

Oxidation of FeS by Fe³⁺_(aq)

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The oxidative dissolution of iron monosulfides (FeS) releases toxic elements, such as heavy metals and arsenic, in natural solutions [1]. Also, partial oxidation of sulfur from FeS minerals produces sulfur-bearing compounds which may alter the redox properties of natural media [2]. Hence, it is important to understand the reactions between FeS minerals and oxidative solutions.

In this work we examine the kinetics and mechanism of oxidative dissolution of synthetic FeS in presence of Fe³⁺_(aq) by monitoring the pH, Eh and total dissolved Fe concentration ([Fe]_{total}) of oxidant solutions during their contact with FeS that lasted 4 hours. Note that concentrations of dissolved sulfur were too low to be reliably quantified. The experiments were performed in acidic media (2 ≤ pH ≤ 3), 25 °C and [Fe³⁺_(aq)] spanning the [10⁻⁴; 10⁻³] mol L⁻¹ range.

The experimental data indicate that Fe³⁺ was removed from the solution at pH > 2. A progressive increase in pH values and an Eh decrease within 4 h of reaction time were also observed. The reaction order of FeS oxidation with respect to [H⁺] is estimated to 0.65 at initial pH 3.0, and increases up to 1.0, when initial pH decreases [3], indicating that [H⁺] is an important parameter of FeS oxidation. In contrast, ferric iron concentration has only a small effect on FeS oxidative dissolution rate in studied [Fe³⁺_(aq)] range.

Taking into consideration present findings it can be stated that mechanism of FeS oxidation starts with the protonation of mineral surface [2]. Thereafter, the adsorbed protons accelerate Fe²⁺ release [3]. Finally, Fe³⁺_(aq) may adsorb at the surface and oxidize the sulfur moieties to insoluble species, presumable polysulfide (S_n²⁻_(s)) and elemental sulfur (S⁰_(s)).

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Two competing processes in petrogenesis of basaltic magma conduits

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A recent geochemical study of dolerite dykes from many regions of the world has revealed that small dolerite dykes (<50 cm wide) representing shallow parts of basaltic magma conduits are remarkably zoned [1-5]. The zonation is compositionally anomalous since compatible and incompatible components behave in a manner inconsistent with predictions of fractional crystallization of basaltic magma. Here we put forward a novel concept interpreting the anomalous compositional trends in dolerite dykes as a result of competition between two petrogenetic processes with opposite effects on dyke composition. These are (a) the filling of dykes with magmas that become increasing more evolved with time and (b) *in situ* cumulate growth of these inflowing magmas against dyke sidewalls. The first process makes inward-solidifying rocks geochemically more evolved whereas the second process more primitive. The combined operation of these two competing processes results in intricate chemical profiles of dykes. Geochemical modelling indicates that all the observed patterns in distribution of compatible and incompatible elements in small dolerite dykes can be reproduced by variations in the relative contribution of these two petrogenetic processes. One important implication of this study is that compositional zonation of small dolerite dykes is indicative of an effective magma fractionation along sidewalls of the deeper parts of basaltic magma conduits.

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