

Soil Selenium and Human Health in China

Fordyce F M¹, Johnson C C², Appleton J D², Zhang G³ and Ge, X³.

1. British Geological Survey, West Mains Road, Edinburgh, EH9 3LA, UK

2. British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK

3. Institute of Rock and Mineral Analysis, Baiwanzhuang Road 26, Beijing 100037, China

Selenium (Se) is a naturally occurring metalloid element which is essential to human health in small doses (deficiency level < 0.04 µg/day,) but can be toxic in excess (> 900 µg/day). Se plays a vital role in many metabolic functions and is an essential component of the biologically important glutathione peroxidase (GSH-Px) anti-oxidant enzymes. In China, Se deficiency has been linked to an endemic degenerative heart disease known as Keshan Disease (KD) and an endemic osteoarthropathy which causes deformity of affected joints, known as Kaschin-Beck Disease. Selenium deficiency has also been implicated in the onset of oesophageal cancer. Se toxicity (selenosis) is less widespread and causes hair and nail loss and disorders of the nervous system. Although these diseases had been linked to environmental Se levels by previous investigators, it was not clear why some villages suffered Se deficiency or Se toxicity diseases whereas others in close proximity did not.

A recent investigation funded by the UK government Department for International Development into the prediction and remediation of Se-related diseases in China was designed to address these issues. The aims of the project were to develop a methodology for delineating areas where Se deficiency or toxicity may prejudice human health and to identify some of the main controls on Se availability.

Soil, grain, drinking water and human hair samples are examined to determine the controls on Se availability in three regions of China as follows: (i) low environmental Se-KD, Zhangjiakou District, (ii) low environmental Se-KD/ high environmental Se-selenosis, Enshi District and (iii) low environmental Se-oesophageal cancer, Cixian District. In each region, five low disease incidence, five moderate disease incidence and five high disease incidence villages were studied. Results show that geology exerts a fundamental control on environmental Se concentrations at the regional and local levels resulting in a wide range of Se concentrations within individual villages and between villages in close proximity to each other. The majority of samples in the low-Se villages are deficient or marginal in Se and that Se availability to plants is inhibited by adsorption onto organic matter and Fe oxyhydroxides in soil. Soil pH is also an important factor controlling the bioavailability of Se in deficient and toxic environments. In the Zhangjiakou region, the dry soil colour is a very useful guide to soil type and is probably the best visual indicator of KD risk in this area. In the Enshi, region, grain rather than soil Se concentrations give a better indication of selenosis risk. No link between low environmental Se and oesophageal cancer was apparent in the present study.