Inversion of Soil Heavy Metal Content by Spectral Characteristics in Mining Concentrated Area

XIE Hongbin[1, 2], LIU Dong[2] YANG Xue[1, 2], TAN Dejun[1, 2], JIAN Ji[3], LUO Zhenfu[1]

[1]Chongqing Key Laboratory of Exogenic Mineralization and Mine Environment,Institute of Geology and Mineral Resources, No. 177-9, Changjiang 2nd Road, Yuzhong District, Chongqing 400042 China,hongbinxie@163.com
[2]Chongqing Research Center of State Key Laboratory of Coal Resources and Safe Mining, No. 177-9, Changjiang 2nd Road, Yuzhong District, Chongqing, 400042 China [3]Key Laboratory of Geoscience Spatial Information Technology,Ministry of Land and Resources of the P.R.China,182366479@qq.com
No.1 East 3 road ErXian brige ChengHua distrct,Chengdu University of Technology,Chengdu 610059 China,75789355@qq.com

Abstract: Environmental pollution problem was the most severe test in today's world, and the mining pollution made it even worse, had seriously affected the surrounding residents. So the diagnosis of pollutant was very urgent. Due to the high expenses and complicated work procedure, the chemical, physical and biological method, which commonly used in environmental pollution detection, were not good enough to solve that. Thus the hyperspectral remote sensing, as an image-spectrum merging technology, made it's fast and vast areas to detect the location and characteristics of pollutant. Therefore a direct identification pollution content solution base on field hyperspectral data has been proposed in this study to provide technical reference for soil environmental quality investigation.

For inversion the heavy metal content in a mining concentrated area, ASD FieldSpec® Pro FR was used to the soil spectrum reflectivity measurement, and sent parts of soil samples to do some chemical test at the same time. The chemical test showed that the element arsenic (As), cadmium (Cd) and zinc (Zn) was in excess of the standards. After some reasonable preprocessing with spectral data, potential pollution elements' spectral characteristics could be extracted by selection analysis, such as the continuum-removal, first derivative.Then correlation analysis with chemical test results, and the best spectral characteristics for the three elements could be obtained. The spectral characteristics of As, Cd and Zn were R2320/R1755,R2260/R2210R and R1920/R480, which were highly correlated to the three actual content with Pearson correlation coefficient of -0.811,-0.703,-0.635. To get the best inversion model of pollutant, this study used multivariate regression analysis on chemical element content and spectral characteristics reflected value, which had the highest multiple correlation coefficients should be chosen for that. The statistics showed the inversion model of As, Cd and Zn should be $y = -47.7\ln(x) + 6.176$, $y = 17603e^{-12.2x}$, $y = -89.283x + 242.75$, which multiple correlation coefficients

were R^2=0.696(As), R^2=0.555 (Cd), R^2=0.4031(Zn). Put the three model in corresponding band or layer stack of Aster image, processed by radiation correction,atmospheric correction and geometric correction, that the heavy metal content could be inversed directly.
It is concluded that the method established in this study provide an important theoretical and technical foundation for diagnosis of soil pollutant, especially in vast area of soil environmental quality investigation, it has more efficiency. However, the inversion accuracy is very dependent on images' spectral resolution. The Zn, which had a lower multiple correlation coefficients in this paper, is due to the insufficient of spectral resolution in Aster image. So the hyperspectral imaging technology and it's popularize is the key to the development and application of the heavy metal content inversion. The spectral analysis and digital image processing technology need further study to make the inversion result more reality.

Keywords：Mining concentrated area；Hyperspectral；Heavy metal；Spectral characteristics;Inversion