EFEE
7th WORLD CONFERENCE ON EXPLOSIVES & BLASTING
15th - 17th September 2013 Moscow, Russia
Time countdown to the conference date: 7 days 03:16:54

New convincing results in the reduction of fines obtained thanks to digital simulation

A case study in an open-pit mine

By Dr Thierry BERNARD

Philippe DOZOLME

T&T DNA-Blast Software

Imagine you can fix

a blast fragmentation issue

in one day !

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An Incredible Story

of a quarry in a competitive environment that was loosing money because of fragmentation technical issues and that fixed them thanks to blasting simulation

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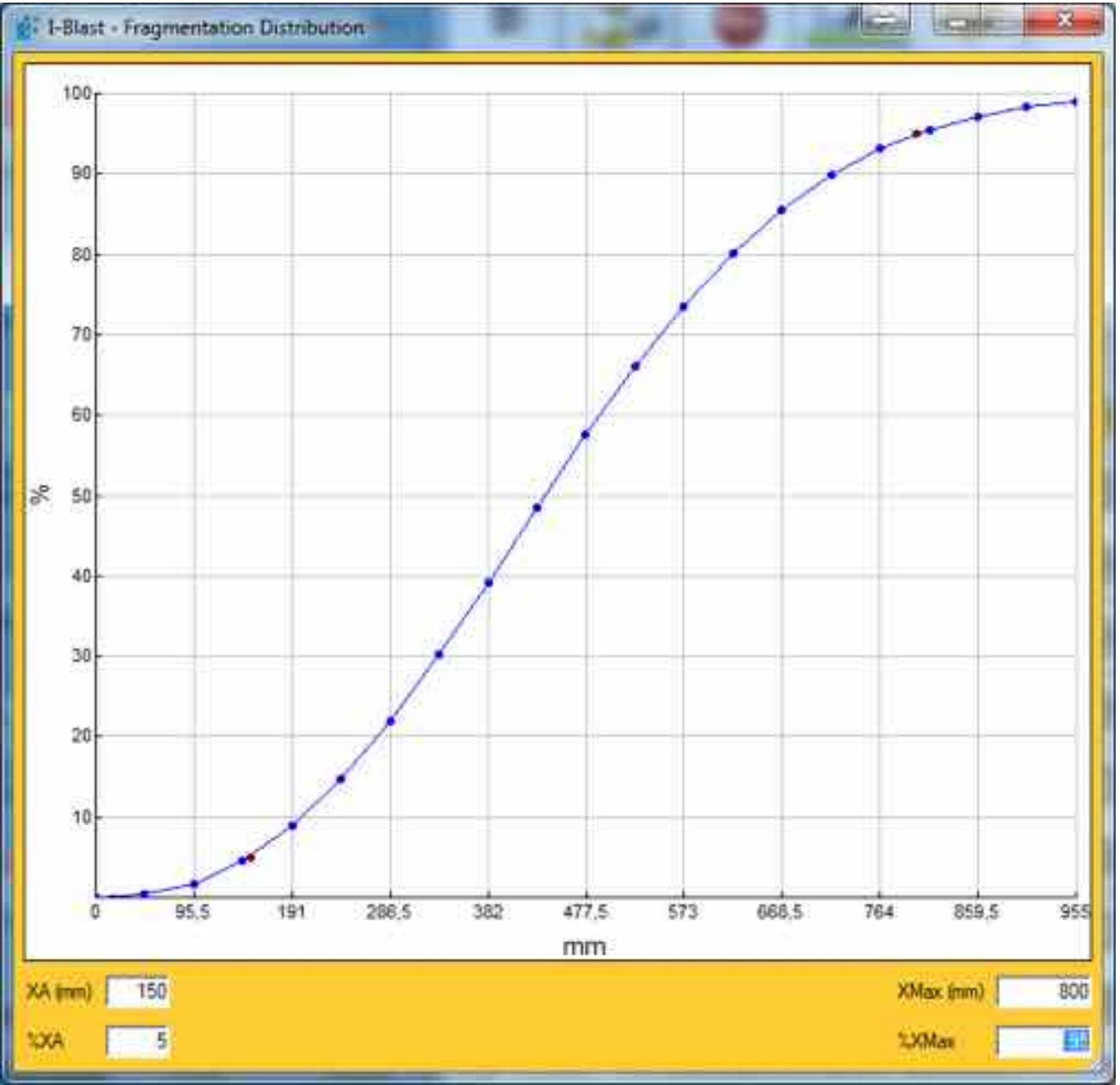
Fragmentation Objective of the quarry



>800 mm, 5%

<150 mm, 5 %

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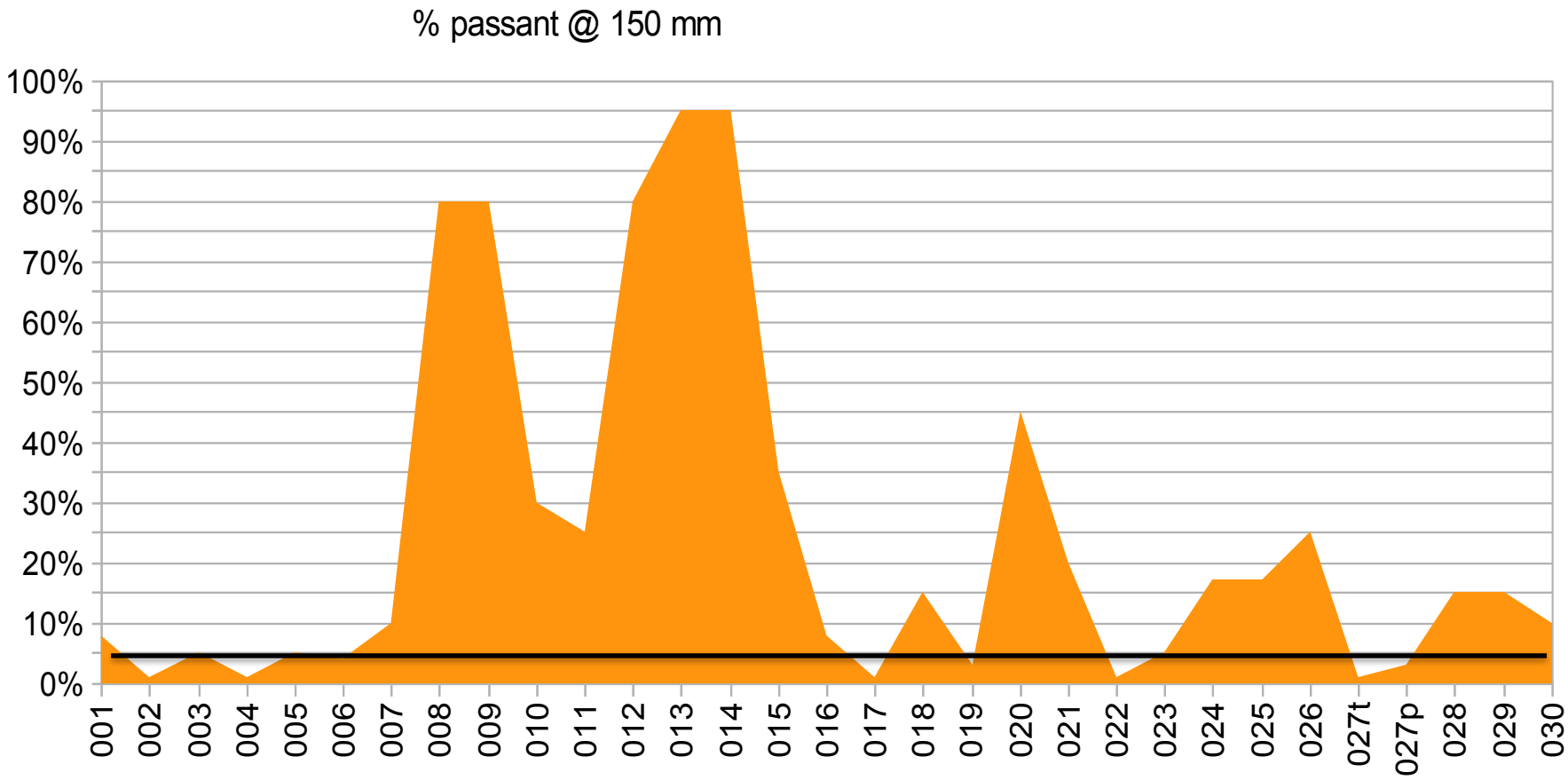
Losing Ore

TEREX

T&T
DNA-Blast Software
FOR A MILLION DOLLAR BENEFIT

Percentage passing size @ 150mm (Blasts 1 à 30)



5 % objective achieve in only 35,5% of blasts

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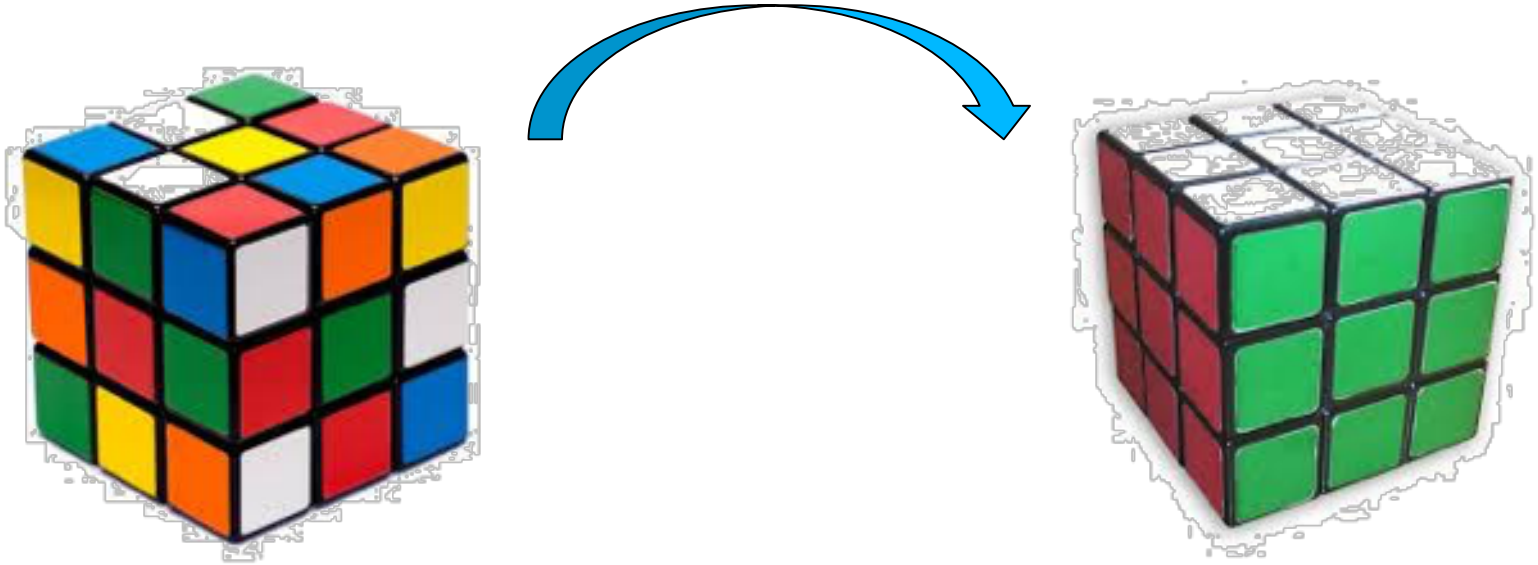
Losing Ore, Losing money

