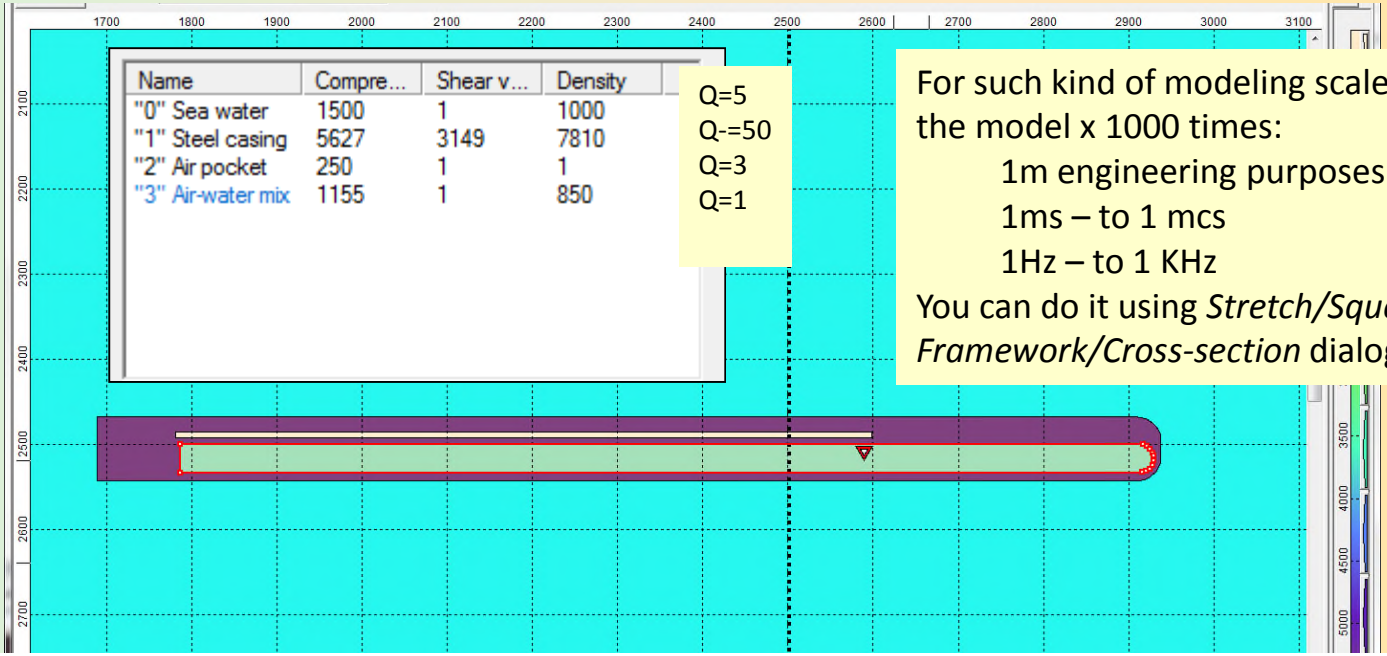
Modeling for Engineering Purposes



For such kind of modeling scale it is better to upscale the model x 1000 times:

1m engineering purposes corresponds to 1mm

1ms – to 1 mcs

1Hz – to 1 KHz

You can do it using *Stretch/Squeeze* option from *Framework/Cross-section* dialog.

"Canister" Model

1. Air pocket height =0.07 m; Vp=250m/s; 250 [m/s]/0.07[m]~3500[1/s] Hz = 1 [wavelength]
2. Air-water mix height 0.33 m; 3500[1/s]*0.33 =1155 m/s; = 1 [wavelength]
3. Steel casing height 0.75m; 0.75[m]*3500[1/s]*=2625m/s ~ 1 [wavelength]
4. Steel upper casing height 0.33 m; Vp=5627m/s; 5627 [m/s]/0.33[m]~17000[1/s] ~ 1/5 [wavelength]
5. Steel casing length 4.68 m; Vp=5627m/s; 4.68[m]*3500[1/s]*=16380[m/s]/5627[m/s] ~ 3 [wavelength];

www.tesseral-geo.com

The task of seismic modeling for “Canister” model can be divided on 3 subdivisions:

