Trace element and Re-Os isotope signatures of the Early Cambiran black shales in the Tarim Basin, NW China: Implications for paleoenvironmental settings

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The Ediacaran-Cambrian transition was a key period in the Earth's history, as it recorded a wide range of major changes in the continental configuration, biological evolution, global climate, ocean geochemistry and redox conditions. Chemical and isotopic signatures from black shales can serve as potential proxies for paleoenvironmental reconstruction. We here for the first time present a systematic study of Re-Os isotope geochemistry and major and trace elements (including REEs) of organic-rich black shales in the lower Cambrian Yurtus Formation to elucidate the paleoenvironmental settings and hydrothermal activity of the Tarim Block.

The significantly high enrichment factor of Ba, V, Cr, Ni, Cu, Zn, Mo and U, redox-sensitive element ratios (e.g. U/Th, V/Cr, V/(V+Ni) and Ni/Co), the seawater-like distribution pattern of PAAS-normalized REEs (intermediate negative Ce, weakly positive Eu and positive Y anomalies), as well as the high TOC content (up to 24.70%) collectively suggest that the lower Cambrian black shales were deposited in an anoxic continental shelf environment with hydrothermal fluids playing a key role in the extraction and enrichment of certain trace elements (Ba, P , V and Ni) and explosion of organisms during the Ediacaran-Cambrian transition.

The Re and Os contents of the black shales analyzed vary from 0.5 to 115.27 ppb and 0.57 to 17.40 ppb, respectively. No Re-Os isochron ages have been obtained from the Kungaikuotan outcrop section due to the relatively large sampled intervals (2-3 m) and strong weathering effects (with a loss of Re up to 90%). Some unweathered samples with high TOC reveal an initial $^{187}Os/^{188}Os$ value of about 0.85±0.07 (calculated age of 530 Ma), which is similar to the Os_i value (0.87±0.07) of the lower Cambrian Niutitang black shales in South China [1]. The Os_i composition herein is much lower compared with the lower Cambrian shales in the Lesser Himalayas (1.18±0.02), and the lower value might indicate a combined effect of hydrothermal fluid and relatively limited clastic input [2].

[1] Xu et al. (2011) Eocn. Geol. 106 , 511-522.

[2] Singh et al. (1999) Geochim. Cosmochim. Acta .63, 2381-2392.