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Interactive comment on “A normalised seawater strontium isotope curve and the Neoproterozoic-Cambrian chemical weathering event” *by* G. A. Shields

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The author suggests an interpretation of the seawater 87Sr/86Sr through Earth history in terms of relative change between continental weathering and mantle input. He introduces for the first time a variable carbonate isotopic composition. There are many interesting speculations in this contribution, and some of them might not withstand the test of more complex modelling. Anyway, given that the author answer to the following questions, I support publication of this contribution.

General comments.

During the late 80s and early 90s, the 87Sr/86Sr of seawater as recorded in sedimen-

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tary carbonates was considered as a promising tools for reconstructing past continental weathering rates (see for instance Raymo, 1989). However, it has been shown that this might be not straightforward.

Indeed, my first point is related to the long term evolution of the 87Sr/86Sr of continental silicate and carbonate rocks being weathered. Shields suggested a rather linear increase in these isotopic ratios through time. This might be an oversimplification. It has been demonstrated that locally high isotopic ratios of the source rocks may strongly influence the seawater 87Sr/86Sr. Indeed, riverine runoff display quite a large range of strontium isotopic values. For instance, it is well known that Himalayan rivers display a quite high isotopic ratio (0.7295 for the Ganges-Brahmapoutra, Galy et al., 1999), far above the global mean value of 0.7119 (Palmer and Edmond, 1989). These high isotopic ratios are the result of the mixing of the weathering of rather radiogenic carbonates from the Tethyan Sedimentary Series and of highly radiogenic silicates in the Lesser Himalaya area (Galy et al., 1999). As a result, several modelling studies have shown that the Cenozoic increase in the seawater 87Sr/86Sr is largely linked to this increased isotopic ratio in part of the global river runoff (namely the Himalayan area), rather than to an increase in the Sr delivery to the ocean (Goddéris and François, 1996 ; François and Goddéris, 1998). So the major change in the Sr isotopic budget of the ocean during the Cenozoic seems to be linked to a major change in the isotopic ratio of source rocks in a defined area, as a result of local geological processes. At least for the Cenozoic, the 87Sr/86Sr is not a good index of continental weathering fluxes. The reconstruction of Shields is not a in agreement with this conclusion, since it suggests a major increase in the weathering contribution from 45 % to about 75 %. This questions the validity of the older part of the curve in fig 1., showing the weathering contribution as a function of time. I think that the evolution of the 87Sr/86Sr of river global runoff through geological times is not monotonic, but displays peaks that are not yet constrained.

Second, there is a debate about the impact of continental vegetation on the weathering rates. Contrary to the author, I think the question is not solved yet. Berner (2004) is amongst the supporter of a major increase in chemical weathering of silicate rocks in response to the colonization of continental surfaces by vascular plants. There are many reasons to agree with this, as demonstrated by Moulton et al. (2001). However, the study by Moulton et al. (2001) was performed on recent lava flows in Iceland. There is not doubt that the rapid spreading of land plants on those fresh and unaltered surfaces will rapidly enhance weathering. However, humid tropical area are today amongst the weaker contributor to chemical weathering (Gaillardet et al., 1999 ; Edmond et al., 1995, Probst and Boeglin, 1998). Despite a dense vegetation cover, the thick soils developed in these area prevent high weathering rates, shielding the bedrock. So the link between vegetation and weathering rates is not so straightforward. There is still no clue whether, on a global point of view, weathering was more intense on a naked or vegetated Earth. Once vegetation has spread above continental surfaces, weathering rates should be enhanced in some part of the world, but should rapidly decrease in other parts (such as the tropical humid belt). Nobody knows precisely what should be the impact of vegetation on a global scale on weathering. As exemplified by Millot et al. (2002) and Von Blanckenburg (2005), physical denudation might be the main controlling factor of weathering. It is further instructive to see that there is no major positive drift in the 87Sr/86Sr of seawater during the Devonian, while this period has witnessed the major development of vascular plants above continents. I would guess that most of the impact of terrestrial vegetation on weathering would be located around the end of the Devonian, when vascular plants evolved, instead of the beginning of the Phanerozoic.

My next point is related to the link that Shields suggests between the d34S and 87Sr/86Sr of seawater. The author raised an interesting correlation between both curves. Increased weathering should supply more nutrient to the sea, and thus enhance the burial of organic carbon and the subsequent sulfate reduction and pyrite accumulation. This process will increase the d34S of seawater at first order. However, any increase in the weathering rate of continental surfaces will also increase the

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oxidation of reduced pyrite at the Earth surface, at least at first order, through runoff dependency. I'm not sure what will be the outcome of this, but this ask for a more complex modelling than proposed here.

Interactive comment on eEarth Discuss., 2, 69, 2007.