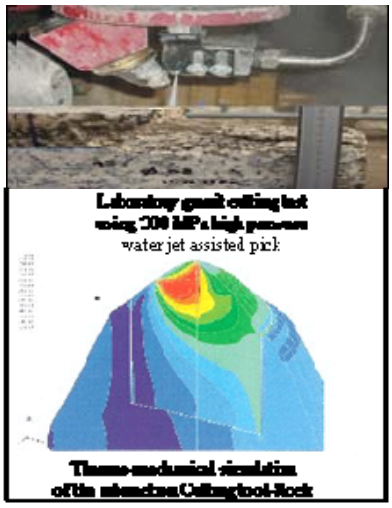
# Developement of innovative excavation techniques

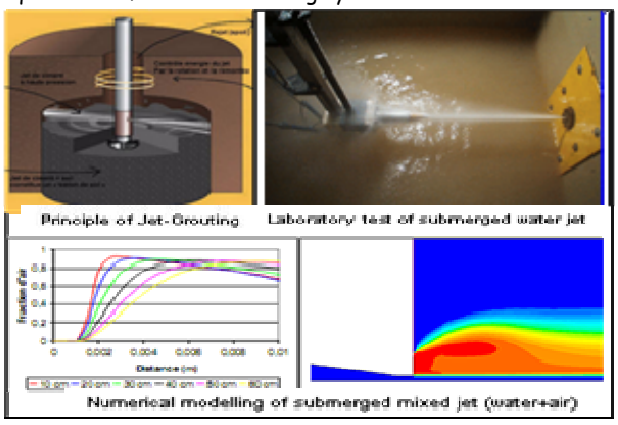
Success in underground construction projects is mainly dependent upon the wise choice of the construction technique itself. Over the last thirty years, the GEOSCIENCES department has been leading research with the clear target to develop new soil excavation and rock-cutting techniques able to reduce costs as well as induced nuisance particularly in urban context.



Laboratory gunit cutting test using 200 MPa high pressure water jet assisted pick

Thermo-mechanical simulation of the abrasive Cutting tool-Rock

Based on an understanding and modeling of the soil and rock cutting process, it is necessary to identify the criteria to respect while optimizing and/or designing a cutting process according to specific implementation conditions (tunneling, deep trenching in civil engineering, mining). Indeed rock-cutting covers a wide technical and scientific domain : rock mechanics, theory of rock breakage and material science for tool-rock interaction, mechanics when dealing with stress distribution on the cutting head or static and dynamic equilibrium of the whole cutting system.




In the field of hard and abrasive rock cutting, the research project of the department aims at fundamental understanding and modeling the cutting process in order either to control rock fragmentation or to reinforce the cutting tools.

For soil excavation, a primary concern is to improve the soil mechanical characteristics. The jet-grouting technique consists in elaborating a "concrete" by mixing *in situ* the soil with a cement grout. From a borehole, a high kinetic energy cement jet erodes the soil and gets mixed with the unconsolidated material. On this subject, the department has contributed to develop, and validate using laboratory full-scale experiments, a mixed jet monitor, increasing significantly the jet performances, by protecting the cement jet with a compressed air annulus and optimizing design and operating parameters.

For urban construction sites, reducing environmental impacts and work induced nuisance is an essential challenge : it is crucial to reduce execution time, to reduce the amount of generated waste and to simplify their treatment and disposal, to limit occupied surface … These impacts are especially important for tunnels achieved with the covered trench technique, as far the cost-effective and most widely used method when applicable (as a matter of fact when the tunnel does not extend beneath existing constructions). The department has been involved for several years in the development of new principle and a technology for the excavation of the walls of covered trenches.