Science & Technology

# The Laws of Subduction

By
Paul Hond
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She’s got thirty-six guns, fifty computer monitors, and four decks, and Sean Higgins ’02GSAS can’t stop thinking about her. The *Marcus G. Langseth* sails the Mediterranean now, moving glacially at 4.5 knots somewhere off the coast of Greece. On a cloudless day, in an aquamarine sea, miles of yellow cables unspool from her winches, trailing off the ship’s back and stretching into the deep. Even when Higgins, a senior research scientist at Columbia’s Lamont-Doherty Earth Observatory and director of marine operations, is at home in White Plains, he can feel her tug.

The *Langseth* is the alpha ship of the University–National Oceanographic Laboratory System fleet, the only vessel of the fleet’s seventeen that is fully equipped to gather seismic data under the ocean. The long yellow cables dragging behind her are rigged with hydrophones. These pick up the sonic reflections of the air guns, which are towed underwater by their own cabling and strategically arrayed. *Thud*! — a unison discharge of air — *thud*! — and another — *thud*! — the chorus sends bubbly reverberations that penetrate five to twenty miles through the oceanic crust and mantle. This acoustic imaging, together with ocean-floor seismometers that measure any movement of the ground, produces 2D and 3D maps of the underlying geologic structures. It also identifies the faults and folds associated with subduction, the process by which one tectonic plate slides under the other, creating mountains, volcanoes, and earthquakes.

Though the *Langseth* is thousands of miles from Higgins, her vibrations run through him. He and his team keep the thirteen-million-dollar-a-year enterprise afloat, making sure the ship is available and working, untangling the Gordian knot of regulatory regimes, and endlessly juggling the schedules and needs of the ship’s crew and scientists (up to fifty-five). This fall, when she was docked at the Brooklyn

Navy Yard for upgrades, Higgins led tours. He knows her every compartment, can articulate the questions she is made to address: How do plate tectonics work? What causes geohazards like earthquakes and tsunamis?

Higgins has answers, too. He'll tell you that 95 percent of the ocean floor is unmapped. He'll tell you about Marie Tharp, the Columbia cartographer who in the 1950s created ocean-floor maps that led to the discovery of the central rift valley that runs through the Mid-Atlantic Ridge, the longest mountain chain in the world. He'll tell you about Marcus Langseth '65GSAS, the Lamont researcher who studied the earth's heat flow and devised instruments used to perform a similar study of the moon for NASA. He'll tell you that "understanding tectonic history and structure will give us a better sense of how subduction zones behave, and a better sense of how our dynamic planet acts as a system."

He thinks of her, then, as she floats on faraway seas, plumbing the mystery of what drives plate tectonics. "There are fundamental earth processes that we still don't understand," he says, as she makes her distant soundings.

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