

## **Heavy metal Source Apportionment in soil by Using Vanadium Isotopic ratios and Speciation Characteristics**

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Panzhihua city is one of the largest mining bases in China, which is famous with a huge vanadium-titanium magnetite ore deposit. Vanadium is a trace element necessary to human being, but it can be toxic and cause multiple physical diseases on certain content level. Therefore, it is of great significance for the implementation of pollution control to identify sources of vanadium in the soil of Panzhihua region. Vanadium has two stable isotopes of  $^{50}\text{V}$  (0.24%) and  $^{51}\text{V}$  (99.76%). It can exist as multivalent states in nature system, the redox reaction, adsorption and desorption process inevitably lead to isotopic fractionation. The first-principles calculations have been applied to show that vanadium can also produce significant isotopic fractionation at low temperature, which indicated that the application of vanadium isotopes on source tracing is feasible.

According to our investigation, V, Cu, Cd and Ti possess high pollution coefficients, followed by Zn, Mn, Ni, Cr, Hg, Pb and As. The topsoil of Panzhihua mining area has been polluted by V, and the average content of vanadium in surface soil is 2.79 times the soil background value in China. In this paper, the present situation of heavy metals such as vanadium pollution in soil of Panzhihua area was investigated. The vanadium isotope ratios in soil and some end components were measured and used to trace soil contamination. The results show that the range of vanadium isotope in soils ranges between  $-0.620\text{‰} \sim -0.737\text{‰}$ . The range of end-component components is between  $-0.518 \sim -0.941\text{‰}$ . V isotopes in combustion process of coal and blast furnace slag can produce strong fraction. The main anthropogenic source of vanadium pollution in the surface soil was considered as the fly ash produced by smelting, and the effect of coal fly ash is greater than that caused by blast furnace slag. The risk degree of vanadium in soil was evaluated in Panzhihua area. Interestingly, we also used the fraction characteristics of elements to trace the pollution, and the result showed to be consistent with the isotopic tracing method.