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Modelling long-term transportation of ore-sourced geochemical elements in the vertical profile of the loess cover

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A long drill core of 110 meters above the Diyanqinamo W-Mo deposit in the Inner Mongolia of China was chosen. 106 Samples were collected in every one meter of the drill core and the contents of 33 elements were measured using a portable x-ray fluorometric analyzer. Two nonparametric methods of Spearman rank and Kendall-τ were applied to test the correlation between the contents and the depths of the samples from the ore-body. It shows that the contents of 18 elements out of the 33 are nonlinearly correlated with the depths. The 18 elements are S, W, Mo, Fe, Cu, Zn, Pb, Sn, Sb, Te, V, Ti, Ni, Mn, Th, Rb, Cs and As, including all the principal elements related with the deposit[1]. From statistical point of view, we regard that these 18 elements might be sourced from the ore-body through the transportation processes in the vertical profile of the loess cover above the deposit.

The HP filter was used to extract the trends of the transportation or the distribution patterns of the contents of ore-sourced elements [2]. The results show approximately that the contents of Mo, S, W and Te decrease from the ore-body to the ground surface in exponential patterns; Fe, Cu, Ni, Mn, and Sb in linear patterns; Rb, Cs, Sn, Zn, Ti and V in second order polynomials; exceptionally, Pb, Th and As increase in inverse-U patterns (Fig. 1)[3].

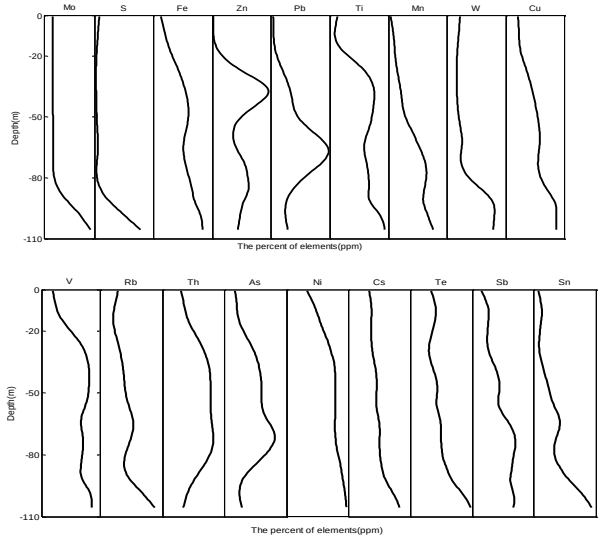

Figure 1: Vertical patterns of the contents of ore-sourced elements extracted by HP filter

To model the trends of the transportation of ore-sourced elements in the loess cover, we proposed a hypothesis that the change rate of the content C of an ore-sourced element with respect to the distance h from the ore-body is proportional to the ratio of C^{α} to h^{β}, based on which we got a general model $C=C_0(1-kh^{1-\beta})^{1/1-\alpha}$(Fig. 2), where C_0 is the initial content and k is a parameter. The hypothesis for building the general model can result in exponent, logarithm, line and polynomial as the special cases. The general model and the special cases can be used to fit the extracted trends well statistically.

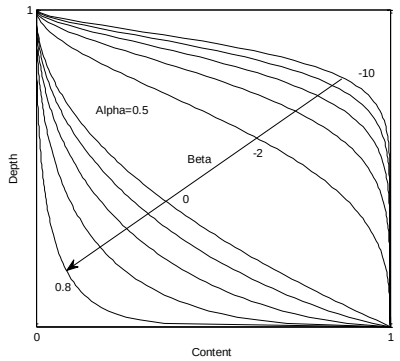

Figure 2: Curves of the model

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References:

[1] Xu D et al. (2012) Earth Science 37(6): 1133-1139 (in Chinese)

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