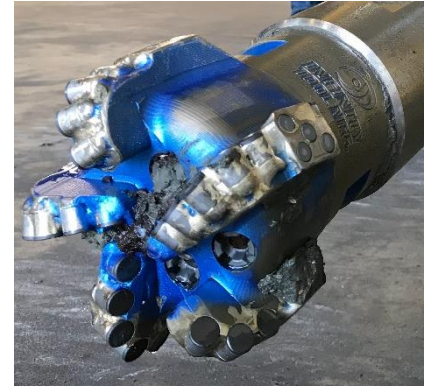
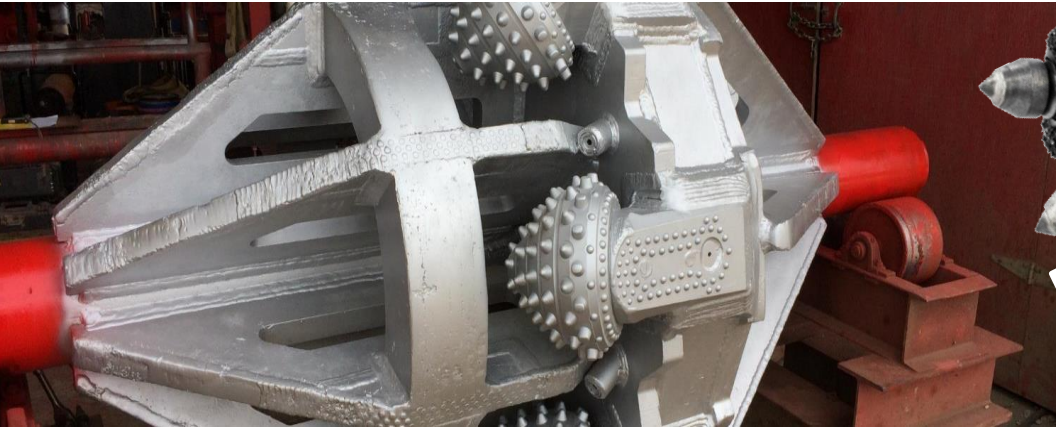
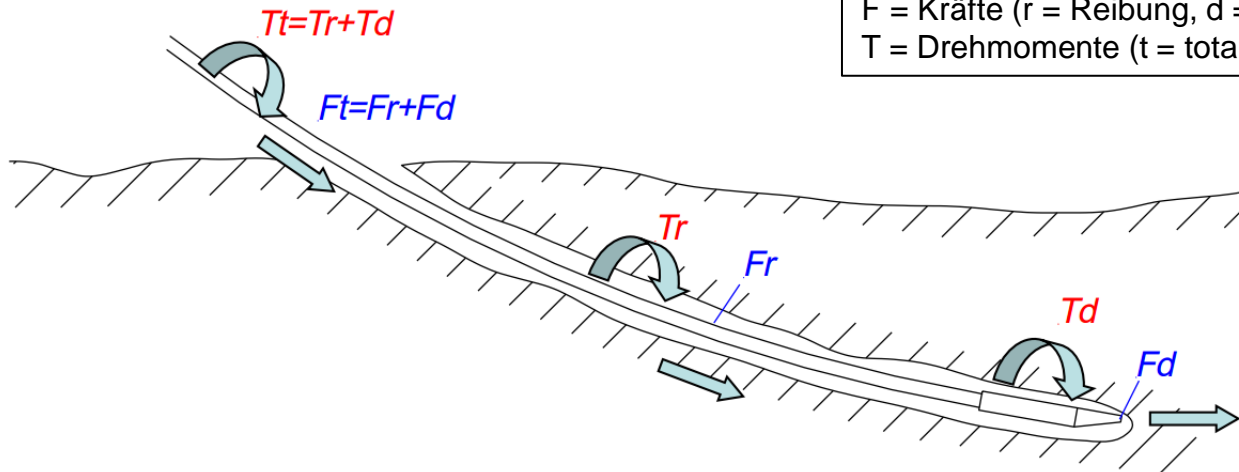


