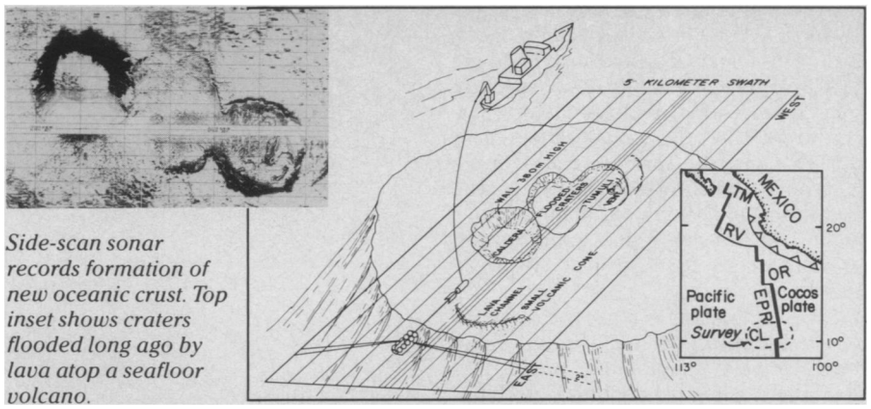
As crust is born, new sonar system allows ridge-side view

A new side-scan sonar that supplies details of seafloor spreading has given scientists a first-hand glimpse of the birth of ocean crust. The sonar images show evidence of a cycle that culminates when molten rock wells up from the mantle, quickly cooling to become new seafloor. The images were taken along 500 kilometers of the East Pacific Rise from 13° to 9° north of the equator. In this area the Pacific and Cocos plates are spreading apart at rates of 12 centimeters per year.

The side-scan sonar, which bounces short pulses of sound off the seafloor, was developed by International Submarine Technology, Ltd. to be used in the 1980 search for the sunken ocean liner *Titanic*. The scientific appeal of the images produced from the sonar reflections is that they provide an undistorted view of the seafloor with detail as fine as the aerial or satellite photographs so useful to geologists who study the land.

The sonar system, called Sea MARC I, is towed behind an oceanographic vessel at depths from 100 meters to 400 m above the seafloor. It is tethered to an electrical cable that can be unrolled to its maximum length of 10 kilometers. The 3-mile-wide swath recorded by the sonar is wide enough to show the entire width of the East Pacific Rise, the world's longest spreading ridge.



Side-scan sonar records formation of new oceanic crust. Top inset shows craters flooded long ago by lava atop a seafloor volcano.

Lamont Doherty Geological Observatory

On the January cruise, led by William Ryan of Lamont Doherty Geological Observatory in Palisades, N.Y., and J. Paul Fox of the University of Rhode Island in Narragansett, the marine geologists were able to view an unexpected string of craters perhaps 10,000 to 12,000 years old that had collapsed in sequence along the top of a small undersea volcano, or seamount, as the thin crust ripped apart.

The deep-sea sonar may help scientists refine details of what they know about the mechanics of seafloor spreading. Ryan says the sonar images at various points along the ridge show distinct stages in the birth cycle, beginning with the tearing of crust in a narrow belt only a few hundreds of meters wide. As the crust is pulled taut by the plates moving on either side, more cracks appear and the zone of stretching widens. Finally, the brittle crustal skin ruptures. Pressure is released over the underlying mantle, and lavas erupt, covering and filling in pre-existing cracks. As the new crust cools, spreading continues, and the process of stretching, cracking and eruption begins again.

Ryan says that distortion of the crust may advance for tens of meters along the ridge until it is covered by fresh lavas — new crust. He adds that the pulling open, tearing and cracking may be a "much more continuous process than volcanic outpouring" of new material. —*C. Simon*

Second Superfund buyout proposed: A Missouri dioxin site

A second hazardous waste site has been marked for buyout and permanent relocation of its residents using Superfund, a pool of money created by Congress to expedite cleanup of contaminated areas. The first site slated for such action was Times Beach, Mo., a town of 800 homes that is contaminated with the dangerous chemical dioxin (SN: 2/26/83, p. 132); the second site, a dozen-home section near Imperial, Mo., is another area contaminated with dioxin. Both the politics and engineering complexities associated with the proposed Imperial buyout paint a grim picture of what is ahead for the state of Missouri as it deals with its now 27 confirmed sites of dioxin contamination.

Most of Missouri's dioxin problem stems from the spraying in the early 1970s of dioxin-contaminated sludge plus waste oil to control dust on unpaved roads and horse arenas (SN: 1/22/83, p. 60). The Imperial homes sit atop dioxin-contaminated soil that had been taken for landfill from one of the sprayed arenas. The site's hazardous waste problem first was discovered in 1974 but for years thereafter largely neglected by state and federal officials.

Finally, last year, a multi-agency effort to address the problems at Imperial and at the other Missouri dioxin sites was launched. Results of soil sample analyses indicated that the Imperial area is plagued by dioxin concentrations as high as 360 parts per billion. Officials at the Atlanta-based Centers for Disease Control recommend that human exposure be restricted to soil dioxin levels less than 1 ppb. So the Environmental Protection Agency, controller of Superfund, contracted a Missouri engineering firm to assess the available temporary waste-stabilizing and permanent cleanup technologies for the Imperial area. The results of this assessment, summarized in the accompanying chart, were disclosed recently in meetings of EPA's William Hedeman with Rep. Richard A. Gephardt (D-Mo.), whose district includes Imperial.

Option	Years (est.)	Millions (est.)
1 Construction of a grout curtain (This involves digging a ditch around the contaminated area and filling it with a clay-like substance in order to prevent migration of the toxic material.)	3-4	$29
2 Removal of dirt and placement in an on-site vault	3-4	$9-11
3 Removal of dirt and placement in an off-site landfill or storage facility	4	$5-8
4 Incineration of dirt	8	$29+
5 Detoxification of dirt via application of chemicals (Use of a sodium hydroxide and polyethylene glycol mixture to dechlorinate — remove the chlorine atoms from — the dioxin now is being tested. Estimates of time and cost include that needed for further development of this technique.)	11	$58-77

EPA officials already had determined that if all of the estimated times for the various remedial options exceed two years, it would be cheaper to buy out and move residents, rather than to temporarily relocate them, clean up the area and then allow them to return. The estimated times for the various remedial actions range from three to 11 years. Initially, however, EPA and Missouri officials said only temporary relocation would be offered until the issue deadlocking the Times Beach buyout — who will take title to that land — is resolved (see page 270). That decision was met with outrage among Imperial residents and Gephardt, who charged officials with treating the residents like "pawns in a highly political game." Then, on April 6, Missouri officials said that even though the state has not agreed to take title to Times Beach, it will take title to the smaller Imperial site; EPA followed suit and agreed to a buyout. —*L. Garmon*