Automatic Monitoring of Drilling Process

(DPM)

for Mechanical Profiling of Both Soil and Rock Grounds

by

Zhong-qi Quentin Yue

Civil Engineering Department, The University of Hong Kong, Hong Kong, P.R. China

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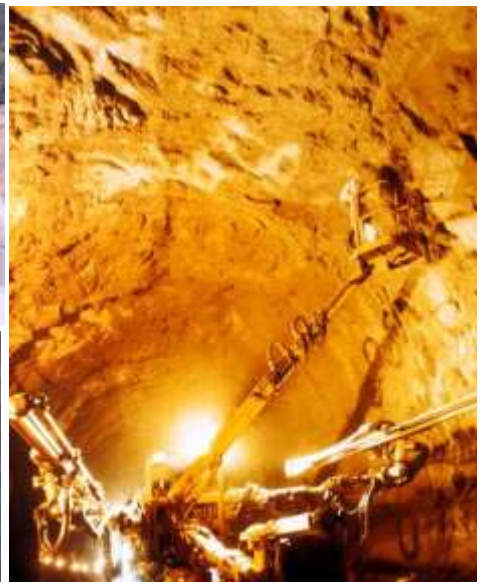
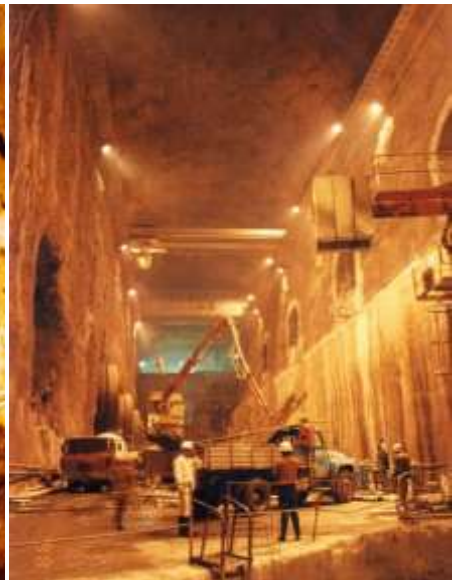
Introduction



Construction projects are in mountains & in depth.
These grounds always comprise both soils and rocks.





The Issue & Need

A test tool is needed for

continuously and automatically measuring and profiling the in-situ mechanical properties of both soil and rock grounds.

