Drilling for microbes

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For scientists who study subseafloor sediment, it's not unusual to spend a lot of time at sea aboard a ship with a gaping hole in its hull. Known as a moon pool, the hole serves as a portal for the ship's weighty drilling equipment to retrieve core samples of seafloor sediment thousands of meters below. Aboard scientific research vessels, such as the *JOIDES Resolution*, University of Rhode

Island oceanographer Steve D'Hondt and colleagues have collected sediment from all over the globe and use these samples to probe the nature of the microbial life beneath the seafloor, yielding clues to the limits to life on Earth.

To identify these microbes and better understand their activities and habitats, D'Hondt leads teams of ~30 international

scientists with wide-ranging expertise on seagoing expeditions. These sedimentologists, geophysicists, geochemists, and microbiologists work demanding 12-hour shifts 7 days a week for the duration of each expedition, which typically lasts about 2 months.

D'Hondt and colleagues have discovered that, on average, subseafloor microbes breathe a million times more slowly than microbes on the surface world: so slowly that they can barely glean enough energy to repair their cells, much less to reproduce, D'Hondt says. "These microbes are really pushing at the limits of what it means to be alive." In addition, in sediments that lack oxygen they've found that microbes simultaneously use a number of competing energetic pathways that are traditionally thought to exclude each other: iron reduction, sulfate reduction, and methane production. "It's an underground economy, if you will, where instead of all the microbes just taking in one product, they take up whatever product is available at the price that they can afford to pay," D'Hondt explains.

The most recent exciting result of these expeditions is the discovery that the number of microbes present in almost any marine sediment can be predicted by measuring properties of the surface world, such as sedimentation rate and distance from shore. Using this information, the team suggested that the total amount of biomass in the seafloor might be substantially smaller than previously thought. These findings suggest that the surface world has profound effects on subsurface life, but D'Hondt hopes his studies will also help to reveal how these microbes affect the chemistry of the ocean and the atmosphere, and ultimately, the environment in which we live.

The scientific ocean drilling vessel *JOIDES Resolution* features an ~7-meter-diameter moon pool. Image courtesy of William Crawford (Integrated Ocean Drilling Program, Texas A&M University, College Station, TX).