301 – Part A – The Chemical Crusher: Drilling and Blasting

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QUARRY ACADEMY

How to Create Value and Maximize Profit in the New Economy

- **Answer:**

1. Provide exactly the right amount of energy to each rock as it moves:
   - Out of the bench, (Chemical Crushing)
   - Through the production process, and
   - Into product piles.
2. Minimize the activity required to produce

   (time to do the necessary steps)
3. Minimize the energy required to produce.

   (equipment and men to do the necessary steps)

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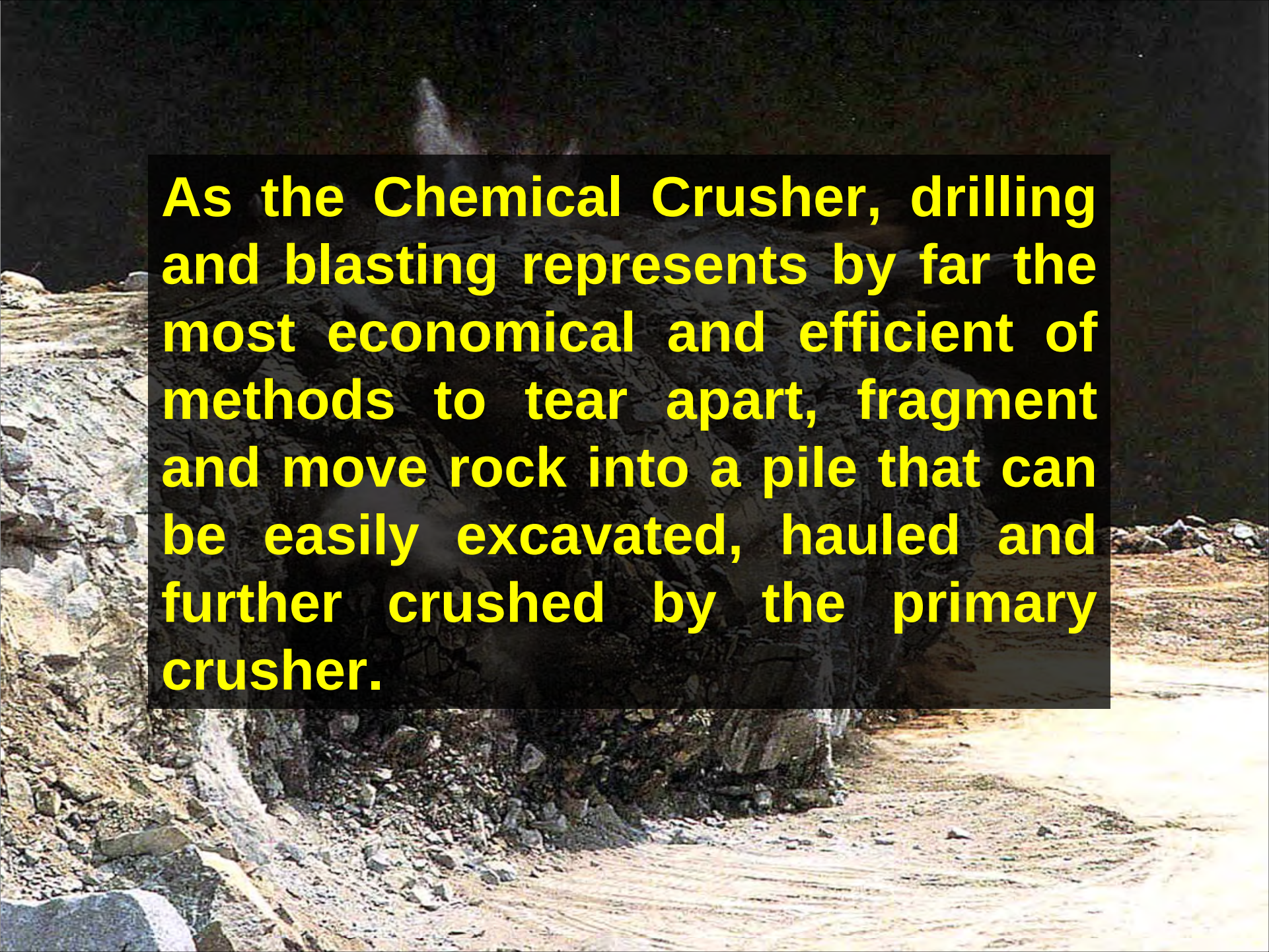
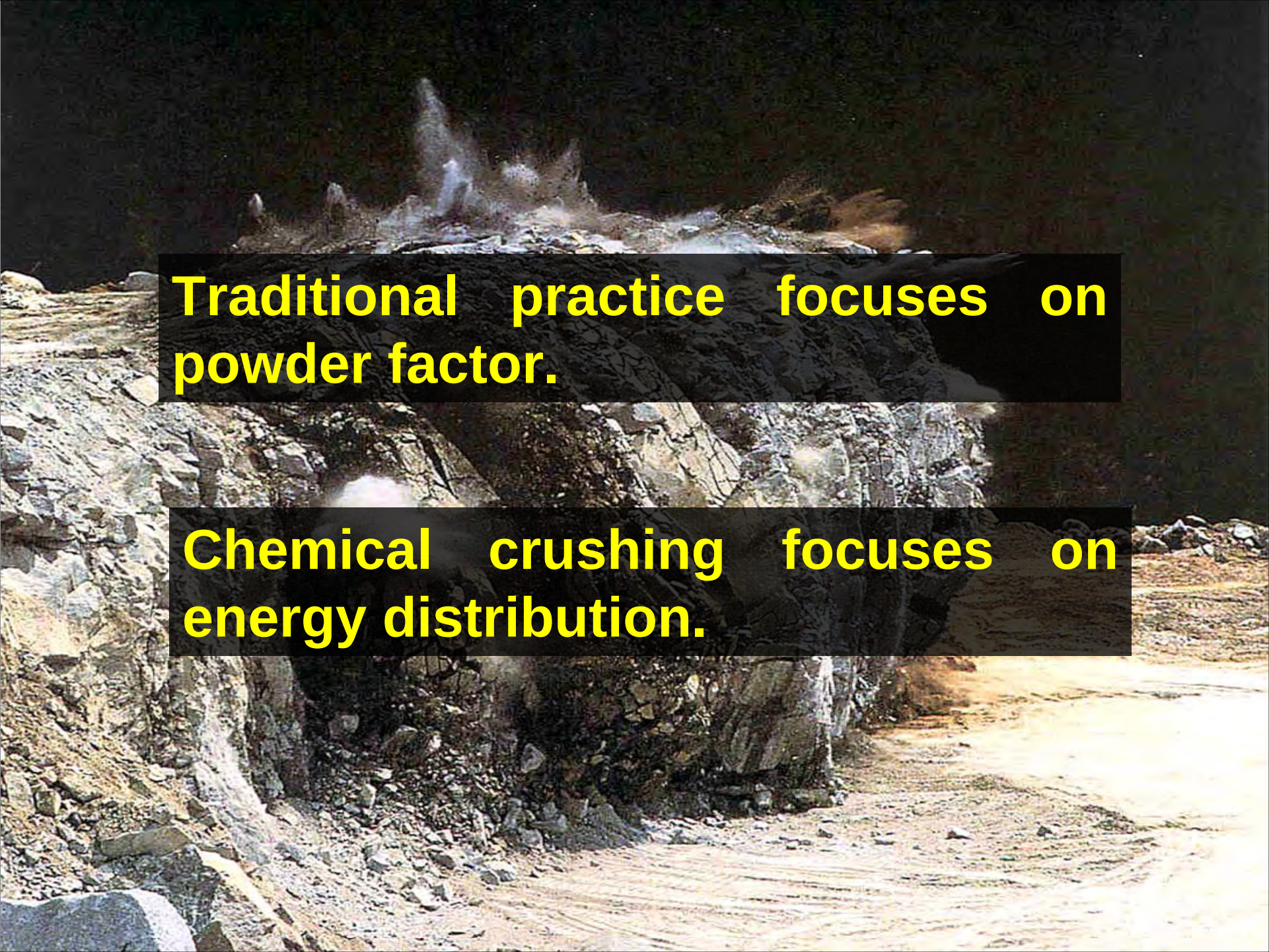

As the Chemical Crusher, drilling and blasting represents by far the most economical and efficient of methods to tear apart, fragment and move rock into a pile that can be easily excavated, hauled and further crushed by the primary crusher.


