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Editorial: Advances in geochemistry and macromolecular structure of coal

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Editorial on the Research Topic
Advances in geochemistry and macromolecular structure of coal

In recent years, studies on the macromolecular structure and geochemistry of coal have been the focus of scholars from various countries. For the pore structure of coal, factors such as paleogeographic patterns, depositional environments and depositional processes control the original material of coal reservoirs, which causes the pore development of coal to be significantly influenced by multiple factors such as total organic carbon content, micro fraction and mineral fraction (Zhao et al., 2018). The molecular structure models of coal have gone through the stages of Fuchs lignite model, Given bituminous coal model, Wiser bituminous coal model, Shinn bituminous coal model, Domazetis lignite model, Yuzhou lignite model and South African coal model in turn, and the proposed molecular structure models of coal reveal that the chemical composition and molecular structure morphology of coal are diverse and complex (Cui et al., 2019). The study of soil heavy metal migration, solid waste utilization and shallow groundwater ion content in mining areas is conducive to in-depth research on the geochemical characteristics of coal rocks such as organic micro component, saturated hydrocarbon distribution, depositional environment and coal-forming parent material. Based on the Research Topic "Advances in Geochemistry and Macromolecular Structure of Coal", the macromolecular structure characteristics, geochemical related research of coal were introduced. This Research Topic was from the Geochemistry section of the journal "*Frontiers in Earth Science*".

Zheng et al. selected 26 coal samples from No. 1 which is coal in the Shanxi Formation of Zhangji and Xinjier mines in the Huainan coalfield as the study sites and determined the mineralogical and geochemical composition of the coal samples by using DMA-80mercury-measuring instrument, XRF, XRD, and ICP-MS to analyze the relationship between the depositional environment of coal seams and mercury enrichment. The results showed that the average values of mercury content in Shanxi Formation in the study area were higher than the background values of coal in China and the world. Compared with the mercury content in the Crust, it showed a significant enrichment. In addition, they concluded that land source input was not conducive to mercury enrichment and sea water activity was conducive to the enrichment of mercury in a certain extent (Zheng et al.). This study provides a reference for further research on the depositional environment of coal seams and mercury enrichment in Huainan coalfield, and reveals the intrinsic connection between the pore structure of coal and mercury enrichment.

Coal is a complex sedimentary rock whose depositional background determines the material basis for microscopic pore development. The Ordos Basin, one of the largest and most extensively studied Jurassic coal reservoirs in the world, was investigated by Lv et al. By studying the sequence-stratigraphic context of the lacustrine Yan'an Formation near Dongsheng in the Ordos Basin, they explored the factors controlling the peat accumulation and the cyclicity in the coal-bearing strata. They found that coal development in the area was controlled to some extent by fluctuations of the lake level, that the development of the stratigraphic sequence controlled the vertical distribution of coal seams, and that basin subsidence and climate were the main controlling factors for the development of the coal seams and the coal-bearing succession (Lv et al.). This study helps to deepen the theory of coal formation in Ordos Basin, and also provides theoretical support for the improvement of coal mining efficacy in Ordos Basin.

The molecular structure of coal contains a large amount of aliphatic carbon, aromatic carbon and oxygen-containing functional groups, in addition to small amounts of S and N. Ren et al. used gas chromatography-mass spectrometry to determine the polycyclic aromatic hydrocarbons (PHAs) concentrations in surface soils, and analyzed the composition, spatial distribution and sources of PAHs in the largest coal mining subsidence area in Suixi County, southwestern Huaibei City, and evaluated their potential carcinogenic risk. The results showegd that the concentration of PAHs ranged widely, and the proportion of high molecular weight in contaminated areas was significantly higher than that in uncontaminated areas. The distribution of PAHs in the contaminated areas differed significantly, with higher concentrations of PAHs in the soils near an industrial park and coal gangue piles. In addition, the carcinogenic health risk values for adults in the contaminated areas were higher than the safety standard prescribed by the United States Environmental Protection Agency at 95% confidence level, with relative exposure duration (ED) and soil surface area of skin exposure being the most important parameters for adults, and ED and body weight for children. The risk of cancer in adults and children in contaminated areas was five times higher than in uncontaminated areas (Ren et al.). This study presents the spatial distribution, possible sources and carcinogenic risk evaluation of potential PHAs in coal mining subsidence area in Suixi County, southwestern Huaibei City, which is of reference for further studies on the link between the molecular structure of coal and environmental pollution.

In order to understand the distribution characteristics of heavy metals and their migration and transformation behaviors in the AnqingGuichi ore-cluster region in the Middle-Lower Yangtze metallogenic belt, Chen et al. selected one of the gold mines as the study area, and carried out a study on the concentration and migration and transformation mechanisms of gold mining waste and the surrounding soils. The concentration and migration mechanisms of As and typical heavy metals Cd, Zn, Pb, Cu, Cr, and Ni in gold mining waste and surrounding soil were investigated. The results showed that the concentrations of As in both the mine waste sites and soils were high and seriously polluted. The mineral particles in the tailings can migrate to the soil through atmospheric transport, rainwater leaching, and surface runoff, etc., leading to the accumulation of heavy metals (Chen et al.). This study provides a detailed report on the distribution and migration mechanisms of heavy metals in the AnqingGuichi ore-cluster region, which provided a reference for the prevention and control of heavy metal pollution in this mining area.

Zhao et al. measured the F^- content of mine water in the Panyi, Paner, Pansan, Guqiao, and Xieqiao mining areas of Huainan, and specifically analyzed the distribution characteristics of F^- content in shallow groundwater, its distribution pattern and environmental effects in China by combining relevant data. This study found that the average F^- content in shallow groundwater was the lowest in southwest China, high fluoride zone in south, northeast and northwest China, and low fluoride zone in north, east and central China, and there were differences in the average F^- content in groundwater among provinces and cities. F^- in shallow groundwater mainly exists in ionic, complex ionic and organic fluoride molecular states. The impact of high F^- content in shallow groundwater on the environment was mainly manifested in the increase of water F^- content and soil F^- and vegetable F^- content. The effects of high F^- content on human body were mainly manifested in the increase of urinary F^- content in children, the high incidence of dental fluorosis in children, the increase of fluorosis incidence in adults with age, and the impact of cognitive function in the elderly (Zhao et al.). These results provide a basis for fluoride pollution control and treatment of highly fluoridated water in China.

To solve the problems of coal-gangue accumulation in mine and the pollution of cadmium (II) and lead (II) in wastewater, magnesium silicate hydrate (M-S-H) was synthesized by thermochemical method, and Cd (II) and Pb (II) were adsorbed by M-S-H. Qing et al. explored the effects of initial solution pH, initial metal concentration, adsorbent dose, temperature, reaction time and coexisting ions on the adsorption performance of M-S-H. The results showed that M-S-H could achieve effective adsorption of Cd(II) and Pb(II), and the adsorption mechanisms were mainly electrostatic interaction, ion exchange and surface complexation (Zhang et al., 2023). The synthesized M-S-H from coal gangue in this study can effectively remove metal ions from water, which opens up new possibilities for the reuse of coal gangue.

Author contributions

BY, DW, RS, and MR were guest associate editors of the Research Topic, DW and JW wrote the initial draft, BY, RS, and MR revised and edited the text.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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