

A sequential extraction scheme to determine element mobility in pyrite-bearing siliciclastic rocks

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Sequential extraction is a standard technique for element fractionation and mobility determination in soils. It comprises the successive treatment of a sediment with various solvents to differentiate between exchangeable, acid-soluble, reducible and oxidizable fractions [1]. A sequential extraction was performed on a sandstone and a siltstone which contain pyrite to investigate its applicability to siliciclastic rocks. The focus of this study was to enhance the oxidation step, which had originally been designed to attack only organic matter, towards the oxidative dissolution of microcrystalline pyrite (FeS₂) and integrate it into a sequential extraction scheme optimized for siliciclastics. Pyrite quantification is important because in addition to iron and sulfur mobilisation, pyrite dissolution acidifies the groundwater and may release toxic trace metals.

An experimental series of different oxidation procedures for pure pyrite at different temperatures was conducted with hydrogen peroxide (H₂O₂) as the oxidant. Two sequential extraction schemes with interchanged step order and individual extraction procedures were compared to determine the most suitable approach for pyrite-bearing siliciclastics.

It was found that pyrite dissolution is most effective (> 85 % for pyrite-solvent-ratios between 0.167 and 16.7 g/l) with a mixture of H₂O₂, the complexing agent ammonium acetate (NH₄OAc) and nitric acid (HNO₃) for pH control. Contrary to the recommendations of the commonly used improved BCR scheme [2], an extraction at room temperature is preferable compared to 85 °C in order to minimize the loss of mobilised iron due to reprecipitation. A sequence with the step order “exchange – acid solution – reduction – oxidation” was found to be suited best for pyrite-bearing siliciclastic rocks with low contents of organic matter and carbonates.

[1] Tessier *et al.* (1979) *Anal. Chem.* **51**(7), 844-851.

[2] Rauret *et al.* (1999) *J. Environ. Monit.* **1**, 57-61.