Let’s find a solution



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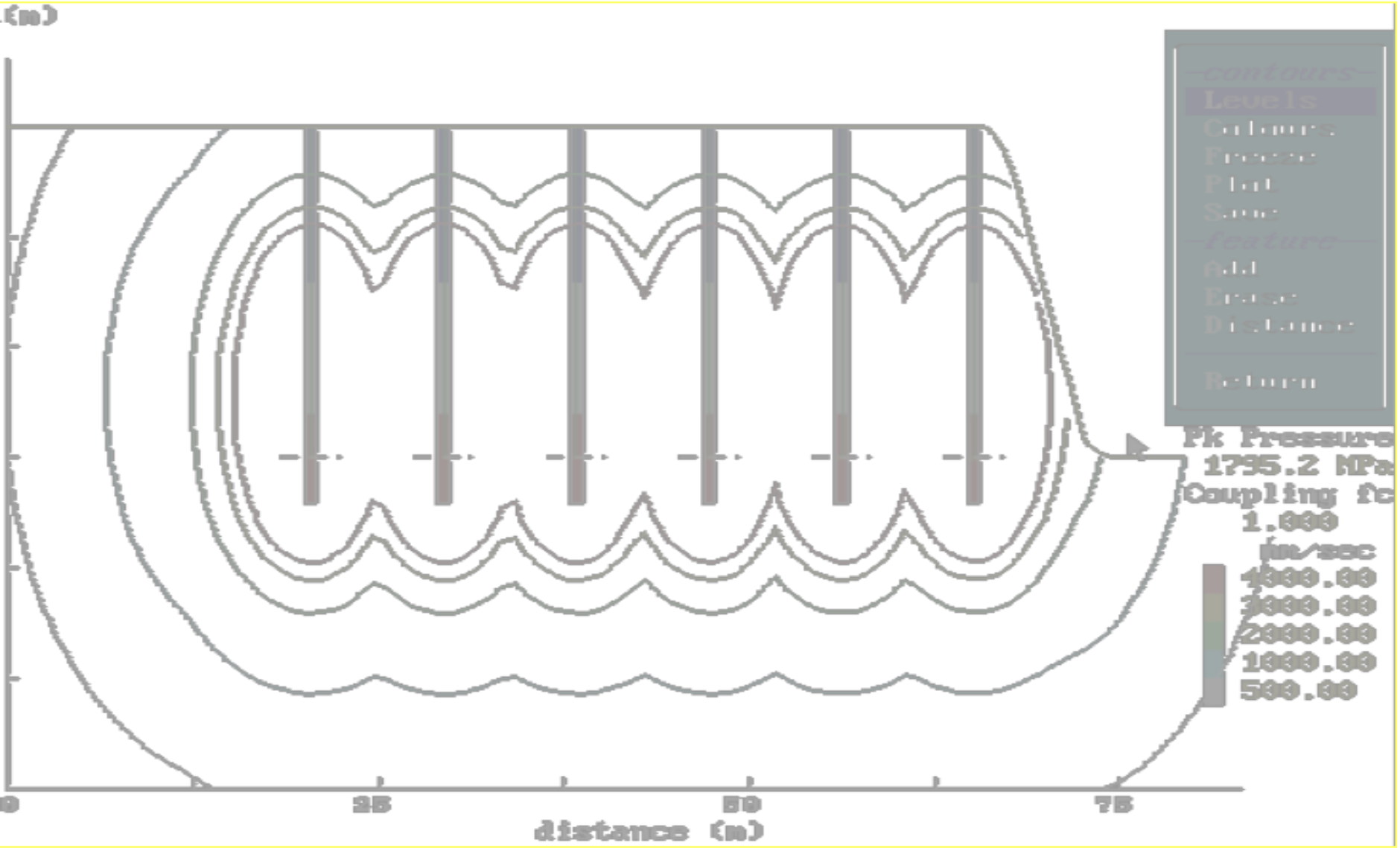
Standard Statistical Software



Kuz-Ram model

KUZ-RAM FRAGMENTATION ANALYSIS

Project	BILA STRANA, w = 5,0 m a = 3,5 m, ANFO patrone
Rock Type	bijelli vapnenci

Intact Rock Properties		
Rock Factor		
Rock Type	vapnenac	
Rock Specific Gravity	[illegible]	SG
Elastic Modulus	[illegible]	GPa
UCS	[illegible]	MPa

Jointing		
Spacing	[illegible]	m
Dip	[illegible]	deg
Dip Direction	[illegible]	deg
In-situ block	[illegible]	m

Pattern Design		
Staggered or square	1	
Hole Diameter - vapnenac	55	mm
Charge Length	9,6	m
Burden	5	m
Spacing	3,5	m
Drill Accuracy SD	0,1	m
Bench Height	12,5	m
Face Dip Direction	85	deg
Powder Factor	0,03	kg/tonne
Charge Density	0,09	kg/m³
Charge Weight per hole	20,83	kg/hole

Blastability Index	5,97	
Average Size of Mate	4	cm
Uniformity Exponent	0,65	
Characteristic Size	0,07	m

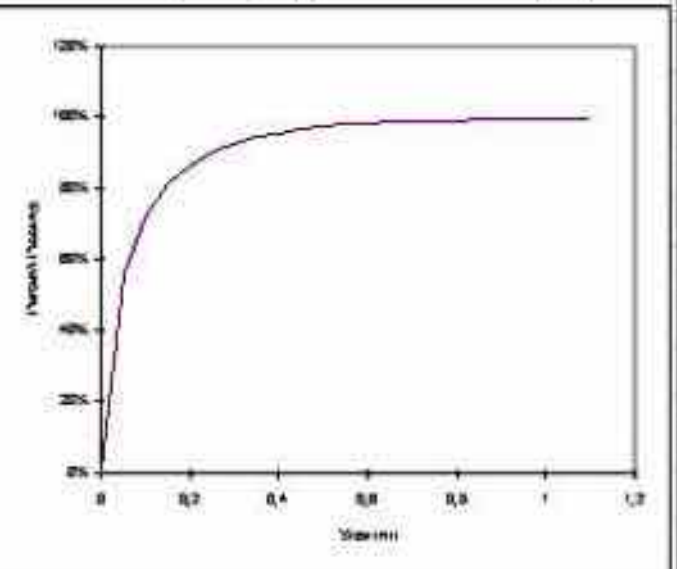
Notes

Square pattern = 1, staggered pattern

Explosives		
Density	[illegible]	SG
RWS	[illegible]	Anfo
Nominal VOD	[illegible]	m/s
Effective VOD	[illegible]	m/s
Explosive Strength	100	

Fragmentation Target Parameters		
Oversize	0,12	m
Optimum	0,7	m
Undersize	0,03	m

Predicted Fragmentation		
Percent Oversize	23,6%	m
Percent In Range	32,0%	m
Percent Undersize	44,4%	m



Percent Passing	Size (m)
0,0%	0
55,8%	0,05
72,3%	0,10
81,2%	0,15
86,6%	0,20
90,2%	0,25
92,7%	0,30
94,5%	0,35
96,7%	0,40
96,7%	0,45
97,4%	0,50
97,9%	0,55
98,4%	0,60
98,7%	0,65
98,9%	0,70
99,1%	0,75
99,3%	0,80
99,4%	0,85
99,5%	0,90
99,6%	0,95
99,7%	1,00
99,7%	1,05
99,8%	1,10

Kuznetsov Equation

$$Xav. = A\,K^{-0.8}\,Qe^{0.167}\,(115/E)^{0.633}$$

Rosin Rammler Equation

$$R = exp\left[-\left(\frac{D}{D_m}\right)^n\right]$$

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Trials and errors

- 10 proposals
- 3 blasts per option
- 30 blasts
- 20 weeks
- 5 months

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Losing Ore

Losing money

Unable to find a quick solution

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SOLUTION

Simulation based on Physic

quick and accurate versus empirical or statistical equations, trials & errors

Visual forecast

Simple, Straight forward understanding

Cost effective

Straight to the point

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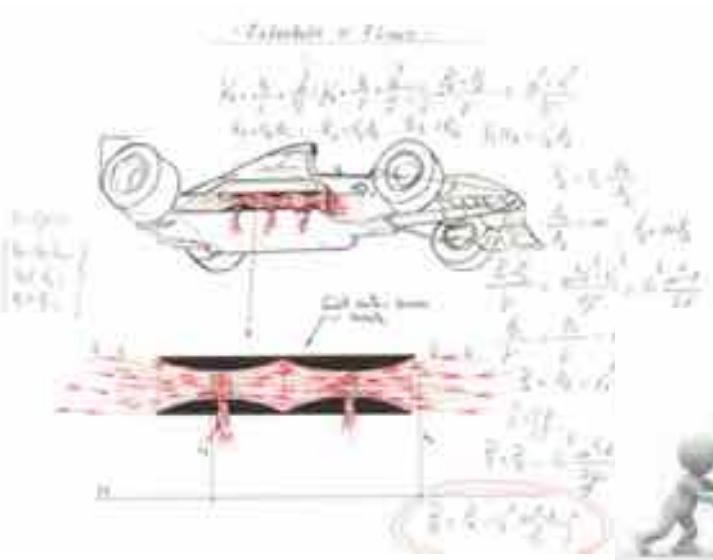
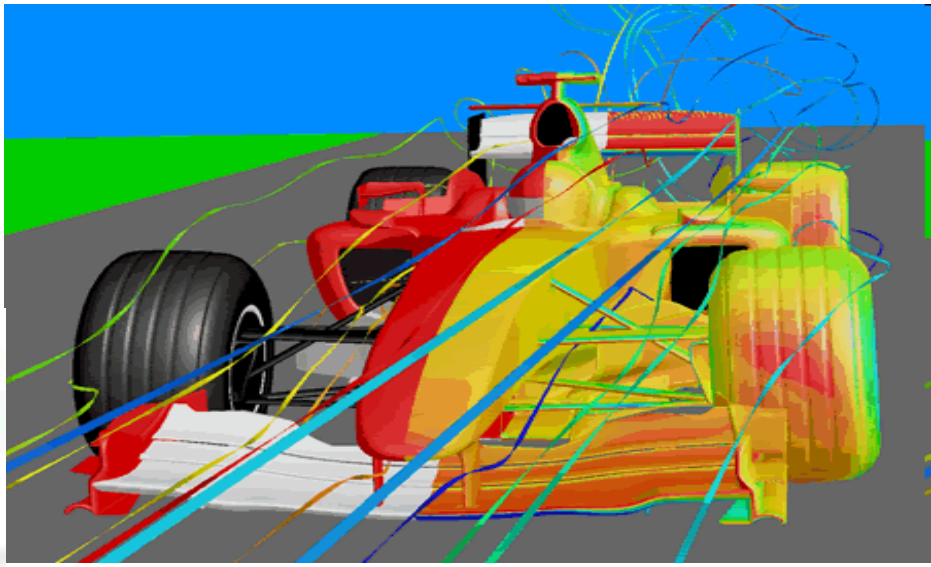
Physic Based Simulator





