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A TEM and STXM study of microbial alteration of submarine basaltic glass from the Ontong Java Plateau

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Glass shards collected in a 337.7 m thick sequence of volcaniclastic tuffs recovered during ODP Leg 192 on the Ontong Java Plateau contain textural, geochemical and isotopic signatures that suggest they were partially altered my microbial activity. Initial study of these samples[1] found evidence of tubular to vermicular, channel-like features pervasive in some glass clasts and suggested that they were the products of microbial corrosion of the glass.

We have further characterized these samples at the submicrometer scale by combining Scanning Transmission X-ray Microscopy (STXM) and Transmission Electron Microscopy (TEM). We prepared ultrathin cross-sections specifically across the channels by using Focused Ion Beam milling (FIB)[2]. STXM was used to perform high spatial and energy resolution near-edge x-ray absorption fine structure (NEXAFS) and high resolution imaging. C K-edge and Fe $L_{2,3}$-edges were used to characterize and map carbon speciation and iron redox state in the channel cross-sections. The distribution and speciation variations of these elements in correlation with the channel structures are discussed in terms of biogenicity and geochemical significance. TEM, electron diffraction and electron energy loss spectroscopy (EELS) were used on the same FIB cross-sections to detail the textural and mineralogical features associated with the channels. This study will help demonstrate how studies at the nanometer

scale can be used to elucidate the mechanisms by which global scale processes like basalt weathering can be determined.

1 Banerjee N.R., Muehlenbachs K. (2003) Tuff life: Bioalteration in volcaniclastic rocks from the Ontong Java Plateau. *Geochem. Geophys. Geosyst.* 4, 2002GC000470.

2 Benzerara K., Menguy, N., Guyot, F., Vanni, C, and Gillet P. (2005) High resolution study of silicate-carbonate-micro-organism interface prepared by focused ion beam (FIB). *Geochim. Cosmochim. Acta*, 69, 1413-1422.