Earth Sciences

Stefi Weisburd reports from Orlando, Fla., at the meeting of the Geological Society of America

Sediments travel, make waves in gravel

When a magnitude 7.2 earthquake rattled the Grand Banks (Newfoundland) coast in 1929, a number of underwater telephone and telegraph cables lying within 100 kilometers of the epicenter suddenly snapped. Over the next 13 hours, other cable breaks occurred, progressing farther down the continental slope. Scientists attributed the breaks to a turbidity current, a heavy slurry that raced down the slope at speeds up to 55 km per hour and extended 700 km after a large underwater landslide threw muds into suspension. In fact, the Grand Banks cable breaks offered one of the first compelling demonstrations that turbidity currents exist in deep waters.

Now, the Grand Banks slope has produced another scientific first. Over the last two years, a team of Canadian and U.S. researchers has been using the Sea MARC I (sidescan sonar) and a submersible to survey the underwater effects of the 1929 quake. They have discovered a field of "gravel dunes" – 2- to 3-meter-high ridges 50 to 100 m apart, standing below 1,500 to 4,500 m of water. "This is a new type of bedform which we associated with quite fast flows of the [1929] turbidity current," says Alexander Shor at Lamont-Doherty Geological Observatory (LDGO) in Palisades, N.Y., who has coauthored a paper with David Piper at the Geological Survey of Canada in Dartmouth, Nova Scotia, and John Hughes Clark at Dalhousie University in Halifax, Nova Scotia.

According to Shor, "smaller bedforms develop from fast tidal currents in shallow water, but normally the flows in deep water aren't strong or persistent enough to form [such large features in gravel]." But as more surveys are conducted with sonar systems along coastlines where strong turbidity currents might have flowed, it's likely that more gravel dunes will turn up. Already Alberto Malinverno at LDGO and co-workers report finding similar bedforms off the coast of Nice, France.

Mediterranean salt: Isotopes and ice

At the end of the Miocene epoch, 6 million years ago, the Mediterranean Sea suffered a "salinity crisis." Its connections to other oceans were severed and, according to some estimates, the amount of seawater that evaporated was 30 times as great as the sea's present volume, leaving more than 1 million cubic kilometers of minerals and salts in the basin.

One idea, proposed last decade, to explain this event is that the Mediterranean became isolated by a global drop in sea level, brought on by the growth of ice sheets. While some lines of evidence support ice sheet expansion in the late Miocene, one of the best indicators of increased ice volume – elevated concentrations of oxygen-18 isotopes in the calcium carbonate shells excreted by ocean organisms – has led to contradictory results; one group has found elevated levels, but others have not. Now, David Hodell, Kristin Elmstrom and James Kennett at the University of Rhode Island in Narragansett report enriched oxygen-18 levels in deep-sea cores from five sites in the Atlantic and Pacific oceans – which supports increased ice in the Miocene. Hodell suspects that other researchers failed to find such enrichments either because they didn't sample their cores at small enough intervals or because the crucial sedimentary layers were lost during coring.

Hodell's group also found that the oxygen-18 levels fluctuated quite rapidly during the late Miocene, echoing similar variations in the Mediterranean salt layers. "We're speculating that these variations reflect ice volume changes and sea level changes of 40 to 50 meters," says Hodell. Such sea level drops by themselves could not account for the extremely thick salt layers, however. Hodell thinks a slow uplift of the region contributed to isolating the Mediterranean. The more rapid rise and fall of sea level, he says, could then have triggered the high-frequency cycles of evaporation and basin refill.

Physical Sciences

Ivars Peterson reports from Nashville, Tenn., at the meeting of the Acoustical Society of America

New life for old guitar strings

Guitar strings that go "dead" after a few weeks of intense use have troubled musicians for a long time. Over the years, rejuvenating remedies like boiling the old strings in vinegar have become part of guitarist folklore. With such treatments, the strings, usually consisting of silver or stainless steel wire wrapped around a nylon core, seem to recover for a short time. Then the problem recurs.

Prompted by a question from his son, a classical guitarist, physicist Roger J. Hanson of the University of Northern Iowa in Cedar Falls began investigating what makes strings lose their bright sound. "The folklore provides a good answer," he now concludes.

Hanson and collaborator Gordon O. Munns, suspecting that dirt and sweat rather than changes in nylon properties are responsible for a string becoming dead, discovered that a little bit of fat and clay rubbed into a guitar string duplicates the effect without significantly increasing the string's mass or changing its fundamental frequency. By testing strings before and after this treatment, they found that the sound of dead strings had a much lower proportion of high frequencies.

Remedies like boiling seem to partially clean the strings, says Hanson. Perhaps a mild detergent would work even better, he suggests. But there are other effects that may contribute to a string's changed sound, including the possibility of some corrosion damage. There's a lot more to study, says Hanson.

Quiet flights for turboprops

Future airliners may sport propellers – pinwheels of eight or more thin, swept-back blades that spin rapidly yet are more fuel-efficient than jet engines. But because the blade tips will be able to whip through the air faster than the speed of sound, some researchers are concerned that noise inside such aircraft may be unbearably loud, especially at low frequencies for which conventional damping techniques don't work well.

The turbulence caused by the propellers shakes the aircraft fuselage, which in turn sets in motion the air inside the aircraft, generating low-frequency interior noise. One answer would be to find a way to limit fuselage vibration. Mechanical engineer Chris R. Fuller of the Virginia Polytechnic Institute and State University in Blacksburg suggests that deliberately vibrating the fuselage may at least partly cancel out the sound-induced vibrations and reduce interior noise levels.

In a preliminary investigation, Fuller studied the sound inside a closed metal cylinder meant to represent an aircraft fuselage. An external sound source excited the shell while an interior "minishaker" added its own vibrations. Microphones inside and outside the cylinder mapped the resulting sound patterns. Fuller found that even with just one minishaker set at an appropriate frequency, the interior noise level is reduced almost everywhere. "The new method shows much potential for reduction of propeller interior noise in aircraft," Fuller concludes, "without the penalty of large added weight."

Enhancing low-frequency absorption

Polyurethane foams are often used to control noise by absorbing sound. A recent theoretical analysis shows that the material's effectiveness depends on how a protective facing or backing is attached to the foam. J.S. Bolton of Purdue University in West Lafayette, Ind., says that a small air gap, perhaps only 1 millimeter thick, between a thin foam layer and its facing or backing enhances the material's ability to absorb low-frequency sound. The facing film should not be bonded directly to the foam's surface. The new arrangement works just about as well as a sheet of bare foam, he says, with the added protection that a facing provides.