**ARBEITSWEISEN VON BOHRWERKZEUGEN**  
**FUNKTIONSWEISE VON HDD-WERKZEUGEN UNTER UNTERSCHIEDLICHEN**  
**GEOLOGISCHEN BEDINGUNGEN**



# KRÄFTE WÄHREND DES PILOTBORENS

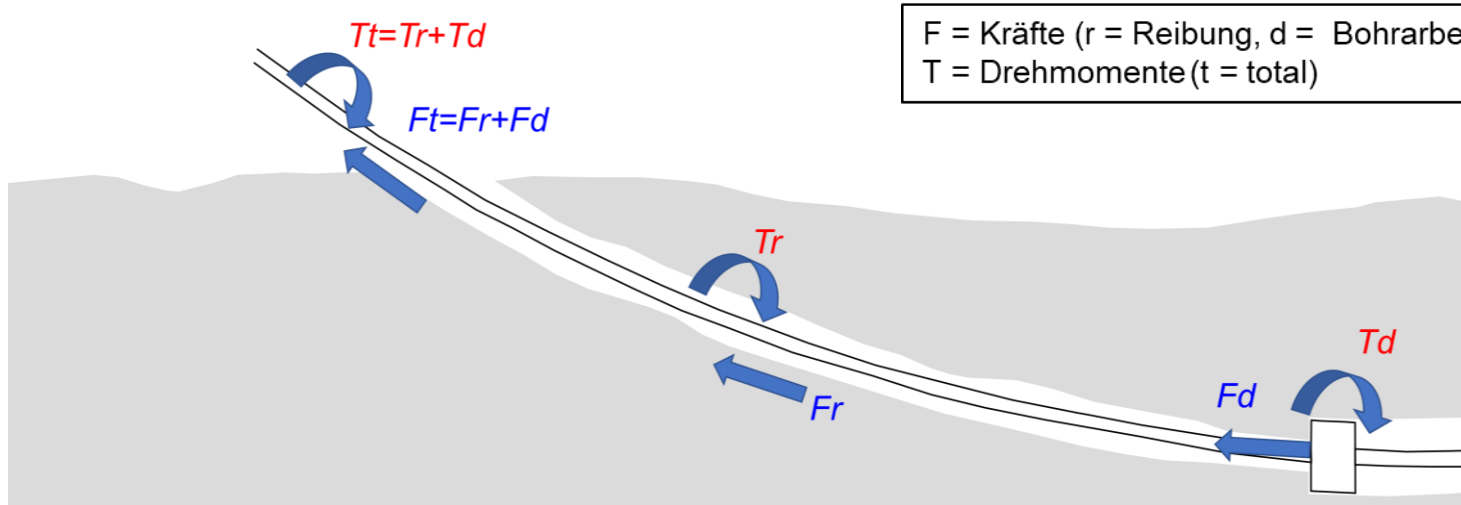
- Forces during drilling
- Forces during steering
  - Thrust force and torque for the drillhead to compact/cut the soil ( $T_d$  &  $F_d$ )
  - Thrust force and torque to overcome drag in the hole ( $T_r$  &  $F_r$ )



F = Kräfte (r = Reibung, d = Bohrarbeit)  
T = Drehmomente (t = total)

# KRÄFTE BEIM RÄUMVORGANG

- *Forces during reaming*
  - *Thrust force and torque for the reamer to compact/cut the soil ( $T_d$  &  $F_d$ )*
  - *Thrust force and torque to overcome drag in the hole ( $T_r$  &  $F_r$ )*



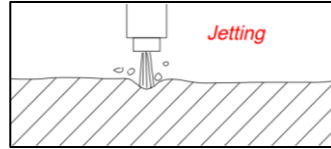
# WAS BENÖTIGEN BOHRWERKZEUGE?

