

Absolute dating of bitumen - Application of the ^{187}Re - ^{187}Os isotope system: The first results from the Polaris Mississippi Valley-type Zn-Pb deposit, Nunavut, Canada

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ABSTRACT

Reporting for the first time a Re-Os date for bitumen demonstrates that this isotope system has potential for establishing the absolute timing of hydrocarbon migration. The Polaris Mississippi Valley-type Zn-Pb deposit is hosted by the Upper Ordovician Thumb Mountain Formation. Sphalerite and galena (ore minerals) occur in veins, disseminations, replacements and open-space fillings. Bitumen occurs in open-space fillings and coatings and is interpreted to have formed syn/late with respect to Pb-Zn mineralization. The timing of sulphide mineralization is Late Devonian time, on the basis of a Rb-Sr sphalerite age of 366 ± 15 Ma and a late Devonian paleomagnetic age. Samples of bitumen were taken from a variety of locations from the main pit at Polaris. Bitumen Re and Os contents are ~5 - 80 ppb and ~50 - 1200 ppt, respectively. The $^{187}\text{Re}/^{188}\text{Os}$ ratios are very high, ranging from ~300 - 1800, and the Os isotopic composition is moderately to highly radiogenic, with $^{187}\text{Os}/^{188}\text{Os}$ ratios ranging from ~3 - 14. An obvious linear trend is defined by four samples on a Re-Os isochron diagram, and yield a date of 368 ± 15 Ma (MSWD = 4.9; Model 3). This date is in excellent agreement with the Rb-Sr sphalerite and paleomagnetic age for mineralization at Polaris. The combined Re-Os, Rb-Sr and paleomagnetic dates suggest that the migration of fluids responsible for both Pb-Zn mineralization and bitumen formation at Polaris was contemporaneous, and was coeval with the Late Devonian Ellesmerian Orogeny.