Determination of the nature and origins of riverine phosphorus in catchments underlain by Upper Greensand

Recent research has indicated high phosphorus (P) concentrations in waters draining from the Upper Greensand (UGS) aquifer to surface waters in the Hampshire Avon catchment, compromising the ecological health of the Upper Avon. It has been suggested that a proportion of this phosphorus is derived from natural mineral sources in the UGS, in the form of P-rich apatite nodules. This could be contributing a natural background P concentration to these waters in addition to anthropogenically derived P delivered to surface waters from diffuse agricultural and point source sewage discharges in the catchment.

The aim of this studentship is to investigate P distribution and character in a range of cores collected from representative areas of the UGS, using high resolution advanced chemical and mineralogical approaches to: identify the natural mineralogical sources of P (primary apatite) in the UGS; determine the rate at which soluble P fractions are released from primary apatite under natural weathering rates; distinguish these primary apatite from secondary apatite formed within the UGS in the presence of anthropogenically derived P, and soluble P in porewater derived from anthropogenic sources; and calculate the background P concentration arising from natural P sources in the UGS.

The student will use advanced techniques including SEM and SEM-EDS approaches to explore the distribution of P within rock samples extracted from the UGS to map its density and distribution in rock slices extracted at different depths from intact cores, augmented with EPMA or synchrotron-XRF where higher resolution is needed. The student will also adopt a multi-isotope approach to distinguish primary from secondary apatite in the UGS. This relies on the different isotopic composition of $\delta^{18}O$-PO$_4$ relative to source type, where, in the absence of biological activity approximate to the source composition but in the presence of biological metabolism, move towards equilibrium with the $^{18}O$-H$_2$O and away from the source value.

The studentship represents a unique opportunity to work at the cutting edge of sedimentary and biogeochemical research, working directly with stakeholder organisations interested in the outcomes of the programme. It is funded by Wessex Water, in partnership with the Environment Agency and Natural England, and would be based at the University of Bristol, supervised by Professor Penny Johnes and Dr Heather Buss, together with Dr Daren Gooddy, British Geological Survey. The studentship is open to UK or EU students.

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