It is duplicating phenomenon mechanism
in order to reproduce the real world

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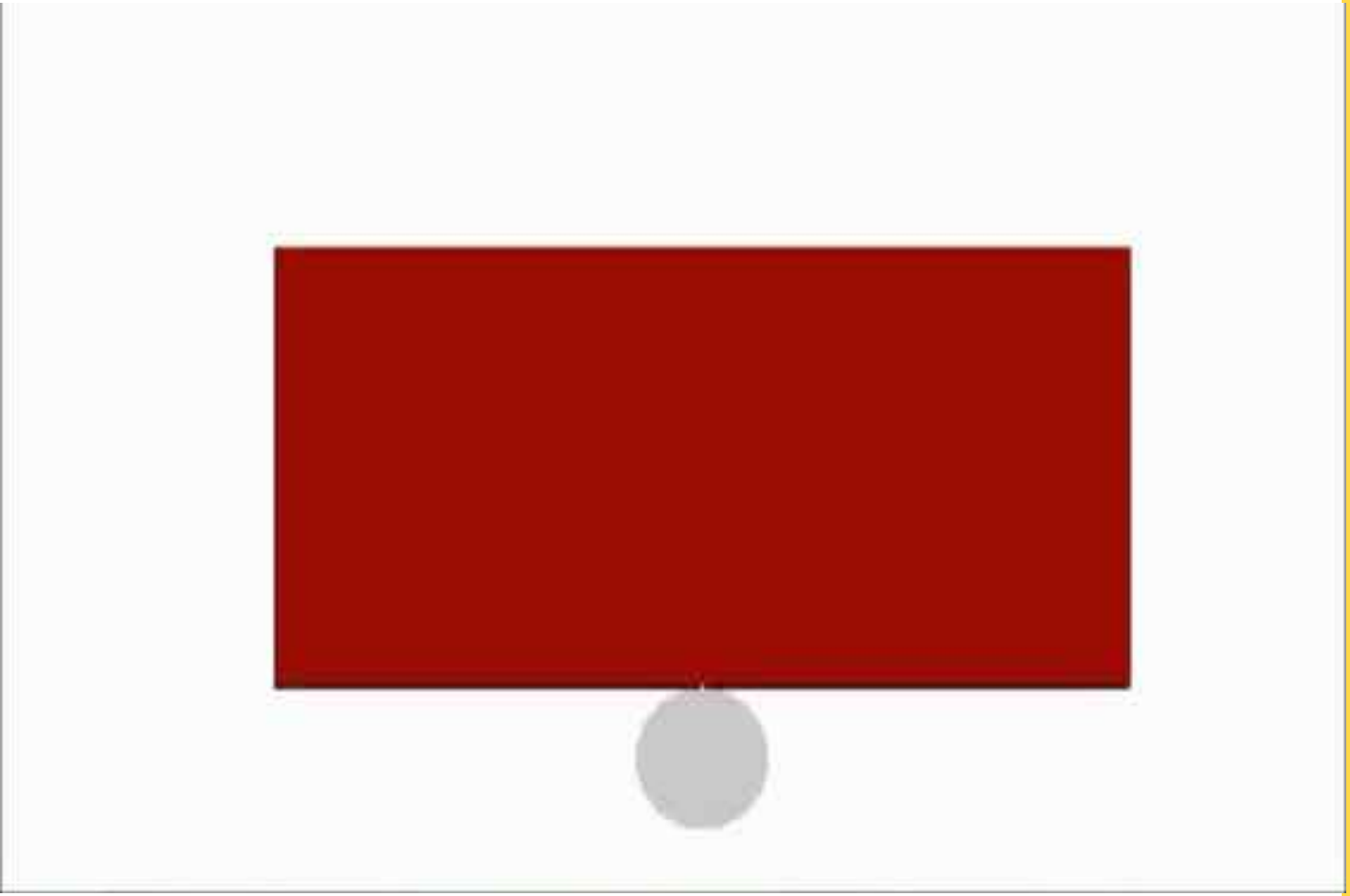
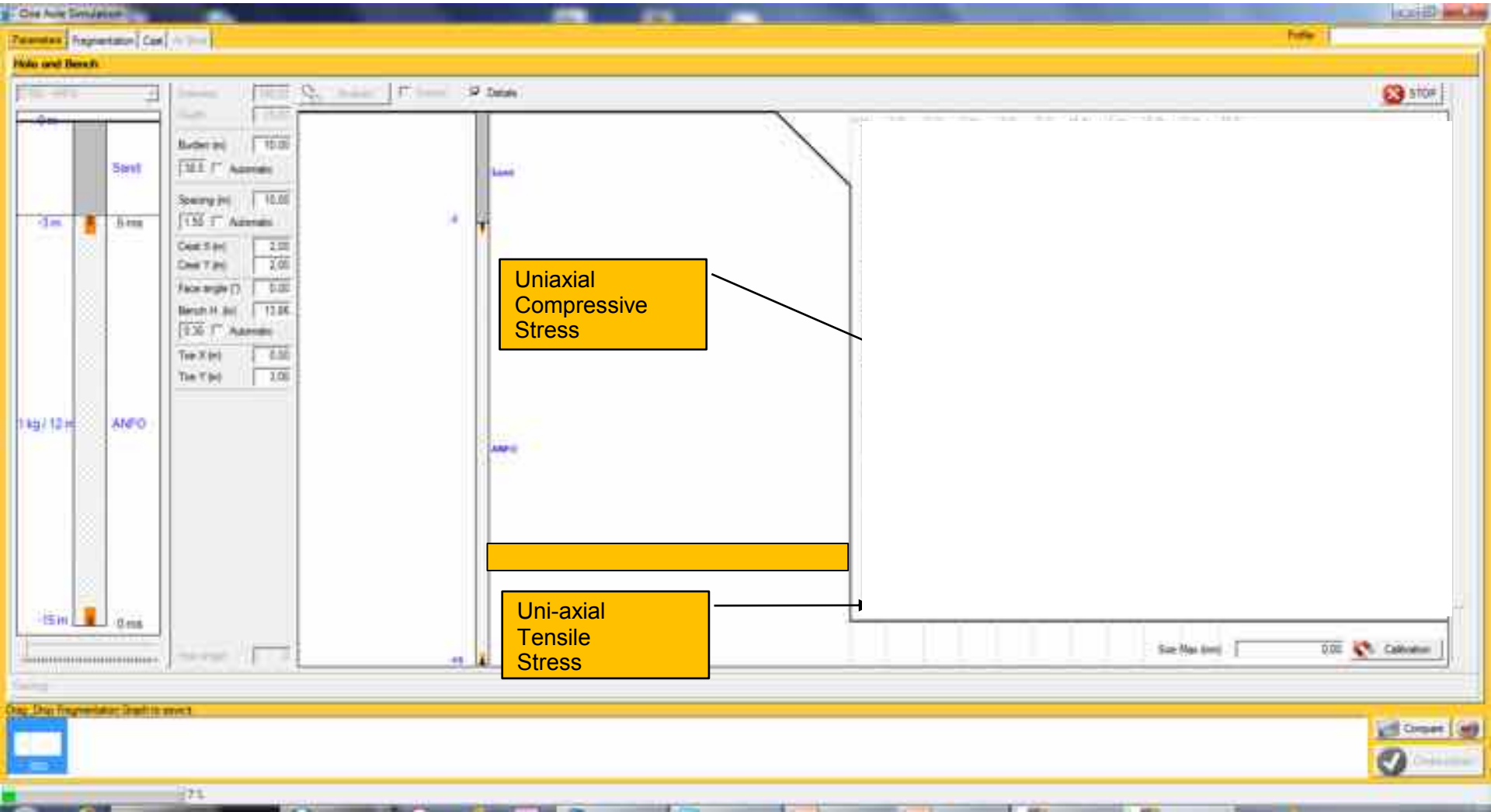
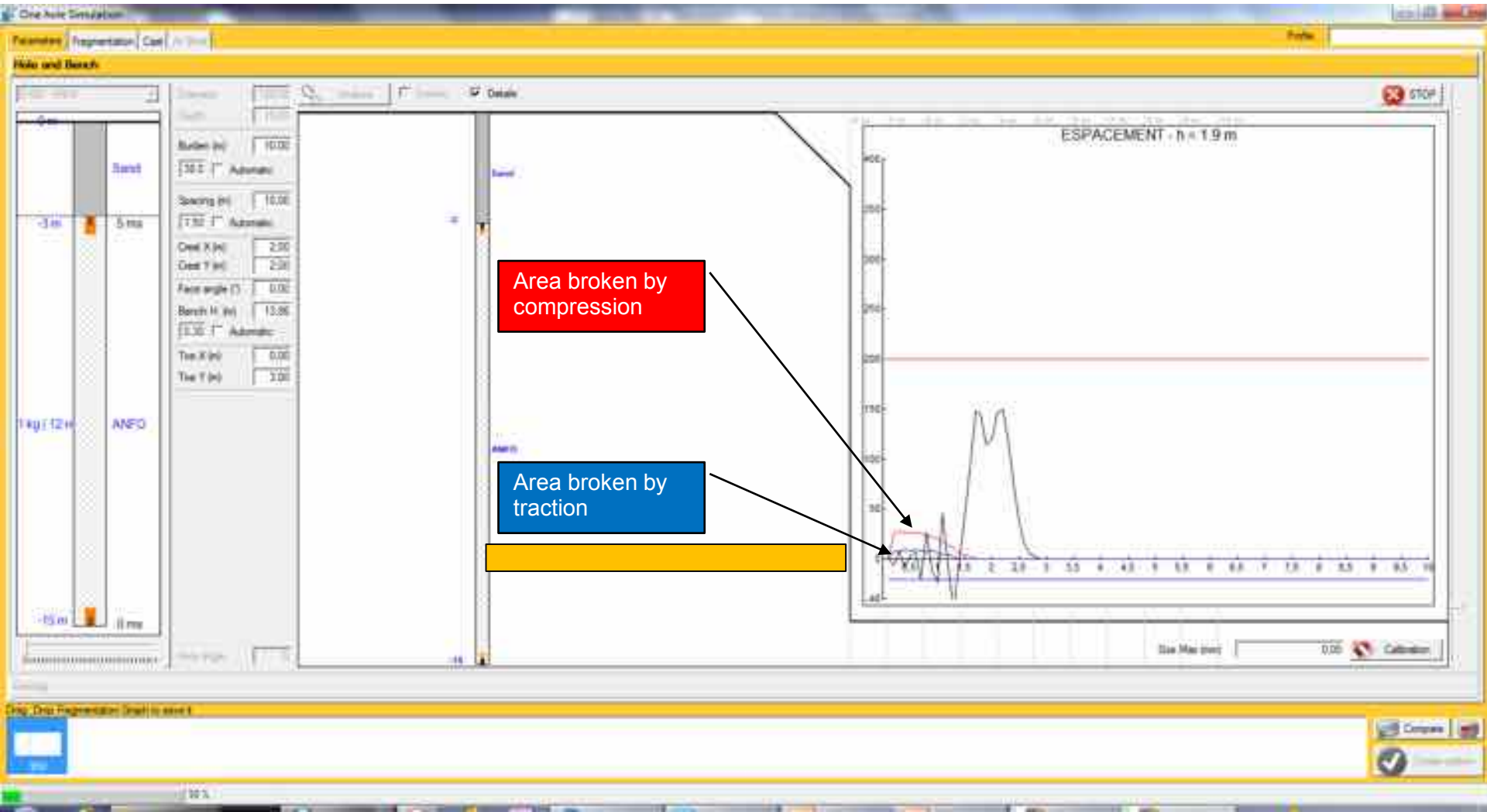


