

Effects of Groundwater Level Decline on Soil-Vegetation System in Semi-Arid Grassland Influenced by Coal Mining

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Abstract

Although it is well known that groundwater significantly influences plant communities, there have been few studies on how the soil and plant communities respond to groundwater level decline in a short time affected by coal mining. This paper examined the changes in groundwater depth before and after coal mining and the soil-vegetation response in a typical semi-arid grassland coal mine area of Hulunbuir Steppe, Northeastern China. The IsoSource model, based on the dual stable isotopes of δD and $\delta^{18}O$, was employed to estimate groundwater contributions to shallow soil (0-100cm) water under different groundwater depths. The results revealed that groundwater was the dominant water source ($75.7 \pm 17.1\%$) for shallow soil water when the groundwater depth is less than 4 meters, indicating that 4m is a threshold in groundwater depth, separating groundwater-dependent, and precipitation-driven vegetation system in the study area. Secondly, a strong non-linear response between vegetation species, height, coverage, and groundwater decline was identified in the coal mine area. The vegetation properties were found to be lowest in the areas where groundwater depth increased from 1.5~4 m to 4~28 m before and after coal mining. Finally, the groundwater level decline in the mining area significantly influenced the groundwater-dependent vegetation ecosystem, with the soil CEC and organic matter reduced, and the plant community degraded, succeeding from mesophytic to xerophytic. Whereas, the soil-vegetation system in the non-groundwater-dependent area has no obvious response to the groundwater decline. These results suggest that caution should be exercised when mining in groundwater-dependent ecosystem regions.

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