Biological activity can lead to the precipitation of amorphous silica. This amorphous mineral can be directly precipitated by organisms (e.g. diatoms), or formed by abiogenic processes on “sticky” microbial surfaces [1,2]. In both cases, the interaction between amorphous silica and organic macromolecules, like proteins, likely play an important role in the formation of amorphous silica. However, weather and how proteins affect the structure, composition and morphology of amorphous silica at the molecular level is only poorly understood.

We are quantifying the effect a characteristic protein (lysozyme) has on the formation of amorphous silica that was precipitated from supersaturated aqueous solutions in the absence or presence of variable lysozyme concentrations (0 – 10’000 ppm).

In the absence of lysozyme, polymerisation of monosilicic acid ($H_4SiO_4$) leads to the formation of silica nanoparticles. Eventually these particles aggregate and form silica precipitates [3,4]. The presence of lysozyme has little effect on silica polymerisation and nanoparticle growth. Synchrotron-based atomic pair distribution function (PDF) analyses show only a minor change in the short range ordering (<10 Å) of amorphous silica precipitated in the presence of lysozyme. This suggests limited structural interactions and little if any incorporation of the lysozyme within the silica structure. We attribute this to the size of the lysozyme molecule, which at about 45 x 30 x 30 Å [5] is likely too large to be structurally incorporated within the silica nanoparticles. High-resolution imaging confirms that the size and morphology of silica nanoparticles were largely unaffected by the presence of lysozyme. However, enhanced particle aggregation was observed in the lysozyme-silica system, suggesting that lysozyme molecules act as a flocculation agent due to their positive surface charge [6]. This led to strong aggregation of individual silica nanoparticles and the incorporation of up to 10.3 wt.% lysozyme into the silica aggregates. As such, lysozyme enhances the precipitation by causing aggregation of silica particles but does not affect the molecular mechanism of silica nanoparticle formation.

[1] Perry. *Reviews in Mineralogy and Geochemistry*. **2003**, 54, 537. [2] Benning et al. *Geochimica and Cosmochemica Acta.* **2004**, 68/4, 729. [3] Iler. John Wiley and Sons. 1979 [4] Tobler et al. *Geochimica and Cosmochemica Acta.* **2009**, 73/18, 5377. [5] Blake et al. *Nature*. **1965**, 206/4986, 757. [6] Forciniti et al. *Biotechnology & Bioengineering*. **1991**, 38/9, 986.