Fragmentation Simulation

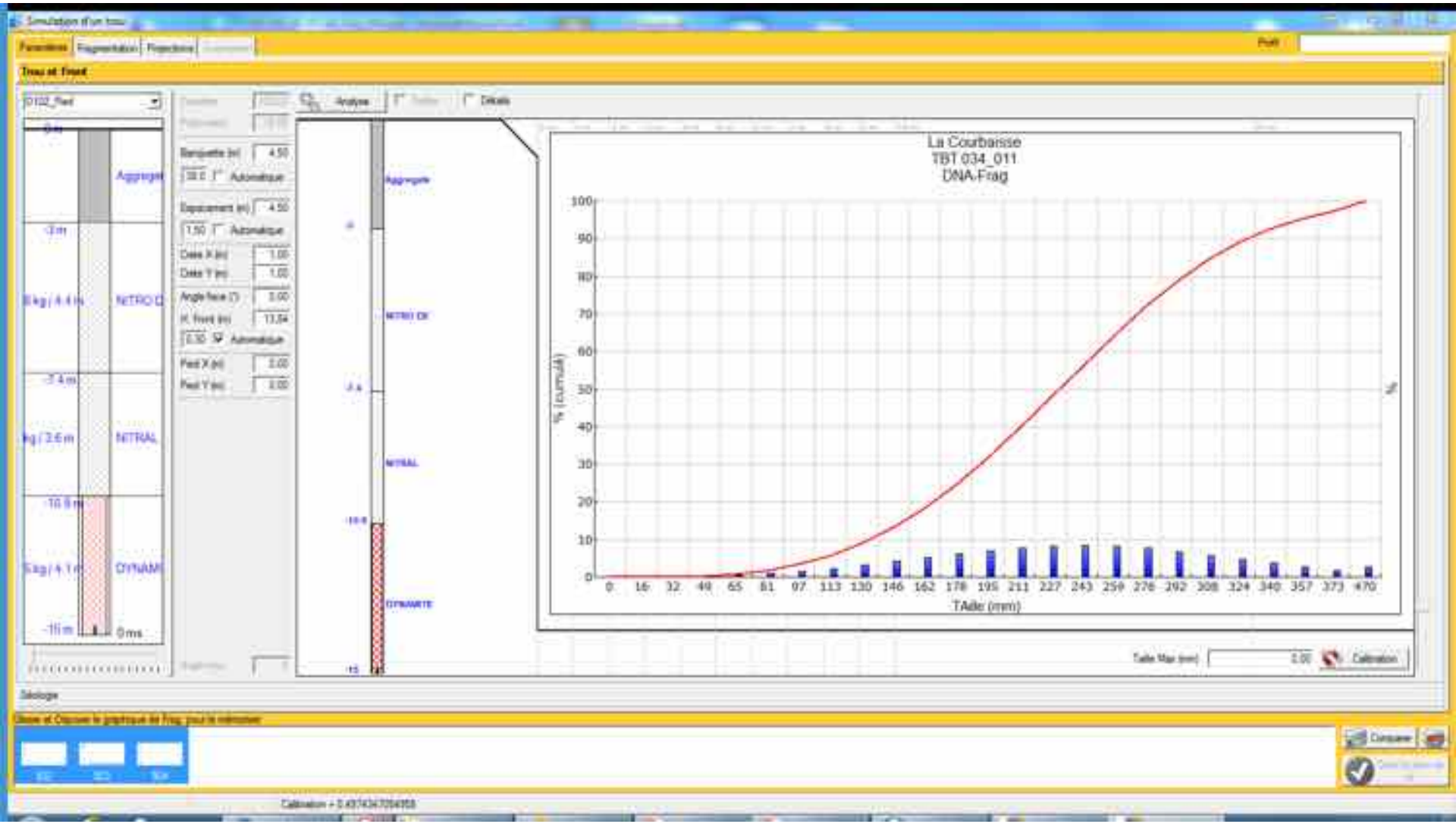
P wave propagation in a horizontal layer



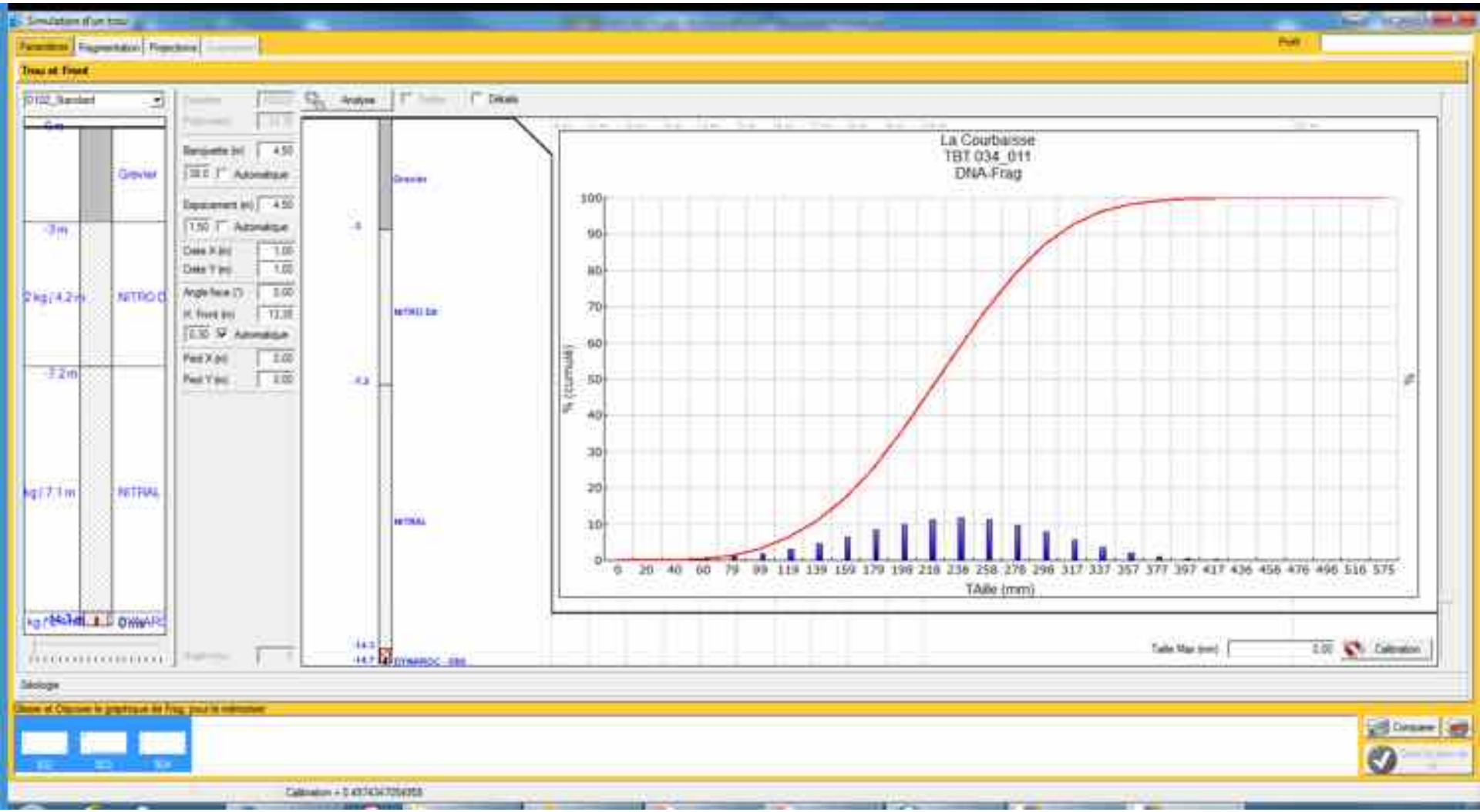
P wave propagation in a horizontal layer



