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Source identification of sea surface oil with geochemical data in Cantarell, Mexico ☆

Caroline C. Texeira [a], Celeste Y. Santos Siqueira [a,*], Francisco R. Aquino Neto [a], Fernando P. Miranda [b], José R. Cerqueira [b], Adriano O. Vasconcelos [c], Luis Landau [c], Miguel Herrera [d], Karen Bannermaman [e]

[a] Universidade Federal do Rio de Janeiro, Instituto de Química, LADETEC, Ilha do Fundão, Rio de Janeiro 21949, Brazil
[b] PETROBRAS Research and Development Center (PETROBRAS/CENPES), Av. Horácio Macedo, No. 950, Cidade Universitária, Ilha do Fundão, 21491-915 Rio de Janeiro, Brazil
[c] Universidade Federal do Rio de Janeiro, LAMCE/COPPE, P.O. Box 68552, Ilha do Fundão, Rio de Janeiro 21949, Brazil
[d] PEMEX Exploración y Producción, Región Marina Norest (PEP/RMNE), Estudios Ambientales, Call 25, No. 48, Col. Guadalupe. Cd Del Carmen, Campeche C.P. 24130, Mexico
[e] MacDonald, Dettwiler and Associates Ltd., 13800 Commerce Parkway, Richmond, British Columbia V6V 2J3, Canada

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ABSTRACT

The Gulf of Mexico is one of the world's largest petroleum regions. Cantarell is an important oil field located in the Akal Pillar province. This region is characterized by several oil seeps. However, there is no consensus on the Cantarell oil seep subsurface provenance. Surface oil samples (seepage) and subsurface oil samples (reservoirs) from the Akal Pillar province were analyzed using gas chromatography with a flame ionization detector (GC-FID) and gas chromatography with a mass spectrometry detector (GC-MS). The data obtained were used to identify and characterize biomarker and diamondoid distributions. Multivariate statistical analyses of geochemical results were made to identify the Cantarell oil seep origin. Geochemical analysis showed small differences between the results which could help the correlation studies between the samples. Cluster analysis indicated a good correlation of the seepage samples with a unique subsurface oil sample, CAN8, from the reservoir in the Paleocene/Cretaceous breccia.

1. Introduction

Large and numerous hydrocarbon seeps have been known to pre-Colombian populations of southern Gulf of Mexico coastal areas for many centuries [1,2]. They referred to them as *chapopoteras* in their native dialect. Onshore oil seeps also attracted the attention of entrepreneurs in the late 19th century with initial production activities west of Tampico. Hydrocarbon exploration and production efforts in southern Gulf of Mexico moved offshore in the 20th century and culminated in 1976 with the giant Cantarell oil field discovery in the Bay of Campeche [2,3]. Mexican exploration activities in this oceanic region began soon after a fisherman, Mr. Cantarell, reported seepage phenomena in the Campeche Bay. The oil fields complex discovered beneath the seeps was subsequently named after him.

Nowadays, PEMEX Exploration and Production (PEP) shares the operational marine area, where vessel related to important fisheries or industrial transport traffic through delicate ecosystems, making it highly sensitive to the presence of oil [4]. Therefore, sea surface oil slicks or deposits on the seashore are immediately related to PEP activities, which generate claims and social pressures with economic and public image impacts [5]. To establish proper environmental management practices, PEP is using spaceborne radar remote sensing together with high resolution geochemistry technology to characterize oil seeps in the Cantarell Complex area.

As part of this research effort, 21 oil samples were collected between 2003 and 2007 from the Cantarell seep as well as different platforms for further geochemical analysis. This procedure was also carried out from 2007 to 2010 to better understand the temporal and spatial distribution of natural seepage phenomena in the Campeche Bay. This study describes methodological aspects and the results achieved in comparing the different samples' geochemical characteristics to determine the

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* Corresponding author at: Instituto de Química da Universidade Federal do Rio de Janeiro (IQ/UFRJ). Avenida Athos da Silveira Ramos, 149, Centro de Tecnologia (CT), bloco A, sala 607, Ilha do Fundão, Cidade Universitária, Rio de Janeiro, RJ 21941-909, Brazil. Tel./fax: +55 21 2260 3967.
E-mail address: celesteyara@iq.ufrj.br (C.Y. Santos Siqueira).

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Cantarell oil seep subsurface provenance. This approach can be used in the future as a complementary tool for an operational multiyear monitoring program in southern Gulf of Mexico.

