

Re-Os Geochronometer Constraint on the Timing of Petroleum Generation and Migration and Associated Tectonism of the Northern Longmen Shan Thrust Belt, Southwest China

SHEN Chuanbo¹⁾, GE Xiang^{1,2)}, David SELBY^{1,2)}, RUAN Xiaoyan¹⁾,
HU Shouzhi¹⁾, PENG Lei³⁾

1) Key Laboratory of Tectonics and Petroleum Resources (China University of Geosciences), Ministry of Education, Wuhan, 430074, China; 2) Department of Earth Sciences, Durham University, Durham DH1 3LE, UK; 3) Faculty of Earth Resources, China University of Geosciences, Wuhan, 430074, China

There are lots of Neoproterozoic-lower Paleozoic outcropping bitumen distributed at the northern Longmen Shan thrust belt in Southwest China, indicative of existing paleo-oil reservoir. The bitumen develops from the Sinian to Permian strata, mainly along the thrust fault plane and fracture system in the lower Cambrian strata. Bitumen Re-Os geochronology is a novel technique that has the potential for wider use to constrain the timing of hydrocarbon generation, to identify source units and to determine the age of fault activity that is associated with contemporaneous bitumen precipitation. Nine Lower Cambrian bitumen samples and three oil samples from the veins along the fault distribution were selected for Re-Os analysis to determine the timing of tectonism and coupled oil generation in the northern Longmen Shan thrust belt. The Re and Os abundances of the bitumen samples range between 283.3~563.3 ppb and 4058.2~15347.3 ppt, respectively. The Re and Os abundances of the oil samples vary between 7.7~9.6 ppb and 90.3~127.2 ppt, respectively. These values are significantly elevated from those of the average continental crust and

previously reported bitumen samples from both hydrocarbon and metalliferous systems, and also the majority of marine and lacustrine organic-rich sedimentary rocks (REFS), which has also been shown by previous studies. The $^{187}\text{Re}/^{188}\text{Os}$ values are high and range from ~ 230.7 to 718.4 and the Os isotopic composition is radiogenic, with the $^{187}\text{Os}/^{188}\text{Os}$ ratios between ~ 2.79 and 3.48. Repeat analysis yield similar Re and Os concentrations, and $^{187}\text{Re}/^{188}\text{Os}$ and $^{187}\text{Os}/^{188}\text{Os}$ values. The bitumen Re-Os isotope data define two positive correlations. One yield a Re-Os date 158 ± 77 Ma with an initial $^{187}\text{Os}/^{188}\text{Os}$ value of 1.85 ± 0.61 (2σ ; MSWD = 76). The remaining samples yield a Re-Os date 199.7 ± 2.6 Ma with an initial $^{187}\text{Os}/^{188}\text{Os}$ value of 2.06 ± 0.01 . The two ages are in agreement with burial history and fluid inclusion analysis in Longmen Shan thrust and adjacent Sichuan Basin, suggesting two stages petroleum generation and migration process. Petroleum generation is a dynamic process and it is most likely that the bitumen Re-Os ages represent multi event of oil influx related to oil generation. The

注: This work was supported by the National Natural Science Foundation of China (No. 41372140, 40902038).

收稿日期: 2015-08-28; 改回日期: 2015-09-28; 责任编辑: 周健。

作者简介: 沈传波。Email: cugshen@126.com。

oil samples from the fault plane suggest that oil generation is protracted and still migrating today. The difference initial $^{187}\text{Os}/^{188}\text{Os}$ ratios of the bitumen indicate they derived from various source rocks, Cambrian shale and Sinian shale. Moreover, the Re-Os ages were coeval with two intense thrust fault movements of the northern Longmen Shan thrust belt during Mesozoic, which also provides a new direct

absolute age evidence for the Late Mesozoic deformation of the northern Longmen Shan thrust belt. Therefore, our bitumen Re-Os geochronology provides a new direct absolute age evidence for the timing of tectonism and coupled petroleum migration in the northern Longmen Shan thrust belt. It also provides a new approach to determine the direct absolute timing of fault activity.