Traditional practice focuses on powder factor.
Chemical crushing focuses on energy distribution.

Why now and not before this time?

- **Our production capability is not broken.**
  - ✓**We can still put down a lot of rock on the ground.**

- **It is the economic model of our industry that is broken**
  - ✓**If we can’t control our selling price, we have to control our costs.**

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Why now and not before this time?

Availability of advanced tools

- Models
  - Blast Fragmentation
  - Blast Vibration
  - Plant Process
- More accurate and precise rock drills
- Accurate and precise electronic detonators
- Differential bulk emulsion explosive loading systems

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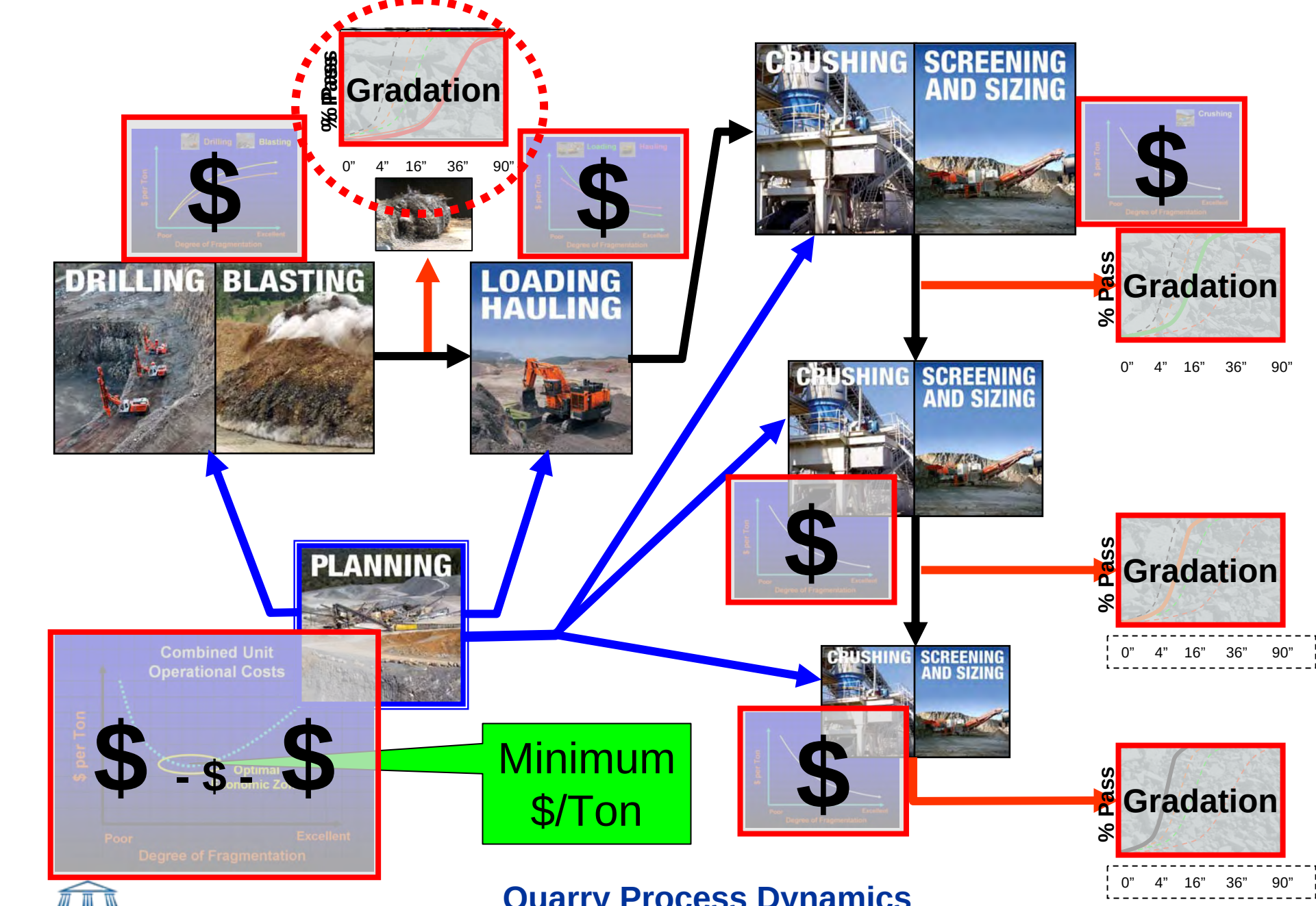
Gradation
% Pass
0” 4” 16” 36” 90”
$
Drilling
Blasting
$ per Ton
Poor
Excellent
Degree of Fragmentation
Loading
Hauling
DRILLING
BLASTING
LOADING
HAULING
CRUSHING
SCREENING
AND SIZING
Crushing
PLANNING
Combined Unit
Operational Costs
$ - $ - $
Optimal Economic Zone
Minimum
$/Ton
Quarry Process Dynamics
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Chemical Crusher

- ✓ **Fully portable and built at the rock bench.**
- ✓ **Disposable and fully consumed on use.**
- ✓ **Except for the diesel and/or electricity to build it, it is internally powered.**
- ✓ **Has design flexibility to meet variable production volumes, changing rock conditions and to produce different rock size gradations.**
- ✓ **Could be assembled daily if necessary.**
- ✓ **Capable of crushing well in excess of 1,100 tons/hr of rock reserves.**
- ✓ **Major drawback is: that, without proper controls, it can have noise, dust and vibration issues.**

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As Chemical Crusher, Drill and Blast Targets extend one step further.

- **Normal Drill and Blast**
  - ✓ **Zero Harm**
  - ✓ **Full Regulatory Compliance**
  - ✓ **Controlled boundaries of blast / excavation**
  - ✓ **Uniform Breakage**
  - ✓ **Easy to dig, load, haul, dump and feed.**
- **Chemical Crusher**
  - ✓ **Control / Influence particle size distribution.**

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Basic Drill and Blast Principles Still Apply.

- **When explosives are detonated they release the chemical energy stored within them.**
- **All that energy will go somewhere:**
  - ✓ **into breaking and fragmenting the rock**
  - ✓ **into moving and heaving the rock**
  - ✓ **into ground vibration**
  - ✓ **into air overpressure and heat**

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Basic Drill and Blast Principles Still Apply.

