

中国东部 CO_2 气地球化学特征及其气藏分布^{*}

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Liao FR, Wu XQ and Huang SP. 2012. Geochemical characteristics of CO_2 gases in eastern China and the distribution patterns of their accumulations. *Acta Pet. et ca.*, 28(3):939–948

Abstract CO_2 gas accumulations are distributed and coexist in eastern China. This study focuses on the origin and distribution of CO_2 gases in eastern China based on geochemical analyses of various basins in eastern China such as Songliao, Bohai, and SCS. The distribution of CO_2 concentrations in natural gases is similar to the $\delta^{13}\text{C}_{\text{CO}_2}$ values and secondarily $\delta^{13}\text{C}_{\text{CO}_2}$ values. Combined analyses of CO_2 concentrations, $\delta^{13}\text{C}_{\text{CO}_2}$ values, and $\delta^{13}\text{C}_{\text{CH}_4}$ values indicate that high concentrations of CO_2 in gases is dominated by biological and carbonic acids, while low concentrations are mainly due to biological and inorganic acids. The distribution of CO_2 gas accumulations is in accordance with the Neogene Qaternary systems and is associated with the evolution of the basin and the migration of CO_2 gas.

Key words CO_2 ; A iogenic gas; Carbonation and hydrolysis; $\delta^{13}\text{C}_{\text{CO}_2}$; $\delta^{13}\text{C}_{\text{CH}_4}$; Distribution

摘要 中国东部 CO_2 气田(藏)发育广泛, 分布复杂。本文对中国东部部分 CO_2 气田(藏)气中 CO_2 的分布, $\delta^{13}\text{C}_{\text{CO}_2}$ 值和 $\delta^{13}\text{C}_{\text{CH}_4}$ 值进行了分析, 结果表明, CO_2 在天然气中的浓度与 $\delta^{13}\text{C}_{\text{CO}_2}$ 值呈正相关, 而与 $\delta^{13}\text{C}_{\text{CH}_4}$ 值呈负相关。结合 CO_2 浓度、 $\delta^{13}\text{C}_{\text{CO}_2}$ 值和 $\delta^{13}\text{C}_{\text{CH}_4}$ 值的综合分析, 表明高浓度的 CO_2 在天然气中主要是由生物和碳酸酸气所控制, 而低浓度的 CO_2 主要是由生物和无机酸气所控制。 CO_2 气田(藏)的分布与新第三纪以来的沉积带和 CO_2 气田(藏)的形成密切相关。

关键词 CO_2 ; 气田; 碳酸化; $\delta^{13}\text{C}_{\text{CO}_2}$; $\delta^{13}\text{C}_{\text{CH}_4}$; 分布

中图法分类号 T18.43

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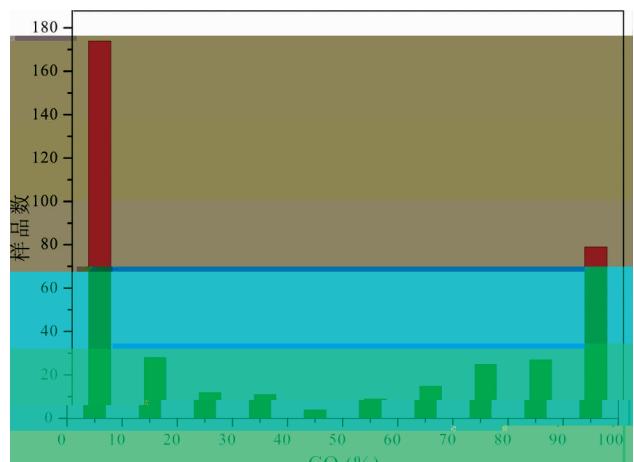


