Re-Os dating of the Lower Cambrian black shales in Guizhou province of South China

JING-HONG YANG[1,2], SHAO-YONG JIANG[1], HONG-FEI LING[1], YONG-QUAN CHEN[1] AND WEI PU[1]

[1] State Key Laboratory for Mineral Deposits Research, Department of Earth Sciences, Nanjing University, China;

[2] The Key Laboratory of Coastal and Island Development of Ministry of Education, Nanjing University, China

In south China, the Lower Cambrian black shale sequence of the Niutitang Formation was deposited over several thousands of kilometers. The lowermost part of this formation contains a thin sulfide ore horizon with an apparently unique and extreme metal enrichment in Mo, Ni, PGE, Se, As, Hg, Sb, Ag, and Au. Re-Os isotope analyses for the Ni-Mo sulfide ores have been reported by Mao et al (2002) and Li et al (2002). In this study, we reported Re-Os isotope data of the host black shales from Guizhou province, which yield an age of 535±11 Ma with an initial $^{187}Os/^{188}Os$ ratio of 0.80±0.04. This age is consistent within error with the Re-Os isochron age (541±16 Ma) of the Ni-Mo sulfide ores (Mao et al., 2002) and the Pb-Pb isotope age of the host black shales (531±24 Ma, Chen et al., 2003) and the Ni-Mo sulfide ores (521±54 Ma, Jiang et al., 2006).

The $^{187}Os/^{188}Os$ value of seawater during Early Cambrian time remains unclear. Singh et al. (1999) reported an initial $^{187}Os/^{188}Os$ of 1.18±0.02 for the Lower Cambrian black shales from the Lesser Himalaya, India. Since in this area there are no reports for the occurrence of noticeable Ni-Mo-PGE-Au enrichments in the black shales, we suggest it is reasonable to consider this ratio as representative of the Early Cambrian seawater Os ratios. This high seawater $^{187}Os/^{188}Os$ ratio is also consistent with a high continental weathering rate during Early Cambrian time as previously been deduced from a extremely high $^{87}Sr/^{86}Sr$ ratio of the seawater. In our study area, the initial $^{187}Os/^{188}Os$ ratio of 0.78±0.19 for the Ni-Mo sulfide ores (Mao et al., 2002) and 0.80±0.04 for the host black shales are therefore slightly lower than the Early Cambrian seawater values as above suggested. We suggest that this lower Os value may reflect a contribution of submarine hydrothermal component for the ores and their host rocks. A comparison of Os isotope data among the Chinese Ni-Mo sulfide ores, the sea-floor massive sulfide deposits and contemporaneous seawater suggests a possible similar hydrothermal forming mechanism for these deposits. The discharge of hydrothermal fluids into the Cambrian ocean may have had a great effect on life during the Cambrian Explosion.

This study is financially supported by China National Science Foundation (grants no. 40372059, 40221301, 40232020).