An Ideal Solution in High-tech Times

Pneumatic Drilling

Drill hole

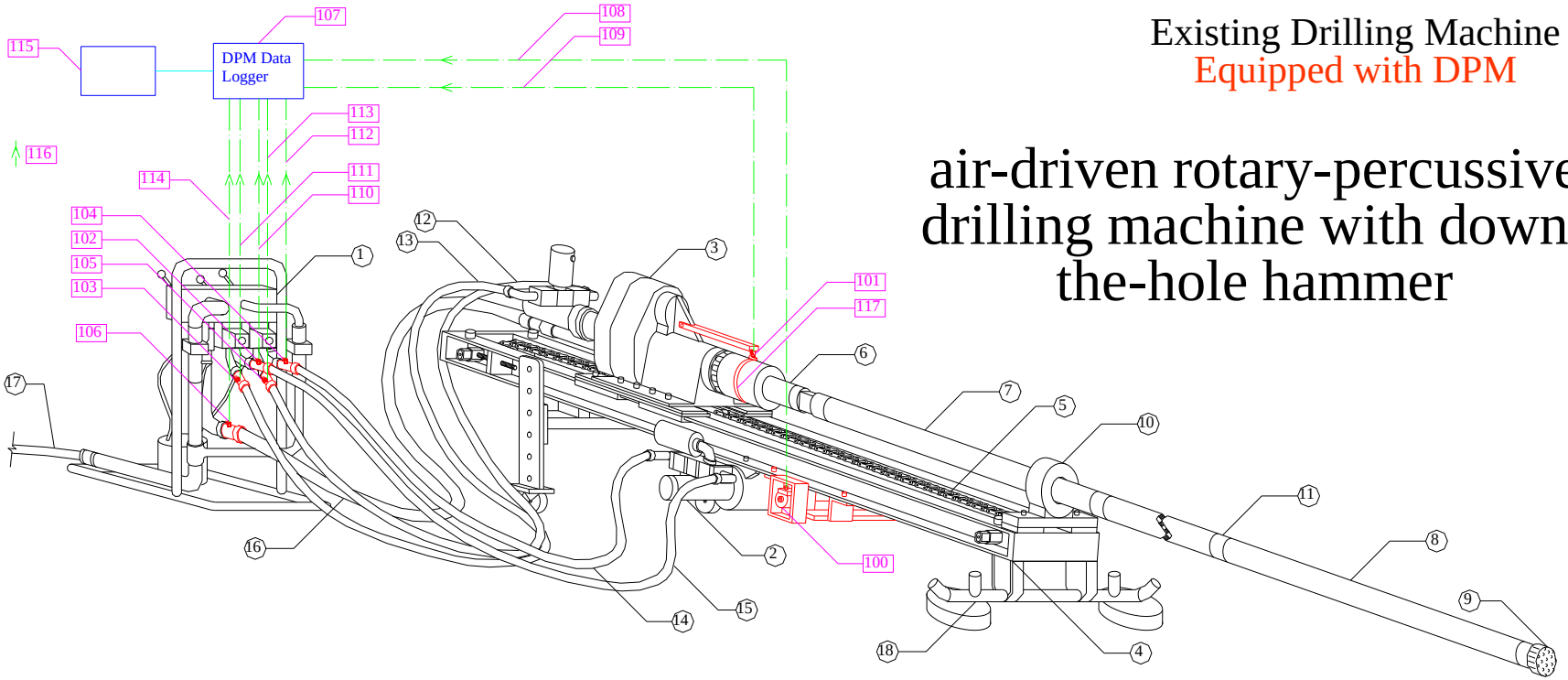
Hydraulic Drilling

1) The formation of drillholes requires mechanically detaching & removing geomaterial from the cut face of drill bit.

2) It is a mechanical failure process of the in-situ geomaterials with depth and

3) It can be used to delineate the geomaterials' strengths & distribution.

Automatic Drilling Process Monitoring



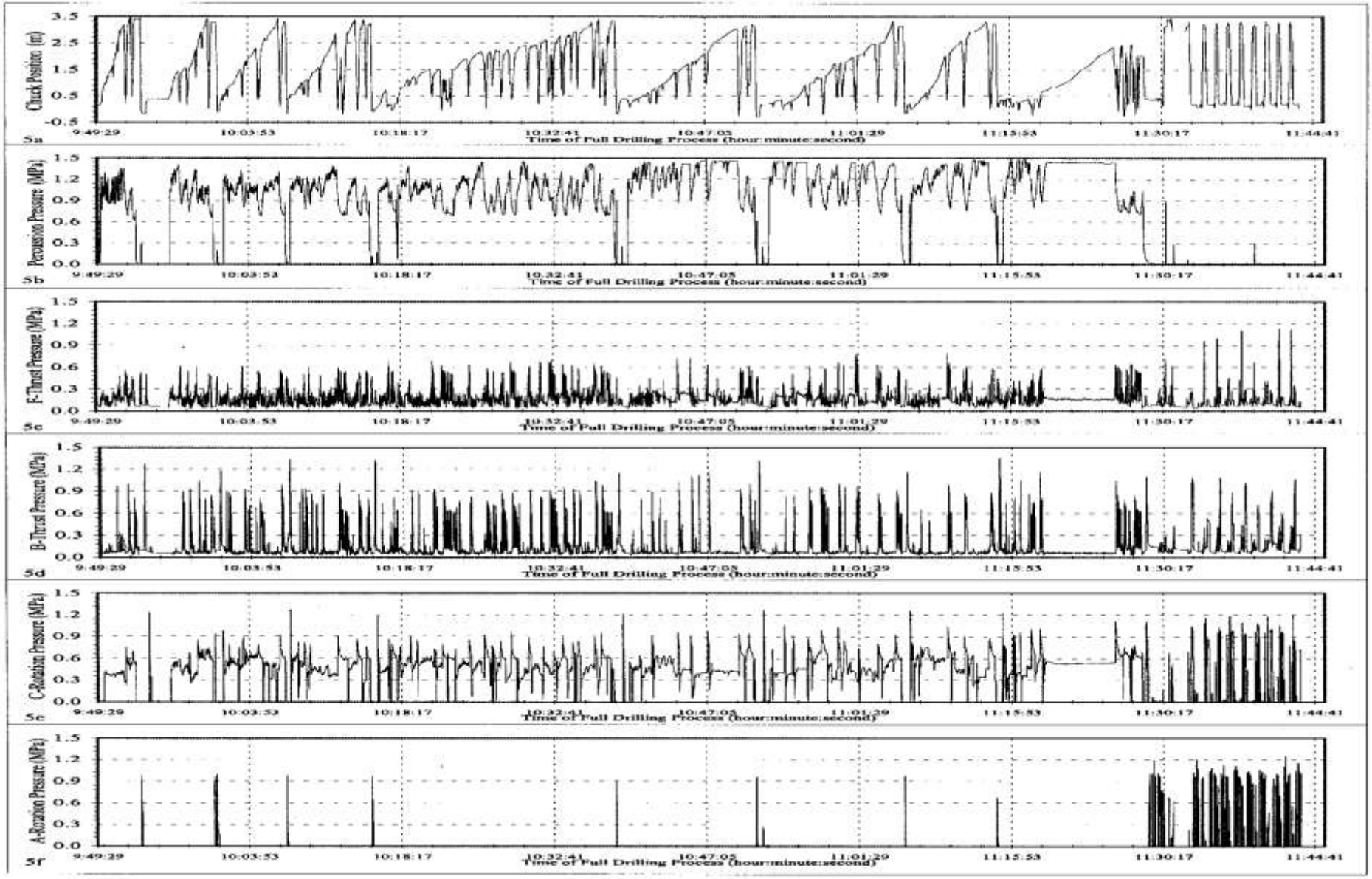
Existing Drilling Machine
Equipped with DPM

