Harry Hammond Hess: Spreading the seafloor

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Harry Hess (1906-1969) in his Navy uniform as Captain of the assault transport Cape Johnson *during World War II. After the war, he remained active in the Naval Reserve, reaching the rank of Rear Admiral. (Photograph courtesy of Department of Geological and Geophysical Sciences, Princeton University.)*

Harry Hammond Hess, a professor of geology at Princeton University, was very influential in setting the stage for the emerging plate-tectonics theory in the early 1960s. He believed in many of the observations Wegener used in defending his theory of continental drift, but he had very different views about large-scale movements of the Earth.

Even while serving in the U.S. Navy during World War II, Hess was keenly interested in the geology of the ocean basins. In between taking part in the fighting in the Marianas, Leyte, Linguayan, and Iwo Jima, Hess -- with the cooperation of his crew -- was able to conduct echo-sounding surveys in the Pacific while cruising from one battle to the next. Building on the work of English geologist Arthur Holmes in the 1930s, Hess' research ultimately resulted in a ground-breaking hypothesis that later would be called *seafloor spreading.* In 1959, he informally presented this hypothesis in a manuscript that was widely circulated. Hess, like Wegener, ran into resistance because little ocean-floor data existed for testing his ideas. In 1962, these ideas were published in a paper titled "History of Ocean Basins," which was one of the most important contributions in the development of plate tectonics. In this classic paper, Hess outlined the basics of how seafloor spreading works: molten rock *(magma)* oozes up from the Earth's interior along the mid-oceanic ridges, creating new seafloor that spreads away from the active ridge crest and, eventually, sinks into the deep oceanic trenches.

Hess' concept of a mobile seafloor explained several very puzzling geologic questions. If the oceans have existed for at least 4 billion years, as most geologists believed, why is there so little sediment deposited on the ocean floor? Hess reasoned that the sediment has been accumulating for about 300 million years at most. This interval is approximately the time needed for the ocean floor to move from the ridge crest to the trenches, where oceanic crust descends into the trench and is destroyed. Meanwhile, magma is continually rising along the mid-oceanic ridges, where the "recycling" process is completed by the creation of new oceanic crust. This recycling of the seafloor also explained why the oldest fossils found on the seafloor are no more than about 180 million years old. In contrast, marine fossils in rock strata on land -- some of which are found

high in the Himalayas, over 8,500 m above sea level -- can be considerably older. Most important, however, Hess' ideas also resolved a question that plagued Wegener's theory of continental drift: how do the continents move? Wegener had a vague notion that the continents must simply "plow" through the ocean floor, which his critics rightly argued was physically impossible. With seafloor spreading, the continents did not have to push through the ocean floor but were carried along as the ocean floor spread from the ridges.

In 1962, Hess was well aware that solid evidence was still lacking to test his hypothesis and to convince a more receptive but still skeptical scientific community. But the Vine-Matthews explanation of magnetic striping of the seafloor a year later and additional oceanic exploration during subsequent years ultimately provided the arguments to confirm Hess' model of seafloor spreading. The theory was strengthened further when dating studies showed that the seafloor becomes older with distance away from the ridge crests. Finally, improved seismic data confirmed that oceanic crust was indeed sinking into the trenches, fully proving Hess' hypothesis, which was based largely on intuitive geologic reasoning. His basic idea of seafloor spreading along mid-oceanic ridges has well withstood the test of time.

Hess, who served for years as the head of Princeton's Geology Department, died in 1969. Unlike Wegener, he was able to see his seafloor-spreading hypothesis largely accepted and confirmed as knowledge of the ocean floor increased dramatically during his lifetime. Like Wegener, he was keenly interested in other sciences in addition to geology. In recognition of his enormous stature worldwide, in 1962 Hess -- best known for his geologic research -- was appointed by President John F. Kennedy to the prestigious position of Chairman of the Space Science Board of the National Academy of Sciences. Thus, in addition to being a major force in the development of plate tectonics, Hess also played a prominent role in designing the nation's space program.

Questions:

1. What did Hess and his crew do while cruising from one battle to the next during World War II?
2. Name the book which was one of the most important contributions in the development of plate tectonics?
3. How did Hess outline the process of seafloor spreading?
4. What was one of the questions that a mobile seafloor explained?
5. How old are the oldest fossils found on the seafloor?
6. How did Hess resolve the problem of continents “plowing” through the ocean floor?
7. What was the evidence that ultimately provided the arguments to confirm Hess’ model of seafloor spreading?
8. What new information further strengthened the theory of seafloor spreading?
9. What event happened in 1962?