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Biogeosciences Discussions

Interactive comment on "Animal-sediment interactions: the effect of ingestion and excretion by worms on mineralogy" *by* S. J. Needham et al.

S. J. Needham et al.

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The authors are grateful for the anonymous reviewers constructive comments.

Reply to general comments

The intention of the experiment was to test the hypothesis that common biological functions, eating and excreting, alter the mineralogy of sediments. The paper was designed to show that these functions do indeed alter the mineralogy of sediments. It was not the objective of the paper to describe such changes in their entirety. We feel that this process, not previously appreciated to be of importance to mineralogy, is of such huge geological impact that the theoretical background, methods and experimental observations deserve to be aired in public at this time.

We published a very short preliminary paper on this subject (McIlroy et al., 2003). This current paper brings together, for the first time, the diverse and obscure literature of relevance to this topic. Also this current paper thoroughly describes the experimental and analytical protocols, thus facilitating duplication of the entire experiments by any

other researcher. Further expansion of the experiments and additional analyses were considered beyond the scope of this paper.

We are pleased that the reviewer appreciates a whole new series of questions after having read this paper. It is our view that good scientific research always leads to more questions than answers.

We take responsibility for the fact that the reviewer failed to appreciate that the only a small fraction of the primary minerals (chlorite and muscovite) were degraded by the action of eating and excretion. Thus while the peaks from newly formed diagenetic minerals were unequivocally defined in the XRD traces there is a predominance of the primary minerals. With the current experimental design it will prove hugely difficult to physically separate, or electron optically resolve, the newly formed minerals from the primary minerals. Thus although the anonymous reviewer has intelligently suggested that some more analytical work could be conducted on the faecal casts, the extremely small quantity of new minerals produced by this process (note, also mixed in with the primary minerals) has rendered such further analyses very difficult. The amount of clay material extracted from the faecal casts is small. There is approximately 20mg of $<$2mm material per faecal cast. It is likely that less than 5% of this 20 mg of material represents new minerals not present in the original material. This makes any specific analysis of the faecal cast samples extremely difficult by any method. At the editors discretion, an SEM image of the whole faecal cast as well as the $<$2mm fraction could be added to the paper to illustrate the problem of further detailed analysis

The reviewer suggested more biological measurements on the lugworm burrowing activity. The feeding and burrowing habits of Arenicola marina have been extensively documented in the biological literature. It was considered to be replication of existing research to include these data within this paper but the readership will be directed towards Beukema (1976), Cadée (1976) and Retraubun et al. (1996)

The reviewer is correct that later measurements after continued sediment processing

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could produce larger changes. However, it was decided inclusion of all the data available would make this contribution too long and with too many figures.

Reply to specific comments

p. 535 line 25. The reference will be changed to Lasaga 1981

p. 543 lines 15-20. The peak is best developed in E2C1 and E2C8, but can also be seen in E2C21. All of these samples are faecal casts samples. Thus half of the faecal samples show this new peak.

p. 544 line 16. The same grain size fraction has been used in all cases for control and starting samples as well as faecal casts so that grain size change is not relevant here.

References:

BEUKEMA, J.J. 1976. Biomass and species richness of the macro-benthic animals living on the tidal flats of the Dutch Wadden Sea. Neth. J. Sea Res., 10, 236-261.

CADÉE, G.C. 1976. Sediment reworking by Arenicola marina on tidal flats in the Dutch Wadden Sea. Neth. J. Sea. Res, 10, 440-460.

MCILROY, D., WORDEN, R.H., AND NEEDHAM, S.J. 2003. Faeces, clay minerals and reservoir potential. Journal of the Geological Society of London, 160, 489-493.

RETRAUBUN, A.S.W., DAWSON, M. & EVANS, S.M. 1996. Spatial and temporal factors affecting sediment turnover by the lugworm Arenicola marina (L.). Journal of Experimental Marine Biology and Ecology, 201, 23-35.

Interactive comment on Biogeosciences Discussions, 1, 533, 2004.