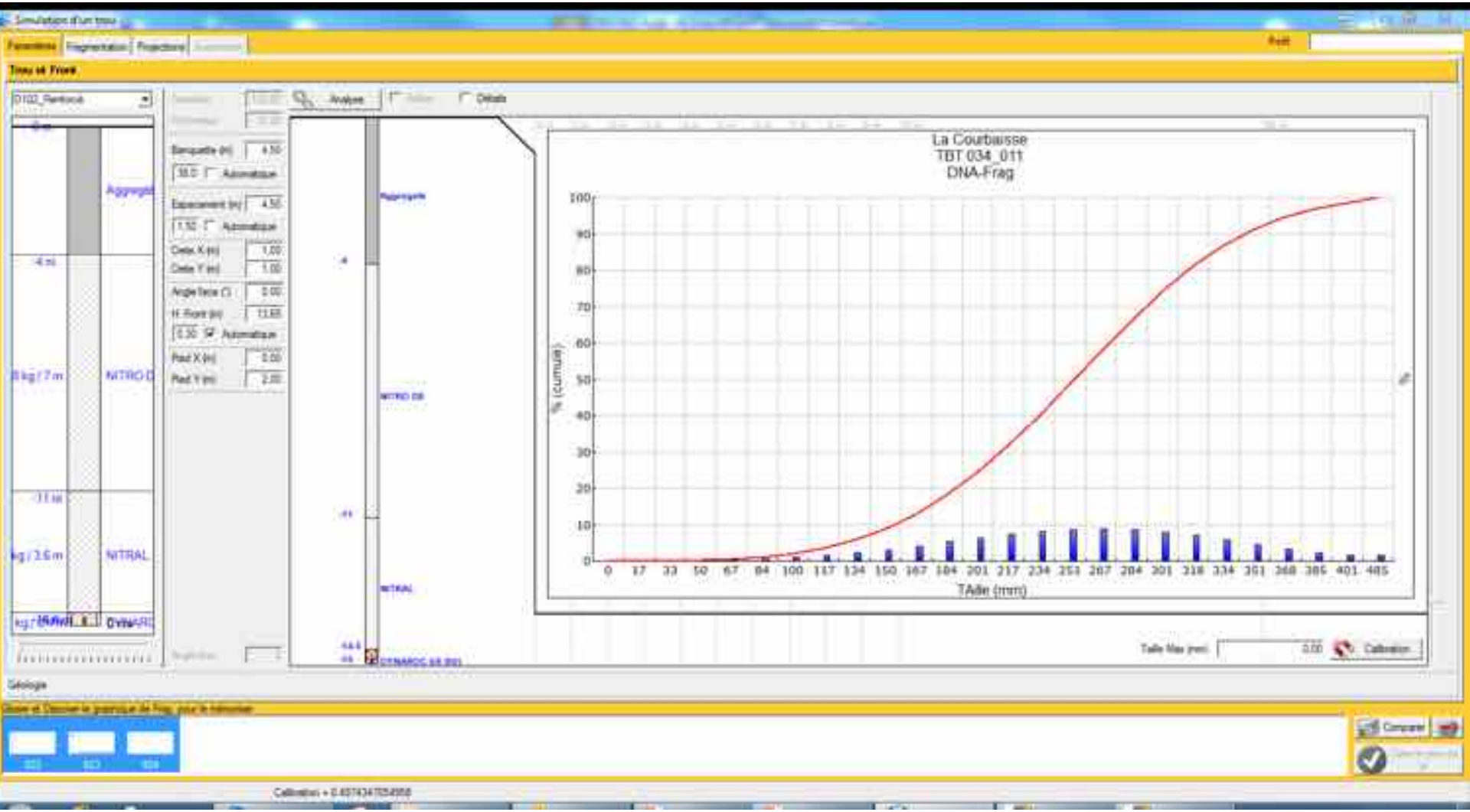
Fragmentation Simulation(#924)



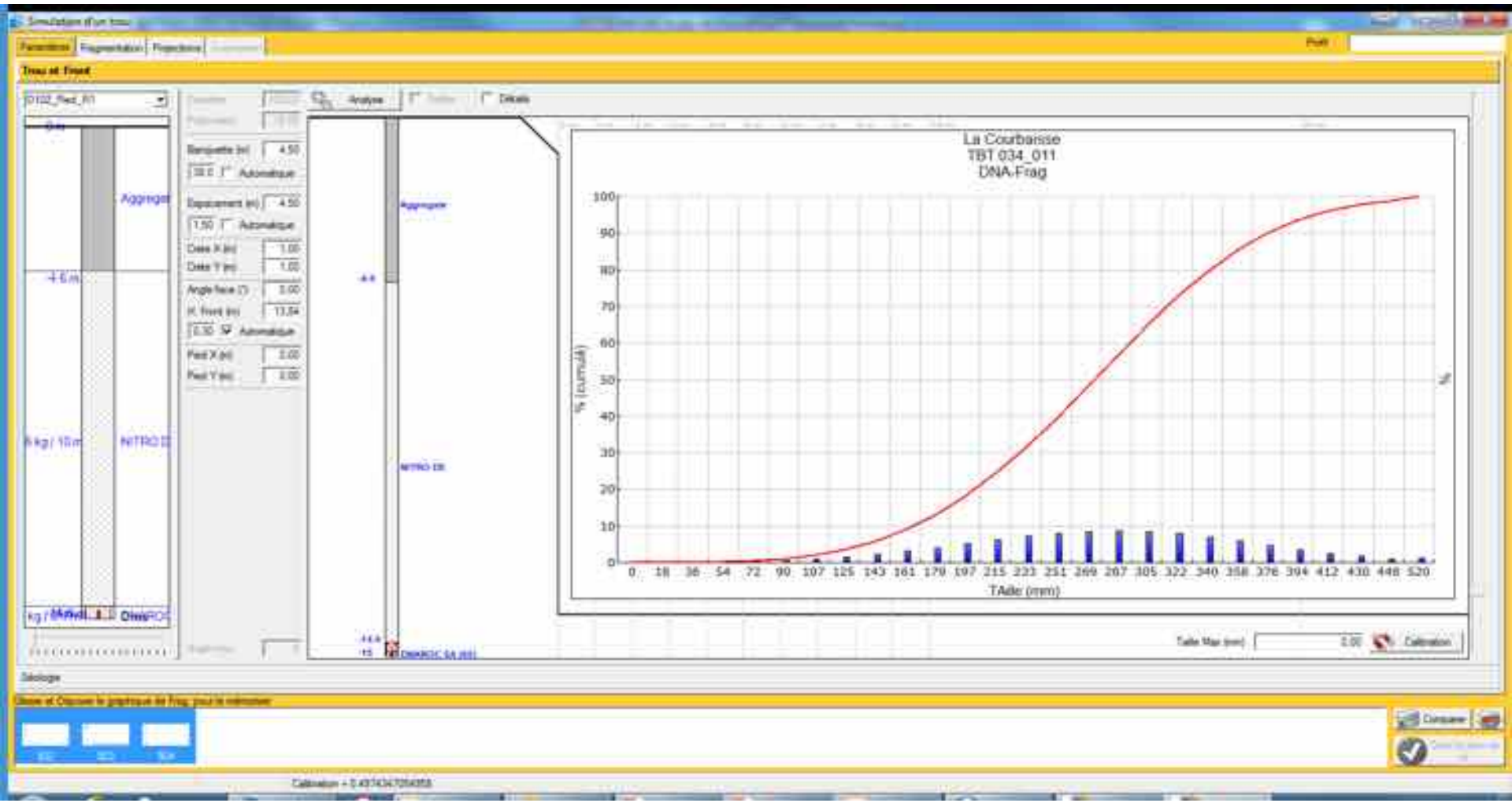
Fragmentation Simulation(#922)



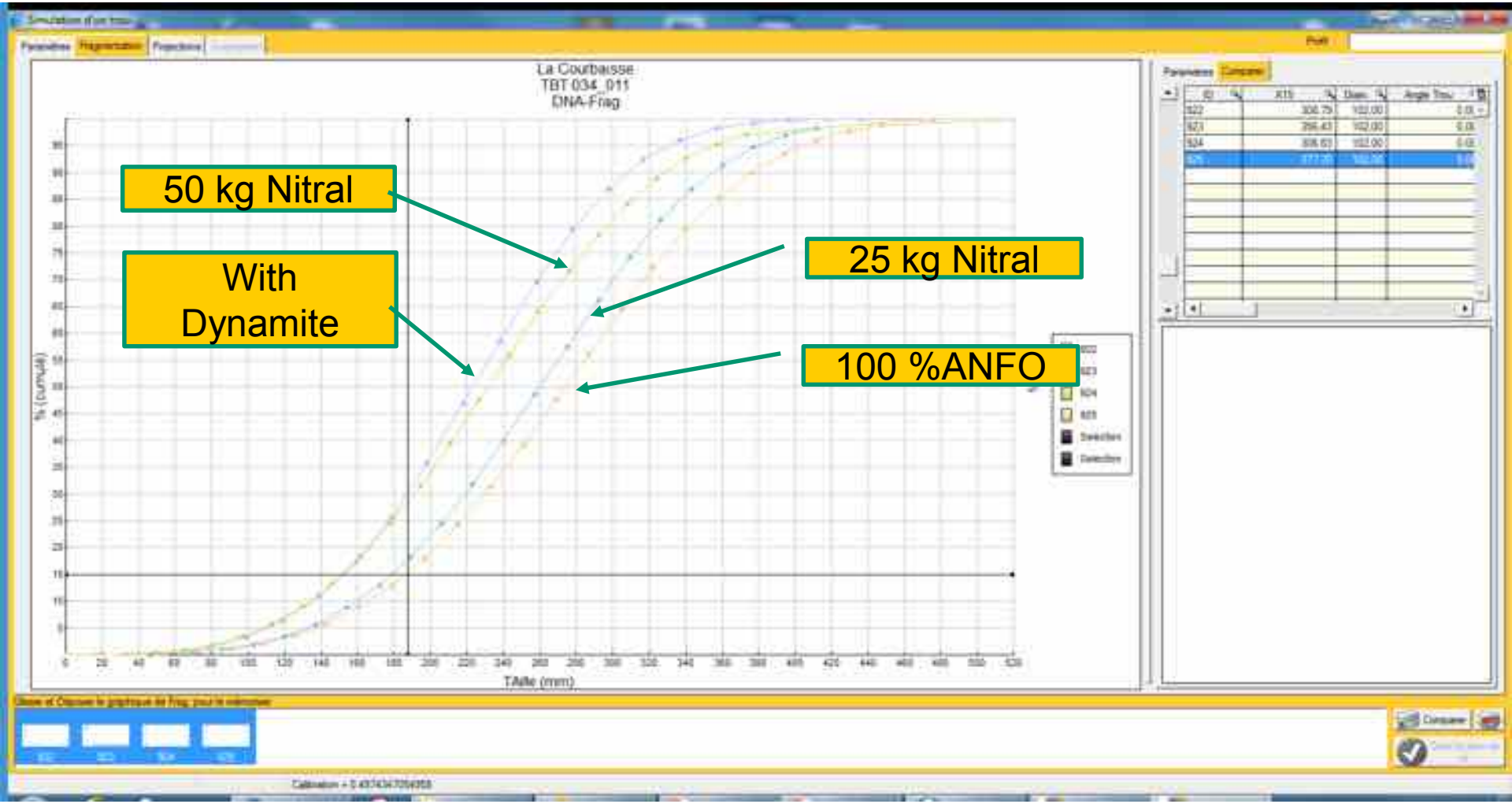
Fragmentation Simulation(#923)