air-driven rotary-percussive drilling machine with down-the-hole hammer

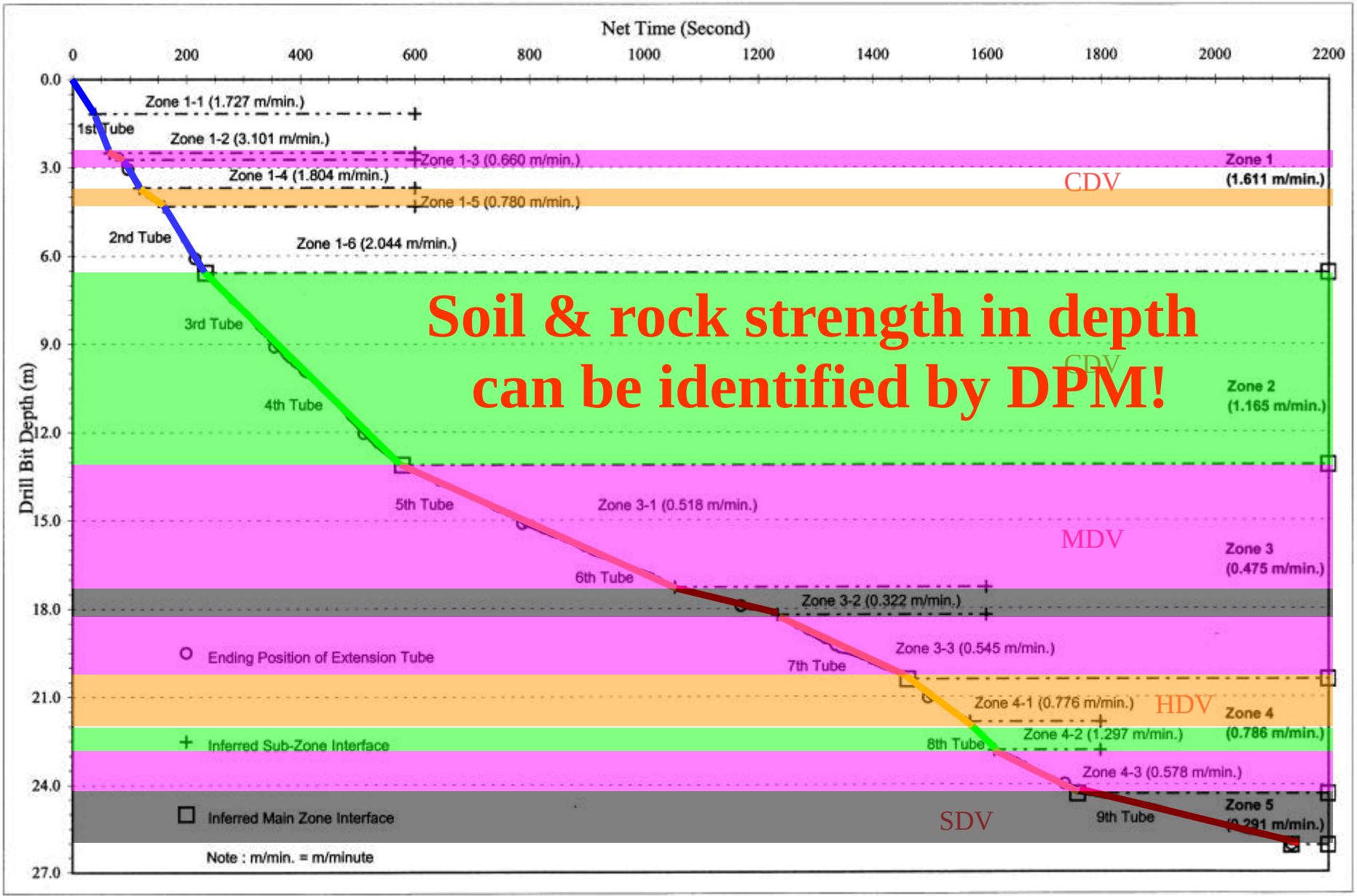
(1) Manual Control Panel	(4) Straight Sliding Beam	(8) Down-The-Hole Hammer	(12) Air Hose-Forward Rotation	(16) Air Hose-Percussion
(2) Pneumatic Thrust Motor	(5) Steel Loop Chain	(9) Drill Bit	(13) Air Hose-Reverse Forward Rotation	(17) Main Compressed Air Hose
(3) Swivel Drill Chuck with Rotation Motor	(6) Shank Adaptor	(10) Rod Clamp	(14) Air Hose-Forward Thrust	(18) Support
	(7) Hollow Rod	(11) Screw Connection	(15) Air Hose-Backrward Thrust	

