Paper Number: 1846

A New Study of Late Permian Marine Sedimentary Environment in the Xingmeng Area, eastern Inner Mongolia, China: Constraints from the Strontium, Oxygen and Carbon Isotopes, Rare Earth and Trace Elements data

Zhang Y. [1], Xing E.[1], Shi L.[1], Peng Y.[1], Zhai D.[1,2], Tian S.[3]

[1]Institute of Mineral Resources Chinese Academy of Geological Science, Key Laboratory of Saline Lake Resources and Environment, Ministry of Land and Resources, Beijing, 100037;
[2]Geophysical Exploration Institute of Hebei Province, Langfang, 065000;
[3]Institute of Geology Chinese Academy of Geological Science, Beijing, 100037

Recently we discovered many typical marine fossils, such as bryozoans, calcareous algae, etc. in multiple limestone layers of Lin 4 and Lin 5 member of Linxi Formation in Lopingian (Zhang et al., 2014), indicating that the Xingmeng area was still in a marine or marine dominated sedimentary environment in the Late Permian. In this study, we collected samples of limestone, dark mudstones and shales continuously from the Linxi Formation in the Linxi Guandi, Zhanpu and other sections in Linxi county, eastern Inner Mongolia, and carried out comprehensive geochemical analyses including major and trace elements, strontium-carbon-oxygen isotopes and biomarkers, in order to further understand Late Permian sedimentary environments in the Xingmeng area.

(1) Strontium, carbon and oxygen isotopes characteristics of the limestones: Strontium isotope analysis results of 8 limestone samples show that the distribution range of $^{87}Sr/^{86}Sr$ is 0.70729~0.70780, with an average ratio 0.70758. There are two minimum $^{87}Sr/^{86}Sr$ in accord with the Late Permian paleo-ocean background $^{87}Sr/^{86}Sr$ (0.70730~0.70740). The limestones $^{87}Sr/^{86}Sr$ basically match the marine limestones $^{87}Sr/^{86}Sr$ (0.70722-0.70767) of Guizhou Luodian Changxin Formation (Tian et al., 1995). Therefore, the ratios indicate that the Late Permian sedimentary environment was marine in the study area. Oxygen and carbon isotopes data of the same limestone samples show a range of Z values between 110~123, with an average 116, close to the marine and continental environment critical value of 120. The Z values are significantly higher than for lacustrine freshwater limestone of the Lower Triassic Xingfuzhilu Formation in the same area (He et al., 1997) demonstrating that the Linxi Formation limestones developed in a more closed setting than those deposited under marine conditions.

(2) The trace elements characteristics of limestones: Limestones show a loss of light rare earths, and Ce and La have negative anomalies. Similar REE patterns are developed for the gulf and nearshore facies. Th/U ratios are 0.3~2.6, with an average value 1.2 (marine limestone deposits<2), and the V/Ni ratios are 0.6~2.2, with an average value 1.5 (marine deposits>1), 82% of the V/Ni ratio samples are over 1. All of above data indicate that dominant sedimentary environment was marine, with the possible influence of terrestrial clastics or meteoric water.

(3) Biomarkers and trace element characteristics of dark mudstones and shales: The Ga /$C_{30\ hopane}$ calculated of 29 samples in Linxi formation are 0.12~0.39, with an average value 0.32. The ratios are significantly higher than fresh / brackish critical value of 0.1. Thus, mudstones and shales of Linxi Formation are interpreted to have been deposited in relatively deep waters of the bathyal environment.

Geochemical data for limestones and the dark mudstones and shales mostly indicate a marine sedimentary environment. Geochemical parameters and typical marine fossils provide strong support for a marine sedimentary environment in the study area. The data further show that rather than a continental environment as inferred in previous studies, the deposits of the Linxi depositional stage in

the Late Permian are predominantly marine. The study also contributes to an understanding of ‘the final closing time of Paleo-Asian Ocean in the Xingmeng area, eastern Inner Mongolia, China’.

Key words: Xingmeng area; Late Permian; marine environment; isotope; trace elements

References:

[1] Zhang Yongsheng, Tian Shugang, Li Zishun, et al. (2014) CHINESE SCIENCE BULLETIN, 59(1): 62-74

[2] Tian Jingchun and Zheng Yunfu. (1995) ACTA SEDIMENTOLOGIC SINICA, 13(4): 125-130

[3] He Zhengjun, Liu Shuwen and Ren Jishun. (1997) REGIONAL GEOLOGY OF CHINA, 16(4): 403-409