- Drehmoment Torque
- Druck-/ Zugkraft Thrust/Pullback force
- Andruck (Belastung) WOB (weight on bit)
- Schlag-Energie Impact energy (hammering)
- Drehgeschwindigkeit Rotational speed
- Düsen-Energie Nozzle power
- Reaktive Kraft des Baugrunds Soil reaction

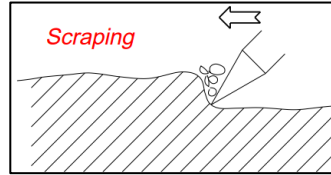


# BOHR- UND ABBAU-MECHANISMEN

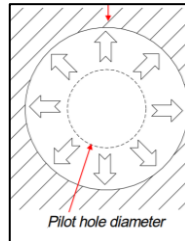
- Düsenstrahl (Jetting)  
(hydrodynamisch)



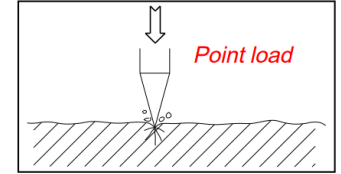
- Schaben  
(drag type bits)



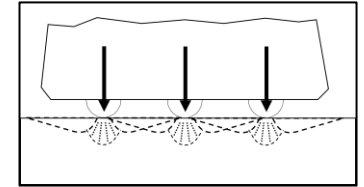
- Verdrängen  
(Displacement)



- Crushing  
(Zerdrücken)

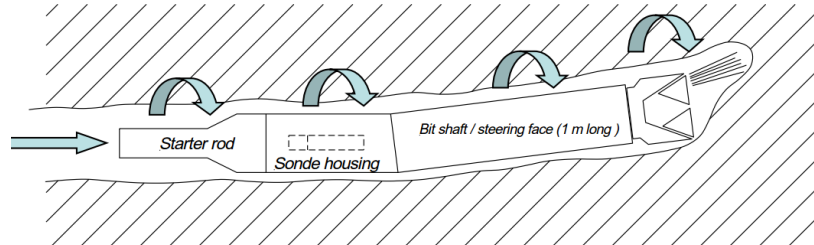
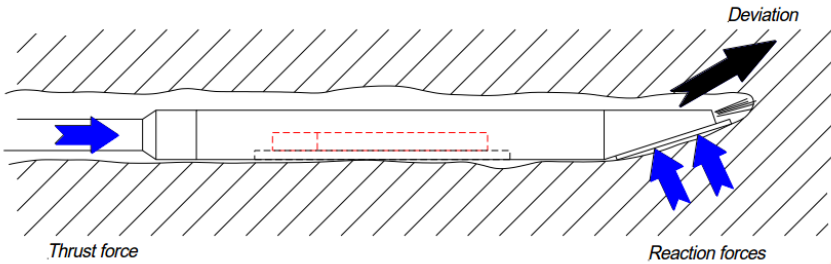
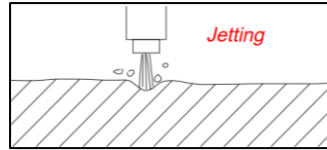


- Crushing  
(Zerschlagen)



# MAIN DRILLING MECHANISMS IN SOIL AND ROCK

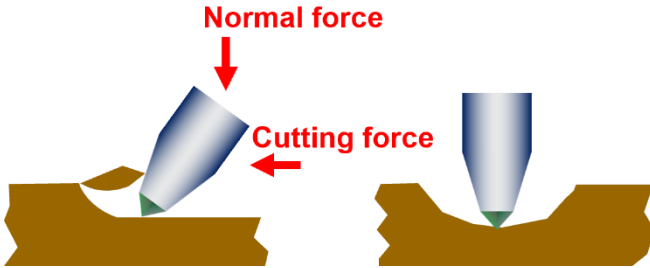
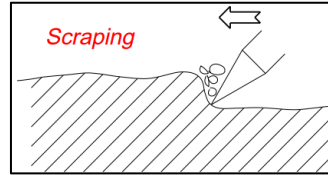
- Jetting (hydrodynamic)



