Ryevitalise: Sediment Fingerprinting

Dr Janet C Richardson, University of Leeds

Project background: Samples were taken across the Derwent catchment to assess the mineralogical composition of the sediment / soil in the laboratory. This information can be used to pinpoint the source locations of sediment within the river systems. Samples of soil, bank and in-channel material were collected for this analysis. In total 61 samples were collected and processed, costing ~ £25/sample to process.

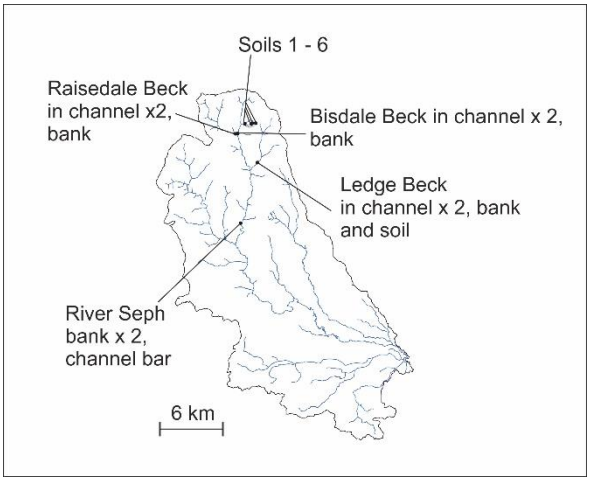

Figure 1 - Sample locations in Rye study area

Methods used: The samples were dried, sieved and powdered. The samples were then processed in a Bruker D8 x-ray diffraction machine at the University of Leeds. The XRD machine shows the phases of different minerals present. The method chosen for this work details the presence of minerals, but it does not show quantities of minerals present. Eighteen samples were taken in the Ryevitalise study area, focused on the River Seph Catchment (Figure 1).

Results: The underlying geology is dominated by sedimentary lithologies dominated by sandstone, mudstone, siltstone and limestone (Table 1). The results of the sediment fingerprinting (Table 1) primarily show quartz, clays (kaolinite), feldspars (albite) micas (muscovite) and chlorites (clinochlore). All of these can be formed from the erosion of the geology in the catchment. Due to the similar geology across the catchment, there is no discernible trend with the data presented. Quartz is a resistant mineral, and at the lowest sample point on the River Derwent dominated the sediment fingerprinting results. There are few indicators in the sampling that limestone is present within the catchment, this is most likely due to the solubility of limestone, causing the signal to dissolve further away from the source areas.

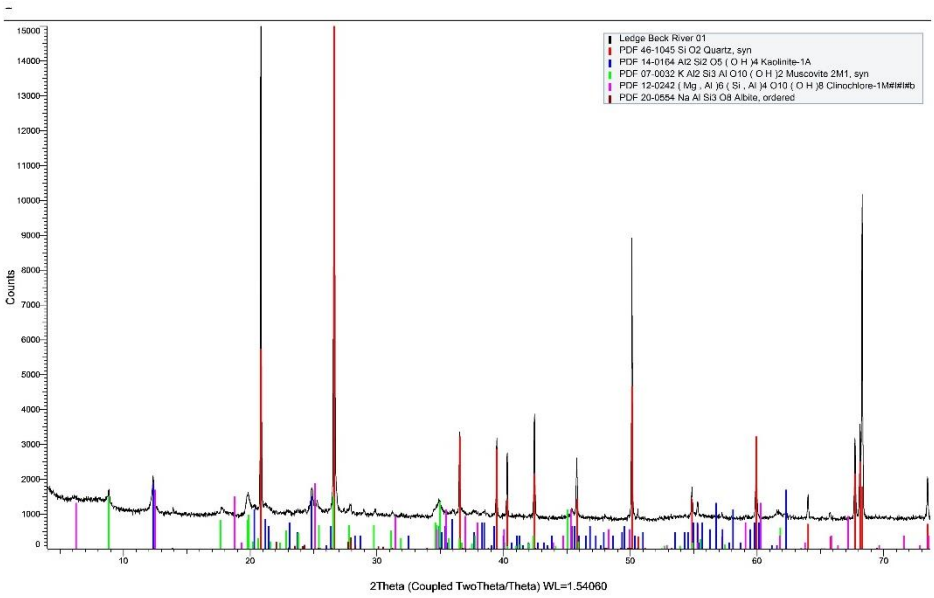

Figure 2 - An example output of sediment fingerprinting.

