Soil, grain and water chemistry in relation to human Se status in China and Sri Lanka

F M Fordyce[1], C C Johnson[1], C B Dissanayke[2], G Zhang[3] and U R B Navaratne[2]

1. British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK
2. Department of Geology, University of Peradeniya, Sri Lanka
3. Institute of Rock and Mineral Analysis, Baiwanzhuang Street 26, Beijing 100037, China

As the trace element status of rural populations in developing countries closely reflect that of their local environment, geochemical studies may be able to identify those areas at greatest risk and also help to elucidate the aetiology of some diseases for which trace mineral status is thought to be a causative factor.

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. Se toxicity 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.

In humans and other animals, iodine is also essential to health and forms an important constituent of the thyroid hormones thyroxine (T4). These hormones play a fundamental biological role controlling growth and development. Iodine deficiency can result in a swelling of the thyroid gland (goitre) and in more extreme cases leads to cretinism, metal retardation, deafness and retarded growth, a group of conditions known collectively as Iodine Deficiency Disorders (IDD). It has recently been suggested that Se deficiency may be an important factor in the onset of IDD as Se deficiency inhibits the conversion of T4 to T3 adversely affecting the thyroid hormone metabolism. In Sri Lanka, despite government iodised salt programmes, endemic goitre is prevalent in the south-west of the island. No systematic measurements of levels of iodine or Se in the environment had been carried out, therefore the possible relationships between Se deficiency and IDD had yet to be established.

A recent investigation funded by the UK government Department for International Development into the prediction and remediation of Se-related diseases in China and Sri Lanka 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.

Results of studies to relate environmental Se levels (represented by soil, grain and drinking water samples) and human Se status (represented by hair samples) for villages with differing incidence rates of KD and Se toxicity in China and differing

goitre incidence in Sri Lanka are presented. The relationships between environmental factors, human Se status and disease incidence are discussed.