DEEP SEA CORES REVEAL NEW INSIGHTS INTO BREAKUP AND CONTINENTAL DRIFT

It is noteworthy that within the 50-year anniversary of the theory of plate tectonics, scientific ocean drilling can continue to unearth new and fundamental knowledge on how continents part and plates move tectonically. A study based on drill cores from the South China Sea (SCS) obtained by the International Ocean Discovery Program (IODP, http://www.iodp.org/) was recently published in the scientific journal *Nature Geoscience (https://rdcu.be/5Syz*), confirming predictions by the plate tectonic paradigm regarding the process of continental breakup – the initial step within the plate tectonic cycle.

Ever since Alfred Wegener hypothesized continental drift in 1915, the process of continental breakup has been a challenge for earth scientists to explain. Plate tectonics predicts that new, 5-6 km thick volcanic crust formed by seafloor spreading fills the crustal-scale void that forms as the continental plates separate during breakup. However, this idea was challenged in the 1990s when studies along North Atlantic rifted margins showed formation of either anomalously 20-30 km thick volcanic crust or no volcanism for tens of millions of years in association with continental breakup. Consequently, it seemed that lacking excessively hot mantle of the type that exists below Iceland to drive breakup and generate initial, excessive volcanism, continents effectively resisted being pulled apart. Instead, the plate was mechanically extended for a very long period of time, with no or extremely minimal volcanism before proper seafloor spreading eventually took place. The plate tectonic prediction of a rapid translation into normal seafloor spreading therefore remained unverified for a long time.

To further investigate continental breakup mechanisms at a location outside the North Atlantic, the IODP Expeditions 367 and 368 aboard the drilling vessel R/V JOIDES Resolution, in 2017, sampled drill cores from as deep as 1600 m below the seafloor in almost 4 km of water at seven sites along the northern margin of the SCS (http://iodp.tamu.edu/scienceops/expeditions/south_china_sea_II.html). From the onboard analyses of the more than 2.5 km of core by the expeditions scientists, it became clear that the evolution of the SCS in fact represents the long sought 'missing link' of continental breakup that is predicted by plate tectonics. Rifting was rapidly followed by breakup and was instantly followed by normal seafloor spreading generating 5-6 km thick ocean crust. This revelation will be followed by post-expedition research on the more than 30 thousand core samples taken by the expedition scientists. Future studies will address details of geochronology, the type and state of the Earth's mantle underlying the SCS, and the record of environmental evolution within the last 30 million years recorded by the deep-sea sediments within the SCS.

Expeditions 367 and 368 involved 68 participating scientists from the United States, China, Japan, Germany, France, Italy, Australia, India, Brazil, Denmark, South Korea, Switzerland and the United Kingdom. The International Ocean Discovery Program is sponsored by the U.S. National Science Foundation and other participating countries. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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