- **To do efficient work in rock, explosives need to be confined in drill hole. Without the drill hole, explosives would not be a practical tool for the quarry industry.**
- **In a correctly designed blast, accurately placed drill holes put the right quantity of explosive energy in the right place!**
- **In a correctly designed blast, an accurate and precise explosive initiation system applies the right quantity of explosive energy at the right time!**

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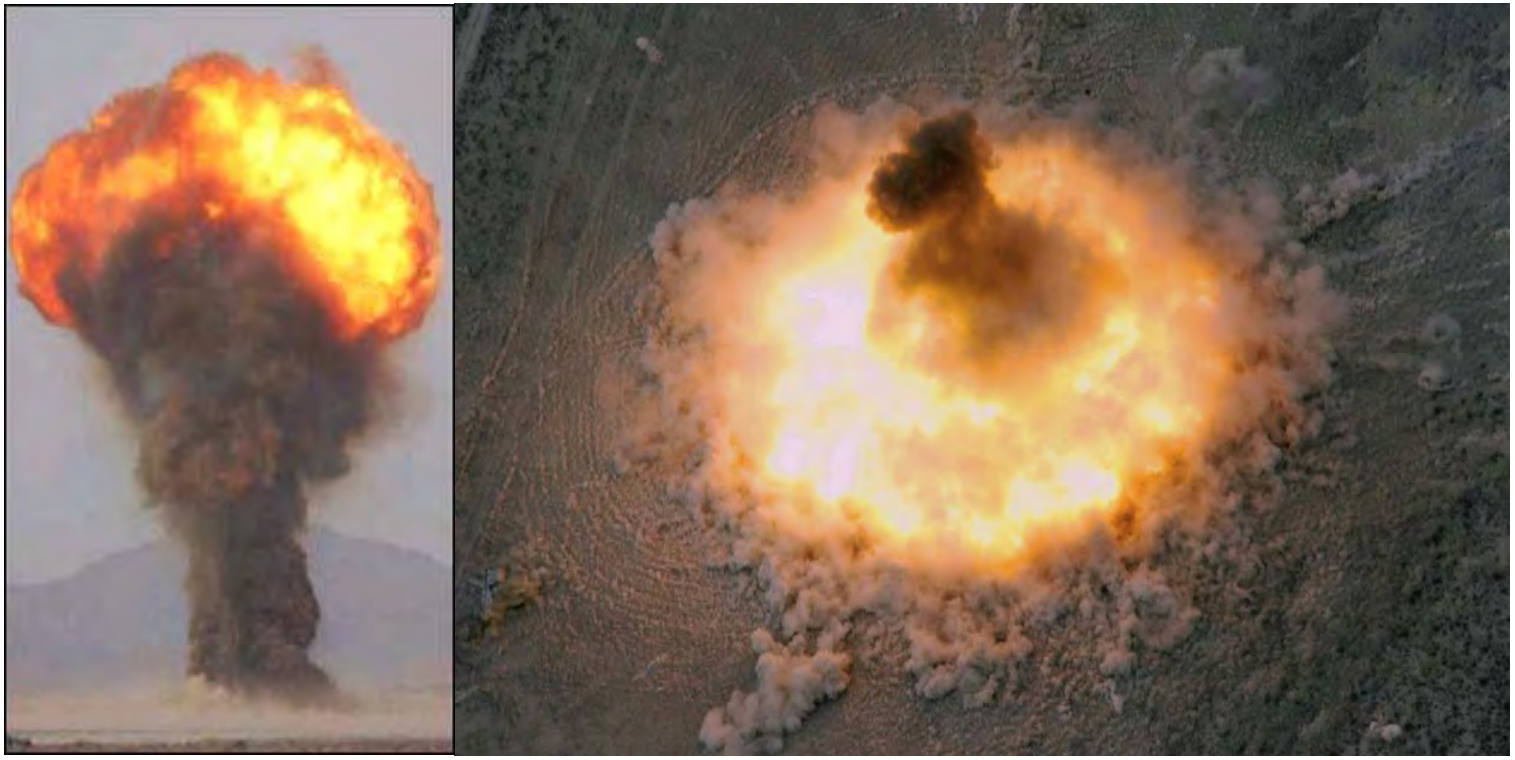
Without the Drill Hole.



Shock and Awe!

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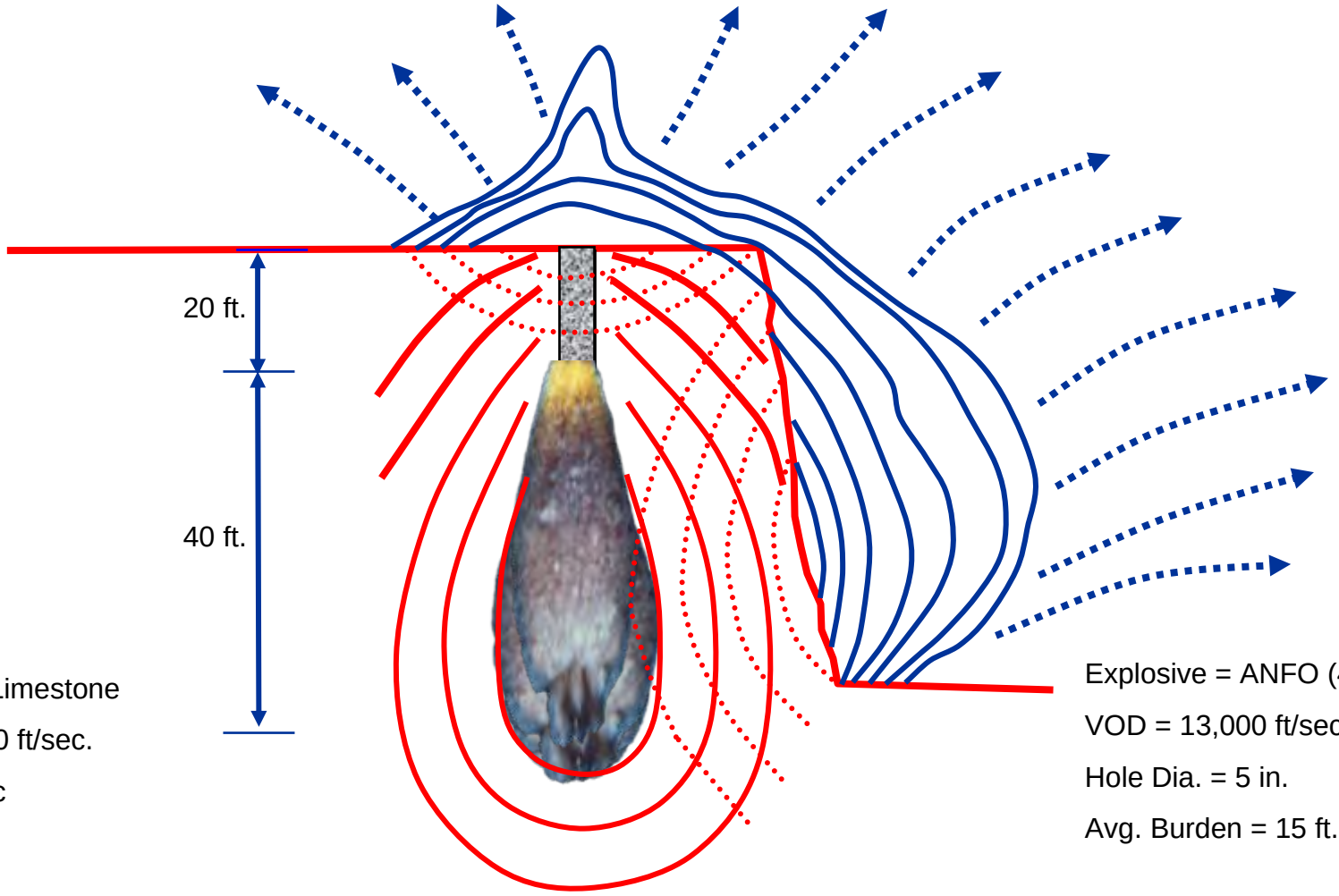
Blast Dynamics
Action – Reaction Energy Release



Material = Limestone

Vp = 15,000 ft/sec.