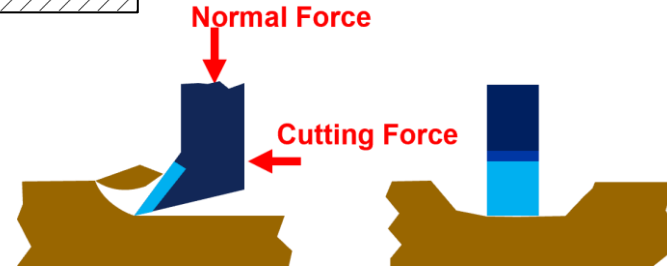
# BOHR- UND ABBAU-MECHANISMEN



- Cutting /Scraping/Schaben



Point attack cutter



Drag Cutter



Soft rock/hard ground slanted bit



Fly cutter



Mill tooth



Shark Teeth plate bit



Shark Teeth reamer

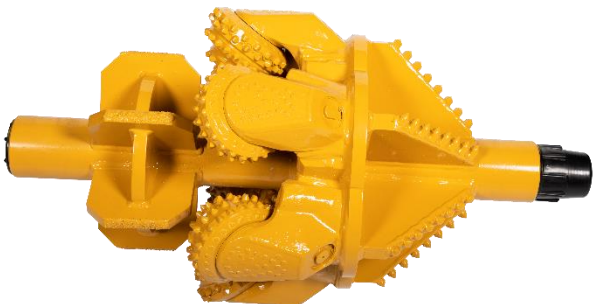
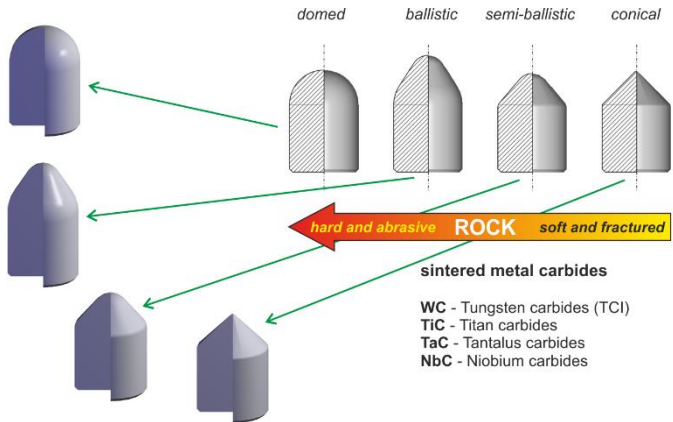
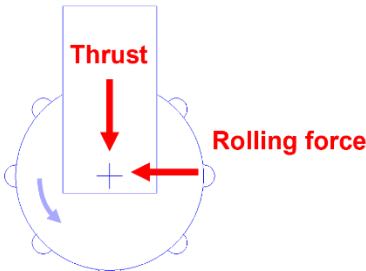
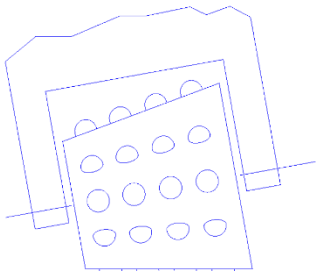
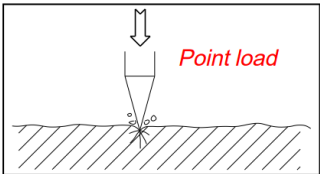


