

Iron dynamics in marine sediments: new insights from a comparison of sequential extraction procedures

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Iron (Fe) is a key nutrient in marine environments and its bioavailability often limits the growth of phytoplankton. Marine sediments can act as both a source and a sink for Fe largely depending on the prevalent bottom water redox conditions. To better understand the dynamics of Fe in the past and present ocean, detailed quantitative insight in the various forms of Fe in sediments is essential. Sequential extractions are the most popular method to determine the different sedimentary forms of Fe. The procedure by Poulton and Canfield [1] is the most widely applied and has provided a wealth of information on the oxygen dynamics of marine environments throughout Earth's history. However, as with each procedure, it has some caveats. For example, the amount of easily reducible Fe oxides (e.g. ferrihydrite) appears to be overestimated, particularly in modern FeS-rich sediments. To prevent such an overestimation a new sequential extraction procedure was recently developed [2] by combining steps from a method for acid sulfate soils [3], with steps from the Poulton and Canfield procedure [1]. Here, we compare the results of both sequential extraction procedures [1, 2] when applied to Holocene sediments from 13 sites from contrasting depositional environments and a wide range of bottom water redox conditions. While the total amount of extracted Fe in both procedures is similar, our results show that the combined sequential extraction procedure [2] indeed better captures the expected amount of easily reducible Fe oxides. We will discuss which procedure is most suitable in what setting and what our study implies for interpretations of Fe cycling in modern sediments and for Fe-based paleo-redox proxies.

[1] Poulton, S. W., & Canfield, D. E. (2005). *Chem. Geol.* 214 (3-4), 209-221.

[2] Kraal, P., Dijkstra, N., Behrends, T., & Slomp, C. P. (2017). *Geochim. Cosmochim. Acta*, 204, 140-158.

[3] Claff, S. R., Sullivan, L. A., Burton, E. D., & Bush, R. T. (2010). *Geoderma*, 155(3-4), 224-230.

