Geophysical Research Abstracts
Vol. 13, EGU2011-1136, 2011
EGU General Assembly 2011


# Earth's layers and their cycles as a framework for teaching geosciences

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The layering of the solid Earth and its fluid envelopes was well recognized by the end of the 19th century. Now we know that the masses in the Earth's layers (except the inner core) are in constant convective motion, the fluid envelopes driven by energy from the Sun, the solid Earth driven by energy from radioactive decay and primordial energy. The layers form a system of interactive components because mass and energy are continuously transferred across layer boundaries. Knowledge about Earth's layers and their cycles has advanced to a level where "Earth-system science" may serve as a framework for teaching geoscience at various levels from high-school to academia (National Res. Council, 1993; Schlager, 2008).

A particularly attractive aspect of Earth-system science in teaching is the fact that humanity lives at the intersection of three layers – solid earth, hydrosphere and atmosphere. Thus, we all have at least intuitive experience with the interaction of layers and with phenomena such as turbulence, erosion and sedimentation. Geoscience teaching can take advantage of this fact. For instance, the formation of the stratigraphic record, one of the most important documents of Earth history, can be taught by direct examination of the relevant processes. Similarly, introduction to non-linear dynamics is facilitated by reference to the observable phenomena of turbulence in water and air even though this topic cannot be taught without some recourse to mathematics (Lorenz, 1993).

Finally, teaching Earth system science will strengthen the ties among the subdisciplines of geoscience and this is of critical importance. In the global debate about environmental change geoscientists should be recognized as experts of the system Earth in the same way physicians are recognized as experts of the human body.

Lorenz, E.N. (1993) 227p. (Univ. Washington Press) Seattle
National Research Council (1993) 346 p. (National Acad. Press) Washington D.C.
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OEGG100:
Earth system science treats the Earth as an interactive system, thus offering a platform for collaboration of the subdisciplines of geoscience and for teaching Earth science to a broader public. Recent advances in quantifying rates and volumes of the various convection cycles have shown that prediction in the geosciences also greatly benefits from the Earth system approach. Timing of volcanic eruptions, location of subsurface resources or earthquake-prone areas, as well as past and future evolution of the climate system greatly benefit from an approach that simultaneously examines all relevant components of the Earth system. Geoscientists should strive to be recognized as experts of the system Earth analogous to physicians as experts of the human body.