions contained in these samples;
4. Investigation of methane stability, particularly in the presence of sulfur and iron.

My impressions were that the petroleum industry was interested, but sceptical that economic concentrations of abiogenic methane will be found. They will continue to keep abreast of the topic but financial support for research will probably not be provided. The U.S. Dept. of Energy may become more involved as the current policy is to undertake high risk research. Academics are interested, but probably because data will help provide an understanding of mantle chemistry and processes.

The United Kingdom has a parallel program at approximately the same stage of development, but there is apparently no formal Canadian participation.

DEEP SOURCE GAS WORKSHOP AGENDA

May 3-4, 1982

Lakeview Inn, Morgantown, West Virginia

Workshop Moderator -- Philip C. White

Workshop Technical Coordinator -- William J. Gwilliam

Workshop Logistical Coordinator -- Bernadette A. Prorock

SUNDAY, MAY 2, 1982

REGISTRATION

4:00-10:00 p.m.
Lobby

MONDAY, MAY 3, 1982

REGISTRATION

7:00-8:00 a.m.
Lobby

MONDAY, MAY 3, 1982

SESSION I

Session Chairman -- William J. Gwilliam

Conference Room B

- 8:00 a.m. Opening Remarks -- A. A. Pitrolo, Director, METC
- 8:15 a.m. Introduction and Overview on Workshop -- Dr. Philip C. White, Energy Consultants, Inc.

ABIOGENIC ORIGIN OF DEEP SOURCE GAS

- 8:30 a.m. "Abiogenesis, A Historical Perspective and New Research Possibilities," Gordon MacDonald, Mitre Corporation
- 9:00 a.m. Questions and Answers
- 9:10 a.m. "Theoretical Proof for Worldwide Deep Source Non-Biogenic Petroleum," C. E. Melton, University of Georgia
- 9:40 a.m. Questions and Answers
- 9:50 a.m. "Experimental Proof for Worldwide Deep Source Non-Biogenic Petroleum," A. A. Giardini, University of Georgia
- 10:20 a.m. Questions and Answers
- 10:30 a.m. BREAK

GEOCHEMICAL AND THERMODYNAMIC STUDIES OF DEEP SOURCE GAS

- 10:45 a.m. "Methane Generation and Survival in the Deep Subsurface," Colin Barker, University of Tulsa
- 11:15 a.m. Questions and Answers
- 11:30 a.m. LUNCH -- Nicklaus Rooms

MONDAY, MAY 3, 1982

SESSION II

Session Chairman -- Charles A. Komar

Conference Room B

1:00 p.m. Deep Gases: Experimental and Thermodynamic Constraints of Their Compositions and Interactions With Rocks," Dave Egger, Pennsylvania State University

1:30 p.m. Questions and Answers

DETECTION AND DIFFERENTIATION OF DEEP SOURCE GASES

1:40 p.m. "Abiogenic Methane in Mid-Ocean Ridge Hydrothermal Fluids." John A. Welhan, Scripps Institution of Oceanography.

2:10 p.m. Questions and Answers

2:20 p.m. "Helium Isotopes, and Rare Gases and Their Usefulness as Deep Source Gas Indicators," John E. Lupton, University of California at Santa Barbara.

2:50 p.m. Questions and Answers

3:00 p.m. Break

DEEP SEDIMENTARY BASIN GAS

3:15 p.m. "Prospects for Gas in Deep Sedimentary Basins," George Claypool, USGS, Denver, Colorado

3:45 p.m. Questions and Answers

DEEP SOURCE GAS ASSOCIATED WITH TECTONIC PROCESSES AT CONVERGENT MARGINS

3:55 p.m. "Subducted Organic Origin Gas Hypothesis for Deep-Source Methane," W. J. Gwilliam, Morgantown Energy Technology Center

4:25 p.m. Questions and Answers

4:35 p.m. "Tectonic Guidelines to Deep Source Gas," Thomas L. Thompson, University of Oklahoma

5:05 p.m. Questions and Answers

5:15 p.m. Announcements and Instructions for Tuesday's work groups, Philip C. White, Workshop Moderator

MONDAY, MAY 3, 1982
(Continued)

6:30 p.m. Social Hour -- Nicklaus Rooms

7:30 p.m. DINNER -- Nicklaus Rooms

Master of Ceremonies -- Philip C. White

"The Need for Basic Natural Gas Research," Bob Kalisch,
American Gas Association

TUESDAY, MAY 4, 1982

SESSION III

Work Groups

8:00-12:00 a.m. Workgroup Topics to Include:

Group 1 -- Abiogenic/Subducted Organic/Deep Sedimentary Basin Organic Theories.
(Depth Considerations \geq 30,000 -- base of upper mantle.)

Group 2 -- Geochemical, Thermodynamic, Physical, and Geological Considerations.

Group 3 -- Use of Carbon Isotopes, Helium Isotopes, Rare Earth Gases, Etc.
(Depth consideration surface and drillable subsurface.)

Group 4 -- Trap Types, Depth Considerations, and Quantification Methodology.

	<u>Group I</u>	<u>Group II</u>	<u>Group III</u>	<u>Group IV</u>
Discussion Emphasis	Source Emplacement	Migration	Detection	Gas Entrapment
Room	601	602	603	604
Chairman	Ferol Fish	Richard McIver	Ian Kaplan	Tex Hartman
Co-Chairman	Charles Byrer Gordon MacDonald George Claypool	Charles Komar Colin Barker Dave Egler Charles Melton	Arlen Hunt John Lupton John Welhan A. Giardini	Rodney Malone Thomas Thompson

12:00 Noon LUNCH -- Nicklaus Rooms

TUESDAY, MAY 4, 1982

SESSION IV

Summaries of Work Groups

Conference Room B

Session Moderator -- Philip C. White

1:30 p.m. Group I Summary -- Source Emplacement -- Ferol Fish
2:15 p.m. Group II Summary -- Migration -- Richard McIver
3:00 p.m. Break
3:15 p.m. Group III Summary -- Detection -- Ian Kaplan
4:00 p.m. Group IV Summary -- Gas Entrapment -- Tex Hartman
4:45 p.m. Closing Remarks -- Philip C. White, Workshop Moderator

- All papers presented in the forum will be compiled in a workshop document along with a summary of the working group findings and recommendations.

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