# Magnesite dissolution rates at the column scale: The control of mineral spatial distribution

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Mineral dissolution plays a major role in various physical, chemical, and biological processes in nature. The rates of mineral dissolution in the field are often quantified by soil depth profiles and the sharpness of dissolution front within soil columns. Mineral dissolution rates can be affected not only by mineral reactivity, but also by other hydrogeochemical conditions, including flow velocity, inlet flow chemical composition, as well as the spatial distribution of minerals. Although potentially an important factor that determines the kinetics of mineral dissolution, the effects of mineral spatial distribution are often ignored. The objective of this work is to understand and quantify the effects of mineral spatial distribution on the overall dissolution rate at the column scale. Both column experiments and reactive transport modeling are used to investigate the dissolution of a reactive mineral (magnesite) imbedded in a sand column in different spatial patterns. The total mass ratios of the two minerals were kept constant. The variables include flow velocity, column length, and sub-column scale mineral spatial distribution. The results show that mineral spatial distribution is important under conditions where the flow velocities are relatively fast comparing to the reaction rates, and when the columns are relatively short. Under conditions where the small-scale heterogeneities are important, the column scale overall dissolution rates are larger when magnesite is spatially distributed evenly, compared to the case where all magnesite is clustered.

# Distribution and release of strontium in rivers around mine: An indicator for the oxidation of sulfide minerals in carbonate area

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Water samples from two mine areas were collected and analyzed for trace elements by ICP-MS. River water showed average Strontium concentration of 630 $\mu g \cdot L^{-1}$ in the Dachang multi-metalliferous mine area and of 790 $\mu g \cdot L^{-1}$ in the Yata gold mine area, were 4 and 5 times higher than the background values (Dachang mean: 155 $\mu g \cdot L^{-1}$; Yata mean: 160 $\mu g \cdot L^{-1}$), respectively. Especially, content of Sr was up to 1704 $\mu g \cdot L^{-1}$ in the adit water of the Dachang mine area.

Sr is abundant in carbonate rocks resulting from its similar ion radius with Ca. Actually, Dachang and Yata mine areas, as the carbonate rocks area, the former has one of the largest antimony deposit in China, and the latter has a significant gold deposit associated with As, Hg, Sb and Tl mineralisation in China. Although acid generated in the oxidation of sulfide minerals in mine tailings, the surface waters in the both of two mine areas are still circumneutral to slightly alkaline because of the neutralization of the carbonate rocks. However, when sulfide minerals such as antimony and arsenious sulphide are oxided, the sulfuric acid can react with carbonate rocks, and then can lead to the release of Sr from carbonate rocks. As a consequence, Sr shows a good correlation with Sb and As in the Pingcun river ($r = 0.99$ and 0.90, $n = 8$) and the downstream river ($r = 0.99$ and 0.94, $n = 6$) of Dachang mine area. Sr only shows a good correlation with As and but a poor correlation with Sb in the Yata mina area ($r = 0.94$ and 0.28, $n = 8$) [1]. Moreover, Sr in river water also shows a good correlation with $SO_4^{2-}$ ($r = 0.96$, $n = 8$) in the Yata mine area. Therefore, it could be concluded that a strong release of Sr in water of mine area can be resulted from the neutralization of acid drainage. Furthermore, Sr can also be regarded as an indicator of the oxidation of sulfide minerals in the mining environment enriched in carbonates.

[1] Zhang *et al*. (2009) *J. Environ. Monit*. **11**, 1570–1578.