[100] Position Transducer	[103] Pressure Transducer-Reverse Forward Rotation	[106] Pressure Transducer-Percussion	[115] Memory Card or Computer
[101] Rotation Transducer	[104] Pressure Transducer-Forward Thrust	[107] DPM Data Logger	[116] Direction of Signal Transmission
[102] Pressure Transducer-Backward Thrust	[105] Pressure Transducer-Forward Rotation	[108] — [114] Wires for DPM Signals	[117] Steel Ring

DPM data in time series

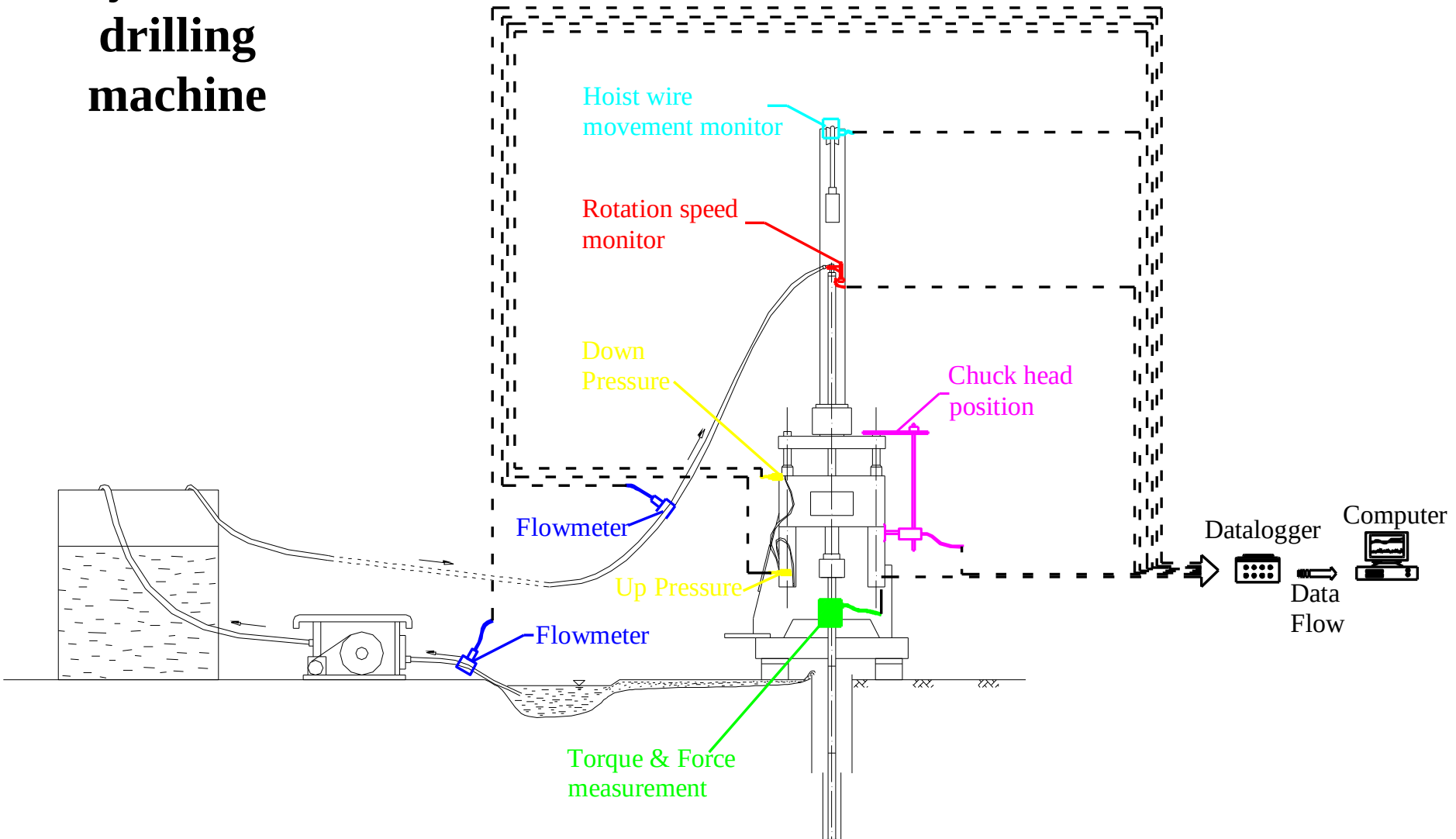


Linear Zones for Geomaterial Strength in Depth



Automatic Drilling Process Monitoring

Hydraulic drilling machine

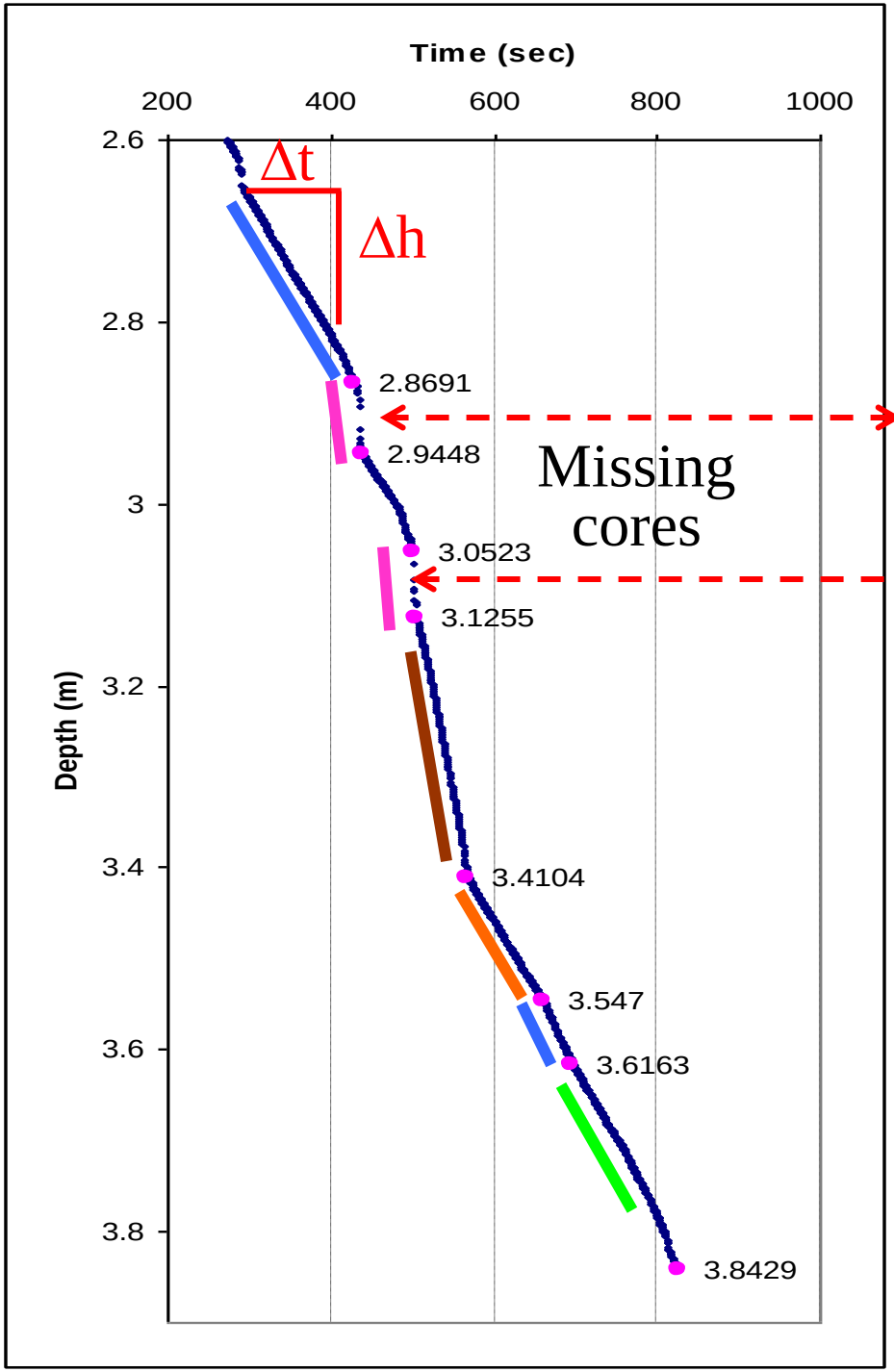


