earth sciences

Continental mantle under the sea

One of the chief methods of studying the earth's mantle is through analysis of igneous rocks found on the ocean floors. Such rocks presumably originated in the mantle under the ocean. The chemical character of certain rocks exposed on the mid-Atlantic Ridge, however, suggest that though they are derived from the upper mantle, they are not related to modern oceanic basalts, but resemble instead the type of mantle material that underlies the continents.

The abundance of these rocks in the equatorial mid-Atlantic Ridge, says Dr. Enrico Bonatti of the University of Miami, indicates that there is either a continuous layer or large blocks of continental type mantle imbedded in the mantle under the ridge.

Dr. Bonatti proposes, in the June 10 JOURNAL OF GEOPHYSICAL RESEARCH, that this mantle material was originally part of a layer of continental-type mantle below the protocontinent Pangaea. As Pangaea rifted and split apart, some of the old mantle material remained nearly static beneath the spreading crust. Seismic surveys have revealed a large anomalous zone of low velocity below the mid-Atlantic Ridge. Dr. Bonatti tentatively identifies this as the residual continental mantle.

Marking off the Precambrian

The Precambrian Era, which ended about 600 million years ago, encompasses 85 percent of the total length of geological time. Unlike other eras, however, this vast period of time has no generally accepted subdivision into periods and epochs.

Drs. Kalervo Rankama and P. R. Dunn of the Australian Bureau of Mineral Resources and Dr. B. P. Thomson of the Geological Survey of South Australia propose the use of the late Precambrian glaciation in Australia as a stratigraphic boundary for a subdivision of the Precambrian.

A large part of Australia was glaciated about 750 million years ago, the three point out in the June 25 NATURE. This ice age, much longer and more severe than any that have occurred since, is well-defined in Australia and has been thoroughly studied. There is evidence of this glaciation in other parts of the world.

There appear to have been two separate glaciations, and the researchers propose to use the rocks between the beginning of the first glaciation and the beginning of the following Cambrian Period as a stratigraphic unit of time in Australia. The subdivision of the Precambrian so defined would begin about 750 million years ago and end about 570 million years ago.

Taking the ocean's temperature from the air

During the average day, the top 30 meters of the world's oceans store a total of 10^{21} calories of solar energy—heat. This energy is released over a 24-hour period, affecting the dynamics of the ocean and atmosphere.

Researchers at the Scripps Institution of Oceanography have developed a method of measuring this total heat loss through airborne infrared measurements. As part of the Barbados Oceanographic and Meteorological Experiment (BOMEX), Dr. Edward D. McAlister and Ernst A. Corduan of Scripps and Dr. William McLeish of the National Oceanic and Atmospheric Administration laboratories in Miami tested their method, comparing results with surface measurements.

They were able to make measurement of water temperature to within 0.01 degree C. The heat-flux values found at night ranged from 0.05 to 0.45 calories per square centimeter of ocean per minute.

The tests demonstrate, the researchers conclude in their report in the June 20 JOURNAL OF GEOPHYSICAL RESEARCH, that airborne measurements of sea-surface temperature not only are feasible but also are more accurate than conventional mercury thermometer measurements.

Stresses in a continent

During the late Triassic and early Jurassic periods (175 million to 195 million years ago) there was a period of widespread volcanism in Australia, Antarctica, Tasmania, Africa and North and South America. The volcanism may be responsible for parallel dikes of rock that have been found in many of these areas.

When the continents are placed in their pre-drift positions, the dikes take the form of a vast radial swarm, converging on a point near the Bahamas. In the May GEOLOGICAL SOCIETY OF AMERICA BULLETIN, Paul R. May of Inexco Oil Co. shows that these dikes may parallel lines of stress in the pre-drift supercontinent. The lines of tension and compression form a spider-web-like net centered in the Bahamas. The compatibility of the dikes and the lines of ocean rifting within this net suggest to May that the stresses were imposed on the continental crust by the mobile upper mantle immediately before the breakup of the continents. These stresses resulted in igneous activity that produced the dikes. Similarity in composition of the dike rock to that of ocean crust formed by sea-floor spreading indicates that the tension fractures reached the upper mantle, he concludes.

Particle tracks in a hurricane

Hurricanes are serious business, and an understanding of how they operate is vital, but field investigations have to await development of suitable storms. Hurricanes can be studied in the laboratory, however, through the use of computer models.

Dr. Richard A. Anthes and James W. Trout of the National Oceanic and Atmospheric Administration's National Hurricane Research Laboratory and Stellan S. Ostlund, a student at Coral Gables (Fla.) High School, used a computer model of a hurricane to produce three-dimensional drawings of particle tracks through a hurricane.

The model they used simulated an eight-day period in the life of the storm, with winds beginning at about 40 miles an hour and increasing to more than 126 miles an hour. Particles beginning at the base of the storm spiral inward at the bottom, they found, reaching an intense updraft region after about 10 hours. Within one to three hours the particle reaches the top—about 10 miles high. Though particles flowed in at the bottom in a symmetrical pattern, they left the top in two distinct streams.