# Appendix A

# Some properties of tricone drill-bit sources

The drill bit is the tool that breaks the rocks at the bottom of the well. The type of drill bit, the hardness of the rock, and the state of wear of the bit influence the elastic signal emitted during drilling. The tricone drill bit has been the only type of drill bit used in the seismic experiments performed during drilling that have been reported in the literature. The OGS experiment that provided the data for this thesis also used a tricone drill bit.

Tricone drill bits are composed of three conical rollers, each with several crowns of teeth (Figure A.1). The drill bit and its two supporting steel units – the drill collars and the drill string – form the drill assembly. The drill assembly is suspended on a swivel and part of its weight is supported by the derrick (Figure A.2). A torque applied at the top of the drill string is transmitted through the drill string to the drill bit. The drill bit rotates at about one cycle per second, and the teeth on the rollers lift and drop the drill assembly (Figure A.3). The pounding of the drill bit on the rocks creates elastic waves which are similar in the far-field to the waves emitted by a vertical point force (Aki and Richards, 1980; Samec and Kostov, 1988).

FIG. A.1. Picture of tricone drill bits. Drill bits with diameters of about 20 inches are used at shallow depths; at greater depths typical values are 12 or 8 inches. One of the rollers of the drill bit in the foreground is broken.

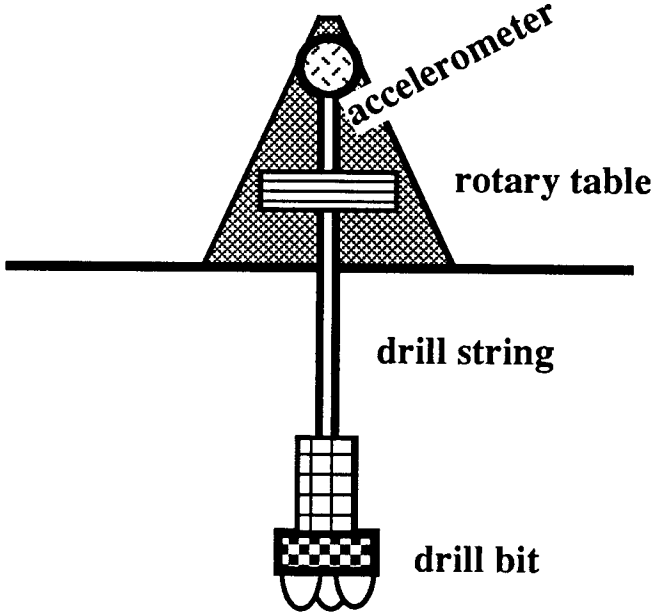


FIG. A.2. The main components of the drill assembly. A swivel is attached to the derrick and partially supports the weight of the drill string. The drill collars, and the drill bit form the drill assembly. During drilling, the drill assembly rotates as a torque is applied at the rotaty table. An accelerometer, attached at the top of the drill string, has been used to obtain an " instantaneous pseudo-impedance" log (Lutz et al., 1972).

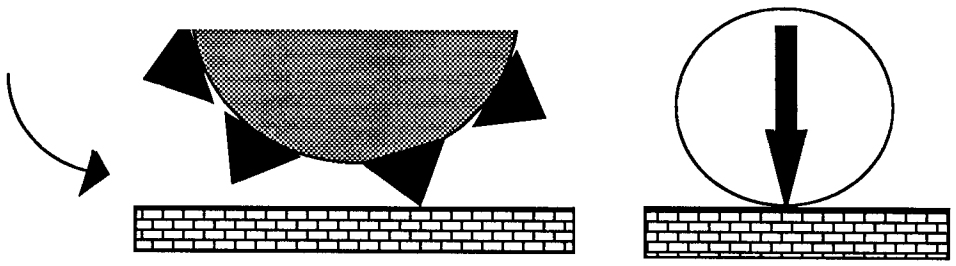

FIG. A.3. As the rollers of the tricone drill bit rotate, the teeth on the rollers lift and drop the drill assembly (left). Lutz and al. (1972) have suggested to model the drill-bit source (right) as a vertical point force.