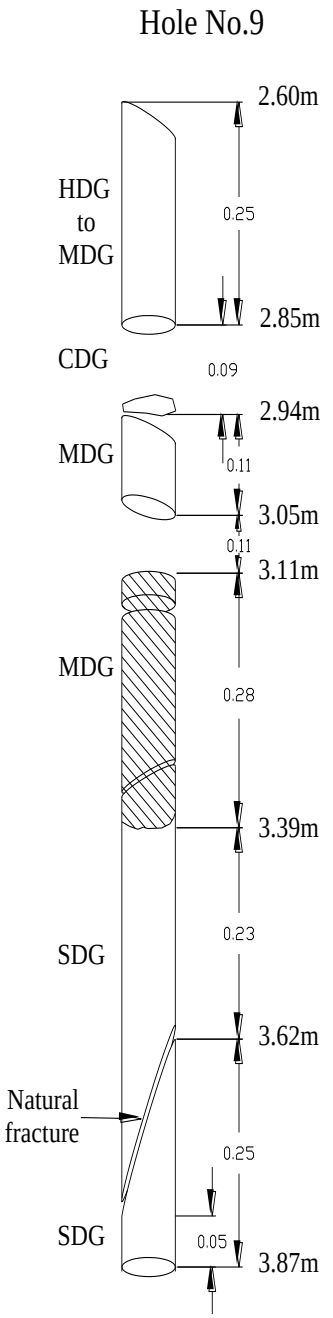
Drilling rate

$$= \frac{\Delta h}{\Delta t} =$$

Slope gradient of time-depth curve

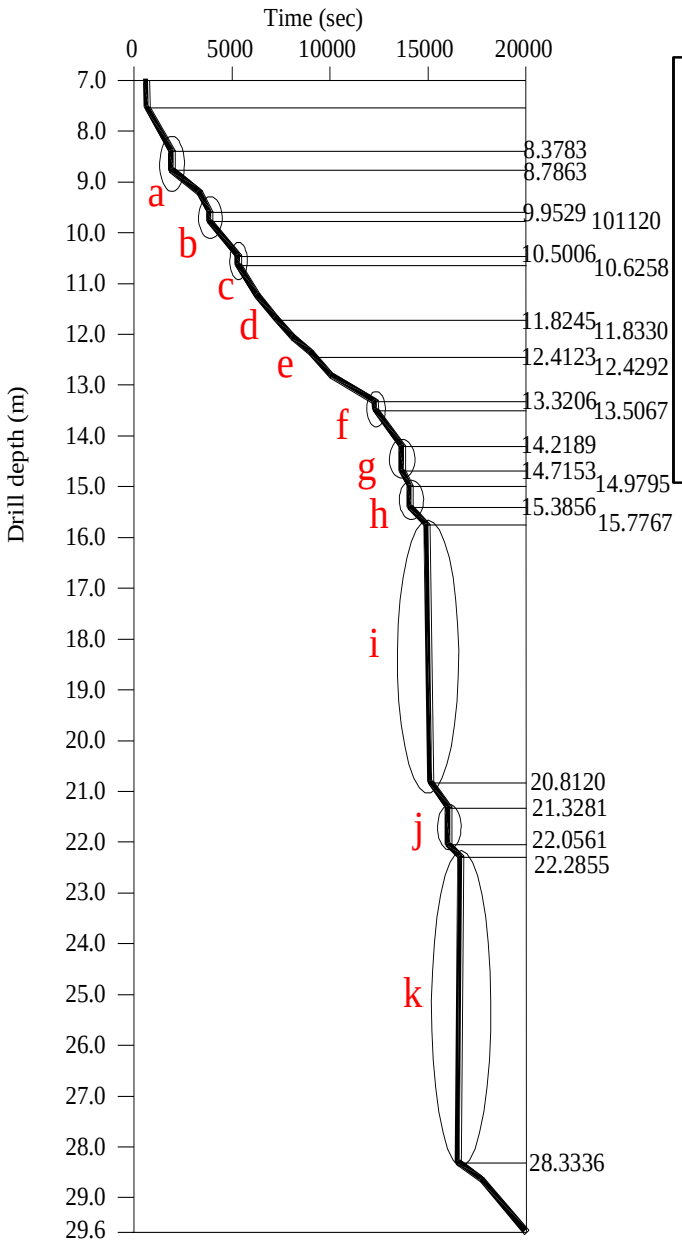
for a linear zone

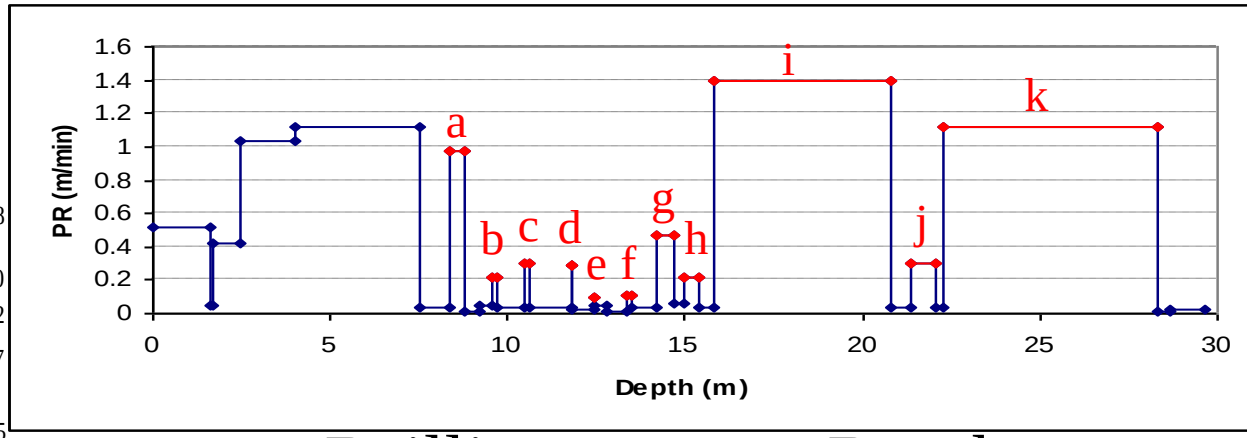




Cavities in Marble

Details of caves location





Drilling rate v.s. Depth

Cores and cavities along drillhole

