Tracing the sources of sulfur in Beijing rain water with stable isotopes

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Acid rain is one of the prominent atmospheric environmental problems in Beijing, China. The stable isotopes of sulfur were used as environmental tracers of sulfur in rain by tracing its sources and identifying rain sulfur turnover rates. 74 rainwater samples in Beijing were collected between August 2010 and December 2012 and the concentrations of SO_4^{2-}, the sulfur isotopic composition and pH were analyzed. The results showed that mean pH in precipitation was 6.42, the acid rain frequency in 2011was 26.9% compared to 13.6% in 2012. The concentrations of SO_4^{2-} ranged from 2.23-82.36 mg/L with a weighted average of 22.44 mg/L, whereas the average value of $\delta^{34}S$ was 4.8 ‰ within range of 2.1‰ and 12.8‰. A pronounced seasonal pattern is discernible for $\delta^{34}S$ in precipitation with data for the winter (7.0‰) > autumn (5.7‰) > summer (3.9‰) ≈ spring (3.8‰), SO_4^{2-} concentration in summer was significantly lower than in the other seasons. $\delta^{34}S$ indicates that the sources of sulfur in rain water include bioorganic sulfur, anthropogenic sulfur (coal combustion) and sulfur from sea spray. Anthropogenic sulfur contributes the majority to the sulfur in rainwater, especially in winter and autumn. For several rainstorms sulfur dominantly originated from sea spray. Results provided important information about the sulfur sources in rain which will help to decrease acid rain and improve air quality in Beijing.

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Research On The Super-Long Life Of Deep Carbonate Oil Reservoir

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Reservoir's destroy is a universal phenomenon and more than one half of the reservoirs are formed later than Oligocene Epoch, which average age is 35 Ma and the average live age is 55 Ma (Macgregor, 1996). As for the ancestral marine basin of China, Palaeozoic marine strata experienced multicycle movements, reservoirs are reformed and destroyed seriously, and there mainly be secondary reservoir. Recently, large ancient deep carbonate reservoirs generated in 290-250 Ma ago have been discovered in the north of Tarim basin. This discovery not only changed the reservoir toplimit age (95Ma) but also brought great belief in exploring ancient reservoir.

The reservoirs distributed in 5500-7200m, and reservoir is Ordovician carbonate, and cap rock is upper Ordovician finely carbonate and mudstone. The oil came from middle-upper Ordovician hydrocarbon source rock in late Permian. Based on hydrocarbon generation history, fluid inclusion, burial history, authigenic Illite K-Ar aging, trap formation and evolution process and so on, the reservoirs formed during 290-250 Ma and were conserved with depth increasing.

For Tarim basin, late Permian is an important generating and expelling hydrocarbon period. Since the Triassic, Ordovician oil reservoirs preserved had been in the process of increasing buried depth with increasing thick cap rock, and the location and form of Ordovician trap are always the same. With depth more than 7000m and reservoir temperature more than 160 °C, the crude oil hasn't been cracked by now, so the zone more deeper is predicted still filled with oil.

Gold tube thermal simulation experiments show that oil cracking depth of Tarim basin is about 7500m and peaked in 9000-9500m combining the compensation effect of the low geothermal gradient and late quickly buried process of Tarim basin. The reservoir temperature of oil cracking is higher than 210°C, and liquid oil can be exist above 9000m. Therefore, the ancient oil reservoirs discovery brings great belief in searching for native marine oil reservoir in complex structure area of Tarim basin, believing the exploring depth can be expanded to 9000m.

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