



Selenium in Paleozoic stone coal (carbonaceous shale) as a significant source of environmental contamination in rural southern China

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Selenium occurs in high concentrations (typically > 10 and up to 700 ppm) in organic-rich Paleozoic shales and cherts (called "stone coal" - shíméi), in southern China. Stone coals are black shales that formed in anoxic to euxinic environments and typically contain high concentrations of organic carbon, are enriched in various metals such as V, Mo, Pb, As, Cr, Ni, Se, etc., and are distinguished from "humic" coal in the Chinese literature. We have examined stone coal from Shaanxi, Hubei, and Guizhou Provinces, People's Republic of China and have focused our study on the mode of occurrence of Se and other elements (e.g. As, Pb, etc.) hazardous to human health. Scanning electron microscope, energy-dispersive analysis and electron microprobe wave-length dispersive spectroscopy were used to identify and determine the composition of host phases observed in the stone coals. Native selenium, Se-bearing pyrite and other sulfides are the hosts for Se, although we cannot preclude an organic or clay-mineral association. Stone coals are an important source of fuel (reserves over 1 billion tonnes), both domestically and in small industry, in some rural parts of southern China and present significant environmental problems for the indigenous population. The stone coals create three main environmental problems related to Se pollution. First, the residual soils formed on stone coal are enriched in Se and other metals contained in the stone coals and, depending on the speciation and bioavailability of the metals, may enrich crops and vegetation grown on them. Second, weathering and leaching of the stone coal contaminates the local ground water and/or surface waters with Se and other metals. Third, the local population uses the stone coal as a source of fuel, which releases the more volatile elements (Se and As) into the atmosphere in the homes. The ash will be extremely enriched with the balance of the heavy metal suite. Disposal of the ash on agricultural lands or near water supplies will contaminate both. Human and animal selenosis has been observed in economically and geographically isolated rural communities in areas underlain by stone coal. However, local Public Health officials have adequately dealt with these cases of local selenium poisoning. In Enshi, Hubei Province, Se-contaminated farmland has been replanted with tea and the Se-enriched tea has been marketed nationally.