The contribution of scientific ocean drilling to the exploration of the Mediterranean

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The Ocean Drilling Program (ODP) is an international basic research program of scientific ocean drilling funded by 20 countries. Five of these countries border the Mediterranean: Spain, France, Italy, Greece and Turkey. Since the seagoing phase of ODP began in 1985, the drilling research vessel *JOIDES Resolution* has occupied some 250 sites, drilled about 600 holes and recovered about 70 km of core from all the major oceans of the world. ODP is the successor to the Deep Sea Drilling Project (DSDP) which ran from 1968 to 1983.

During the 25 years since the start of DSDP, only three DSDP/ODP legs have been dedicated to the Mediterranean Sea. As one would expect, the first leg, Leg 13 in 1970, was exploratory in its nature, comprising a dozen sites scattered throughout the region, from the Alboran Sea in the west to the Nile Cone in the east. Most of the holes drilled were quite shallow; at only two of the 12 sites did holes penetrate deeper than 500 m. Nevertheless, the recovery of Messinian evaporites gave birth to dramatic discoveries about the desiccation of the Mediterranean basins and to the hypothesis of the Gibraltar water fall. The fact that such major discoveries were possible with shallow drilling is essentially because these events occurred very recently in geological time.

Leg 42, in 1975, consisted of a similar number of sites to Leg 13. Again they were scattered throughout the region, including eight sites in the Mediterranean proper and three in the Black Sea. The holes drilled generally penetrated deeper than on Leg 13 and included a 1073 m hole in the Black Sea which bottomed in black shales.

By contrast, ODP Leg 107 was much more focussed, all the sites being located in the Tyrrhenian Sea. The primary thematic objective was to understand the evolution of a backarc basin in a continental setting. But since this was also the only leg to date in which hydraulic piston coring had been carried out in the Mediterranean, it was also possible to address several paleoceanographic objectives.

The present situation of scientific drilling in the Mediterranean is thus one in which a broad-brush regional coverage has been obtained, whilst thematically-focussed drilling has only been conducted in the Tyrrhenian Sea. APC/XCB coring, promising high recovery and undisturbed cores from the upper part of the sediment column, has not yet been attempted in most of the region. Furthermore, many of the holes drilled on Legs 13 and 42 were only spot cored.

The water depth in the Mediterranean is on average about a kilometer less than that in the major ocean basins. This could contribute to the operational efficiency of drilling deep holes. Deeper holes require the setting of re-entry cones, running casing, pipe trips to change drilling bits, in addition to wireline time to retrieve core barrels and make downhole measurements. The shallower the water, the less time all of these operations take.

Since Leg 42 there have been substantial improvements in the way scientific ocean drilling is conducted. Even since Leg 107 in 1986, there have been major improvements to downhole coring and logging equipment and to the equipping of the shipboard laboratories of the *JOIDES Resolution*. For example:

- The Adara device, located in the shoe of the APC, provides accurate in situ temperature measurements for heat flow determination.

- The Pressure Core Sampler (PCS) has been developed to bring cores with their contained gases back to the surface at ambient pressures. The PCS could be used, for example, to recover some of the very gassy sediments that were encountered on Leg 42B in the Black Sea.

- All good quality cores are routinely scanned with the MultiSensor Track (MST), measuring magnetic susceptibility, sonic velocity and density.

- The Formation MicroScanner (FMS) downhole logging tool is now regularly used to produce electrical resistivity images of the borehole wall.

- The shipboard computing system has been substantially upgraded to improve data transfer and assimilation. Further upgrades are in process.

The increasing range of physical property measurements made on cores in the shipboard laboratory is pushing ODP towards core-log integration. Comparison of shipboard measurements on cores with those obtained by downhole logging tools will eventually allow the two data sets to be fully integrated and core to be located at its proper place in the sediment column. By the time the drillship returns to the Mediterranean, possibly as soon as 1994, core-log integration should be far advanced.

At the roundtable workshop on "Focussing scientific objectives for deep drilling in the Mediterranean", a fuller presentation of ODP's technical and scientific capabilities will be made.

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