Each oil sample contains a unique distribution of compounds considered as a fingerprint and oil geochemistry is a fundamental issue for any regional exploration for new frontiers and production programs. It can

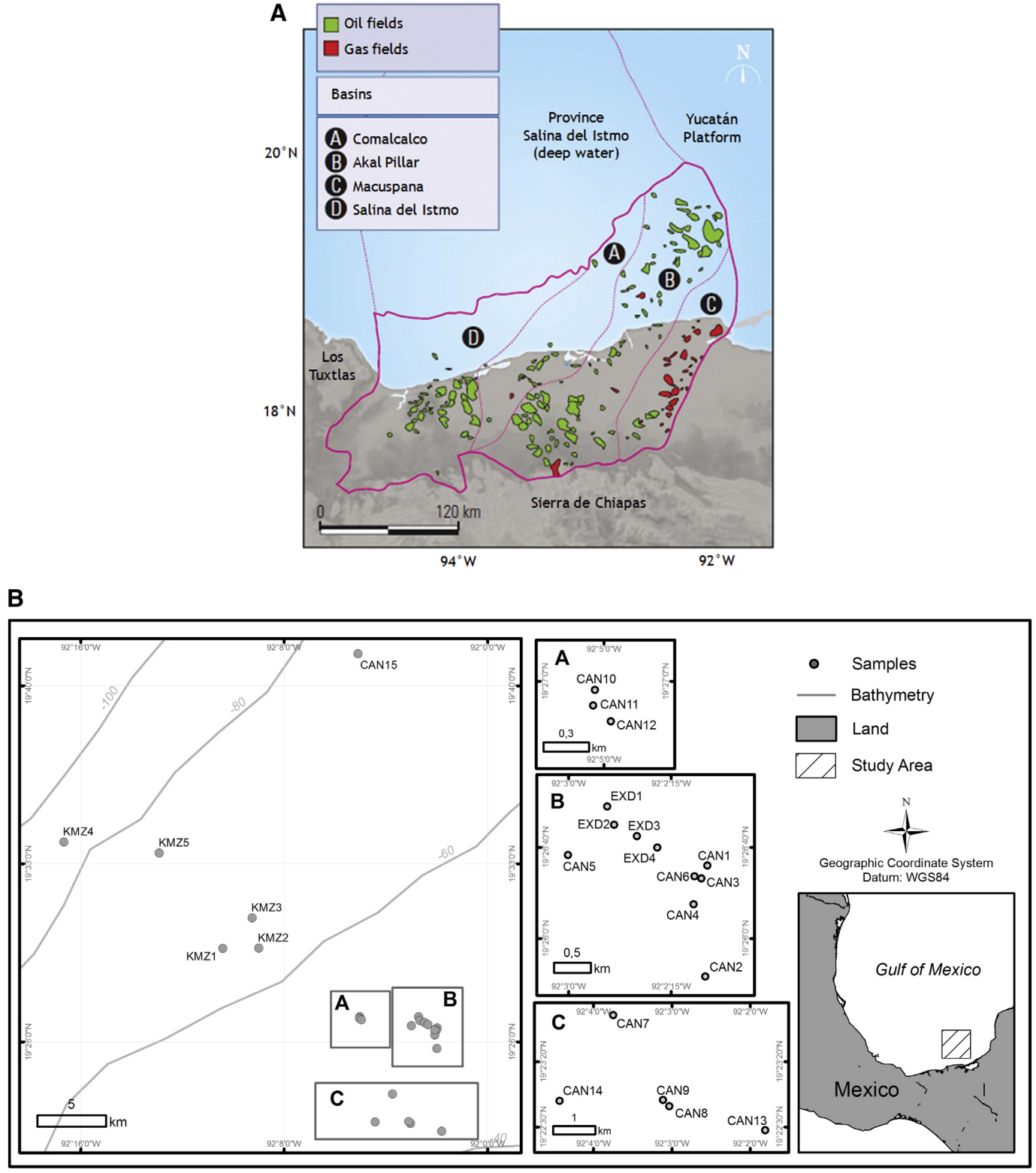

Fig. 1. A: Oil and gas field locations in the Akal Pillar province, Gulf of Mexico (adapted from Miranda et al., 2004). B: Map of Gulf of Mexico identifying the localization of the samples. C: Map of Gulf of Mexico identifying the ocean currents (adapted from http://flowergarden.noaa.gov/about/naturalsetting.html#currents) [6]. D: Map of Gulf of Mexico identifying structural geologic of the sampling site.