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A quarter-century of geophysical results from ODP/IODP CORK observatories

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Since 1991, the Ocean Drilling Program (ODP) and Integrated Ocean Drilling Program (IODP) have instrumented >25 seafloor boreholes with long-term sealed-hole observatories called Circulation Obviation Retrofit Kits (CORKs). Additional installations are planned during the first few years of the 2013-2023 International Ocean Discovery Program (also IODP). Understanding seafloor hydrology and its relationship to hydrothermal and tectonic processes have been prime objectives of scientific ocean drilling since the late 1970's. However, early experience indicated that holes that penetrated through marine sediments into underlying oceanic basement often allowed open exchange between formation fluids and ocean water, perturbing if not totally disturbing the in-situ hydrogeological state. This motivated the CORK approach to seal select holes with long-term sensor strings and data loggers, to record the recovery from drilling disturbances to the in-situ state and monitor natural hydrologic, tidal, and geodynamic signals. A brief summary of the designs of the CORK observatories will be presented (Figure 1), starting from a 1989 concept sketch on a dinner napkin. The original design included a single seal at the seafloor, and later designs have allowed for separately monitoring multiple zones sealed by packers in a single hole. Also, legacy reentry holes can be retrofitted with less expensive "CORK-Lite" models deployed by remotely operated vehicles (ROVs). The sensor strings have always included pressure and temperature monitoring, and many have included self-contained fluid samplers driven by osmotic pumps ("OsmoSamplers") that can be tuned for a variety of geochemical and microbiological sampling objectives. Typically, data and samplers have been recovered and/or exchanged at average intervals of ~1-3 years using manned or unmanned research submersibles. Installations to date have been in sedimented young ocean crust or in subduction settings. Important geophysical findings to date include documenting the following: (1) small pressure and temperature differentials associated with vigorous off-axis hydrothermal circulation in highly permeable young oceanic crust; (2) formation response to seafloor tidal loading; and (3) formation pressure as a proxy for plate-scale strain in response to tectonic stresses and earthquakes.

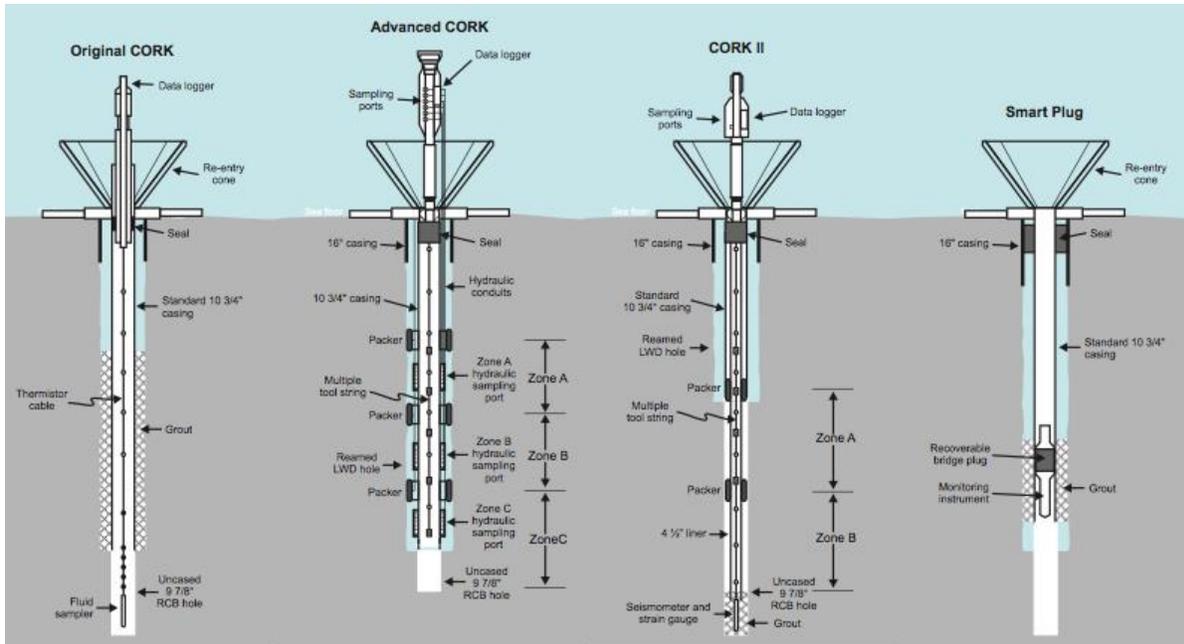


Figure 1: Evolution of main single- and multi-seal CORK designs, 1991-2015

