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## Modes of occurrences of major and trace elements in coals from Yangquan Mining District, North China

Qiming Zheng<sup>a</sup>, Songlin Shi<sup>a</sup>, Qifu Liu<sup>b,\*</sup>, Zhanjie Xu<sup>b</sup>

<sup>a</sup>School of Resources and Environment Engineering, Henan University of Engineering, Zhengzhou, Henan, 451191, China

<sup>b</sup>School of Geological Science and Survey Engineering, China University of Mining and Technology, Beijing 100083, China

**Abstract:** Yangquan Mining District is a major location for anthracite coal production in China. Understanding the modes of occurrences of major and trace elements in Yangquan coal is significant both geochemically and environmentally, although most elements are more depleted than those in Chinese coal. Ten coal bench and two parting samples were collected from No. 15 Coal of Yangquan Mining District. X-ray diffraction analysis was used to determine the proportions of minerals in the Yangquan coal, and X-ray fluorescence and inductively coupled plasma mass spectrometry analyses were used to determine the contents of major element oxides and trace elements, respectively. The mineral assemblages, ash yield, and  $(\text{CaO}+\text{MgO}+\text{Fe}_2\text{O}_3)/(\text{SiO}_2+\text{Al}_2\text{O}_3)$  ratio varied significantly in the vertical direction, which is attributed mainly to vertical variation in the depositional environment. The major element oxides and trace elements in the Yangquan coal were divided into four groups according to cluster analysis, which represent organic or inorganic affinity and different modes of occurrences. The coal benches underlying partings exhibited a rare-earth element and yttrium (REY) distribution pattern characterized by heavy (H)-type. This result differs from other coal benches characterized

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