P = 2.3 g/cc

Explosive = ANFO (40 ft.)

VOD = 13,000 ft/sec.

Hole Dia. = 5 in.

Avg. Burden = 15 ft.

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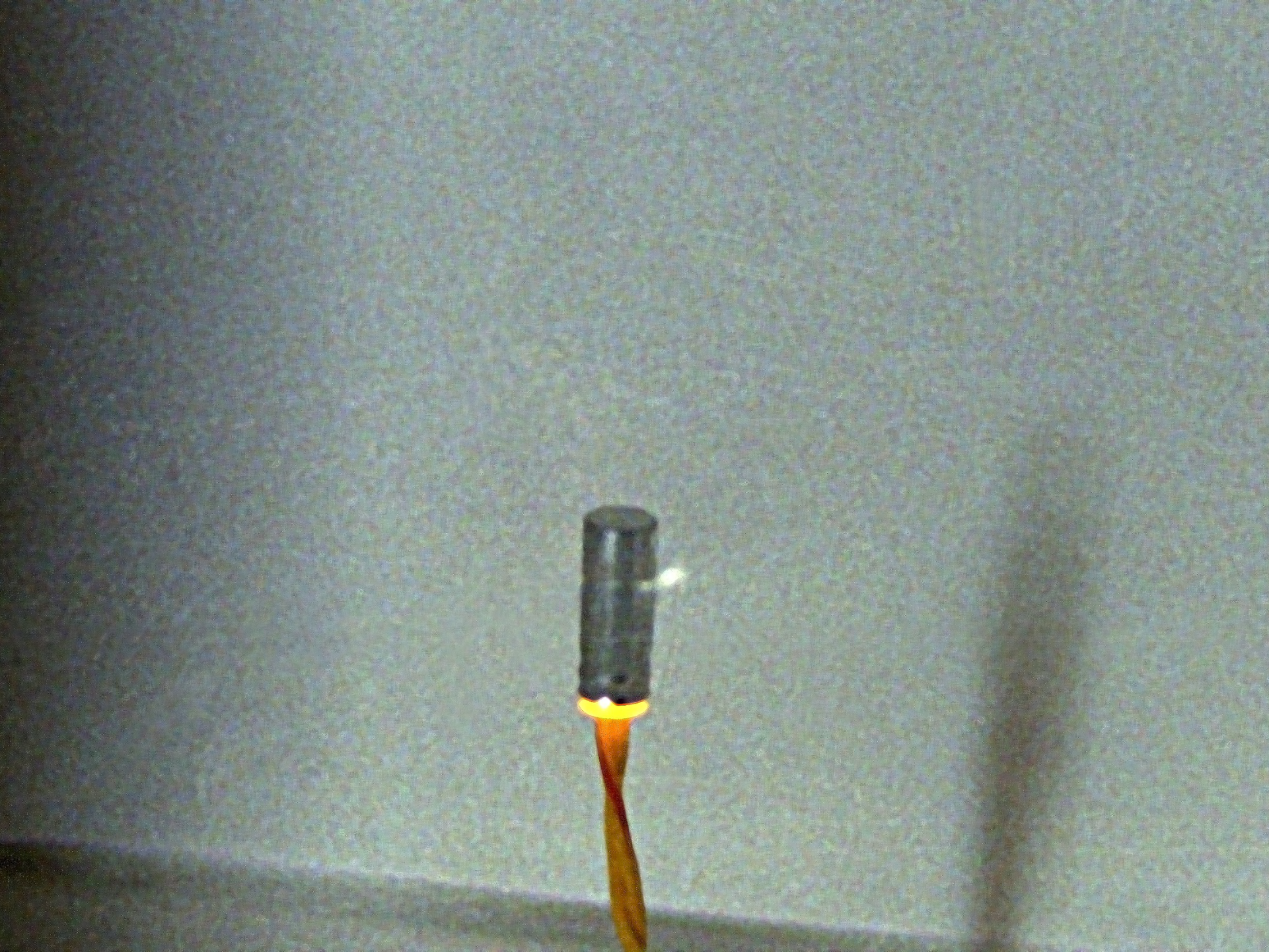

