The Middle and Upper Ordovician $\delta^{13}C$ excursions in South China: Implication for paleoceanographic change

JIANBO LIU[1]*, ZI GUI[2] AND JUNJUN WEN[1]

[1]Department of Geology, Peking University, Beijing 100871, China (*correspondence: jbliu@pku.edu.cn)
[2]University of Nebraska-Lincoln, Department of Geosciences, Lincoln, NE 68588-0340, United States

Several significant positive $\delta^{13}C$ excursions before the Hirnantian have been recognized in the Mid and Late Ordovician, which seems to be global signs. The early Katian Guttenberg excursion (GICE) have been well documented from a number of localities in North America, northern Europe, and Asia, and might reflects global cooling resulting from enhenced marine organic carbon burial and a drawdown of pCO_2. However, the origin of the GICE and other carbon isotopic excursions is still a topic of debate, and need further studies to constrain its origin and relationship with paleoceanographic changes.

A complete carbonate succession of the Darriwilian to lower Katian stages is well exposed near Xingshan County town, the northwestern Hubei Province of South China. The Mid and Upper Ordovician strata in the section consist of the Kuniutan and Pagoda formations, characterized by nodular argillaceous limestone with polygonal cracks, primarily deposited in a deep subtidal setting. Values of $\delta^{13}C_{carb}$ begin at + 0.2‰ in the lowermost Kuniutan Formation and keep in the range of 0.6‰ ± 0.1‰ in the formation with a positive excursion (up to +1.2‰) occurring in the upper Kuniutan Formation, which is possible coeval to the Mid-Darriwilian positive excursion documented in Baltoscandia. A rapid rise in $\delta^{13}C$ values from +0.5‰ in the uppermost Kuniutan Formation through the Datianba Formation to the GICE value of +2.0‰ in the lower Pagoda Formation of the Katian Stage. $\delta^{13}C_{carb}$ values shift back to +1‰ in the upper Formation.

Two positive excursions in $\delta^{13}C_{carb}$ of the Middle and Upper Ordovician at Xingshan show an identical trends in Baltoscandia and North America, representing a global positive shifts in carbon isotopic composition of the Ordovician oceans. The driving forces causing the main late Ordovician shifts in the carbon isotope trend should be global. The GICE interval in Xingshan is characterized by purple skeletal wackestone, deposited under a distinctive paleoceanographic condition. Global cooling and conseqent strongly upwelling on shelf might be responsible for the rapid increases in carbon isotopic composition of the Mid and Late Ordovician oceans.

Geochemistry and origin of dissolved methane and helium gas in geothermal water, Weihe Basin, China

L. JIANCHAO[1,2], L. RONGXI[1,2]* AND L. XIAOJIE[1,2]

[1]Key Lab of Mineral Resources & Geology Engineering, Education Ministry of China, Chang'an University, Xi'an, 710054, China (*correspondence: rongxi99@163.com)
[2]School of Geosciences & Mineral Resources, Chang' an University, Xi'an, 710054, China

Weihe Basin is a Cenozoic graben basin located between Qinling Orogen Belt and North China Block [1]. Geothermal water from big faults across the basin contains abundant soluble hydrocarbon gas in which methane accounts for from 10% to 24% with the highest of 82.44% and helium gas for from 0.15% to 0.3% with the highest of 3.95%. Value of $\delta\ ^{13}C$ of hydrocarbon gas increases with carbon number. Dissovled methane in center area of the Cenozoic deposition of Weihe Basin was biological gas featured with $^{13}C_1$ less than -55‰ while methane from other area was pyrolysis gas with $^{13}C_1$ of -38.7‰ ~ -27.2‰. Zhang Jiapo Formation, a set of Paleogene lacustrine deposition in Weihe Basin with higher abundance of mixed type I and II organic material, was believed to be source rock of biological gas. Palaeozoic carbonate and coal series under Cenozoic sediments were probably the source rocks of pyrolysis gas.

Helium isotope analysis of helium gas released from geothermal water shows that ^3He / ^4He values are between $7.80\pm0.23\times10^{-7}$-$4.7\pm0.24\times10^{-8}$. R/Ra valus of helium gas are less than 1.0. Combined with ^4He / ^{2o}Ne ratios from 220 to 1985, it indicates that helium gas dissolved in geothermal water derived from crust mixed with trace of mantle sourced helium. Regional geological data analysis shows that granite abundant in radioactive uranium, exposed in Qinling Orogen Belt and buried in large areas under Cenozoic sediments in south area of Weihe Basin is the main source rock of soluble helium in geothermal water.

[1] Liu, S. (1998) *Journal of Asian Earth Sciences* **16**, 369–383.