PDC



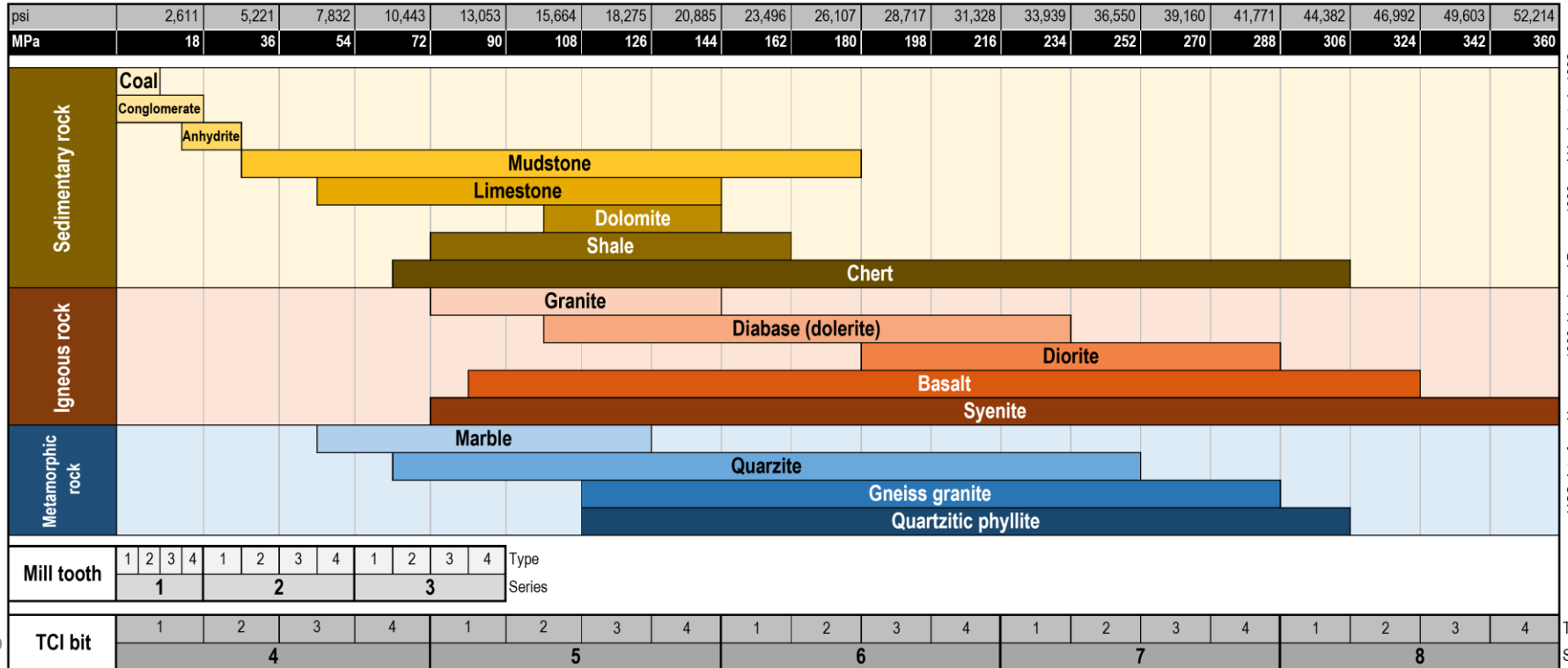
# BOHR- UND ABBAU-MECHANISMEN

- Crushing (Zerdrücken)