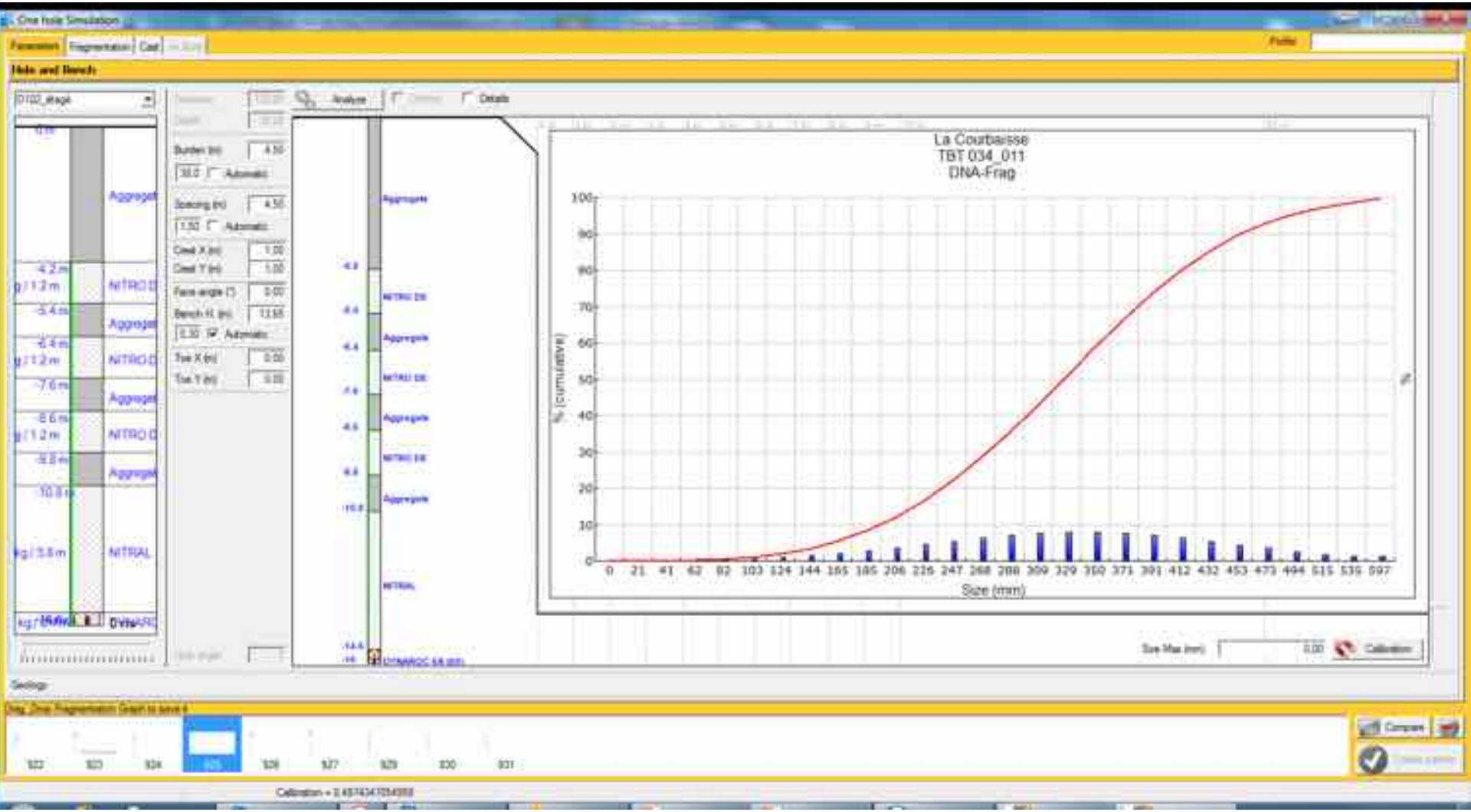
Fragmentation Simulation(#925)



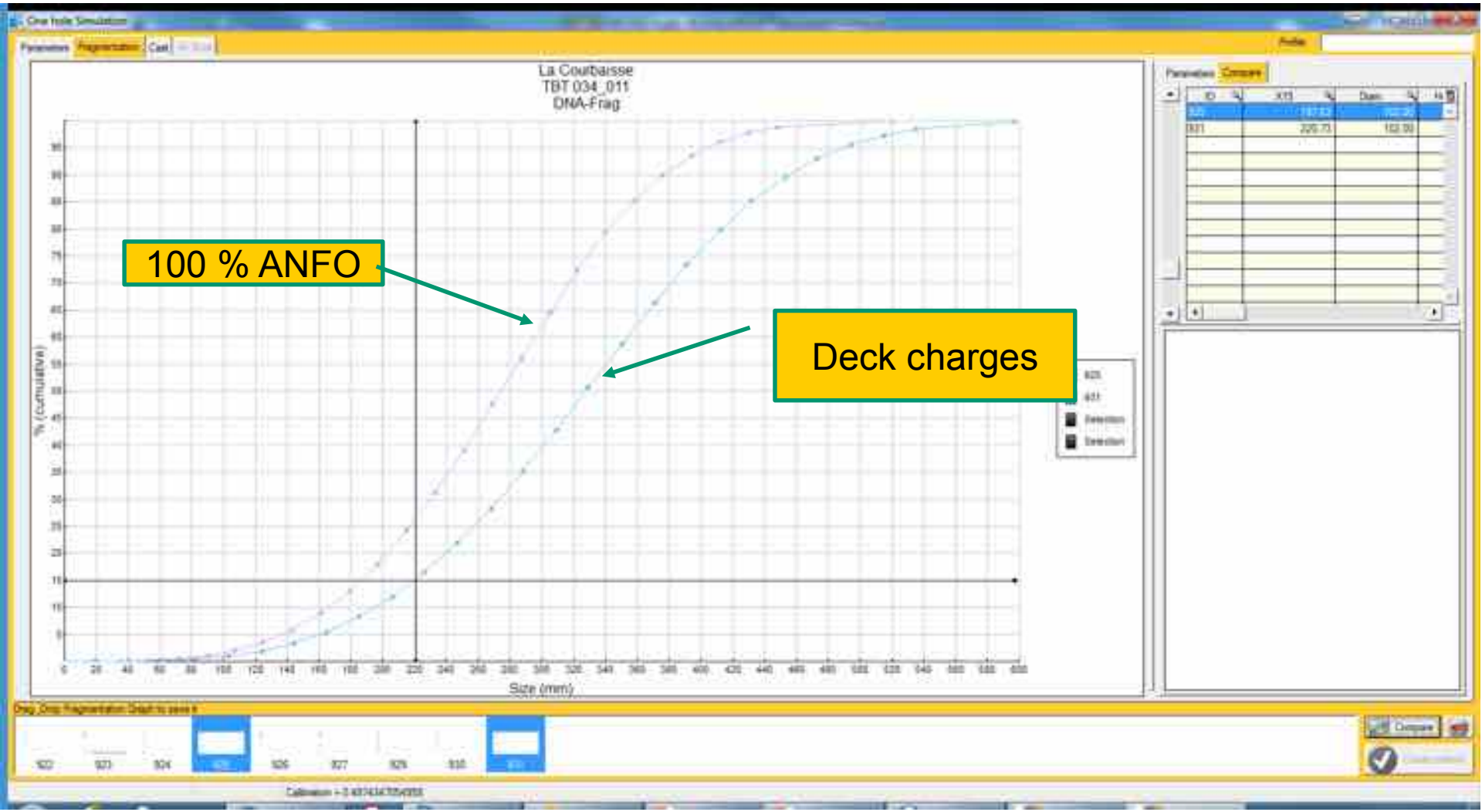
Compared Fragmentation



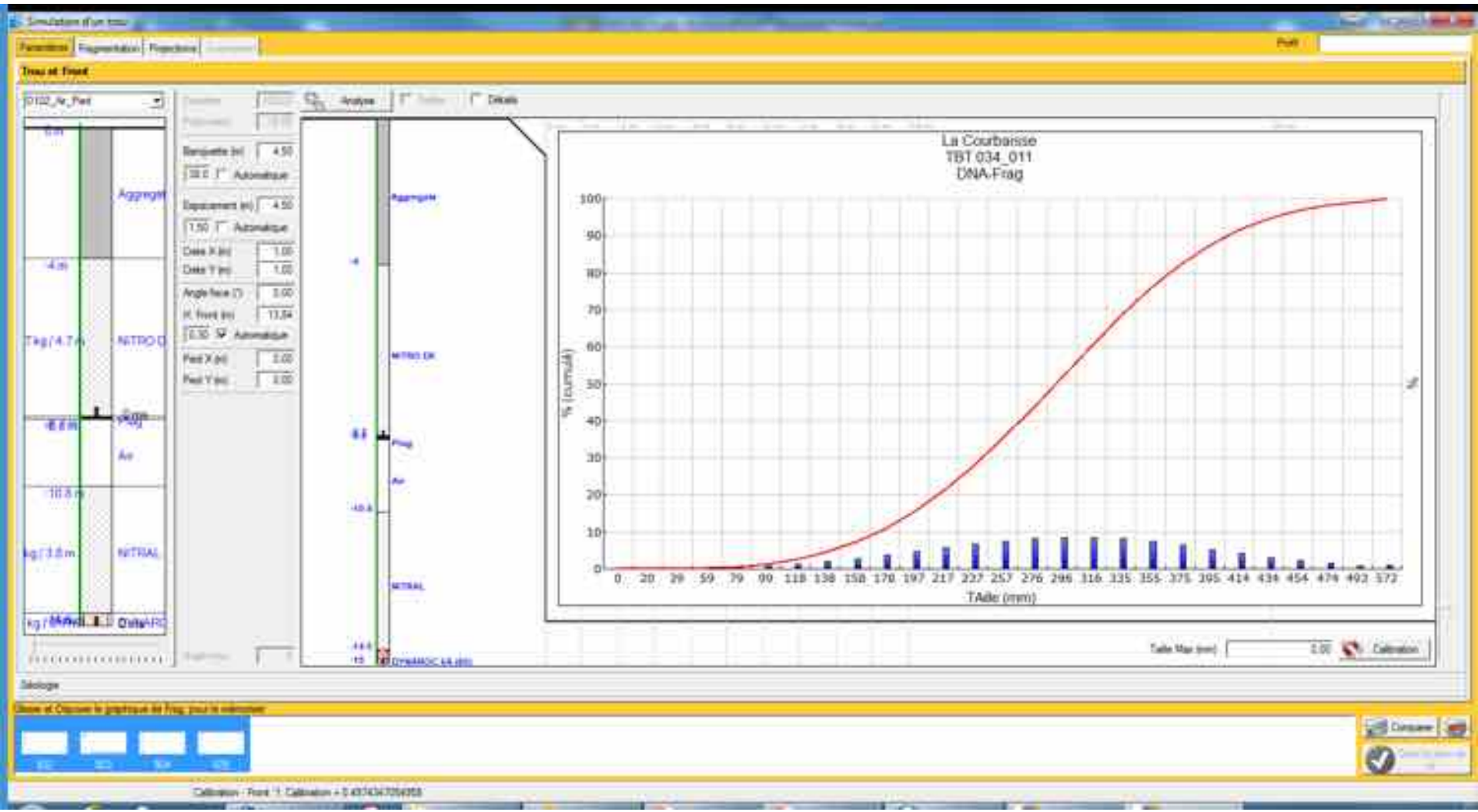
Fragmentation Simulation(#926)



