

EVENING MEETING—MAY 12, 1980

WOLFGANG J. STAHL—Biographical data



Dr. Wolfgang J. Stahl was born August 17, 1935, in Mainz, Federal Republic of Germany. He began his studies in physics and mathematics at the Technical University of Darnstadt in 1955, where he received his MS in nuclear physics in 1962. His thesis dealt with the development of a low-level system for the determination of natural tritium concentrations in hydrogen. He then entered the Technical University of

Clausthal (Germany), where he obtained his PhD in 1968. His doctoral study dealt with the determination of the origin of northwestern German natural gas by determination of its carbon isotopes.

In 1962 he began working for the Federal Institute for Geosciences and Natural Resources (the German Geological Survey) at Hannover, in the Stable Isotope Section. After gaining his PhD in 1968 he became a Lecturer in Isotope Geophysics at the University of Bonn. In 1974 he returned to the Federal Institute of Geosciences and became head of the Stable Isotope Section. In addition to his work there, he has been a lecturer at several UN sponsored seminars on "Generation and Maturation of Hydrocarbons." In 1979 he became head of the Department of Geochemistry and Mineralogy at the Federal Institute for Geosciences, where he presides over a staff of 42 scientists and 95 technicians.

His main research interests are stable isotopes in thermometry, hydrology, and hydrocarbon exploration, especially the development of applications for the field of oil and gas exploration. He has written nearly 50 international publications.

THE USE OF STABLE ISOTOPES IN HYDROCARBON EXPLORATION (Abstract)

Knowledge of the type and maturity of organic matter concentrated in the strata of sedimentary basins, and knowledge of the correlations between source rocks and hydrocarbons are becoming essential prerequisites for successful hydrocarbon exploration.

Carbon isotopes have been used for many years in crude oil/crude oil and crude oil/source rock correlation work. The method is based on the fact that the carbon isotope ratios of crude oils, rock extracts (ie, carbon compounds soluble in organic solvents), and kerogen (insoluble organic compounds) are similar if they are genetically related, ie, if the kerogen is the organic source of the rock extract or of the crude oil.

Several more sophisticated isotopic correlation techniques have been developed recently, such as the "isotope type-curve" method. This method is an empirical approach which gives information on oil/oil or oil/source rock correlation and allows the identification of bacterial degradation of crude oils and rock extracts. Crude oils or rock extracts are separated into saturates, aromatics, heterocomponents and asphaltenes. The carbon isotope patterns of these fractions

are used for oil/oil correlations and for the approximate estimation of the $^{13}\text{C}/^{12}\text{C}$ ratios of the source rock kerogen. The possibilities of oil/oil correlations can be considerably improved in many cases by the additional determination of the hydrogen isotope ratios of the oil fractions.

Gas/source rock correlations are applied even more directly in hydrocarbon exploration. The applications are based on the relationship between the carbon isotope ratios of the methane, and the type and maturity (i.e. vitrinite reflectance R^0) of the organic material from which the methane had been formed.

Typical applications are carbon isotope determinations of methane from:

- new gas reservoirs or gas shows, in order to identify their source rocks. This information can define targets for drilling operations and can influence the drilling strategy in frontier areas
- cuttings which will show if hydrocarbons present in the cuttings have been generated in-situ or not. These isotope determinations permit the identification of migrated hydrocarbons.

The method is presently being improved and modified for the isotopic identification of gases which leak from reservoirs to the surface and are absorbed in surface sediments.

Two main problems have been recognized:

- i) The amounts of methane present in sediments are very small. A technique had to be developed for handling extremely small amounts of gas without introducing isotope fractionation by chemical or mass spectrometric procedures.
- ii) Changes in the hydrocarbon composition and isotope ratios can happen before, during, and after the sampling of the sediments. Procedures have been developed which allow identification of secondary isotope fractionation caused by oxidizing bacteria in the bottom sediments or by degassing during the storage of the samples.

Laboratory experiments have been carried through to overcome these difficulties, and the identification of deeply pooled hydrocarbons by isotope analyses of sediment gases will probably soon become a competitive tool in hydrocarbon exploration.