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Big Data Reveals Geology of World's Ocean Floor

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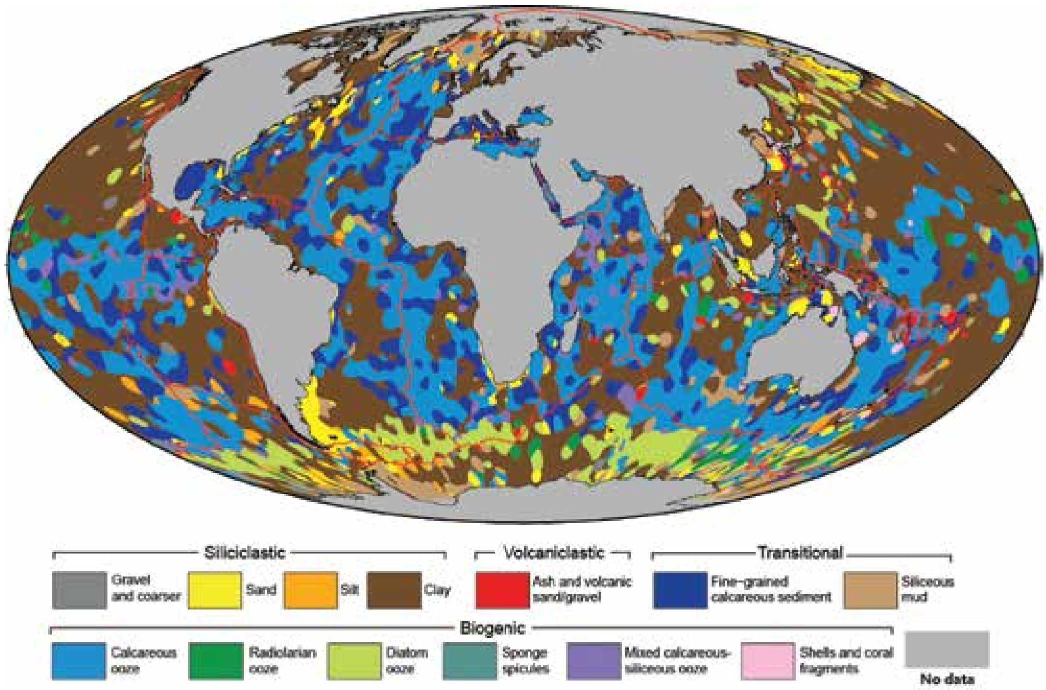
Ocean sediments cover 70% of our planet's surface, forming the substrate for the largest ecosystem on Earth and its largest carbon reservoir – but the most recent map of seafloor geology was drawn by hand over 40 years ago, at the dawn of modern ocean exploration.

That is about to change. In an unprecedented effort, Adriana Dutkiewicz and her colleagues at the University of Sydney and National ICT Australia carefully analyzed and categorized 15,000 seafloor sediment samples to reveal the nature of sedimentary blankets over ocean ridges, seamounts, and the vast abyssal plains. They also developed a method to use modern computer algorithms, a so-called support vector machine, to turn the vast sea of point observations into a continuous digital map.

The first "census of seafloor sediments" reported in the journal *Geology* is rendered as a spectacular, interactive, spinning virtual globe that allows anyone to fly through the colourful patchwork of seafloor geology draped over a terrain map.

The new map completely changes our understanding of what is on the ocean floor. We find a complex patchwork where in the 1970s large continuous belts of seafloor sediments were mapped. Why is this important? The deep ocean floor is a graveyard with much of it made up of microscopic sea creatures called phytoplankton, whose dead remains rain down through the water column like "marine snow." The composition of their shells is used to decipher how our oceans have responded to past climate change. A unique feature of diatom cells is that they are enclosed within a cell wall made of silica. They thrive in sunlit surface waters, produce about a quarter of the oxygen we breathe, and they make a bigger contribution to fighting global warming than most plants on land. Their dead remains sink to the bottom of the ocean, locking away their carbon. Satellites map chlorophyll concentrations in the surface ocean, tracking diatom productivity, but so far we have not had any reliable maps of where diatoms accumulate on the seafloor – we understood the carbon source, but not the sink.



Surprisingly, the new seafloor geology map demonstrates that diatom accumulations on the seafloor are nearly entirely decoupled from diatom productivity maxima in surface waters in the Southern Ocean. Independently, a similar decoupling was recently reported for the Northeast Pacific, supporting these results. That means oceanographers and marine geologists have some work to do. Now that Australia has a new marine research vessel, the *Investigator*, this research opens the door to future voyages aimed at better understanding the workings and history of the marine carbon cycle.

Big Data technologies, paired with old and new data, will now allow us to better predict the impact changing climate and ecosystems may have on the life cycle of diatoms, by jointly analyzing a multitude of sea surface and seafloor observations.

Further Reading

Census of seafloor sediments in the world's ocean
http://geology.gsapubs.org/content/early/2015/07/28/G36883.1.abstract

Interactive seafloor globe
http://portal.gplates.org/#SEAFLOOR

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