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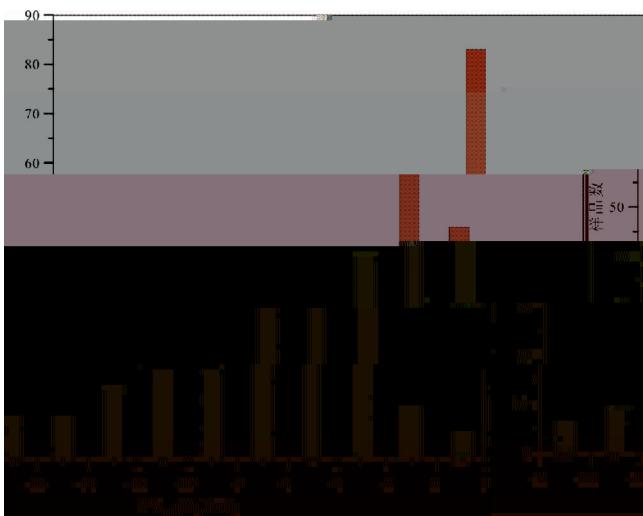
体的，¹²中国北(1)(国研究，¹²87)。高 CO_2 的气()，¹²中国一发有要砂、()，¹²SR后改 CO_2 的；另一发温，¹² CO_2 常常是温()气中的要()，¹²()。

2 中国东部 CO_2 气地球化学特征

中国 CO₂ 气的位素氦位素的，揭示有益的信息。中国一些典高 CO₂ 气的数 1。

统计结果，中国 CO₂ 气的，要间 0
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中国 CO₂ 气的 $\delta^{13}\text{C}_{\text{CO}_2}$ 呈典型的间断性，—30~73‰



Fig' 3 His og a o $\delta^{13}\text{C}_{\text{CO}_2}$, a es o CO_2 in eas e n China

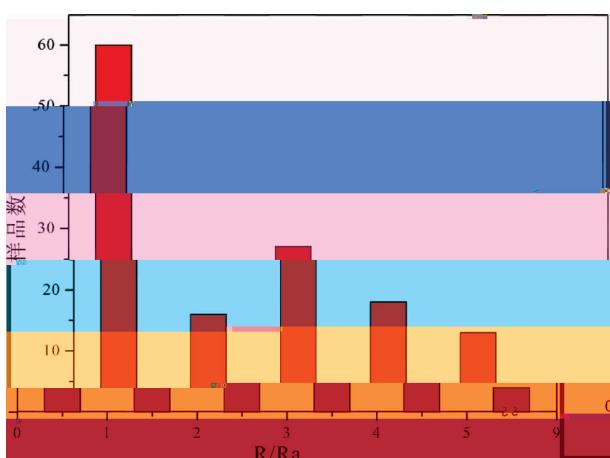
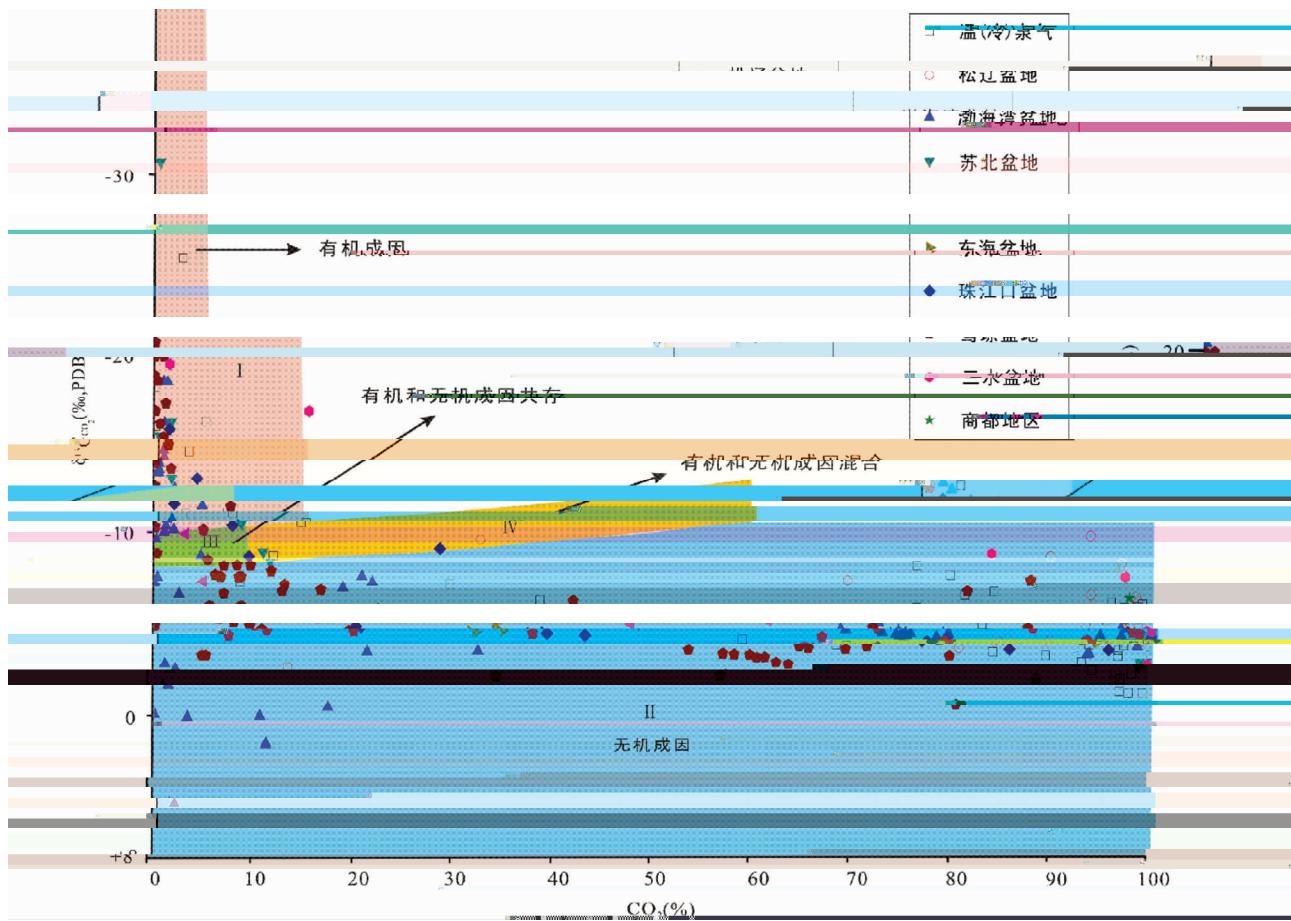