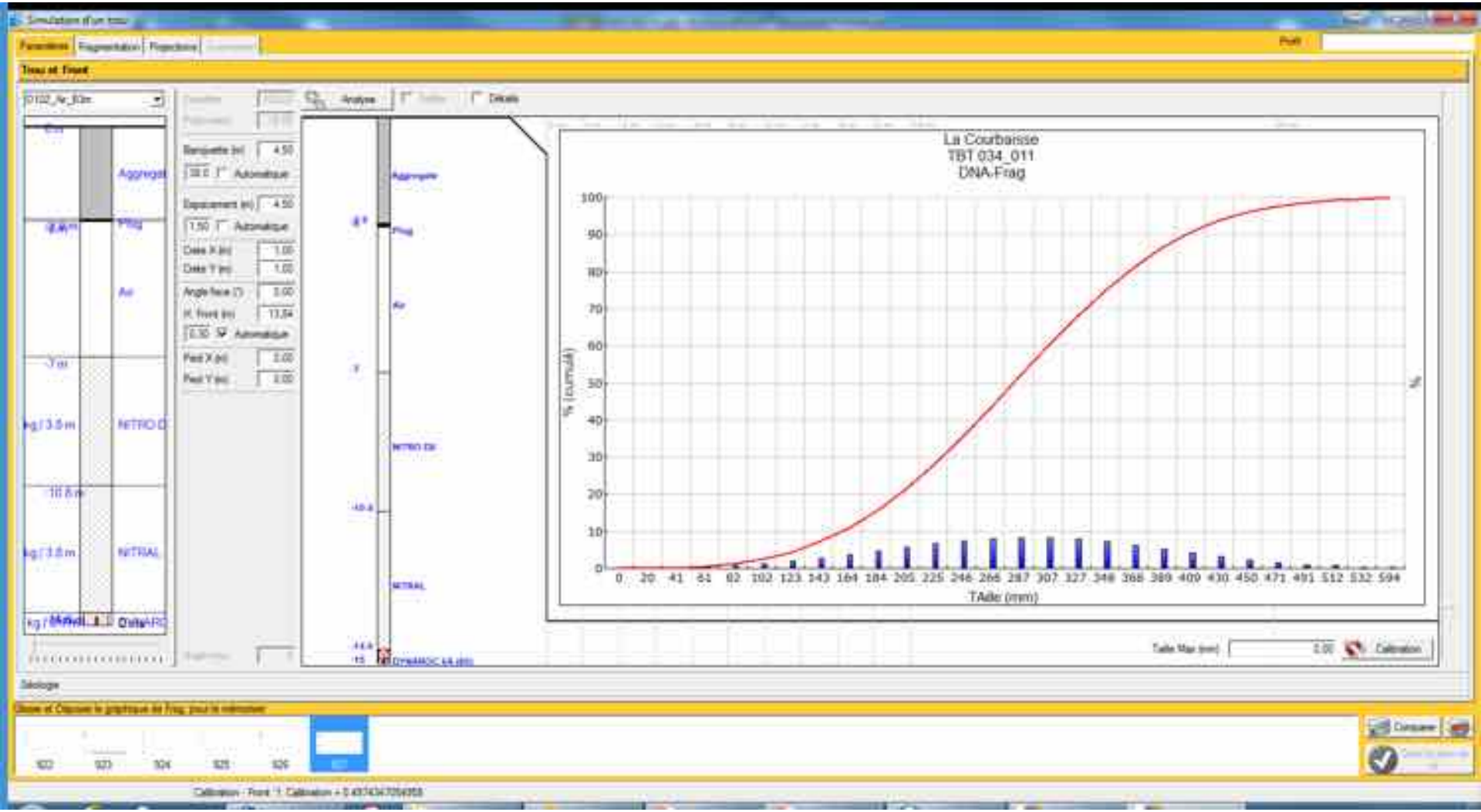
Compared Fragmentation



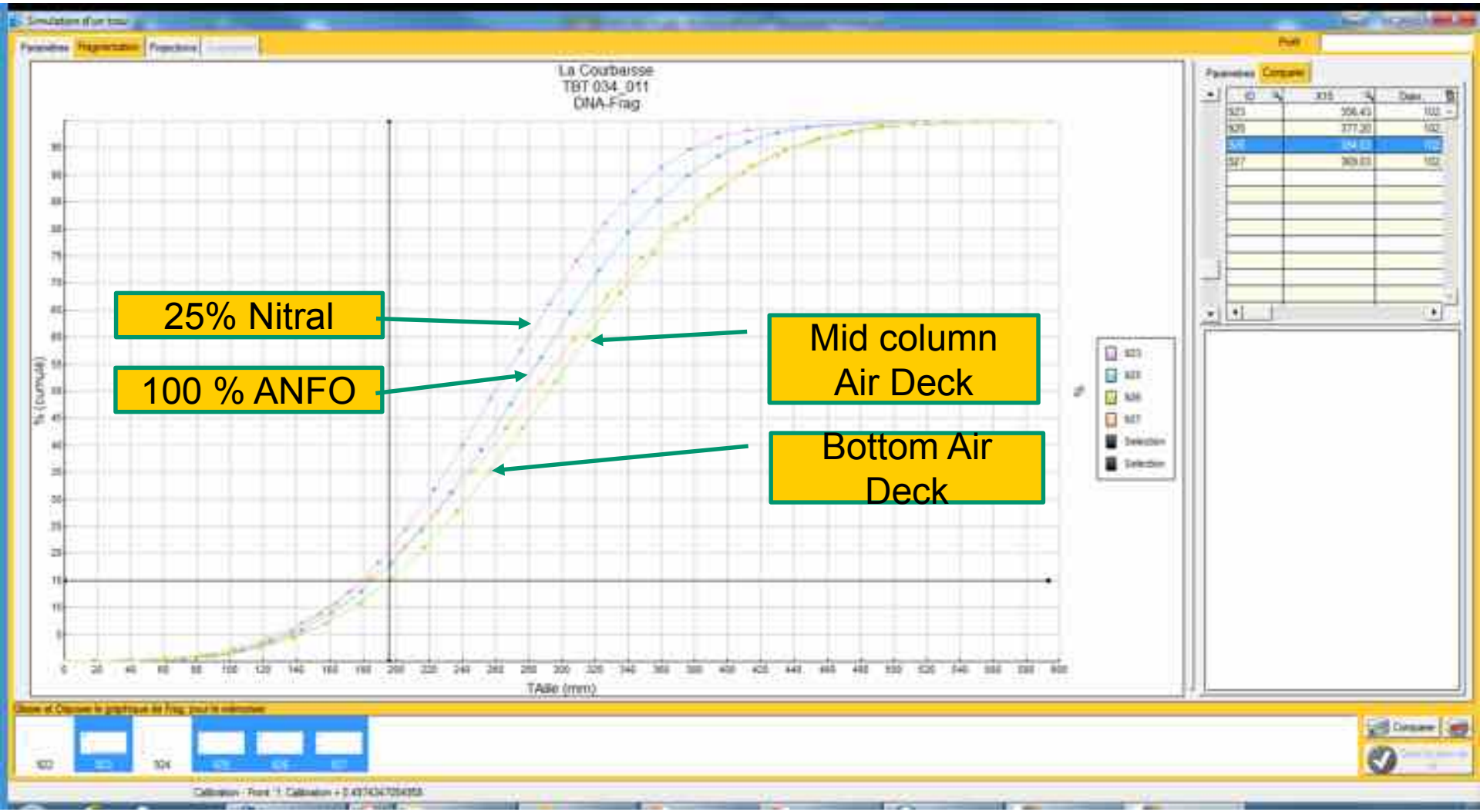
Fragmentation Simulation (#926)



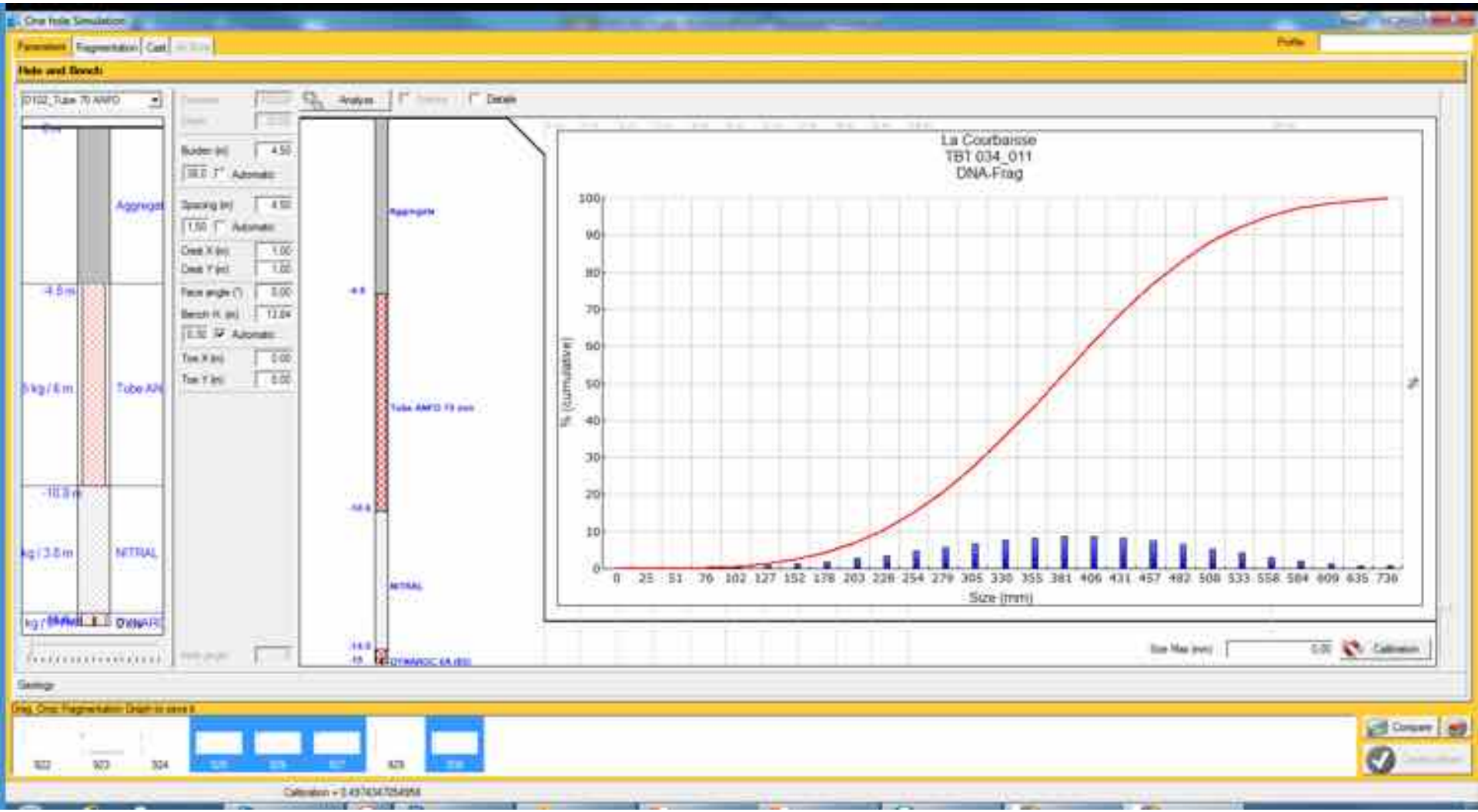
Fragmentation Simulation 926)



