Continental Shelf Research 81 (2014) 80–87

Contents lists available at ScienceDirect

Continental Shelf Research

journal homepage: www.elsevier.com/locate/csr

Research papers

In-situ and on-line measurement of gas flux at a hydrocarbon seep from the northern South China Sea

Pengfei Di [a,c], Dong Feng [a], Duofu Chen [a,b,c,*]

[a] Key Laboratory of Marginal Sea Geology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou 510301, China
[b] Key Laboratory of Marginal Sea Geology, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China
[c] Sanya Institute of Deep Sea Science and Engineering, Chinese Academy of Sciences, Sanya 572000, China

ARTICLE INFO

Article history:
Received 12 April 2013
Received in revised form
28 March 2014
Accepted 2 April 2014
Available online 13 April 2014

Keywords:
Hydrocarbon seep
Gas flux
In-situ and on-line measurement
Fluid activity
Nearshore Yinggehai
Northern South China Sea

ABSTRACT

Natural hydrocarbon seeps in the marine environment are important sources of methane and other greenhouse gases to the ocean and the atmosphere. Accurate quantification of methane flux at hydrocarbon seeps is therefore necessary to evaluate their influence on the global methane budget and climate change. Hydrocarbon seeps on the seabed produce a near-shore gas bubble zone along the shallow western coast of Hainan Island, northern South China Sea. An in-situ and on-line gas flux measuring device was deployed over a hydrocarbon seep to quantify the gas flux by equal volume exchange venting from the seabed offshore of Ledong Town, Hainan Island, over 19 days. The physiochemical parameters and the dissolved methane concentration of the bottom water at the hydrocarbon seep were also measured. The gas flux from the hydrocarbon seep varied from 22 to 77 l/day with the tidal period and was strongly negatively correlated with water depth. The flux data from the seep suggests that the variation in hydrostatic pressure induced by tidal forcing and ocean swell may control the variation of the gas flux. The bottom water dissolved methane concentration, ranging from 26 to 74 nmol/L, was negatively correlated with temperature and water depth at the seabed and positively with the gas flux. The total gas volume released from the hydrocarbon seep was 30.5 m^3 for the 19-day period, providing an estimated gas flux of 600 m^3/yr. The 120 known hydrocarbon seeps along the eastern edge of the Yinggehai Basin could vent a large quantity of methane from the seafloor, which suggests that hydrocarbon seeps on the continental margin of the northern South China Sea may be an important natural source of methane to the atmosphere.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

Hydrocarbon seeps in marine environments are widely distributed on the seabed of almost all continental margins (Judd et al., 2002; Judd, 2003; Judd and Hovland, 2007; Campbell, 2006). Hydrocarbon seeps represent an important pathway by which natural gases, primarily methane, are released from the lithosphere into the hydrosphere and atmosphere. Methane is a strong greenhouse gas with a greenhouse effect approximately twenty times greater than that of an equal quantity of carbon dioxide, and may have an important impact on global climate change (Dimitrov, 2003; Etiope and Milkov, 2004; Etiope et al., 2008). Approximately 20 Tg/yr of methane is discharged into the atmosphere through marine seeps (Judd, 2004; Etiope, 2009), approximately half of the global geological emissions of 40–60 Tg/yr of methane (Etiope and Milkov, 2004; Etiope et al., 2008; Etiope, 2009). However, there are significant uncertainties since few quantitative values for seepage flux exist. Therefore, an accurate estimate of the amount of methane released from hydrocarbon seeps is of great significance for a better understanding of their role in the global carbon cycles and climate change. However, the amount of methane released into the ocean and atmosphere through this pathway is particularly difficult to quantify and, thus, results in considerable uncertainty because of the limited technology and methods. In recent years, much attention has been paid to the long-term in-situ and on-line measurement of methane flux at various hydrocarbon seep locations, e.g., Bush Hill of Mexico; Coal Oil Point seep field, Santa Barbara Channel; Hydrate Ridge; Black Sea; and Hikurangi Margin, New Zealand (Roberts et al., 1999; Tryon and Brown, 2001, 2004; Tryon et al., 2002; Boles et al., 2001; Torres et al., 2002; Leifer and boles, 2005a, 2005b; Leifer et al., 2010; MacDonald et al., 2005; Vardaro et al., 2006; Solomon et al., 2008; Sahling et al., 2009; Krabbenhoeft et al., 2010; Linke et al., 2010; Romer et al., 2012a, 2012b; Etiope et al., 2013). Preliminary

* Corresponding author . Tel.: +86 20 85290286; fax: +86 20 85290130.
E-mail addresses: pfd@scsio.ac.cn (P. Di), feng@scsio.ac.cn (D. Feng), cdf@gig.ac.cn (D. Chen).

http://dx.doi.org/10.1016/j.csr.2014.04.001
0278-4343/© 2014 Elsevier Ltd. All rights reserved.

results show that fluid flow and chemical flux associated with hydrocarbon seeps are both spatial and temporal in nature (Tryon and Brown, 2004; Tryon et al., 2002; Leifer and Boles, 2005b; Solomon et al., 2008). Factors influencing the gas flux include tidal forces, ocean swells, tectonic processess, haline convections, biological pumpings, and transient discharge of subsurface gas reservoirs (Henry et al., 1992; Davis et al., 1995; Wang and Davis, 1996; Orange et al., 1997; Wallmann et al., 1997; Suess et al., 1998; Tryon et al., 1999; Boles et al., 2001; Forrest et al., 2005; Leifer and Boles, 2005b; Talukder, 2012).