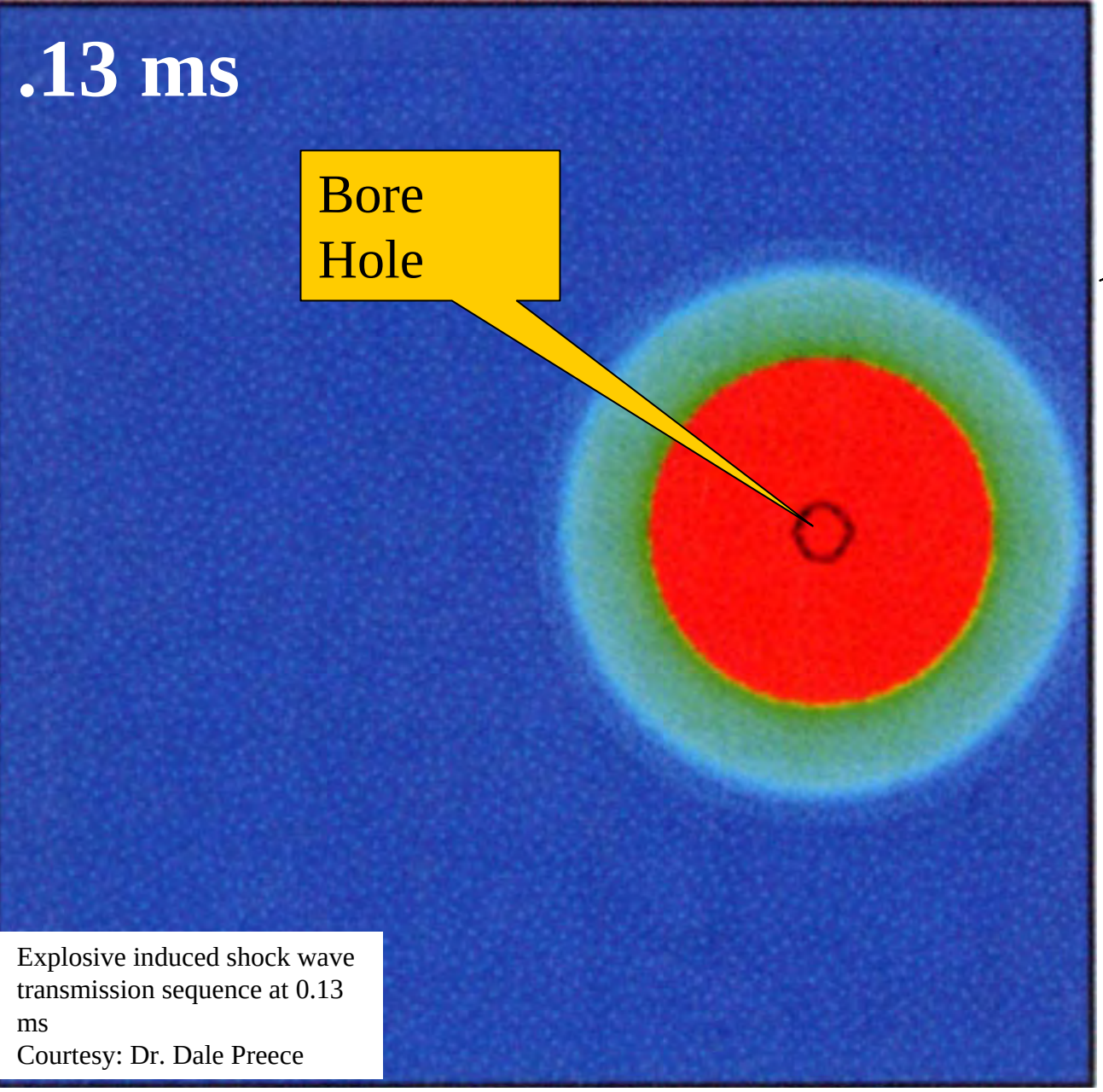

Stress In Vicinity of Blast Hole

Pressure		
	kPa	PSI
	54,000	372,317
	48,000	330,948
	42,000	289,580
	36,000	248,211
	30,000	206,843
	24,000	165,474
	18,000	124,106
	12,000	82,737
	6,000	41,369
	-	-
	(6,000)	(41,369)

Explosive induced shock wave transmission sequence at 0.13 ms
Courtesy: Dr. Dale Preece

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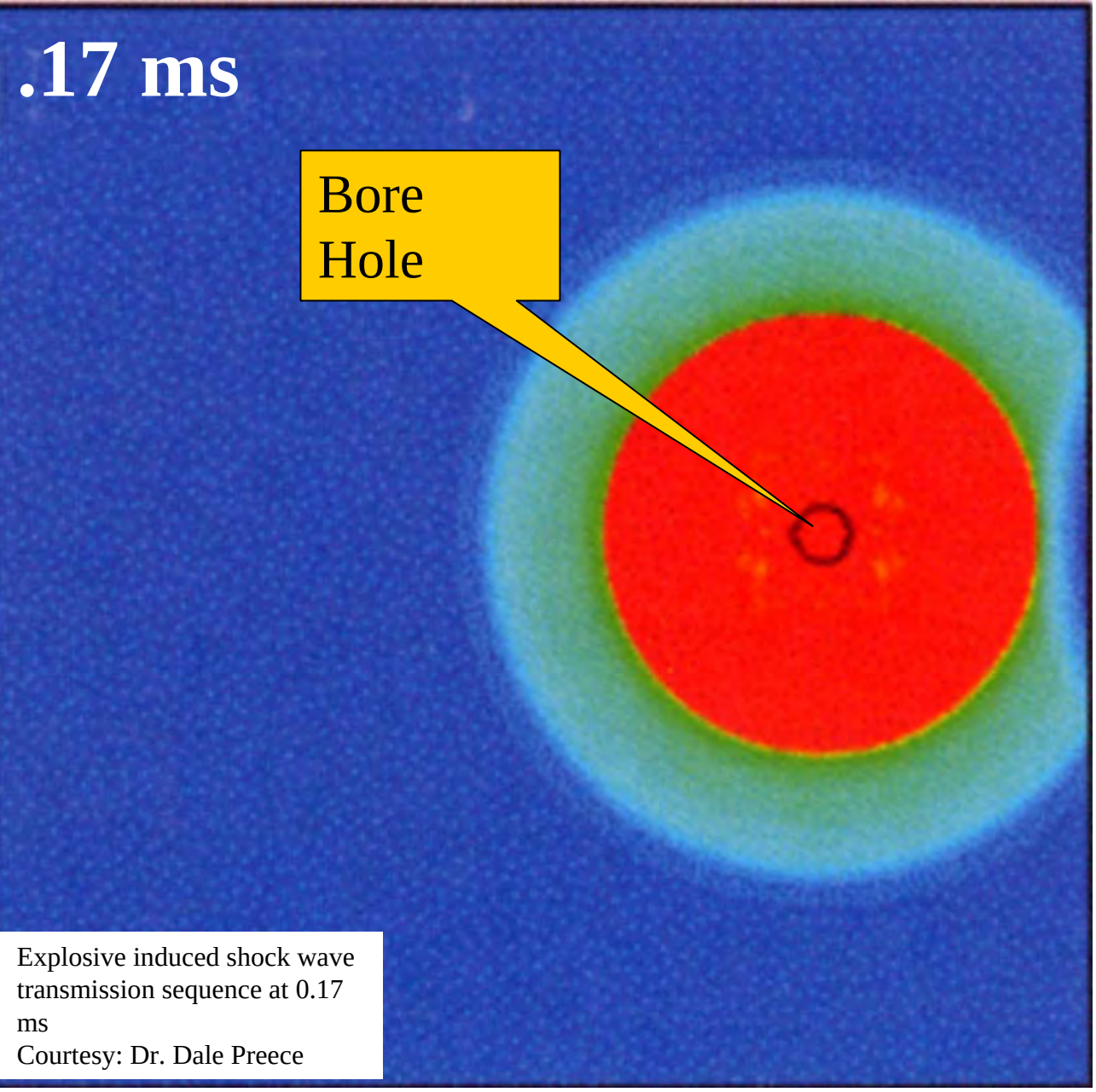

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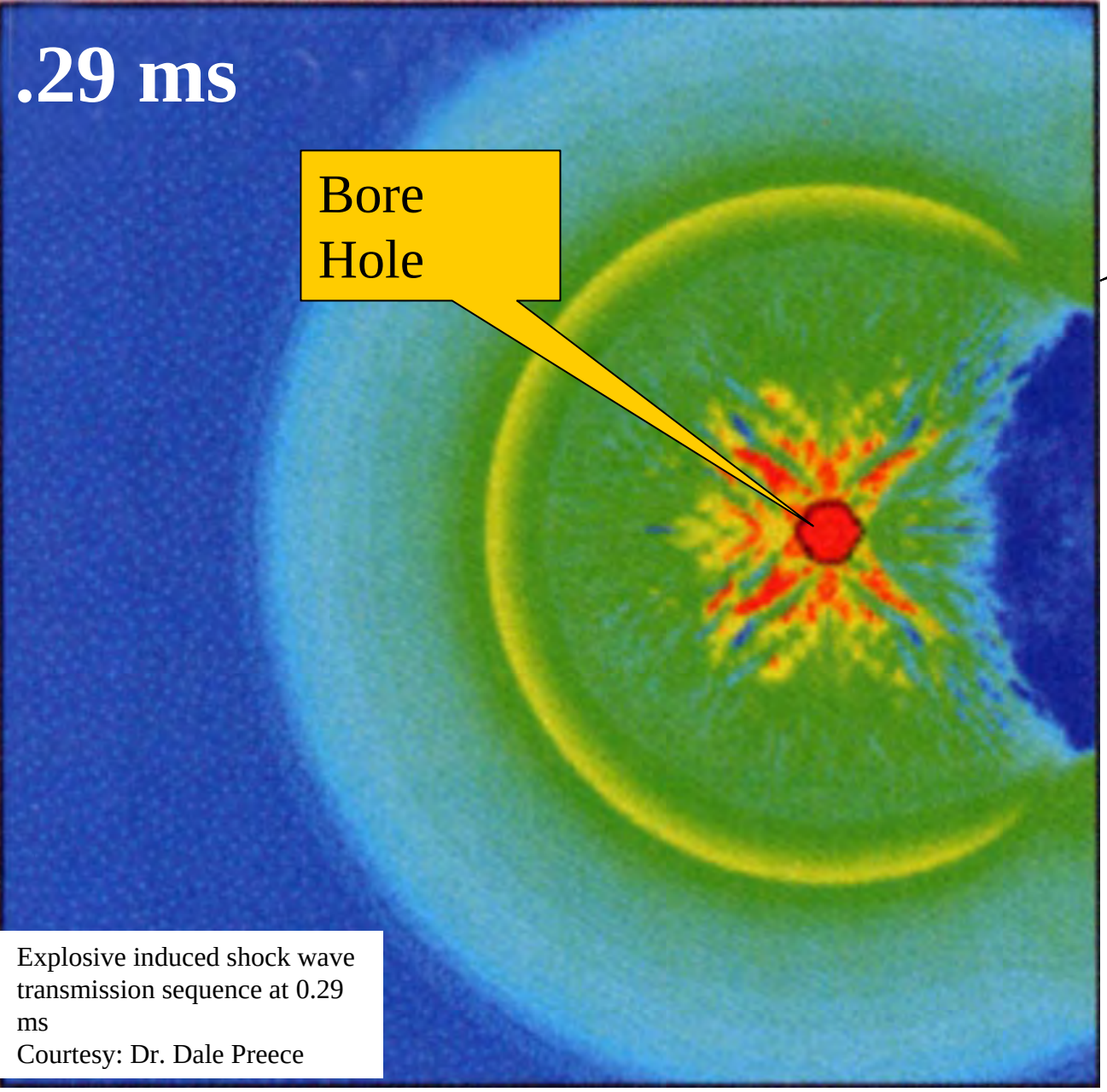
	18,000	124,106
	12,000	82,737
	6,000	41,369
	-	-
	(6,000)	(41,369)

