



Investigations into Rare Earth Oxide Use and Behaviour

Owen Pryce

Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom (o.pryce@lancaster.ac.uk)

The use of tracers which are applied to soils (distinguishable from tracers naturally present in soils) is increasing. Rare earth oxides (REOs) are the most prevalent of the sediment tracers used to tag soils in this manner. REOs have been applied in a host of different countries, at a range of scales e.g. over watersheds in the USA (Polyakov and Nearing, 2004; Kimoto et al., 2006); to examine rill erosion in China (Li et al., 2006); and to investigate the importance of topographical features in arable fields in the EU (Stevens and Quinton, 2008). Many successful experiments have been conducted using the suit of REO tracers, yielding important information on the behaviour of eroding sediments.

However, the majority of publications have focused upon application of REO tracers, applying the tagging and extraction methods developed by Zhang et al., (2001, 2003). Furthermore, the techniques presently being used are known to generate methodological inaccuracies, such as tracer enrichment and non-uniform REO distributions on experimental plots, and analytical interferences when ICP-MS is used for tracer quantification. Unanswered questions regarding the use of REO tracers include: i) what is the effect upon soil of REO tagging?; ii) how is a uniform distribution of REOs in tagged soil achieved? iii) which is the most suitable way of applying REOs, to experimental plots of different scale, and to meet different objectives?; iv) which REOs are unsuitable for sediment tracing?; v) what is the most precise and efficient method of extracting REO tracers from sediments? vi) is the transport behaviour of REO tracers comparable to untagged soils?

In an attempt to answer some of these questions, investigations have been conducted into the effect upon soil particle size of different methods of REO tagging. The ability of these methods to provide uniform distributions of REOs in the tagged soil was calculated. The accuracy and precision of published (Zhang et al., 2003; Stevens and Quinton, 2008), and alternative REO extraction methods was compared using tagged and untagged soils. Extractions were also performed upon REO powders and a certified reference soil to identify which of the commonly used REOs are unsuitable for tracing studies.

This paper will also report on investigations into the transport behaviour of REO tracers at different slope gradients, including comparisons between the transport of sediment bound phosphorus and REOs.

References:

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