The Finding

Modern High Technology Based
Automatic Drilling Process Monitoring
(DPM)
in Real Time

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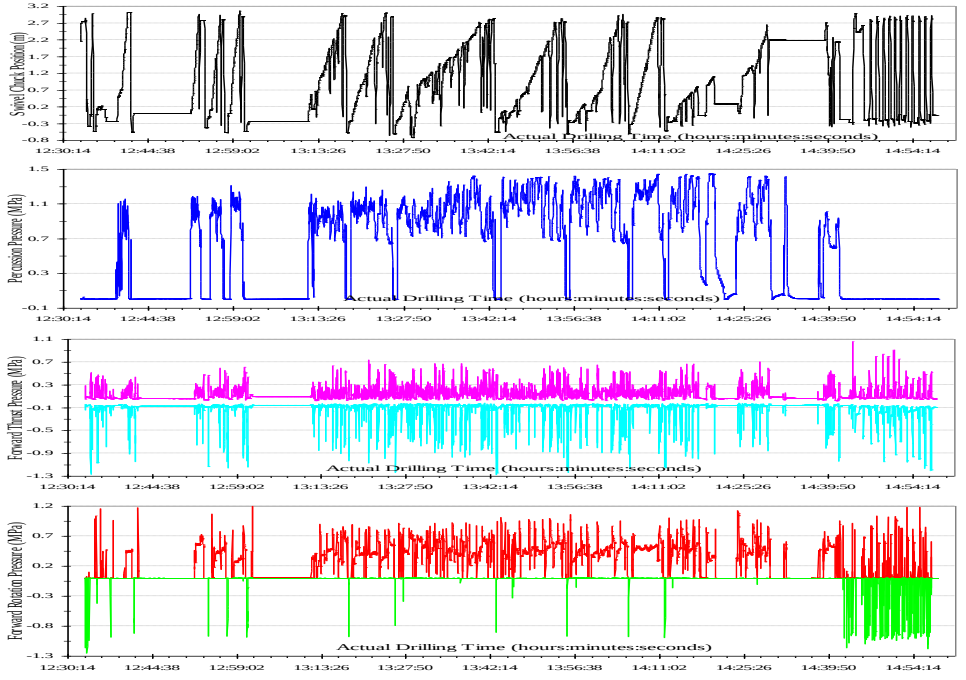
Continuous Measurement of
In-situ Strength and Distribution of
Ground Geomaterials
Comprising Both Soils and Rocks

