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### The 1985-1986 Gibraltar Experiment Hydraulic Control

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During 1985-1986 a consortium of scientists from Spain, Morocco, France, the United Kingdom, Canada, and the United States studied the fluid dynamics of the flow through the Strait of Gibraltar. Individual scientific groups had various objectives, including the effect of the strait on the large scale oceanic circulation, the level of dissipation and small scale structure in the strait, and the forcing of the subinertial flows. The central theme for the experiment, however, was the role of hydraulic control in the dynamics of strait flows. We will discuss the new results in the understanding of hydraulic control as it applies to the Strait of Gibraltar.

Nearly 40 years ago Stommel and H. G. Farmer used hydraulic control and mixing conditions to infer estuarine dynamics. These ideas also appeared fruitful for the understanding of semi-enclosed seas and their straits, and they had been applied to the Mediterranean prior to the Gibraltar Experiment. It was clear that hydraulic control at the strait could profoundly alter the interaction of the Mediterranean Sea and the Atlantic Ocean. In this regard, there were three questions addressed by the Gibraltar scientists:

1. Does internal hydraulic control exist in the Strait of Gibraltar?
2. If so, how does it work? Existing theory considered an ideal strait: single sill, two-layer stratification, regular lateral and bottom boundaries, no rotation, no friction, and steady flow. Could simple theory illuminate the flow in the strait, and which of the idealizations are fundamental?
3. Once the strait dynamics are understood, how can this understanding be integrated into knowledge of the Mediterranean system?

Although work on strait dynamics and on Gibraltar Experiment data continues, there are answers to these questions. The existence of internal hydraulic control within the strait is well established. In particular, the time dependence of the flow and the multiple-sill and contraction geometry of the strait are fundamentally important. The hydraulic control has a profound effect on the Mediterranean, being a key factor in establishing its stratification.

We will present a brief overview of these results, drawing on the work of many Gibraltar investigators. Particularly active in the application of hydraulic theory have been Armi, D. M. Farmer, Bormans, Thompson, Garrett, Stommel, Canizo, and Dalziel. We will focus on the lessons of steady two-layer flow in the strait under the constraint of hydraulic control, and its ramifications for the Mediterranean Sea.