Explosive induced shock wave transmission sequence at 0.17 ms
Courtesy: Dr. Dale Preece

QUARRY ACADEMY



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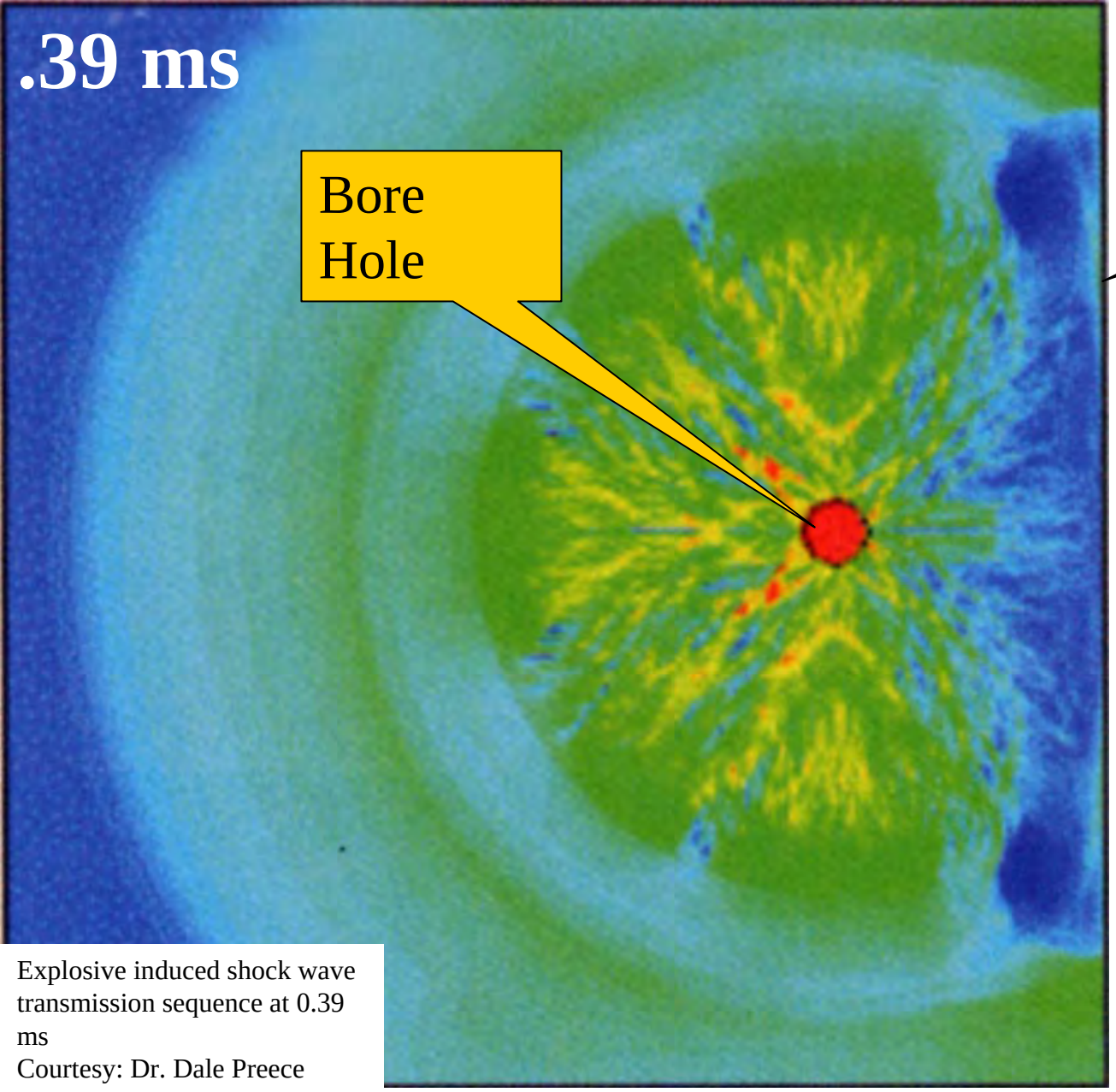
	18,000	124,106
	12,000	82,737
	6,000	41,369
	-	-
	(6,000)	(41,369)

Explosive induced shock wave transmission sequence at 0.29 ms
Courtesy: Dr. Dale Preece

QUARRY ACADEMY



Stress In Vicinity of Blast Hole

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	36,000	248,211
	30,000	206,843
	24,000	165,474
	18,000	124,106
	12,000	82,737
	6,000	41,369
	-	-
	(6,000)	(41,369)

Explosive induced shock wave transmission sequence at 0.39 ms
Courtesy: Dr. Dale Preece

