Synchrotron radiation-based (SR) Fourier transform infrared (FTIR) spectromicroscopy has been used to study bacterial attachment and localization on individual mineral surfaces and on geologic materials. The purpose of this study was to evaluate the application of this technique to investigate the identification of distinct mineral phases within minerallogically heterogeneous basalt. The mineral spectra were collected using the 1.4.3 Beamline experimental endstation at the Lawrence Berkeley National Laboratory (LBNL) Advanced Light Source (ALS). FTIR absorption spectra were recorded in the 4000-650 cm\(^{-1}\) infrared region at a spectral resolution of 4 cm\(^{-1}\) and microscope-focused experimental spot size of 10 µm. The four major mineral constituents of the olivine basalt specimens analyzed were calcic plagioclase, augite, olivine, and ilmenite. Individual representative mineral chips and basalt specimens were mounted on aluminum slides and spectra obtained for multiple locations on each specimen surface. The highly focused 10 µm spot size from the 1.4.3 Beamline FTIR enables the detection of individual minerals within a finely textured and highly heterogeneous basalt specimen. Future work will include the evaluation of this technique to investigate the possible preferential attachment of bacteria to specific mineral phases within a heterogeneous geologic substratum and the influence of bacterial mineral attachment on enzymatic expression.