Earthworm calcite production rates

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It is a little known fact that many species of earthworm excrete calcite granules. These comprise either individual or aggregrates of calcite crystals that can reach up to 2.5 mm in diameter. Despite being described by Darwin (1881) relatively little work has been carried out on these granules. It is known that the granules form by the coalescence of $CaCO_3$ spherulites in the calciferous glands but the function of the granules is unclear – possibilities include, Ca, CO_2 and pH regulation though significant problems exist with each of these hypotheses.

Preliminary work by Canti indicated granule production rates by the earthworm *Lumbricus terrestris* of up to 76 mg calcite in 35 days (2.2 mg per day). Assuming an average earthworm density of 300 m^{-2}, this corresponds to a rate of production of 2.4 moles of calcite m^{-2} $year^{-1}$. Calculated another way earthworm calcite granule production potentially retains c. 60 kgC ha^{-1} yr^{-1} in the soil. Typical CO_2 soil fluxes are 5 – 315 mol CO_2 m^{-2} yr^{-1} and typical soil C sequestration measures would remove 300 to 800 kgC ha^{-1} yr^{-1}. Thus earthworm calcite granules are potentially highly significant in the terrestrial C cycle.

In this presentation we consider the influence of soil chemistry on granule production rates. *L. terrestris* were cultured in high Ca - high pH, high Ca – low pH, low Ca – high pH and low Ca – low pH soils for 70 days. After 35 and 70 days calcite granules were extracted from the soils and production rates were determined. The impact of soil chemistry on production rates and also the impact of the calcite granules on the final soil pH will be discussed.

Reference

Darwin, C. (1881) *The formation of vegetable mould through the action of worms with observations of their habits.*

Residence time of suspended particles in the Dordogne River: Indications derived from ^{7}Be and ^{210}Pb

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Particulates that enter the ocean from rivers are the products of integrated basin-wide processes (soil erosion, sediment transport and deposition in watersheds). The fate of sediments in river is therefore challenging and generally analysed using hydrodynamics models. An alternative method relies on the use of fallout radioactive tracers, such as ^{7}Be, ^{210}Pb and ^{137}Cs, to identify sediment source regions and/or to estimate suspended sediment age or the fraction of the suspended sediment recently eroded from the landscape (Dominik *et al*, 1987; Matisoff *et al*, 2005 and references herein).

This work presents the application of the two naturally occurring radionuclides ^{7}Be ($T_{1/2}$ = 53 days) and ^{210}Pb ($T_{1/2}$ = 22.3 years) to investigate residence times of particles in the Dordogne River (South-West France). The Dordogne River has a watershed of 24 500 km^2 with a mean discharge of 320 m^3 s^{-1} (max 12500 m^3 s^{-1}). It flows westward about 500 km from the mountains of Auvergne, ending into the Gironde, its common estuary with the Garonne River, in the north of the city of Bordeaux. To characterize the suspended sediments of the Dordogne River, repeated samplings were performed from January through August 2007 at selected sites along this river system. Particulate and dissolved activities of radionuclides were determined using a low-background, well-shaped γ spectrometer. Additional examinations of river discharge, rain rate and particulate organic carbon were done to better interprete radioanuclide data. Particulate ^{7}Be and ^{210}Pb activities present marked spatio-temporal variations; dissolved fractions are always low. To derive sediment ages from the present dataset, two distinct modellings have been used: 1/ based on radionuclide budget (Dominik *et al*, 1987), and 2/ using ^{7}Be/^{210}Pb activity ratio (Matisoff *et al*, 2005). The age estimates will be compared in order to discuss the interest of each model in a large river system.

References

Dominik J., Burrus D., and Vernet J.-P. (1987), *Earth Planet. Sci. Lett.* **84** 165–180.
Matisoff G., Wilson C.G., and Whiting P.J. (2005). *Earth Surf. Process. Landforms* **30** 1191–1201.