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表 1 中国东部一些高含 CO₂ 天然气的地球化学数据

Table 1 Geochemical characteristics

| 样品编号 | 产地 | CO₂ 含量 (%) | | CH₄ 含量 (%) | | H₂S 含量 (ppm) | | N₂ 含量 (%) | | C₂H₆ 含量 (%) | | C₃H₈ 含量 (%) | | C₄H₁₀ 含量 (%) | | C₅H₁₂ 含量 (%) | | C₆H₁₄ 含量 (%) | | C₇H₁₆ 含量 (%) | | C₈H₁₈ 含量 (%) | | C₉H₂₀ 含量 (%) | | C₁₀H₂₂ 含量 (%) | | C₁₁H₂₄ 含量 (%) | | C₁₂H₂₆ 含量 (%) | | C₁₃H₂₈ 含量 (%) | | C₁₄H₃₀ 含量 (%) | | C₁₅H₃₂ 含量 (%) | | C₁₆H₃₄ 含量 (%) | | C₁₇H₃₆ 含量 (%) | | C₁₈H₃₈ 含量 (%) | | C₁₉H₄₀ 含量 (%) | | C₂₀H₄₂ 含量 (%) | | C₂₁H₄₄ 含量 (%) | | C₂₂H₄₆ 含量 (%) | | C₂₃H₄₈ 含量 (%) | | C₂₄H₅₀ 含量 (%) | | C₂₅H₅₂ 含量 (%) | | C₂₆H₅₄ 含量 (%) | | C₂₇H₅₆ 含量 (%) | | C₂₈H₅₈ 含量 (%) | | C₂₉H₆₀ 含量 (%) | | C₃₀H₆₂ 含量 (%) | | C₃₁H₆₄ 含量 (%) | | C₃₂H₆₆ 含量 (%) | | C₃₃H₆₈ 含量 (%) | | C₃₄H₇₀ 含量 (%) | | C₃₅H₇₂ 含量 (%) | | C₃₆H₇₄ 含量 (%) | | C₃₇H₇₆ 含量 (%) | | C₃₈H₇₈ 含量 (%) | | C₃₉H₈₀ 含量 (%) | | C₄₀H₈₂ 含量 (%) | | C₄₁H₈₄ 含量 (%) | | C₄₂H₈₆ 含量 (%) | | C₄₃H₈₈ 含量 (%) | | C₄₄H₉₀ 含量 (%) | | C₄₅H₉₂ 含量 (%) | | C₄₆H₉₄ 含量 (%) | | C₄₇H₉₆ 含量 (%) | | C₄₈H₉₈ 含量 (%) | | C₄₉H₁₀₀ 含量 (%) | | C₅₀H₁₀₂ 含量 (%) | | C₅₁H₁₀₄ 含量 (%) | | C₅₂H₁₀₆ 含量 (%) | | C₅₃H₁₀₈ 含量 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Fig' Co e a ion diag a o CO_2 con en s and $\delta^{13}\text{C}_{\text{CO}_2}$ a es in eas e n China (al e ai et al. , 12) a so es; Xiang, 12 ; ai et al. ,12 ,2003,200 ;X et al. ,12 ; X , 127;H ang et al. ,2003;He and Li ,200 ;Chen et al. ,2008;Li et al. ,2008;X e et al. ,2010

