



**BIOSPEC: Sensor development for routine prediction of metal biouptake in freshwaters and soil solutions  
(EC Framework V, EVK1-CT-2001-00086)**

**Problems to be solved**

BIOSPEC addresses the socio-economic problems of preservation and enhancement of the environment and safeguarding existing jobs, as well as contributing to development and implementation of EU policies on Water Quality. Water is recognised as a heritage which must be protected, defended and treated as such (Water Framework Directive 2000/60/EC). The trace heavy metals that we will study are pollutants of environmental concern and significance throughout Europe. BIOSPEC will develop a routine approach for the prediction of metal biouptake that will improve current risk-assessment methodologies, and contribute towards more cost-effective water management strategies, protection of ecosystems, ensuring water quality for human consumption, maintenance of biodiversity by decreasing ecotoxicological risks, and also support rational uses of the environment, e.g. designation of water bodies for recreational or industrial use. Three of the metals to be studied (Cd, Pb, and Ni) are proposed to be listed as priority substances in the field of water policy (2000/0035 (COD)), their use will thus become restricted and possibly phased out with concomitant extensive socio-economic costs (loss of jobs, impacts on income distribution). BIOSPEC will contribute to establishment of more rationally based guidelines for permissible levels of these metals that could minimise this predicted adverse socio-economic impact and provide industry with non-empirical tools with which they can rationally manage effluent release.

**Scientific objectives and approach**

BIOSPEC will determine reliable and predictive quantitative parameters for assessment of the biouptake potential of trace heavy metals (Cu, Pb, Cd, Zn, Ni) by development of robust well-characterised sensors, which can be deployed routinely *in situ* by institutes monitoring water quality. This is a significant advance over any existing methodologies which typically involve extensive sample preparation and multi-step analyses, resulting in various operationally defined fractions which are often meaningless or empirical at best. To achieve this objective, a systematic approach will be adopted in which well-defined simple ligands, isolated natural ligands, soil solution samples and natural freshwaters are analysed in parallel by a range of analytical techniques in conjunction with metal biouptake studies. Furthermore, we adopt an innovative and more appropriate basis for the classification of metal species by differentiating the total metal in terms of dynamic (i.e. mobile and labile complexes) and free metal ion concentrations. Such an understanding of these dynamic aspects has previously been very limited and is crucial to any real progress in the interpretation and practical utilisation of speciation data. Theoretically well-founded dynamic models will be developed that have reliable predictive value, facilitate data interpretation, and can optimise the design and strategy of routine monitoring measurements.

**Expected impacts**

The sensors characterised in BIOSPEC will provide end-users with the appropriate tools for routine monitoring of the potential metal biouptake risk posed by trace heavy metals in freshwaters. Our protocol will facilitate implementation of Community Guidelines on Water Quality. The innovative dynamic approach of BIOSPEC will provide scientifically defensible criteria on which rational development of Community Policy on Water Quality can be based.

**Website** (and contact details): [www.qub.ac.uk/biospec/biospec.html](http://www.qub.ac.uk/biospec/biospec.html)