Dave Stegman

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GEOPHYSICS AND PLANETARY PHYSICS

PLATES AND PLANETS – CLUES TO THE ORIGINS OF EARTH

How do planets evolve? Why is plate tectonics unique to Earth?

Scripps Oceanography geophysicist **Dave Stegman** is peering billions of years back into Earth's early history to reveal some of our planet's most elusive mysteries.

Using state-of-the-art supercomputers and advanced four-dimensional visualization, Stegman is modeling the tectonic plates that move continents around Earth to better understand the dynamic forces and tectonic stresses on the surface that control the size and magnitude of natural hazards, such as earthquakes and volcanoes.

Through his research, Stegman aims to address many of Earth's most important geodynamic events over the past 200 million years, including a 35-million-year phase during the age of dinosaurs when the Earth's magnetic field stopped reversing. Some of the questions he hopes to answer, include: what caused plate tectonics to begin and is it required to initiate and sustain life?

In order to advance their geophysics and tectonics research, Dave Stegman and science team require a series of high-tech tools and equipment:

WISH LIST

Website support **$15,000**

Support for development and maintenance of "The Life Tectonic" website, a highly interactive and collaborative site for promoting Stegman's research activities and for providing educational outreach.

Highly interactive parallelized display **$20,000-$30,000**

The massive amounts of numerical data generated in large-scale computer simulations are simply incomprehensible in their native form and must be rendered using computer graphics. The challenge is to visualize the fine-scale structures of a 3-D model evolving over time without losing sight of the larger picture. The Optiputer technology, developed by UCSD's Calit2, utilizes off-the-shelf hardware to create ultra-high resolution computer screens (several 100,000 pixels). Arrays of high-definition flat screen monitors are virtually stitched together into a single, seamless display (a "super" monitor) and deliver new levels of capability for scientific visualization.

High performance computing storage system **$30,000-$40,000**

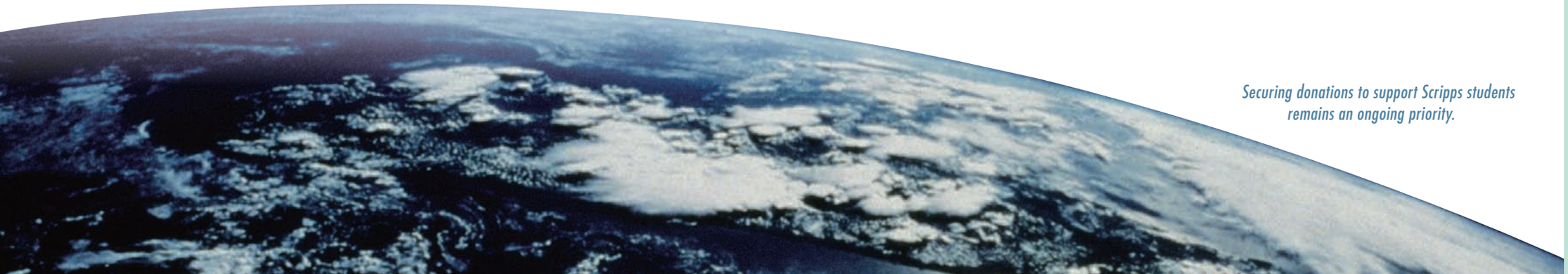
Numerical simulations of the deep Earth generate unprecedented amounts of model output ("data") that need to be available for scientific interrogation. Proper storage and curating are essential to ensure the integrity of previous simulations. An HPC cluster requires a matched storage system on which the computational results can be archived. Network Attached Storage and Storage Array Networks provide the necessary infrastructure for proper data management.

Personal supercomputer **$115,000-$230,000**

The latest in "green" computing is a low-power CRAY CX-1(000) with over 200 cores paired with NVIDIA co-processing GPU cards, yet are small enough to eliminate the need for large specialized rooms with raised floors and increased air-conditioning capacity. This computational workhorse would support most of the research activity in Stegman's group for 3-5 years.

THE FARALLON PROJECT

Robert Petersen, a Scripps graduate student in geophysics, is working with Dave Stegman to understand how subduction of a tectonic plate, known as the Farallon plate, has profoundly influenced the tectonic evolution of western North America since the Cenozoic (65 million years ago to present). Robert will employ state-of-the-art numerical modeling and scientific visualization tools to investigate how subduction of the Farallon plate controlled much of the overlying tectonics, including formation of the San Andreas Fault, volcanism relating Yellowstone and the Snake River Plains of Idaho, and uplift of the Colorado Plateau. This effort will pioneer a new conceptual model for this region and draw attention to the novelty and power of this type of approach towards generating new insights into Earth's tectonic evolution.



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