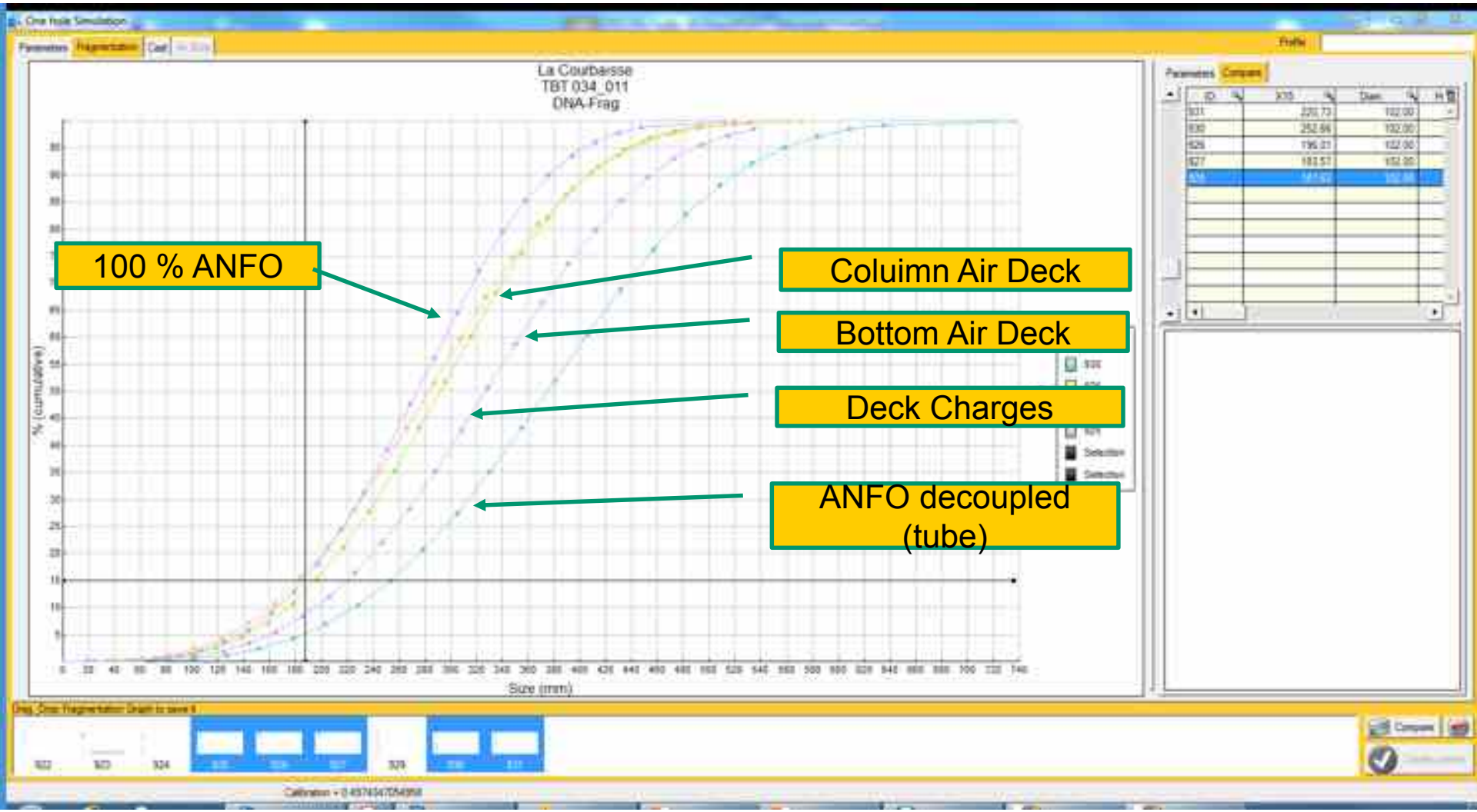
Compared Fragmentation



Fragmentation Simulation (#929)



Compared Fragmentation Summary

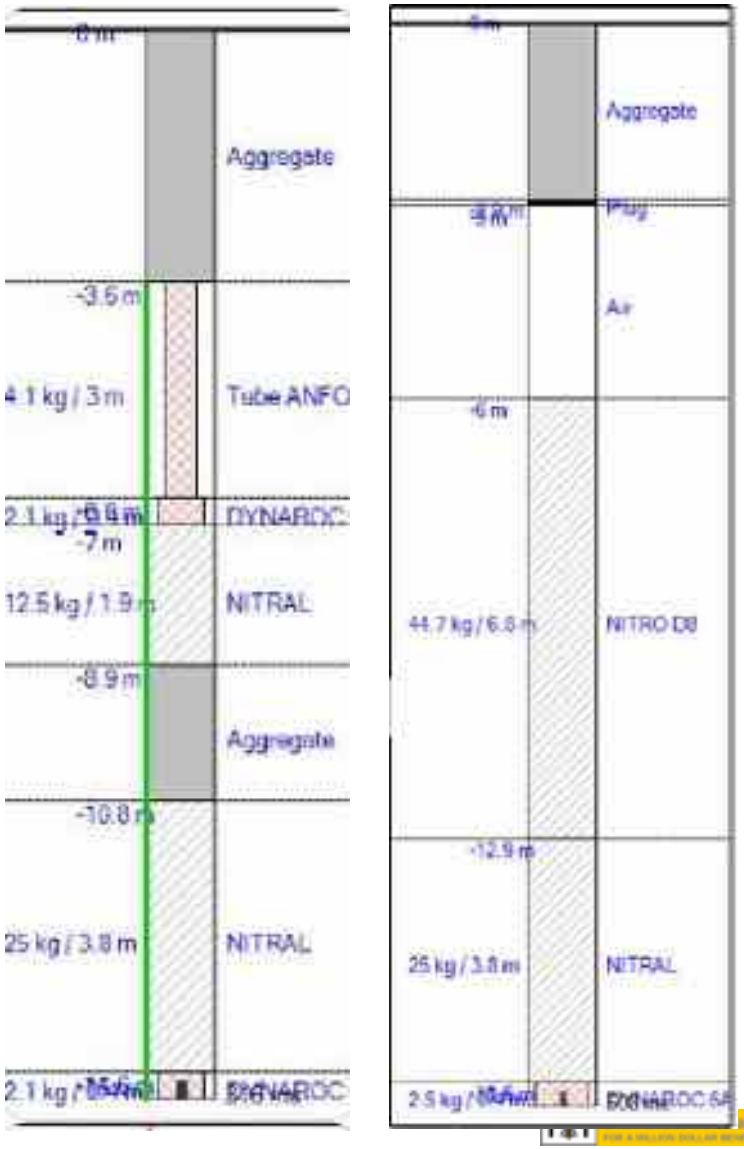


- Taux de fines minimal avec combinaison de
- Charges étagées + chargement d'ANFO en tube 70 mm

Final loading solution

Reducing Bore Hole Shock Pressure by using :

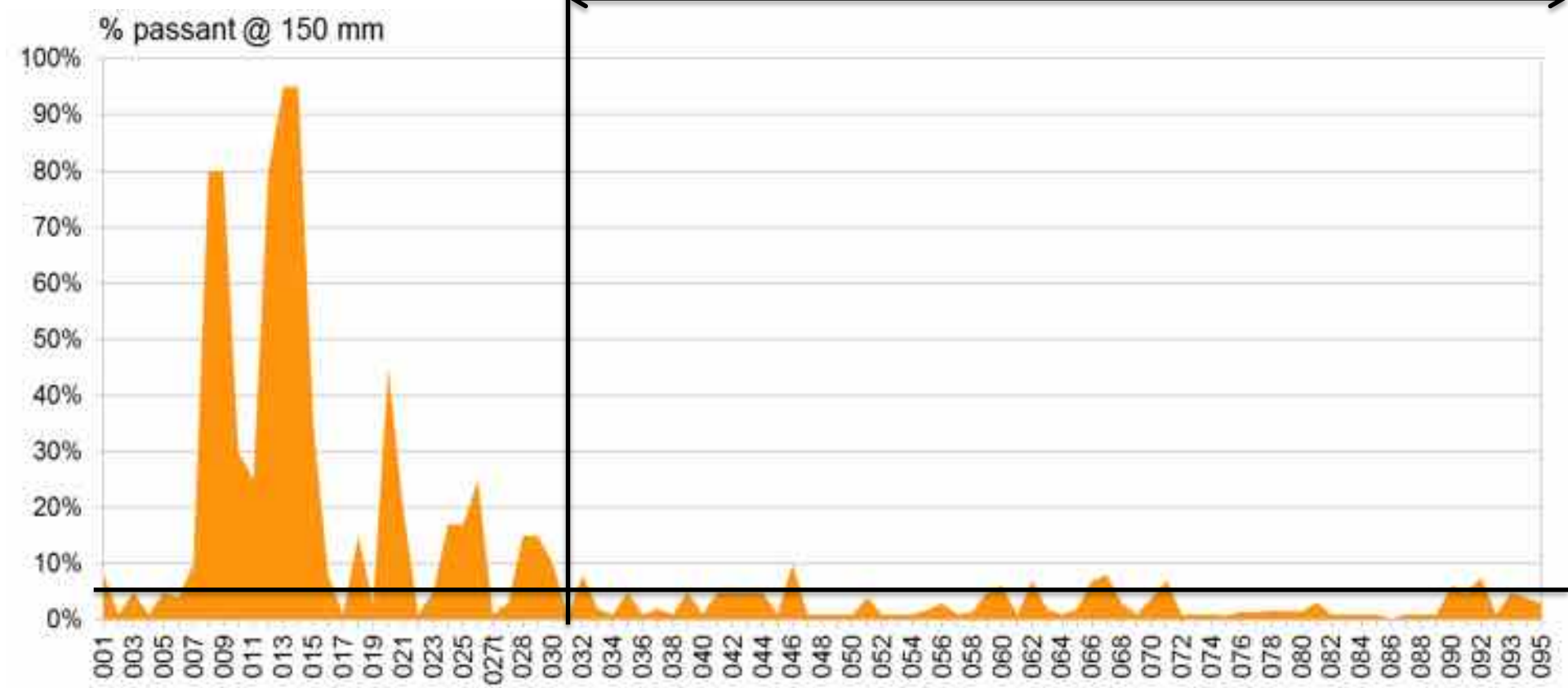
- De-coupled charge
- Air deck
- Deck charges



Results

Before

After
optimization by simulation



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“Fine control process by simulation provides a significant and visible improvement, allowing the crushing plant to run at its expected rate”

(Jonathan Teadi, Quarry Manager, 31/05/2013)

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TAT
PREVISIONNEL

T&T DNA-Blast Software
FOR A MILLION DOLLAR BENEFIT
1/8/2012

T&T DNA-Blast Software
FOR A MILLION DOLLAR BENEFIT
17/8/2012

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CONCLUSION OF THE STORY

Don’t Guess, Scientifically Forecast

Use a Visual Scientific Simulator

You will save Time and Money

T&T DNA-Blast Software