Linking microbial activity and the pore structure of a natural rock with X-ray Computed Tomography

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Bacteria can colonize porous rocks in natural outcrops or building stones. Many studies focused on the negative effect of the colonization, such as biodeterioration or they emphasised the beneficial effect like microbial induced calcium carbonate precipitation (MICP). Some aspects have however been neglected like the effect of biogenic gas production or the linkage between the pore structure of a rock.

*Paracoccus denitrificans* has been used as model organism together with two porous calcareous stones: Tabaire (Spain) with an open porosity and Savonnières (France) which has a complex pore structure. *Paracoccus denitrificans* is a denitrifier creating nitrogen gas out of nitrate which can induce at the same time calcium carbonate precipitation. The colonization potential has been roughly estimated with a flow cytometer. It counted the bacteria that were flushed through the stone samples. In the next phase *Paracoccus denitrificans* grew inside the porous rocks which were imaged several times using X-ray computed tomography. It revealed a significant amount of gas production inside the rocks and could link the gas bubble distribution to the pore structure. The open pore system of Tabaire contained less but larger bubbles, while the gas bubbles within Savonnières were more isolated from each other. MICP, the other potential reaction product has not been clearly identified. The results are very promising and show the potential of this visualization technique. The effect of the X-rays on the growth and activity of bacteria is a major concern of this technique. Exposure did not lead in another experiment to lower growth or a high direct mortality but more research is necessary to exclude this potential drawback.