$\delta^{13}\text{C}_{\text{CO}_2}$ -20.7 ‰; 三水 $\delta^{13}\text{C}_{\text{CO}_2}$, 2‰ (▲)。

2.3 氦同位素特征

中国高 CO₂ 气的 R R (R 的³He/H, Ra 气的³He/H, 一 14, 10³, a in et al., 1970) 最 8% (海 水凹陷 W 13 1 1, Chen et al., 2008), 型 的特 征。R R 最 0 011(南 3 泉气, 12), 的特征。莺琼 气中 R R 凹陷 (), R R 均, 最 11。海 R R 高, 所有 1, 渤海湾 气中 R R 要 -0 1 2 全, 松辽、苏北、三水、珠江口 R R 要 2。体上, R R -0 本 的 最

3 中国 CO_2 

3.1 CO₂ 气鉴别指标

CO_2 、 $(\delta^{13}\text{C}_{\text{CO}_2})$ 的特征是 CO_2 的有利工具。有 CO_2 一 -20 ; CO_2 -10 , 都是 $($ $, 12$)。

的 CO_2 具有 $\delta^{13}\text{C}$ 的研究; Goddard et al. (1981) 认为 CO_2 的 $\delta^{13}\text{C}$ 与上层大气的 $\delta^{13}\text{C}$ 相关, $\delta^{13}\text{C}_{\text{CO}_2} = -2 + 0.01 \times \delta^{13}\text{C}_{\text{air}}$, 平均