Figure 2 shows an example output of sediment fingerprinting, the peaks measured represent the different minerals present in the sample (each mineral has a recognised spectrum), the highest peaks are related to quartz – n.b. the height of the peak does not relate to the amount of quartz in the sample. The grey box shows the minerals present within the sample derived from the mineralogical signals identified.

Table 1 *– Sediment Fingerprinting results*

Location	Sample type	Minerals present	Underlying bedrock geology composition
Bisdale Beck	bank	Quartz, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
Bisdale Beck	in channel (1)	Quartz, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
Bisdale Beck	in channel (2)	Quartz, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
Ledge Beck	in channel (1)	Quartz, kaolinite, muscovite, clinochlore, albite	Sandstone, mudstone, ironstone, siltstone, limestone
Ledge Beck	in channel (2)	Quartz, kaolinite, muscovite, clinochlore, albite	Sandstone, mudstone, ironstone, siltstone, limestone
Ledge Beck	soil	Quartz, kaolinite, clinochlore, muscovite, albite, microcline	Sandstone, mudstone, ironstone, siltstone, limestone
Ledge Beck	bank (1)	Quartz, albite, kaolinite, chlinochlore, muscovite	Sandstone, mudstone, ironstone, siltstone, limestone
Ledge Beck	bank (2)	Quartz, kaolinite, clinochlore, muscovite, albite	Sandstone, mudstone, ironstone, siltstone, limestone
Ledge Beck	bank (3)	Quartz, albite, kaolinite, muscovite, clinchlore	Sandstone, mudstone, ironstone, siltstone, limestone
Raisedale Beck	in channel (1)	Quartz, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
Raisedale Beck	in channel (2)	Quartz, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
Raisedale Beck	bank	Quartz, microcline, albite, kaolinite, muscovite, clinochlore	Sandstone, mudstone, ironstone, siltstone
River Seph	in channel bar	Quartz, albite, muscovite, kaolinite	Sandstone, mudstone, ironstone, siltstone, limestone
River Seph	soil (1)	Quartz, albite, clinchlore, kaolinite, muscovite	Sandstone, mudstone, ironstone, siltstone, limestone
River Seph	soil (3)	Quartz, kaolinite, muscovite, clinchlore, albite	Sandstone, mudstone, ironstone, siltstone, limestone
River Seph	soil (4)	Quartz, kaolinite, muscovite, clinchlore, albite	Sandstone, mudstone, ironstone, siltstone, limestone
River Seph	soil (5)	Quartz, kaolinite, muscovite, albite	Sandstone, mudstone, ironstone, siltstone, limestone
River Seph	soil (6)	Quartz, kaolinite, albite	Sandstone, mudstone, ironstone, siltstone, limestone

Lessons learnt: The sediment fingerprinting completed on the River Derwent catchment was undertaken to under the minerology variation within the catchment, however quantities were not calculated, this has meant that no trends have been identified due to the similar geology in the tributaries of the catchment. The following recommendations for future work are proposed:

- Use sediment fingerprinting to understand quantities of minerals within the samples – this may help discern relationships and trends.
- Use grain size analysis before and after tributaries joining the main river – sample at systematic points of the main river course, this will allow for the identification of the tributaries that are supplying fine grained material to the main channel system. Sampling in a range of different flow types will help capture the multiple pathways in the sub-catchment. Sampling involves collecting a tub of in channel suspended material and using grain size analysis to record any trends.
- It is important to sample during different flow conditions, often sources of fine grained sediment may differ depending on the intensity and location of rainfall events.