

NISKIN WATER SAMPLER and GRABS/CORERS-PRACTICALS

NISKIN WATER SAMPLER

Niskin bottles. Open Niskin bottles are attached to a cable and lowered to water depths where seawater samples are to be obtained for chemical analysis. A metal messenger “trips” each bottle on the cable individually, causing it to fill with water and close securely.

A rosette cluster. Water collecting bottles are arranged around a rigid, circular frame in a rosette pattern. Technicians are able to close the bottles individually as the array is lowered or raised through the water column.

Sampling Depths

Chemists must establish the exact sampling depth for each bottle. Otherwise, the analytical work, no matter how accurate, is of limited use in determining the exact chemical structure of the water column. A common technique is to measure the length of the cable between the ocean surface and the depth at which the bottle was triggered by the messenger. However, the cable rarely hangs straight down, because of the drift of the ship relative to the bottles on the cable. Depth corrections are applied by measuring the angle of the cable and by noting the difference between the temperature readings on the pressure-protected and unprotected thermometers mounted on the sampling bottles. (Temperature discrepancies are indicators of water pressure, which is a function of water depth). When near-bottom water samples are collected, it is customary to attach a pinger (a pulsing sound source) to the free end of the cable. Sound signals reflected off the [sea floor](#) and transmitted to the ship are used to determine the distance between the pinger and the bottom to within a meter or so.

Analytical Procedures

Analytical [procedure](#) reveal temperature and salinity of water, recorded in the [reversing thermometers](#), which are fastened to water-sampling bottles. Better precision (up to 0.0001°C) is obtained by using temperature-sensitive materials, such as quartz crystals, which vibrate at frequencies that depend on temperature. These signals are transmitted electronically to the ship. This allows the temperature of the water to be monitored continuously as the instrument is lowered. Because the composition of seawater is constant, chemists traditionally have determined water salinity by chemical titration—the process of standardizing silver nitrate against a normal seawater sample of known chemical composition. The electrical conductivity of seawater, which is proportional to the total concentration of dissolved ions, is now used routinely to determine salinity rapidly. The salinometer compares the electrical conductivity of an unknown sample with that of a known, standard sample of seawater, and converts the difference into a salinity value after correcting for temperature effects. An important instrument called the CTD (conductivity, temperature, depth) consists of a salinometer, an electronic thermometer, and a pressure sensor. As it is lowered through the water column, the CTD transmits electronic signals to the ship, where they are stored in a shipboard computer for analysis later.

GRABS/CORERS-PRACTICALS

Various simple but durable devices are available for collecting sediment samples from the [ocean floor](#), even from the deepest, most inaccessible parts of the sea. A long-established technique is scraping the ocean bottom with a dredge—a rigid metal frame to which is attached a sampling bag made of chain or tough netting. Dredges are suitable for obtaining large, bulk samples of either rock or sediment. As they are dragged, however, they bite the bottom indiscriminately and mix samples together in the sampling bag. Also fine sediment such as mud tends to be washed out of the sample. Because of these effects, oceanographers employ dredges almost exclusively to collect hard rock rather than soft sediment. Less disturbed samples of mud and sand are collected by grab samplers—spring-loaded metal jaws that take a bite out of the bottom and close tightly around the sediment sample. Dredges and grab samplers merely sample the surface layer of sediment. Deeper penetration of soft sediment is accomplished by [gravity corer](#). This hollow metal tube, known as a core barrel, is pushed into the sediment by the force of gravity. The corer is lowered to the bottom, where the heavy weight

at the top of the device drives the barrel into the sediment. A plastic liner that has been inserted into [the core](#) barrel allows oceanographers to extract the sediment core intact from the sampler and also serves as a temporary storage container. Gravity corers are capable of taking cores of between 1 and 2 meters long, depending on the properties of the sediment. Sediment cores longer than 20 meters are routinely obtained by piston corers. This type of corer has a piston that slides up [the core](#) barrel as it penetrates the bottom. The action of the piston extrudes water from [the core](#) barrel, allowing the sediment core to enter the liner with minimal disturbance and compaction. Once [the core](#) is on deck, the plastic liner with its sample of sediment is extruded from [the core](#) barrel and is taken to a laboratory for detailed examination. Geologists carefully study the layering and composition of sediment particles to determine the geological history of the [earth](#).

At present, the best technique for sampling the ocean bottom is platform drilling, which was first developed by petroleum engineers on land and is now adapted to the ocean, even the deep ocean. The [procedure](#) is very expensive, but the scientific results are priceless. Marine geologists not only recover cores of sediment more than 1 kilometer in length, but also they can drill into the hard rock of [the crust](#) beneath the sedimentary layers. The Glomar Challenger—the 122-meter-long vessel that completed an illustrious international career of drilling, even in the remotest regions of the oceans, collecting hundreds of kilometers of core sample—has been retired.