In search of the microbe/solid interface: A new approach using super-resolution vertical scanning interferometry measurements

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The analysis of initial bacterial attachment to solid surfaces is crucial for an improved and quantitative understanding of the development of biofilms on surfaces. Biofilms on rock, metal and glass surfaces play key roles in natural and engineered systems, in diverse processes ranging from weathering and corrosion to charge transfer in microbial fuel cells. Here we present the results of a study using *Shewanella oneidensis* MR-1 as a model organism. We used Vertical Scanning Interferometry (VSI) and Atomic Force Microscopy (AFM) to investigate the initial stages of cell attachment to glass, steel, aluminum, and carbonate surfaces. Although VSI results obtained using opaque and translucent surfaces are unambiguous, highly-reflective metal surfaces such as polished steel occasionally produce apparent observational artifacts. In these cases, bacteria appear as rod-shaped pits rather than as "positive" cells on the steel surface. This inversion is corrected when the bacteria are treated to increase their opacity. This phenomenon is the result of an interaction between light white light reflected from the bacteria's top membrane surface, and the light reflected from the bacteria-metal interface. These results suggest that (1) information can be recorded from the bacterial cell membrane and bacteria on surfaces using VSI; (2) in addition, with appropriate modifications to the analytical software, these data may offer a unique window for direct study of the bacterial/substrate interface. This optical information, a superposition of at least two correlograms, can thus be used for quantitative observations. In concert with recent progress of super-resolution techniques, imaging and characterization of the previously invisible bacteria-substrate interface *in vivo* will provide new insights into interactions that occur at this important junction.

The impacts of Sn-W, Ba-Pb-Zn and W-Au-Sb old mine workings on the environment at central Portugal

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At Segura, granitic pegmatite veins with cassiterite and lepidolite, hydrothermal Sn-W quartz veins and Ba-Pb-Zn quartz veins intruded the Cambrian schist-metagraywacke complex and Variscan granites. They were exploited for Sn, W, Ba and Pb until 1953. At Sarzedas, W-Au-Sb quartz veins and Sb-Au felsitic dikes intersect the complex and were exploited for W, Au and Sb until 1951. Tin, W, B, As and Cu anomalies in soils and stream sediments from Segura are related to Sn-W quartz veins, whereas Ba, Pb and Zn anomalies in soils and stream sediments from this area are associated with Ba-Pb-Zn quartz veins. At Sarzedas, Sn, W, As and Sb anomalies in soils and W, Pb and Sb anomalies in stream sediments are associated with W-Au-Sb quartz veins and Sb-Au felsitic dikes. The contents of trace elements decrease from soils to stream sediments and waters, due to their relatively low mobility. Soils from Sarzedas must not be used for agriculture, human residence, commerce and industry due to their high Sn, As and Sb contents, whereas soils from Segura should not be used for agriculture and human residence due to their high Sn, B, As and Ba contents and industry due to the high As content. Among these trace elements, the most abundant in soils and stream sediments are Sb at Sarzedas and Ba at Segura. There is no significant acid drainage associated with old mine workings in both areas due to neutralization of acid waters, attributed to marble intercalations in the schist-metagraywacke complex and also siderite in the mineralized veins and dikes from Sarzedas. At Segura, waters associated with Sn-W quartz veins and As anomalies in soils are the richest in As, whereas the waters related to the Ba-Pb-Zn quartz veins are the richest in Fe and Mn. These waters from Segura should not be used for human consumption and agriculture due to their high As, Fe and Mn contents, whereas waters related to W-Au-Sb quartz veins and Sb-Au felsitic dikes from Sarzedas must not be used for human consumption due to their high Fe, Mn and Sb contents. Arsenic, Fe and Mn reach higher contents in waters from Segura than in those from Sarzedas. The W-Au-Sb and Sb-Au old mine workings caused higher impacts on soils and stream sediments, but lower impacts on waters than Sn-W and Ba-Pb-Zn old mine activities.