earth sciences

From our reporter at the annual meeting of the Geological Society of America last week in Washington

Patterns in rates of ridge spreading

The rate of sea-floor spreading varies greatly from ridge to ridge. The Mid-Atlantic Ridge, for example, spreads at a rate of 2 centimeters per year, while the East Pacific Rise spreads 18 centimeters per year. Apparently there is a relationship between a ridge's rate of spread and the depth at which its magmas originate.

Kenneth F. Scheidegger of Oregon State University analyzed plagioclases (a common mineral) from the crests of the Mid-Atlantic Ridge, the Gorda and Juan de Fuca Ridges and the East Pacific Rise. He found a significant correlation between the composition of the plagioclases and the spreading rate of the ridge from which they were taken; rocks from slower-spreading ridges were higher in calcium.

Calculations of the temperatures at which the plagioclases formed permitted a further conclusion: "It appears that magmas ascending beneath a slowly spreading ridge are significantly hotter and therefore, form significantly deeper than those beneath a fast spreading ridge." Hotter magmas come from deeper within the mantle. Scheidegger estimates that magmas at the Mid-Atlantic Ridge formed one and a half to two kilometers deeper than those at the East Pacific Rise.

Seamounts and fluctuations in sea level

Two undersea mountains in the northeast Pacific, the Cobb and Bowie Seamounts, have terraces at a depth of about 216 meters that appear to have been cut by waves. Possible explanations for these terraces are that the mountains might once have been uplifted to above sea level and since subsided, or that the terraces might have developed during formation of the seamounts.

These explanations, says Maurice L. Schwartz of Western Washington State College, are unlikely. The uniform depth of the terraces, and the existence of other similar terraces at the same depth throughout the Pacific, suggest that they indicate a lowering of sea level. One terrace in the southwest Pacific has been dated at 13,600 to 17,000 years old.

Sea-level curves for this period show a low of only 130 meters below present. Schwartz believes that the 216-meter terraces are evidence of a quick dip in sea level of almost double the known low. Such a dip, he says, could have been caused by a number of factors coincidentally acting together, such as buildup of ice sheets and displacement of the earth's gravitational field. The geoid, the surface that is everywhere perpendicular to the pull of gravity, coincides with sea level, so that gravity changes would mean changes in the pattern of sea-level highs and lows. Schwartz concludes that there may be more factors involved in sea-level changes than heretofore considered.

History of Antarctic ice cap

On most continents affected by the ice ages, there is evidence of interglacials—warmer periods when the glaciers retreated.

Wesley E. LeMasurier of the University of Colorado conducted a field study of volcanic glass fragments from Marie Byrd Land in Antarctica. They contain evidence that a thick ice cap has existed continuously in Antarctica since the Eocene (36 million to 58 million years ago). Independent marine evidence, however, shows climatic oscillations throughout the Cenozoic (65 million years ago to the present). These oscillations suggest the possibility of interglacials in Antarctica, but attempts to correlate evidence of climatic highs with evidence for absence of glaciers have been unsuccessful.

Factors such as the opening of the Drake Passage and development of the Antarctic Circumpolar Current may have complicated the marine record, and made correlations difficult, LeMasurier suggests.

Undersea channel for sediments

The Maury Mid-Ocean Channel transports sediment for distances as great as 2,250 kilometers from sources on Iceland and the Faeroe Islands. The channel follows the deepest axis of the northeast Atlantic, eventually emptying into the Biscay Abyssal Plain.

Seismic profiles, report Bruce F. Molnia of the University of South Carolina, and William F. Ruddiman of the Naval Research Laboratory, show that the channel is 5 to 15 kilometers wide and contains up to 400 meters of sediment—mostly coarse sand and gravel.

Turbidity currents may be responsible for sediment deposition, but periodic cold dense masses of water from the Norwegian Sea rework the sediment and are responsible for keeping the channel open, the researchers report. These influxes may have velocities up to one meter per second. The existence of the channel is a result of three factors, they conclude: the coarseness of transported sediments, the Norwegian Sea influxes and the location of the channel at the deepest axis of the ocean basin.

Mapping a blight

Coal mining operations in the Appalachian region have resulted in stripping of some 1.3 million acres of land. This strip mining exposed clay, coal, shale and sandstone containing the mineral pyrite to air and moisture. Oxidation of pyrite produces sulfuric acid and heat. The stripped land produces an estimated 1,500 tons of acid per day.

Moid U. Ahmad and Bobba A. Ghosh of Ohio University and John W. Antalovich of Kucera and Associates, Inc., conducted ground temperature measurements of six stripped-mine sites in southeastern Ohio. At a depth of two feet they found temperature anomalies (deviations from normal) of from three to 10 degrees C. between acid and non-acid producing areas.

The researchers found that higher temperature anomalies coincide with higher pyrite content and high acidity. Their measurements indicate that air temperature does not significantly affect the temperature anomaly at a depth of two feet. Infrared imagery pictures also showed high temperature anomalies associated with acid-producing areas. This information may permit mapping of the acid-producing areas of Appalachia, they conclude.