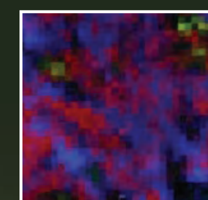
Perseverance seeks evidence of past life with PIXL

With the exclamation, "Touchdown confirmed!" broadcast from mission control at the Jet Propulsion Laboratory, Senior Principal Physicist **Tim Elam** and millions of people around the world celebrated the safe landing of *Perseverance* after its 300-million-mile journey to Mars. As planned, *Perseverance* parachuted down into Jezero Crater, which at least once in the past was filled by a lake and retains a delta formed by outflowing water.

As the self-identified 'chief spectroscopist' of the Mars rover mission, Elam's analyses of data collected by PIXL – the Planetary Instrument for X-ray Lithochemistry – puts him front and center in the search for evidence of ancient life on Mars. After the February landing the science mission began in earnest. Several rocks have been targeted for close inspection and samples collected and cached for eventual return to Earth on a future mission.



Perseverance uses a tool on its robotic arm to abrade the surface of a targeted rock. Then PIXL can interrogate the newly revealed surface with its X-ray beam. Elam explains that he contributes two interpretive components to PIXL data streaming back from Mars: converting PIXL emission spectra excited by its X-ray beam to elemental composition – the rock's chemistry – and mapping the elements distributed on the surface. In one of the early samples PIXL identified over 20 elements in a 3 x 3-mm target area.

Elam's interpretations are then shared with the vast science team dedicated to analyzing the rock's origins and composition. Looking at PIXL's element map and focusing on the salt grains flecked in one of the samples, the team has posited that this particular volcanic rock likely spent a considerable amount of time underwater, where the salts percolated through the rock's pores and were then trapped when the lake dried.

Biosignatures – fossil evidence of past biologic processes in Jezero Crater – would be the ultimate finding, but until cached samples are returned to Earth for close examination such determinations are challenging. For now, PIXL and its companion instruments on *Perseverance* are providing greater insight than ever before about the Martian surface.

image: NASA/JPL-Caltech

precise undersea navigation for persistent gliders

Collaborative efforts among Principal Engineer **Sarah Webster** and colleagues at the Woods Hole Oceanographic Institution last year resulted in successful field tests of an acoustic navigation system for Seaglider. A low-power sensor improves the accuracy of Seaglider's undersea position calculations by an order of magnitude and could enable the vehicle to spend more of its time and energy making observations in deep ocean volumes of interest to oceanographers.

Seagliders fly underwater by changing buoyancy mechanically to dive and ascend on shallow glide paths. They stay on course by dead reckoning between GPS position fixes obtained at the surface during each dive cycle or, when operating under sea ice and denied the surface, by receiving acoustic signals from infrastructure-intensive subsea beacons.

During field experiments off the California coast, a surface beacon transmitted position information to Seaglider at regular intervals. An acoustic modem and precision timing and attitude sensors integrated on Seaglider used the one-way travel time calculation to determine the glider's position relative to the beacon.

In upcoming experiments planned for 2022 in the Gulf of Mexico, a single uncrewed surface vehicle will support two gliders surveying a region of interest. The navigation sensors draw very little energy and enable gliders to forego frequent trips to the surface so that limited stored power is expended on persistent, long-term observations of the deep ocean interior or seafloor.