# Nb-Zr systematics of U-Pb dated achondrites

TSUYOSHI IIZUKA[1,2*], WAHEED AKRAM[3], YURI AMELIN[2] AND MARIA SCHÖNBÄCHLER[3]

[1]DEPS, University of Tokyo, iizuka@eps.s.u-tokyo.ac.jp (*presenting author),
[2]RSES, Australian National University
[3]SEAES, University of Manchester,

The short-lived radionuclide $^{92}$Nb decays to $^{92}$Zr with a half-life of 36 Ma [1]. Nb and Zr are both refractory lithophile elements and can fractionate from each other during partial melting of the mantle. Thus, Nb-Zr isotope systematics can potentially place chronological constraints on early planetary silicate differentiation. This application requires the initial abundabce of $^{92}$Nb (or $^{92}$Nb/$^{93}$Nb) and its homogeneity in the solar system to be unambiguosly defined. Yet previously reported initial $^{92}$Nb/$^{93}$Nb values range from ~$10^{-5}$ to >$10^{-3}$ [2-6], and remain to be further constrained. All but one of the previous studies estimated the initial $^{92}$Nb/$^{93}$Nb using Zr isotope data for single phases with fractionated Nb/Zr in meteorites such as zircons and CAIs, under the assumption that their source materials and bulk chondrites had had identical initial $^{92}$Nb/$^{93}$Nb and Zr isotopic compositions [2-5]. To evaluate the homogeneity of the initial $^{92}$Nb abundance, however, it is desirable to define internal mineral isochrons for meteorites with known absolute ages. Although Schönbächler et al. [6] defined Nb-Zr internal isochrons for two meteorites (Estacado and Vaca Muerta), their absolute crystallization (or possibly recrystallization) ages are not precisely constrained, leading to uncertainties in the resultant estimate for the initial $^{92}$Nb/$^{93}$Nb of the solar system.

To establish the solar system intial $^{92}$Nb/$^{93}$Nb and its homogeneity, we are studying the Nb-Zr systematics of minerals from achondrites whose absolute crystallization ages were precisely determined with the U-Pb chronometer. Abundances of trace elements including Nb and Zr were determined by LA-ICPMS for pyroxene, plagioclase, pyrite, spinel and/or opaque minerals from 3 eucrites (Agoult, Ibitira and A-881394), 5 angrites (SAH99555, D'Orbigny, NWA2999, NWA4590 and NWA4801) and Acapulco. The results reveal that Agoult, Ibitira and NWA4590 contain phases with reasonably high Zr contents and a good spread in Nb/Zr (<0.01 for pyroxene and ~3 for opaque minerals and spinel) to define precise internal isochrons. These minerals and whole rock samples were further processed for Zr separation and analyzed for Zr isotopes by MC-ICPMS. We found that the spinel and opaque mineral fractions have restricted positive $^{92}$Zr anomalies up to 30 ppm relative to the terrestrial standard samples. We are still in the process of determining their Nb/Zr isotopic ratios, but preliminary results of Zr isotope analyses, combined with the approximate Nb/Zr of minerals estimated by LA-ICPMS, suggest that the initial $^{92}$Nb/$^{93}$Nb is in the order of ~$10^{-5}$, consistent with the results of previous work using the internal isochron approach [6].

[1] Nethaway et al. (1978) *Phys. Rev. C* **17**, 1409–1413. [2] Sanloup et al. (2000) *EPSL* **184**, 75-81. [3] Yin et al. (2000) *ApJ* **536**, L49-L53. [4] Münker et al. (2000) *Science* **289**, 1538-1542. [5] Hirata (2001) *Chem. Geol.* **176**, 323-342. [6] Schönbächler et al. (2002) *Science* **295**, 1705-1708.

# The role of extracellular polymeric substances in nanoparticle-biofilm interactions

KAORU IKUMA[1*], ANDREW S. MADDEN[2], AND BORIS L. T. LAU[1]

[1]Department of Geology, Baylor University, Waco, TX, USA, kaoru_ikuma@baylor.edu (* presenting author), boris_lau@baylor.edu
[2]School of Geology and Geophysics, University of Oklahoma, Norman, OK, USA, amadden@ou.edu

## Introduction

Environmental surfaces are ubiquitously covered with biofilms that are primarily made of "sticky" bacterial extracellular polymeric substances (EPS). While various nanoparticles (NPs) have previously been shown to interact strongly with biofilms and EPS, the mechanisms of interaction have remained unclear. EPS consist of a range of organic compounds including various polysaccharides, proteins, and lipids that may play different roles in NP-biofilm interactions. Our objective in this work is to determine the different surface interactions between NPs and individual EPS components. A quartz crystal microbalance with dissipation monitoring (QCM-D) was used to quantify the kinetics and extent of the deposition of hematite NPs (FeNPs) and galena NPs (PbNPs) onto surfaces coated with model and natural EPS components.

## Results and Discussion

Frequency shifts were observed during the deposition of EPS components and NPs onto QCM-D sensors (e.g., protein and PbNPs in Fig 1A). Such observed shifts were used to calculate changes in NP mass deposited onto various surfaces. For example, FeNP deposition (in 10mM NaCl, pH 6) was 1.6 fold slower but ~10% greater onto surfaces coated with a model polysaccharide (alginate) compared to a model protein (bovine serum albumin; BSA) (Fig 1B). We expect that the observed differences between varying EPS components were due to differences in charge and hydrophobicity. Experiments are currently underway to test this hypothesis.

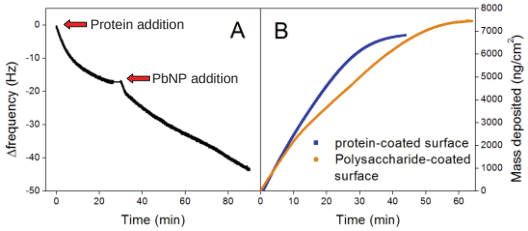


**Figure 1: NP deposition onto QCM-D sensor surface coated with EPS components.** (A) Frequency shifts measured by QCM-D during protein and PbNP deposition onto the sensor surface. (B) FeNP deposition onto surfaces coated with proteins or polysaccharides.

## Environmental Implications

As natural biofilms may act as a major sink for NPs, a detailed mechanistic understanding of the role of EPS and its components in NP-biofilm interactions is crucial for determining the environmental fate and transport of engineered NPs.