# DRUCKFESTIGKEITEN VON FELS UND ZIFFER 1 UND 2 DES IADC CODE (ROLLENMEIßEL)

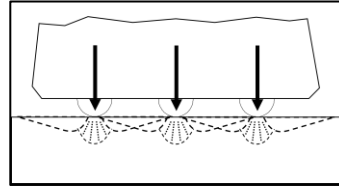


UCS data from Hanssen, 1988; Hoek and Brown, 1980 and Hoek et al., 1992

# BOHR- UND ABBAU-MECHANISMEN



- Crushing (Schlagen)
- Bohrhammer

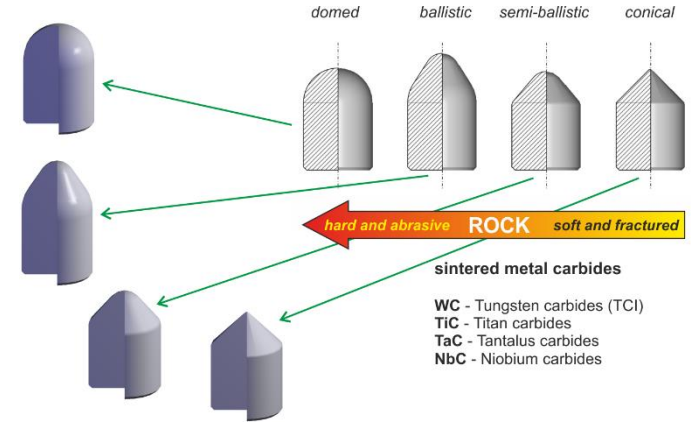
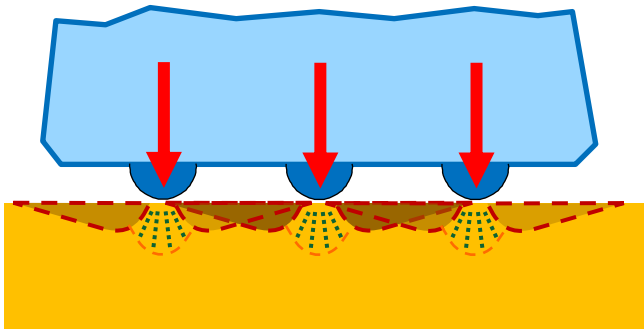


Hammering force  
(impact)



**2100-2300 blows/min**

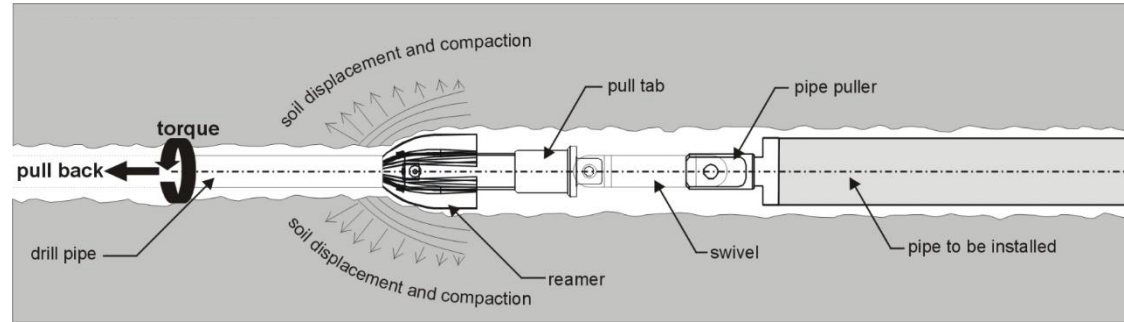
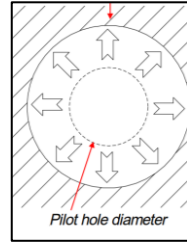
- Dynamic forces
- Rock brittleness



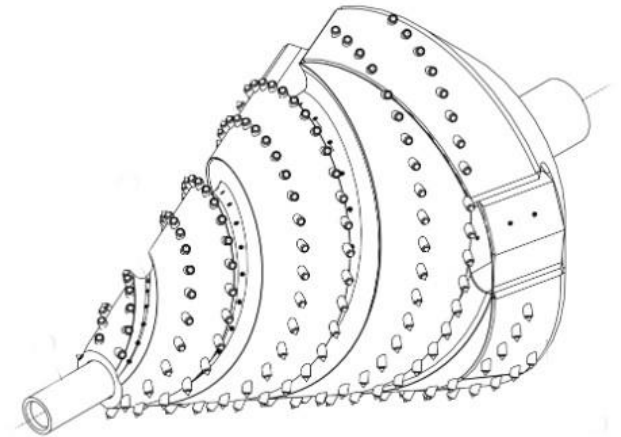
# BOHR- UND ABBAU-MECHANISMEN








- Verdrängen



Barrel reamer (compacting)



