Trace metals in soils and their relationship with scrapie occurrance

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Regional geochemistry has in the past been linked to varous diseases including molybdenosis and/or molybdenum toxicity in sheep, cattle and elk (due to high Mo), selenosis in horses (high Se), Keshan and Kashin-Beck diseases in humans (low Se), karies (F-deficiency), fluorisis (high F) and cancer (high arsenic). Therefore knowledge of regional geochemistry of soils is imperative when studying the epidemiology of a variety of diseses.

In this study we are investigating whether trace metals in the natural environment have a role to play in the development of prion diseses. These diseases include scrapie in sheep, BSE in cattle, CJD in humans and CWD in deer. Biochemical research has recently demonstrated that the protein in the brain that are damaged in prion diseases need copper in the prion “tail” to keep their structure. If there is not enough copper the prions can take up manganese and unfold. Molecular dynamics calculations have shown that this prion unfolding process needs copper first to be reduced to Cu^{+}, then copper is replaced by divalent manganese and once manganses oxidises the prion unfolds.

There are five steps that are involved with getting an element from soil solids to plant tops: 1) desorption or dissolution from minerals; 2) diffusion and convection within the soil; 3) sorption or precipitation at new sites located on the soil nutrient storage facility; 4) absoption by roots; and 5) translocation from roots to plant tops. For step 4, roots may modify the solution chemistry or the root zone, locally, changing soil properties such as pH or redox potential (rhizosphere effect). Once the plants are consumed by animals or humans we also need to consider the absorption of the metals as well as the function of the metals in the body.

Here we have analysed soils from areas where scrapie is prone to develop and other areas where scrapie has never occurred. We have found that in areas where scrapie is prone easily reducable manganese is high. In the same areas bioavailable copper appears to be low. This work is further being extended by investigating the effect of Mo on copper metabolism as well as the bioavailablity of metals as a function of soil pH and organic content.

Characterization of fly ash by SEM/EDS and Raman spectroscopy

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Introduction

Fly ash particles are a sub-produt of coal combustion and their impact on human health is well-known and demands the existence of accurate and sensitive analytical methods for detection and analysis of these particles. Using the combination of Scanning Electron Microscopy (SEM/EDS) and micro-Raman spectroscopy analytical techniques, we have characterised fly ash particles from the stack of a Portuguese thermal power plant and its surroundings.

Results and conclusions

The analysis of the stack revealed the existence of glass spheres (calcium-rich; aluminium-silicate with Fe, Mg and Ti; complex aluminium-silicate with Fe, Na, P, S, K, Ca and Ti) (Fig. 1) and carbonaceous particles. In Figure 2 are the Raman spectra of carbonaceous particles sampled in the stack and in the filters from the surroundings. The different spectrum (Fig. 2) led us to consider the contribution of anthropogenic particles from pollutant sources other than the Power Plant.

Figure 1: SEM/EDS of glass spheres from the stack.

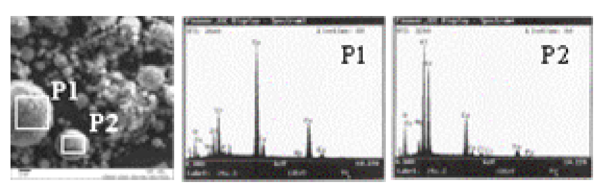

Figure 2: Raman spectra obtained in carbonaceous particles from the stack and the surroundings.