Biogeosciences Discussions, 1, S292–S295, 2004
www.biogeosciences.net/bgd/1/S292/

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.

Received and published: 19 October 2004

The authors are grateful to the reviewer for the valuable comments. Constructive comments from non-clay mineralogists or sedimentologists are most welcome to improve the quality of the manuscript.

Reply to general comments.

We feel that the most serious issue raised by the reviewer was that of replication of the data. However, the experimental tanks have been in operation for a long time with very large numbers of faecal casts collected and with much XRD data generated. The experimental tanks were sampled many times throughout the course of the experiment and all the results produced are identical. Thus the XRD data have been replicated many times over the course of the last two years. Note that repeating these experiments would take more than two years.

We do not deny that the precise causative mechanisms for the mineralogical changes were not pursued within the manuscript. Identification of the mechanisms is not a sim-

ple matter since biological systems are very complex. It is unlikely that a single factor could produce the observed changes. It is more likely that the interaction and combination of many factors, for example, gut pH and bacterial influences, are important. This is particularly difficult to simulate in the laboratory. We consider it likely that gut bacteria affect the ingested minerals although it is not possible to obtain lugworms without gut bacteria, to test this hypothesis. Similarly, we are not yet confident that we could obtain a pure strain of gut bacteria from a lugworm (also to test this hypothesis). Thus it was considered out of the scope of the present series of experiments and this paper to try to define the mechanisms in this manner. However, this is a direction we would like to take the experiments in the future. The purpose of this manuscript was to identify a novel geological process that may have significant bearing on sediment composition and reservoir quality. The focus of this contribution was not to elucidate the precise causative mechanisms for the changes identified.

The reviewer considered that we had understated previous work on the subject of clay mineral synthesis during sediment ingestion and excretion. We appreciate the reviewers insights into the biological literature and we will incorporate some of the papers to which the reviewer referred. Although substantial work has been performed on the influence of bacteria on carbonate and sulphide minerals, very little has been published on the biosynthesis of complex silicate minerals (such as clay minerals). In the geological, mineralogical and sedimentological realms, there is presently minimal appreciation of the role of micro- or macro-biological processes on the formation of common clay minerals from the kaolinite or smectite groups (Worden and Morad, 2003). We consider studies of assimilation of metals during digestion to be interesting but not wholly relevant unless the mineralogical and mineral chemical context of the assimilation process is considered.

The reviewer is correct that the current manuscript is based on an idea first published in McIlroy et al. (2003). This preliminary paper was a very short offering that, for the first time, linked the living activities of macrobiotic creatures to the clay mineralogy in

BGD

1, S292–S295, 2004

Interactive Comment

sediments. Many more samples have been collected and analysed since that paper was published and the present contribution is based on these later data. McIlroy et al. (2003) did not contain any background literature on the subject area nor did it contain details of the experimental method. The current contribution was intended to be a blend of background literature, experimental and analytical methods and new data. As the reviewer observed, the current paper also presents the results of a new additional experiment using earthworms and crushed slate.

We have employed several literature sources that use the term proboscis. However, we acknowledge that these are old sources (e.g. Fostersmith 1976; Wells 1954). More recent literature uses the term eversible pharynx. Thus all reference to the term proboscis; will be expunged from the paper at the reviewers behest and the word relatively will be inserted before the phrase non-selective.

Reply to specific comments

p.538, line 1. The word hostile will be changed to chemical

p.545. line 19. A sentence describing the pH of earthworm guts (6.9) will be added here.

References

Fostersmith, R.L. 1976. Role of head coelom in proboscis eversion in Arenicola marina (L). Journal of Experimental Marine Biology and Ecology 23: 85-96.

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.

Wells, G.P. 1954. The mechanism of proboscis movement in Arenicola marina. Quarterly Journal of Microscopical Science 95: 251-270.

Worden R.H. and Morad S. 2003. Clay minerals in sandstones: a review of the detrital and diagenetic sources and evolution during burial. In (Worden, R.H. and Morad, S.

BGD

1, S292–S295, 2004

eds.) Clay mineral cement in sandstones. International Association of Sedimentologists, Special Publication, 34, 3-41.

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