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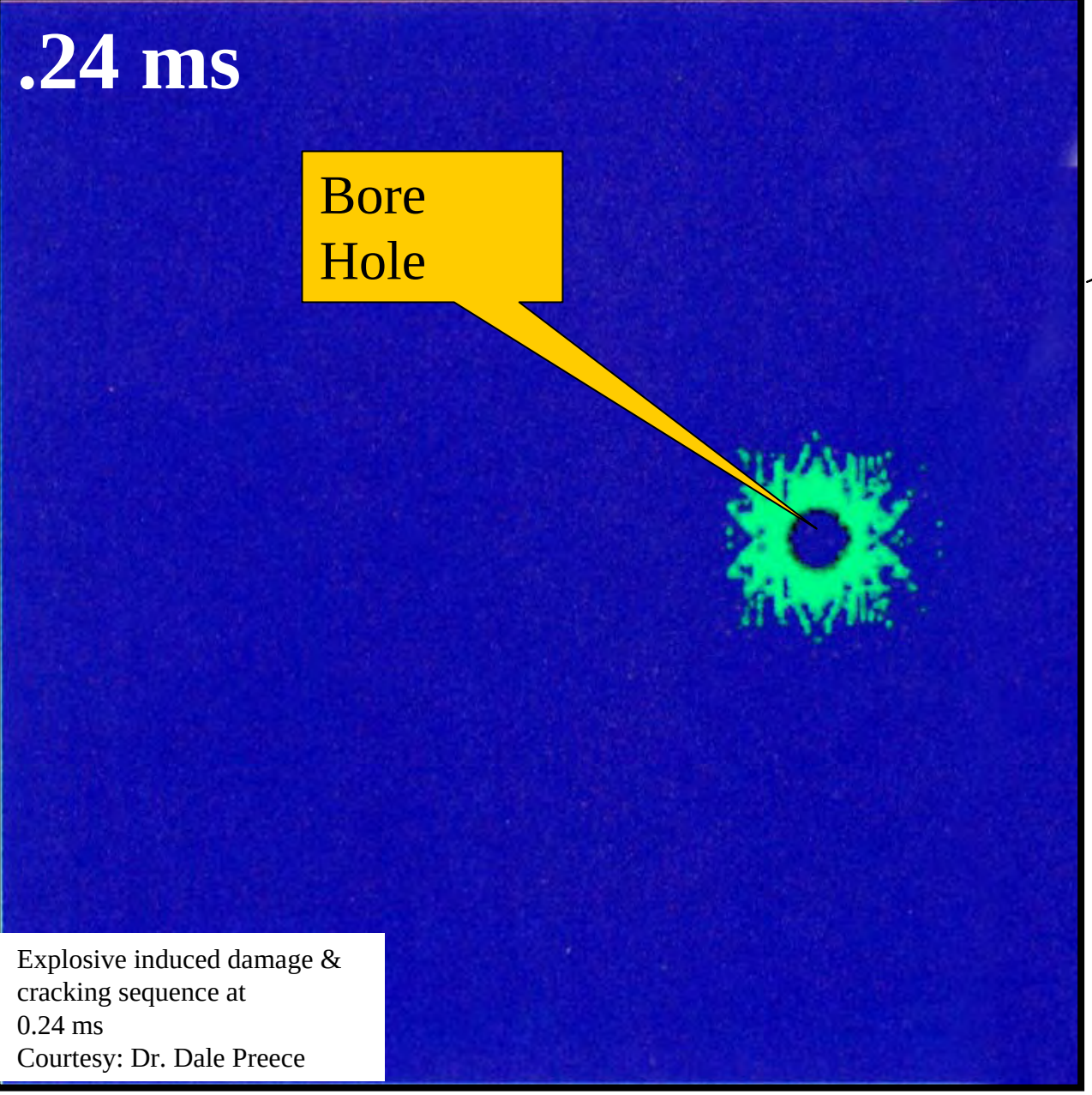
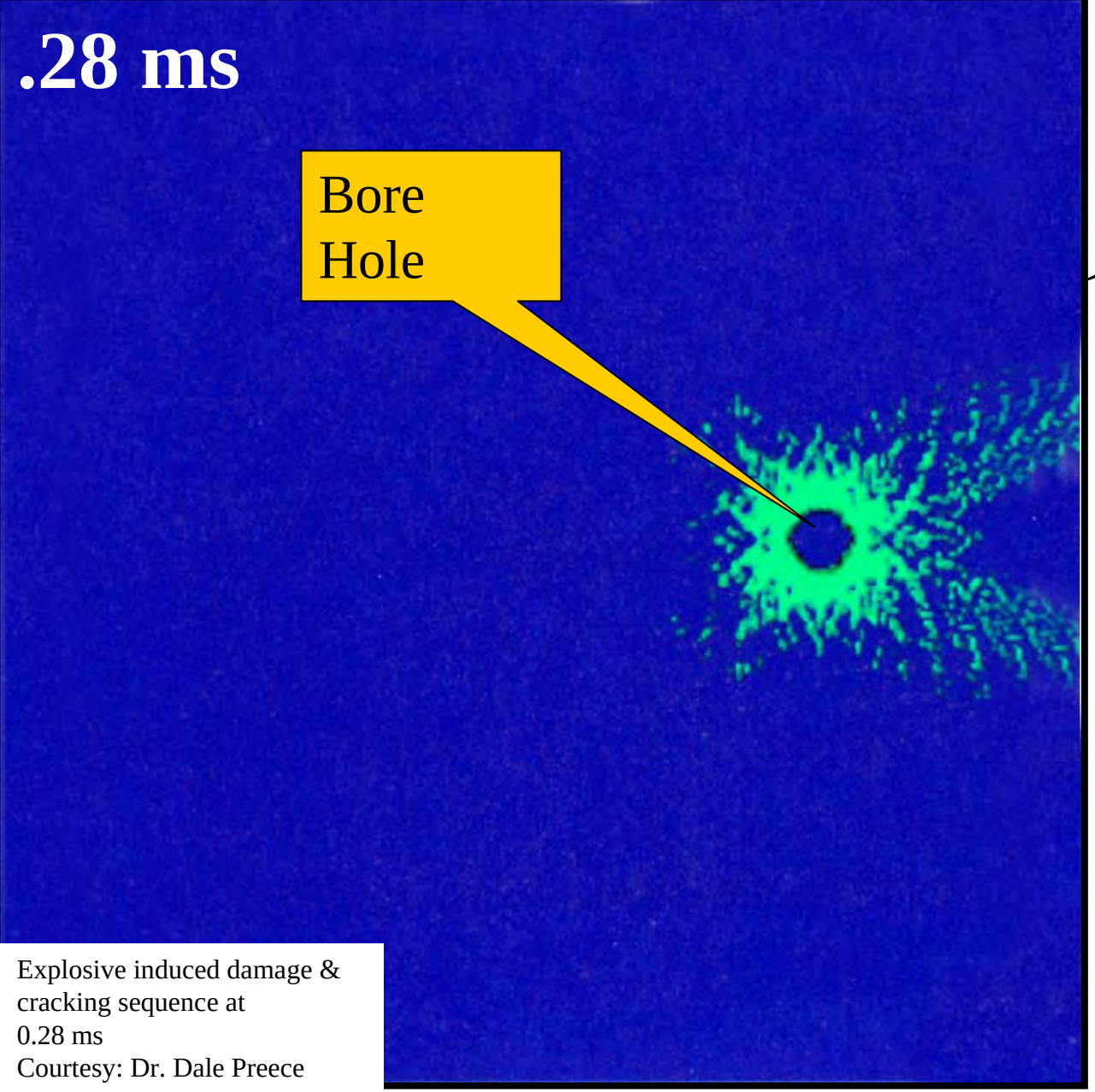


Explosive induced damage & cracking sequence at 0.24 ms
Courtesy: Dr. Dale Preece

Cracking In Vicinity of Blast Hole

QUARRY ACADEMY



Cracking In Vicinity of Blast Hole

Explosive induced damage & cracking sequence at 0.28 ms
Courtesy: Dr. Dale Preece