The Yinggehai Basin is a Cenozoic era oil–gas basin on the northern shelf of the South China Sea. The basin is characterized by abundant hydrocarbon seeps, pockmarks, and mud volcanoes on the seabed (Huang et al., 2003, 2004, 2005 and 2009),. More than 120 hydrocarbon seeps have been found on the seabed at water depths less than 50 m along the eastern edge of the basin near the western coast of Hainan Island. The gas rises to the sea surface to form a near-shore bubble zone (Fig. 1A) (Huang et al., 2009). The gas, primarily thermogenic methane, originates from the Miocene hydrocarbon source rock in the central depression of

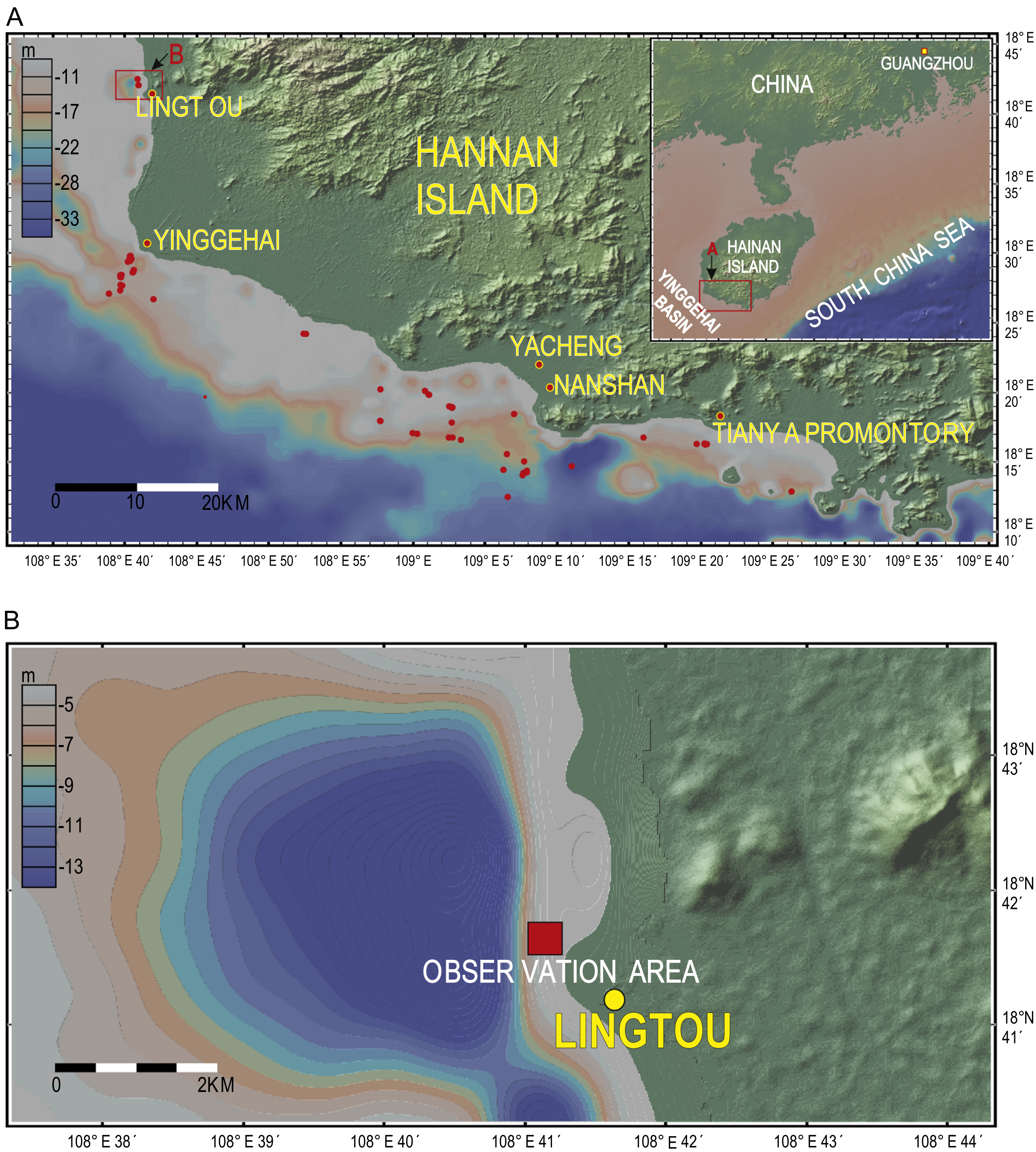

Fig. 1. (A) Bathymetric map of the Yinggehai Basin and the distribution of the near shore hydrocarbon seeps (red dots). (B) Location of the in-situ and on-line hydrocarbon seep observation area near Lingtou Promontory. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Download English Version:

https://daneshyari.com/en/article/4531906

Download Persian Version:

https://daneshyari.com/article/4531906

Daneshyari.com