Re-Os age for marine-influenced coal

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The age of coal deposition is crucial for reconstruting the thermal history of sedimentary basins and correlating coal beds of exploration interest. Radiometeric dating of coal beds in the absence of tonsteins, however, has seen only limited success. Here, we employ the Re-Os geochronometer, along with total organic carbon (TOC) and Rock-Eval data, to determine the timing and conditions of a marine incursion at the top of the Matewan coal bed, Kanawha Formation, Pottsville Group, West Viginia, USA. A modified van Krevelen diagram shows Type-I organic matter in these coals; the observed range for the hydrogen index (HI: 267-290) indicates dominance of aliphatic hydrocarbons with lower carbon chain length ($<C_{19}$). Average Re (107.6 ± 16.4 ng/g) and Os (0.52 ± 0.09 ng/g) concentrations are higher by few orders of magnitude than those reported earlier for terrestrial coals [1]. A Re-Os isochron for the Matewan coal provides an age of 325 ± 13 Ma (Model 3; MSWD=12; n =19; 2σ) with an initial $^{187}Os/^{188}Os$ ratio of 0.87 ± 0.88. This first Re-Os age derived from coal samples overlaps the age for the overlying Betsie Shale Member within uncertainty [2].

Interestingly, external precision of replicate Os analyses shows a positive correlation with HI. The HI is a measure of marine influence; thus samples with the most profound marine influence also have the best analytical reproducibility. Equilibration of Os isotopes with seawater under marine conditions swamps variability inherited from terrestrial plant debris, decreasing scatter on the isochron. The $^{187}Re/^{188}Os$ ratios of the Matewan coals (3299.4-5134.1) are significantly higher than those reported earlier for Phanerozic black shales, but overlap that of present-day seawater (~4270). Thus the $^{187}Re/^{188}Os$ ratios indicate that both Re and Os are primarily of marine origin, and confirm efficient removal of both elements from a highly-sulphidic water column into the coal. The observed dominance of seawater-derived Re and Os in marine-influenced coals makes Re-Os geochronology a viable tool for constraining depositional ages.

[1] Baioumy *et al* (2011) *Chem. Geol.*, **285**, 70-81 [2]: Lyons *et al* (1997) XIII International congress on Carboniferous and Permian, **157**, 159-166