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► **To cite this version:**

Luiz Frederico Rodrigues, João Marcelo Ketzer, José Cupertino, Adolpho Augustin, Daniel Praeg. Gas hydrate studies in Brazil: future perspectives. XVI Latin American Congress on Organic Geochemistry, ALAGO - Associação Latino-Americano de Geoquímica Organica, Aug 2023, Aracaju, Sergipe, Brazil. pp.141-142. hal-04272611

HAL Id: hal-04272611

<https://hal.science/hal-04272611>

Submitted on 6 Nov 2023

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Gas Hydrate Studies in Brazil: Future Perspectives

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This paper was selected for presentation by an ALAGO Scientific Committee following review of information contained in an abstract submitted by the author(s).

Introduction

Gas hydrates are energy resources whose organic carbon mass is greater than all other fossil fuels combined and are considered an alternative energy source [1]. In addition to their importance as an energy resource, studies of gas hydrates also provide important information about the Earth's carbon cycle and climate change. Changes in ocean water temperature conditions can cause the dissociation and release of large amounts of methane and carbon dioxide into the atmosphere. Massive destabilization of the gas hydrate system can also cause large underwater mass movements, with potential impact on subsea installations such as oil or even major catastrophes in coastal areas such as generation of tsunamis [2]. The existence of gas hydrates in Brazilian territory was confirmed in the Pelotas Basin [3] and in the Amazon fan [4].

Experimental

The Amazon deep-sea fan is approximately 250 km from the mouth of the Amazon River and extends 700 km seaward from the outer edge of the continental shelf to water depths of over 4,000 m in the Demerara Abyssal Plain [5]. The Rio Grande Cone is located in the southern portion of the Pelotas Basin and has a water depth between 200 and 3,000 m, 200 km from the city of Rio Grande. It has been deposited since the lower Miocene [6].

Results and discussion

The gas hydrates from Amazon deep-sea fan present in their composition CH₄ (95%), CO₂ (4%) and C₂H₆ (1%); methane isotope analysis ($\delta^{13}\text{C}$ between -61.7 and -59.2‰ and δD between -206 e -205‰) and ethane ($\delta^{13}\text{C}$ between -31.5 and -30.8‰). These results indicate a biogenic origin with possible thermogenic contamination. This mixing may have occurred during the vertical migration of thermogenic gases through the sediments, until reaching the microbial gas deposits at shallower depths. The thermogenic influence is possibly related to the connection provided by faults connecting deep gas

sources to surface deposits. (Figure 1A). In the Rio Grande Cone, the gas in the hydrate is mostly methane with trace amounts of ethane. Isotopic analysis of methane carbon indicates a microbial origin, whose values varied between $\delta^{13}\text{C}$ from -69,3 to -66,7 (Figure 1B). Likewise, studies of free gases in sediments were produced by the product of microbial methanogenesis, that is, gaseous hydrocarbons were mainly generated by the microbial reduction of CO₂ [7].

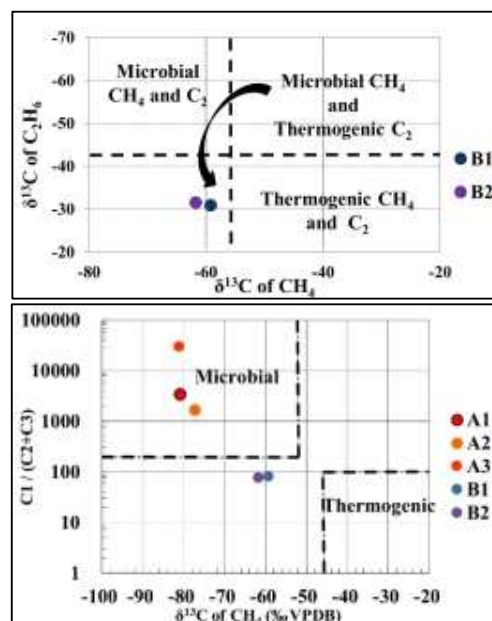


Figure 1. a) Graph showing the relationship between the compositions of C1/(C2+C3) versus ¹³C of gases from hydrates, plumes and gases dissolved in sediments from Amazon deep-sea fan. b) Relationship between the values of $\delta^{13}\text{C}_{\text{C}_2\text{H}_6}$ e $\delta^{13}\text{C}_{\text{CH}_4}$ for samples from different areas of the Rio Grande Cone.

Conclusion

These discoveries in Brazilian territory aroused the need to carry out additional research that foster the understanding of its occurrence and the future use of this resource in other sedimentary basins. Recently, the works

resulting from these analyzes have aroused the interest of the world scientific community due to the importance of hydrates not only as an alternative energy resource but also for their importance for understanding the carbon cycle and its impacts on climate change. In the Amazon deep-sea fan, a cooperation project is being carried out between Brazilian universities (FURG, PUCRS, UFRGS, UNISINOS, USP, UFF, UERJ and UFESP), Linnaeus University, in Sweden, and French research institutes (IFREMER, GEOAZUR and LSCE). The objective of this project is to study the past climate history of the equatorial margin of Brazil over the last million years, to determine the behavior of gas hydrates in relation to submarine landslides of great impact and to evaluate the extent of gas leaks in the Amazon.

Acknowledgment

The authors would like to thank Petrobras S/A for financial support, Sens Ltda for supporting research and the Post-Graduate Program in Technological and Environmental Chemistry at FURG.

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ANNALS

XVI LATIN AMERICAN CONGRESS ON ORGANIC GEOCHEMISTRY

Editors:

Alexandre Andrade Ferreira

Alberto Wisniewski Junior

Boniek Gontijo Vaz

Marcelo Corrêa Bernardes

Georgiana Feitosa da Cruz

ISBN nº 978-65-00-75016-4

ARACAJU - SE
2023