

Origin and evolution of waters in the Hancheng coal seams, the Ordos Basin, as revealed from water chemistry and isotope (H, O, ^{129}I) analyses

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The coal seams in the Permian Taiyuan Formation and the Carboniferous Shanxi Formation are the primary reservoirs for the coalbed methane (CBM) in the Hancheng region in the Ordos Basin. In this paper, the origin and evolution of waters associated with CBM production were studied on the basis of water chemistry and isotopes including the chloride and iodine compositions, oxygen and hydrogen stable isotopes, and radioactive isotope ratio of $^{129}\text{I}/^{127}\text{I}$. The ratio of $^{129}\text{I}/^{127}\text{I}$ of water was determined by accelerator mass spectrometry (AMS). The result shows that the formation water is of NaHCO_3 and NaCl types with the total dissolved solids (TDS) varying from 1532.29 mg/L to 7061.12 mg/L. The values of ^{129}I and I/Cl ratio indicate that the formation waters were diluted by meteoric water. The $^{129}\text{I}/^{127}\text{I}$ ratios range from 6.6×10^{-13} to 1459.5×10^{-13} . The $^{129}\text{I}/^{127}\text{I}$ ratios for most of the samples are between the $^{129}\text{I}/^{127}\text{I}$ initial value and that of recent anthropogenic water. This age of the formation water samples, obtained through the ^{129}I decay curve method, ranges from 0 Ma to 18.5 Ma, suggesting that the waters from the Taiyuan Formation and the Shanxi Formation are very young. Two different origins of water are identified in the Hancheng region. One group is dominated by pre-anthropogenic meteoric water, and is characterized by $^{129}\text{I}/^{127}\text{I}$ ratios lower than the initial value of 15×10^{-13} and δD , $\delta^{18}\text{O}$ values of waters below the Global Meteoric Water Line. The other group is characterized by $^{129}\text{I}/^{127}\text{I}$ ratios in excess of 15×10^{-13} , which has undergone variable degrees of dilution by recent anthropogenic water.