Pseudomonas brassicacearum mineral weathering activity is linked to iron homeostasis and can participate to soil organic carbon stabilization

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Interactions between organic matter and mineral surfaces have been proposed as a major driver of the soil organic carbon stabilization (Kleber et al., 2021). Recently, it has been shown that mineral weathering produces inorganic nanophases that can play a key role in stabilizing organic matter by coprecipitation (Rasmussen et al., 2018; Tamrat et al., 2019). The contribution of living organisms, including bacteria, to mineral weathering is now widely recognized (Wild et al., 2022). However, we still do not fully understand the mechanisms driving bacterial weathering, particularly the genetic regulations governing the interaction (Uroz et al., 2022).

We studied how the phytobeneficial bacterial strain *Pseudomonas brassicacearum* NFM421 (Achouak et al., 2000) interacted with biotite, a natural iron containing phyllosilicate. By constructing chromosomal mutants, we demonstrated that this bacterium increased biotite dissolution mainly through the production of two siderophores: pyoverdine and ornicorrugatine. Using molecular biology tools, we have also identified that the bacterial strains efficiently meet its iron requirements by weathering this mineral, leading to improved microbial growth. Another mechanism involving direct physical contact with the biotite allows the bacterium to get iron even if it cannot produce pyoverdine or ornicorrugatine.

As the strain is weathering biotite for nutrients, it consequently releases structural ions (silicium, aluminium and iron not absorbed by bacteria). In soil solution, these elements could interact with surrounding organic metabolites to form carbon-stabilizing coprecipitates. Understanding these mechanisms could lead to innovative agro-ecological techniques for increasing soil carbon storage and mitigating climate change.

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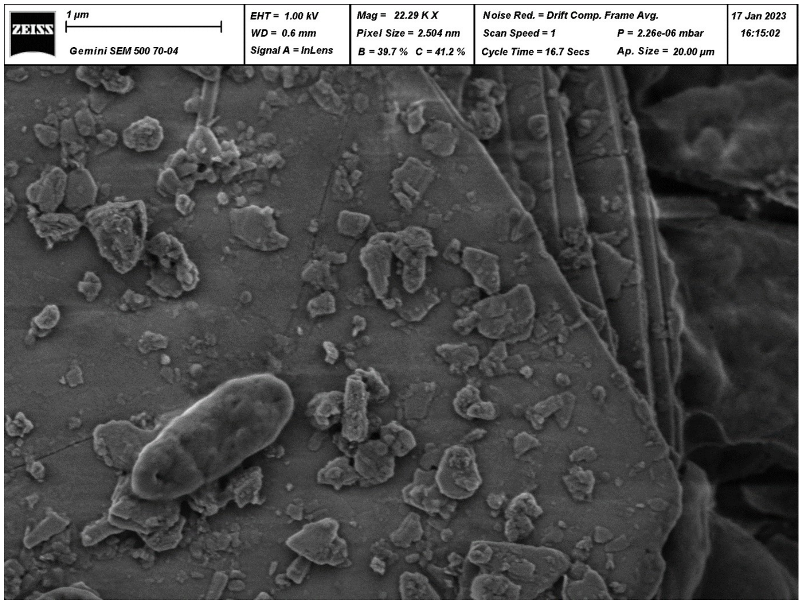

Figure 1*: Pseudomonas brassicacearum* cell on the surface of a biotite particle (Scanning Electron Microscopy, Centre Pluridisciplinaire de Microscopie électronique et de Microanalyse)

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