Fluted reamer (combined cutter-compacting)

	Baugrund	HDD-Arbeits-Phase		Bohr-Mechanismus
		PILOT	REAMING	
		Bohr-Werkzeuge		
	<ul style="list-style-type: none"> <li>Weicher, loser feinkörniger Boden, <b>spülbar</b> (Sand, Schluff, Ton oder/und Torf)</li> </ul>	<ul style="list-style-type: none"> <li>Jet Bit mit Steuerplatte</li> </ul>	<ul style="list-style-type: none"> <li>Cutting reamers</li> <li>Mixing reamers</li> <li>Barrel reamers</li> </ul>	<ul style="list-style-type: none"> <li>Spülen/Jetting</li> <li>Schaben</li> </ul>
	<ul style="list-style-type: none"> <li>Fester feinkörniger <b>spülbarer</b> Baugrund</li> </ul>	<ul style="list-style-type: none"> <li>Spül-Garnitur (Jetting assembly)</li> </ul>	<ul style="list-style-type: none"> <li>Compacting reamers</li> <li>Combined (mix of previous categories)</li> </ul>	<ul style="list-style-type: none"> <li>Displacement/Verdrängen</li> </ul>
	<ul style="list-style-type: none"> <li>Fels, Festgestein</li> </ul>	<ul style="list-style-type: none"> <li>Mud motor und Zahn-,TCI- oder PDC-Bit</li> <li>Doppelrohr-System: Zahn-,TCI- oder PDCBit</li> <li>DTH Hammer: TCI hammer bits (slanted, eccentric)</li> <li>Angeschrägter Jet-Bit für Fels</li> </ul>	<ul style="list-style-type: none"> <li>Rollenerweiterer (Hole openers: TCI/Mill tooth roller cones)</li> <li>Rundschaftmeißel-Räumer mit massivem Körper</li> <li>PDC reamers</li> </ul>	<ul style="list-style-type: none"> <li>Zerdrücken</li> <li>Schlagen</li> </ul>
	<ul style="list-style-type: none"> <li>Sandig kiesige Mischböden (standfestes stabiles Bohrloch)</li> </ul>	<ul style="list-style-type: none"> <li>Angeschrägter Jet-Bit für Fels</li> <li>Doppelrohr-System: Zahn-,TCI- oder PDCBit</li> <li>DTH Hammer: TCI hammer bits (slanted, eccentric)</li> </ul>	<ul style="list-style-type: none"> <li>Combined</li> <li>Hole openers: TCI/Mill tooth roller cones</li> <li>Compacting reamers</li> </ul>	<ul style="list-style-type: none"> <li>Cutting/Schaben</li> </ul>
	<ul style="list-style-type: none"> <li>(Sehr) grobe, nicht bindige und nicht verfestigte Schichten (Bohrloch nicht standfest)</li> </ul>	<ul style="list-style-type: none"> <li>Methoden zur Strabilisierung des Bohrlochs (Installation Casing, Zementinjektion o.a.)</li> <li>Angeschrägter Jet-Bit für Fels</li> <li>DTH hammer: TCI hammer bits (slanted, eccentric)</li> </ul>	<ul style="list-style-type: none"> <li>Combined</li> </ul>	<ul style="list-style-type: none"> <li>Verdrängen</li> <li>Schlagen</li> </ul>

**Haftungsausschluss:** Die obige Tabelle ist Diskussionsgrundlage für einen DCA-Workshop unter DCA-Mitgliedern. Sie ist keinesfalls eine Technische Regel und damit nicht Grundlage für (vertrags-) rechtliche Angelegenheiten.