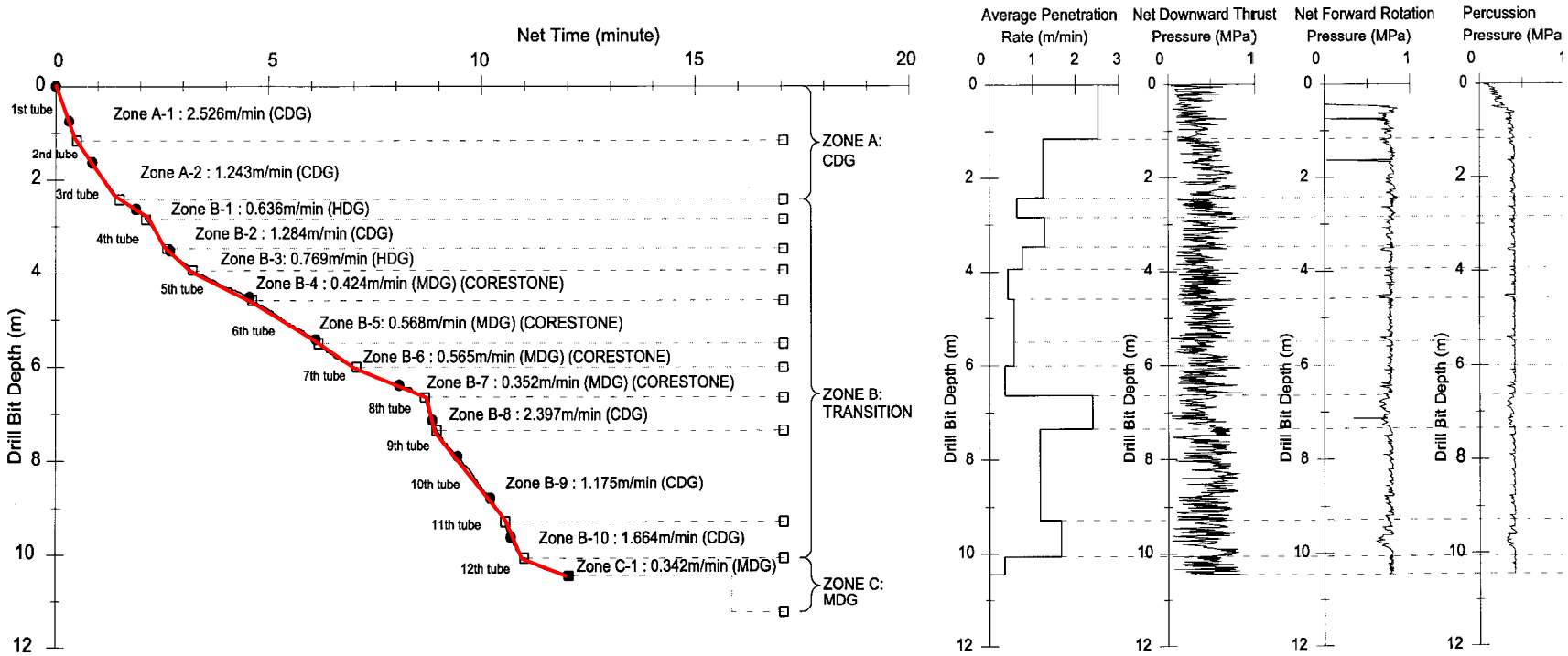
DPM : Technology Innovation

USA & China
Patents



DPM : Scientific Discovery

Linear zones of bit-depth vs drilling time !
Constant drilling rates at individual zones!



Knowing the weak and strong zones for quality geotechnical engineering !

DPM : Applicable to Various Drills

Air-driven rotary-percussive drilling machines equipped with down-the-hole hammer & hydraulic drills

Recommendations

Automatic monitoring of conventional drilling works
can upgrade the drilling works
to become an in-situ technique of choice
for
assessment and measurement of
the continuous quality & strength distribution of
geomaterials in
grounds
composing both soils and rocks.