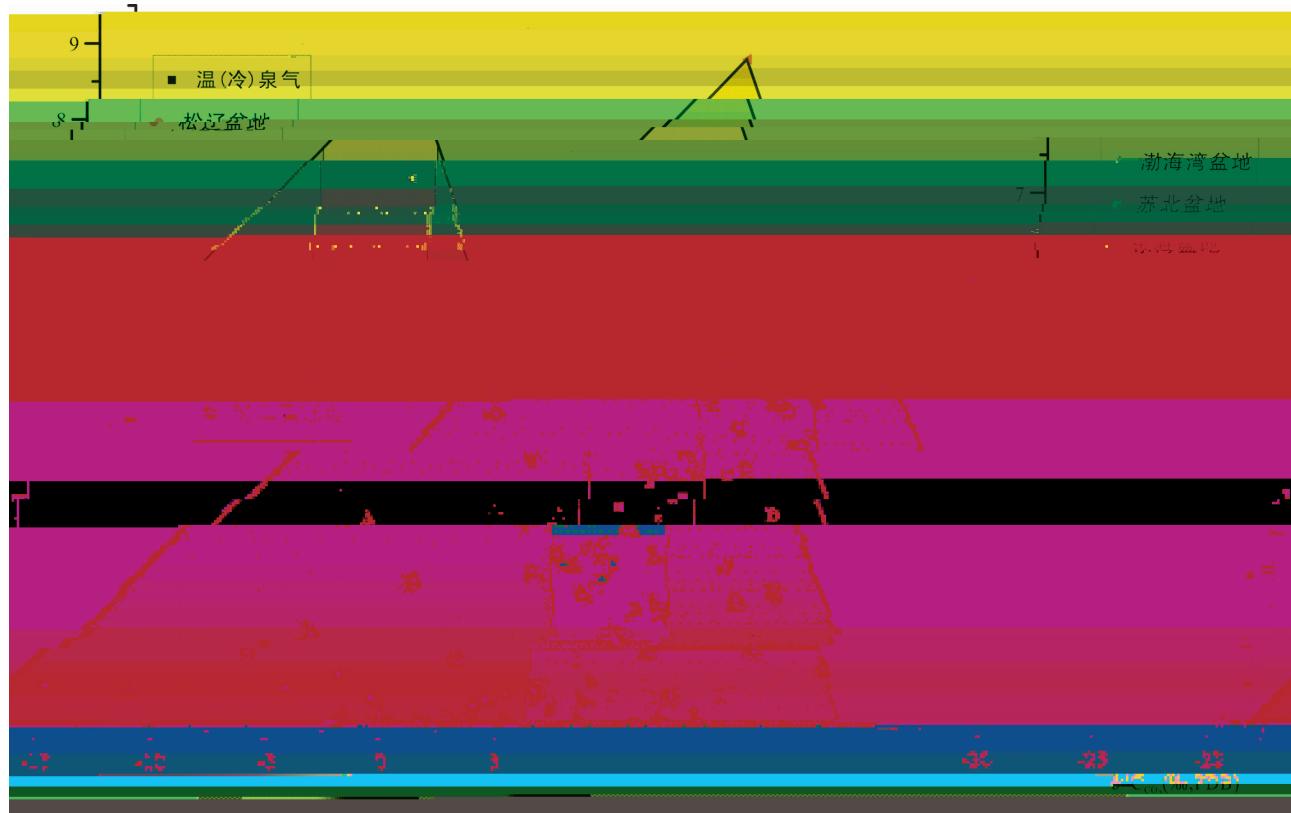


图 1 中国 CO₂ 温(冷)泉气位素 R Ra 数典, 2003, 2003;

R Ra $\delta^{13}\text{C}_{\text{CO}_2}$ (1) 中国 CO_2 气分

A : $\delta^{13}\text{C}_{\text{CO}_2}$ ↑ 8 , R Ra , , ,
CO₂ 有 , 有 分 。
类 的 CO₂ 要 、 分温

() 。 中 有 的
3 气 ($\delta^{13}\text{C}_{\text{CO}_2}$) , R Ra
氮的 , $\delta^{13}\text{C}_{\text{CO}_2}$ CO₂ 要 有 ,
CO₂ He 时 的 He 很 , 合
发 律

律律 律 律

3 第四章 分布 及其 CO_2 气(藏)、气 分布
 第 3 章 为第四纪(N)和第四系(Q)的气藏和 CO_2 气体的分布及见于中国东部的气藏。

	CO_2 ()
I	
II	、 、 、 、 、 ()
III	
IV	3 、 21 、 1 、 、 、 、 2 、 、 、 、 、 3
V	、 1 、 ()
VI	、 13 1 ()
VII	
VIII	、 、 、 18 1 、 22 1 、 28 2 ()
IX	1 1 、 1 1 、 21 1 、 8 1 、 1 1 、 1 2 、 1 3 、 ()

(1977)。

CO_2 () ,
 CO_2 ,
 ○ 1

CO_2 () CO_2
 (1),

,
 (1、3)。

4.2 中国东部 CO_2 气(藏) 藏

CO_2 () ,

CO_2 ,

○

, , ○

,

○

, , , ,
 10 800 , 400 000 ,
 7

, (1980^①);

, , ,
 CO_2 ; ()
 ,

(

邻,位特的地构造位置,
商都的CO₂气是在油气地具一定的泛
的CO₂气之是,在CO₂气具有一定的远景
CO₂气,因CO₂气具有一定的远景
类地背景域均有因CO₂气的远景
在(薛军民,2010)。

结论

- (1) 东CO₂气的分上型典型的U字型,分间0~10,值10~100;δ¹³C_{CO₂}介0~1之间的样品数最多,2~3之间。
- (2) CO₂、δ¹³C_{CO₂}值R、Ra值东

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