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Bacteriophages affect precipitation of iron minerals

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The influence of bacteriophages on the precipitation of minerals, particularly iron minerals, is poorly understood [1]–[3]. Here, two different bacteriophages, *Escherichia* phage P1 (icosahedral) and *Pseudomonas* phage Φ6 (icosahedral, lipid-enveloped), were used to check whether they could affect mineral precipitation. Mössbauer spectroscopy was used to characterise the iron mineral particles. The size distribution of these minerals was also determined. Epifluorescence microscopy was used to image the attachment of bacteriophages to the mineral particles after precipitation.

The size of the mineral particles in the presence of bacteriophages differs significantly depending on the type of bacteriophages compared to the control sample (Fig. 1. The size distribution of iron phosphate mineral particles. Among the studied iron minerals, precipitation of phosphates revealed the most distinct impact of bacteriophages). Mössbauer spectroscopy revealed differences in the magnetic properties of the particles, particularly in experiments where iron oxides were precipitated in the presence of bacteriophages.

Epifluorescence microscopy has shown the strong attachment of bacteriophage capsids to the surface of iron oxides (Fig. 2. Maghemite with bacteriophages. The fluorescence comes from DNA/RNA of the phage capsids, which are strongly bound to mineral particles). In contrast, no bacteriophages were visible on iron phosphates. It is possible that bacteriophages are covered or built up with phosphates, which interrupts the fluorescence staining.

It has been suggested that bacteriophages can bind ions from the solution and alter the local concentration of ions [2], [3]. Thus, precipitated minerals may differ in mineral particle size in the presence of bacteriophages, as bacteriophage capsids may behave like crystallisation surfaces [2]. Importantly, it is believed that bacteriophages may also have environmental implications, as they are abundant in all environments. It has already been shown that bacteriophages can alter the crystallographic structure of carbonate minerals and their agglomeration [1].

[1] M. Słowakiewicz et al., *Geochim. Cosmochim. Acta*. 292, 482–498 (2021), doi: 10.1016/j.gca.2020.10.012.
[2] P. Działak et al., *Biogeosciences*. 19, 4533–4550 (2022), doi: 10.5194/bg-19-4533-2022.
[3] P. Działak et al., *RSC Adv.* 13, 926–936 (2023), doi: 10.1039/D2RA06661K.