

**RADIOACTIVITY OF SEDIMENTS AT THE ATACAMA ROVER ASTROBIOLOGY DRILLING STUDIES FIELD SITE.** Jon Rask<sup>1</sup>, Brian Glass<sup>1</sup>,<sup>1</sup>NASA Ames Research Center, Moffett Field, CA 94035, [jon.c.rask@nasa.gov](mailto:jon.c.rask@nasa.gov)

**Introduction:** During the 2018 Atacama Rover Astrobiology Drilling Studies (ARADS) field activities [1], we conducted a survey of surface and subsurface sediment radioactivity. Our objective was to characterize the radiation environment of various near-surface sampling locations, as well as along the entire profile of a 2.60 m deep pit that had been dug near one of the ARADS rover drill site locations. This pit was used to collect samples that have been well characterized [2] for comparison to samples collected and analyzed by the rover (Fig. 1.)



Figure 1: The ARADS rover and pit field site.

**Methods:** A Ludlum 19 micro-r-meter (Ludlum Measurements, Inc.) capable of sensing x-rays and gamma rays (0-5000  $\mu\text{R/hr}$ ), was operated in the field to gather radiation data. The micro-r-meter was held within three to five centimeters of the surface of sediments at each location, and radioactivity levels, measured in triplicate as  $\mu\text{R/hr}$ , were read from the instrument and recorded. Additionally, a radon detector (Corentium, with alpha spectrometry and digital sensor technology) was deployed at the bottom of the 2.60 m pit for a period of 7 days to determine if radon was present in the air.

**Results:** We observed background radiation to be approximately  $\sim 10$   $\mu\text{R/hr}$  in the air and at the surface of each sampling site. Radioactivity was observed to increase with depth in all shallow pits, and also in the 2.60 m pit. We observed that radioactivity at the bottom of the 2.60 m pit to be approximately twice that of the surface ( $\sim 23$   $\mu\text{R/hr}$ ). For the radon survey, our preliminary results suggest that initial readings after 24 hours of data collection showed levels in the air to be  $\sim 0.3$  pCi/L, and  $\sim 0.4$  pCi/L after seven days of data collection.

**Discussion:** Our findings suggest that small amounts of x-ray and gamma-ray emitters, such as

thorium and uranium, are likely present in the sediments around the Yungay region of the Atacama, as well as in the sediments of the ARADS “pit” drilling site. The observation of very low levels of radon, a byproduct of the natural decay of thorium and uranium, is consistent with our observations of low levels of radioactivity. The presence of small amounts thorium and uranium in Atacama soils may also have astrobiological significance. With regard to fossil biomolecules, it is known that degradation of organics by gamma radiation is dose dependent [3][4], and that the radiolysis rate of large biomolecules is faster than smaller biomolecules [5]. However, it should be noted that the radioactivity we observed is at very low levels, and could potentially serve as an energy source for subsurface biology. For example, if microbes in Atacama soils have evolved to consume hydrogen produced from radiolysis of water, we predict that their presence may be enhanced during periods of increased rainfall and could be observed using genetic sequencing techniques. In either case, our work is relevant to the search for life on Mars, especially in regions where radioactive elements appear to be concentrated. Additional study is needed to understand how the radioactivity in Atacama soils alter contemporary and ancient subsurface biomolecules. In summary, the [indirect] observation of thorium/uranium at the ARADS drilling site is a step toward further characterization of the local sediments, and may serve as an analog of the thorium-enriched regions of Acidalia Planitia on Mars [6].

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**References:** [1] B. Glass, et.al. (2019), AbSciCon abstract 104-2. [2] Wilhelm, M. B., et. al., (2017), Organic geochemistry, 103, 97–104. [3] Kminek, G., & Bada, J. L. (2006), Earth and Planetary Science Letters, 245(1-2), 1-5. [4] Blanco, et.al., (2018), Astrobiology, 18(12), 1497-1516. [5] Pavlov, et.al. (2012), Geophysical research letters, 39(13). [6] G.J. Taylor, et.al. (2006), Journal of Geophysical Research: Planets. 2006 Mar 1;111(E3).