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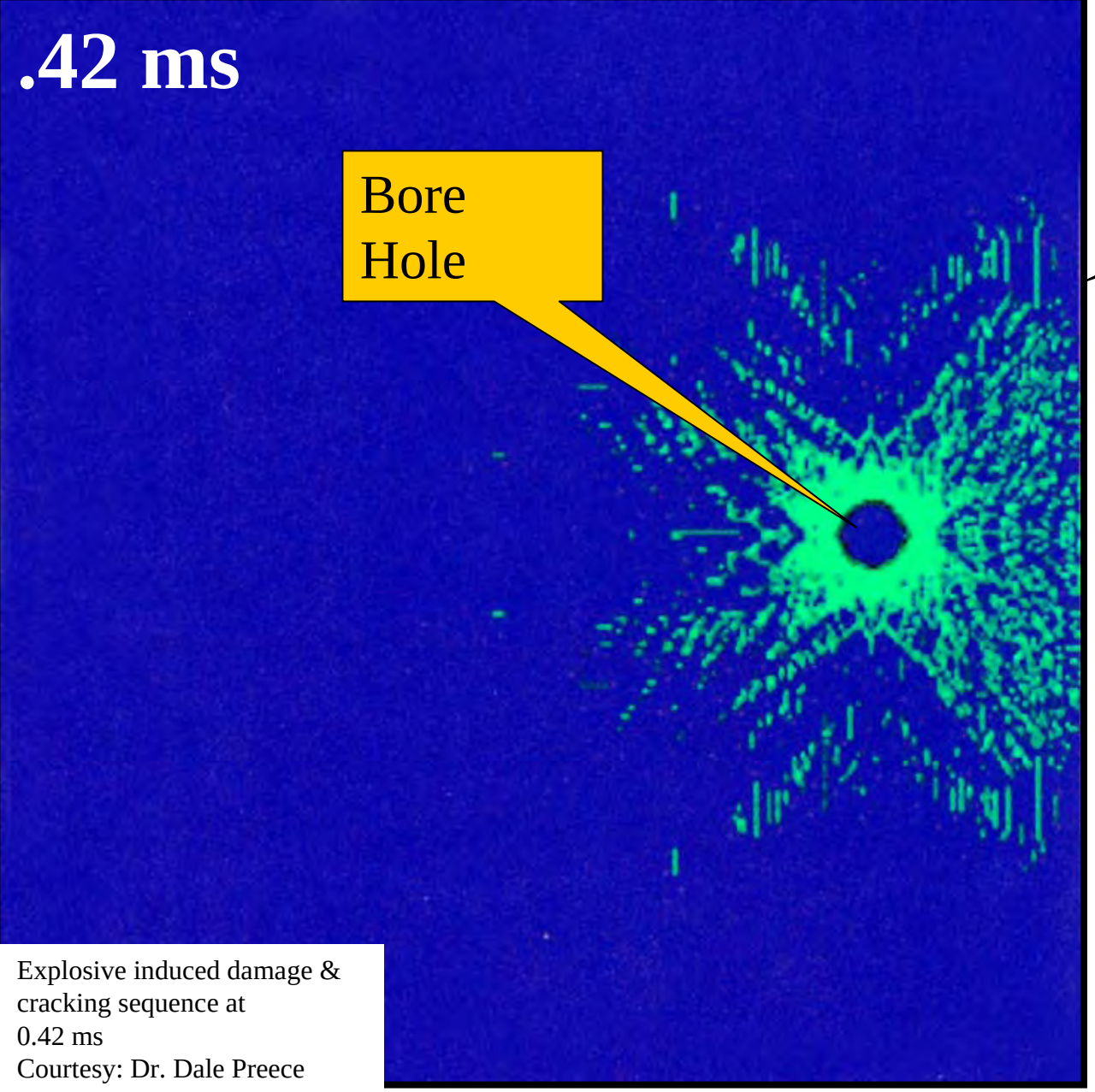

Cracking In Vicinity of Blast Hole

Explosive induced damage & cracking sequence at 0.42 ms
Courtesy: Dr. Dale Preece

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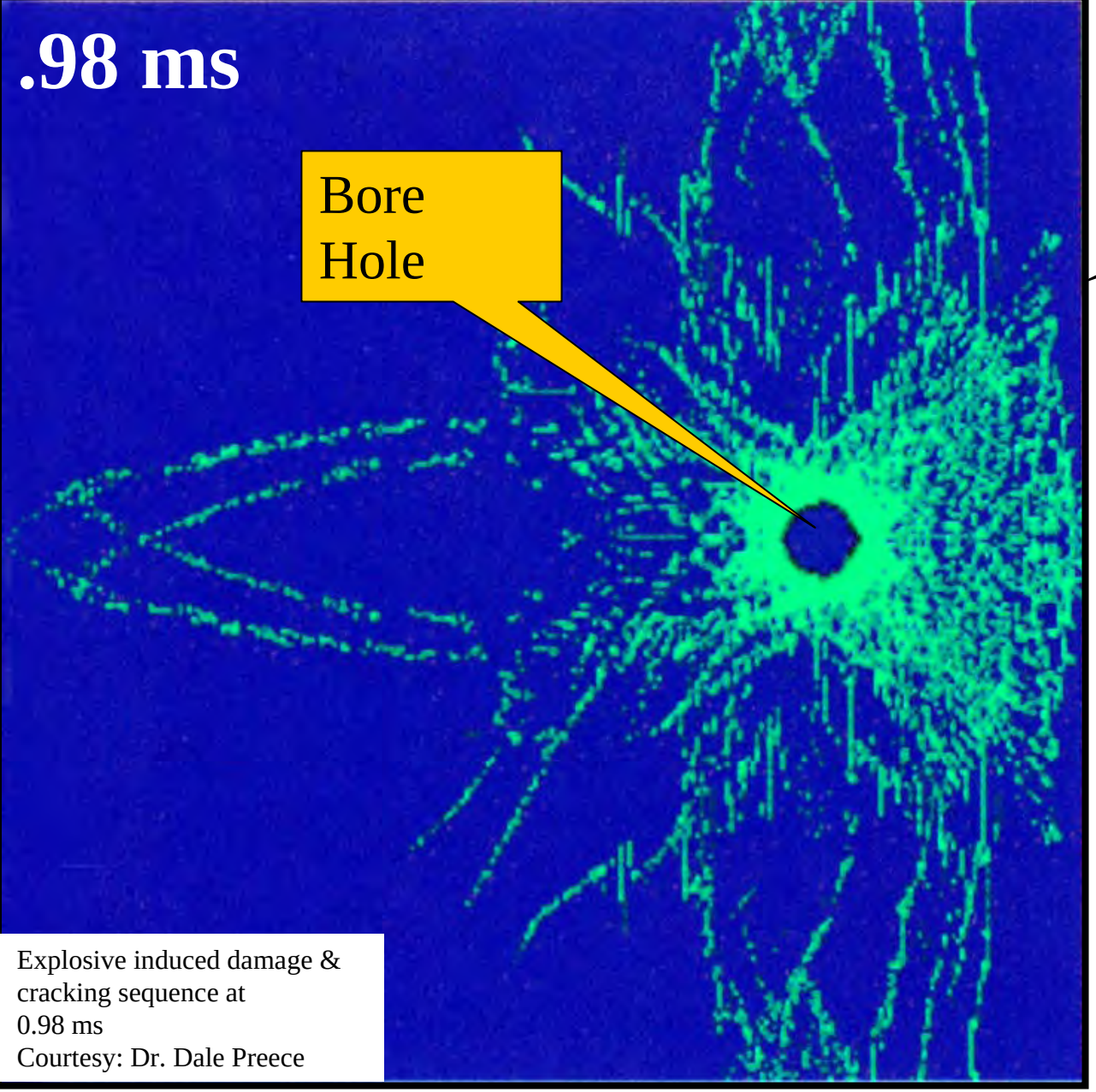

Explosive induced damage & cracking sequence at 0.98 ms
Courtesy: Dr. Dale Preece

Cracking In Vicinity of Blast Hole

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