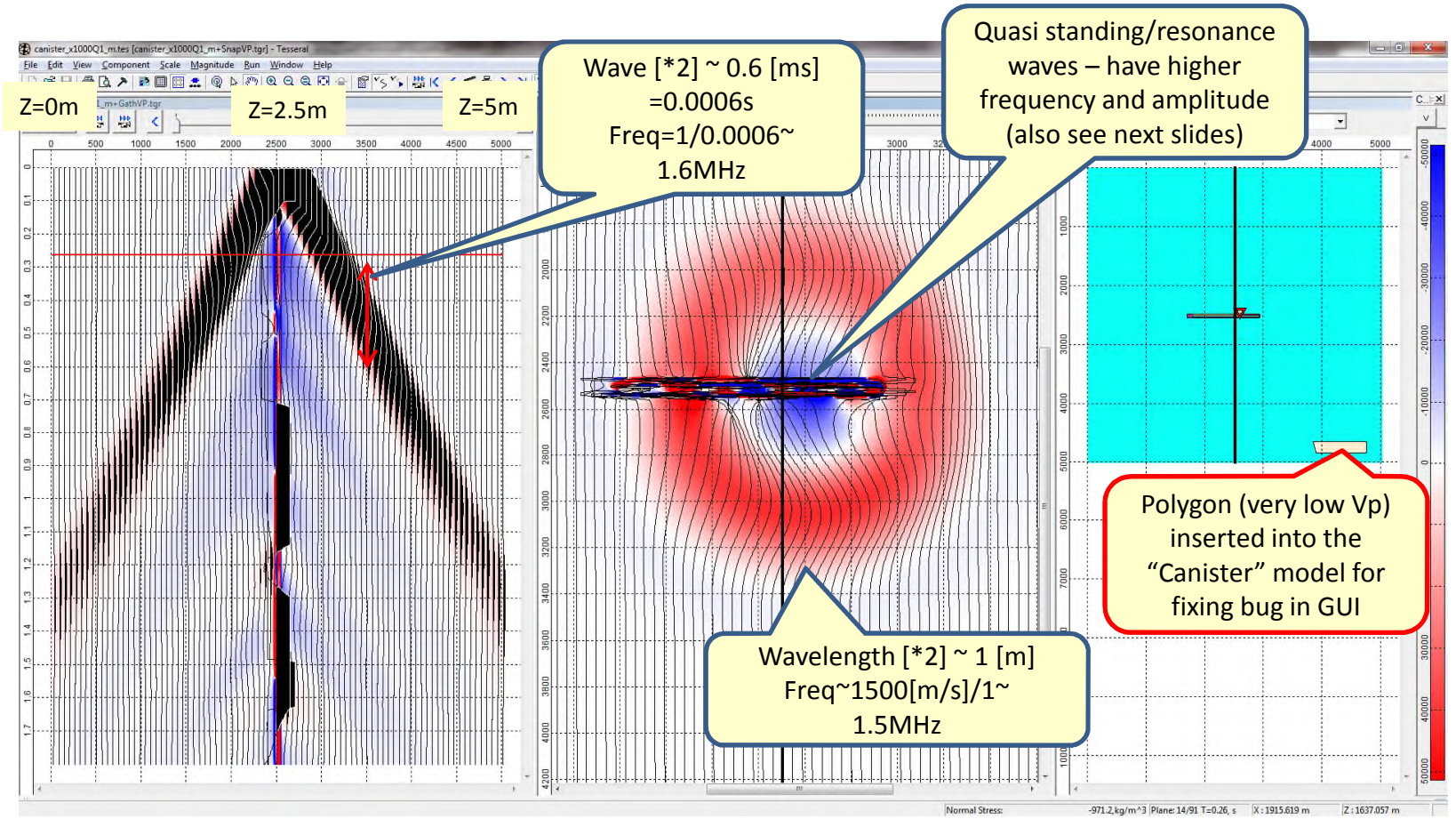
1. Using Tesseral for seismic engineering purposes:
    - Because this package mainly is intended to be used for seismic (prospecting) modeling, there are shown some issues which require additional development and relating bug fixing.

2. Modeling of “Canister” seismic response;
    - What is best approximation to wave equation to be used;
    - What is best frequency (range) of modeled seismic source;
    - What effects (both seismic and engineering) must be taken into account;

3. Modeling of sea water seismic response;
    - How water layer is influencing (visible) range of seismic frequencies used.

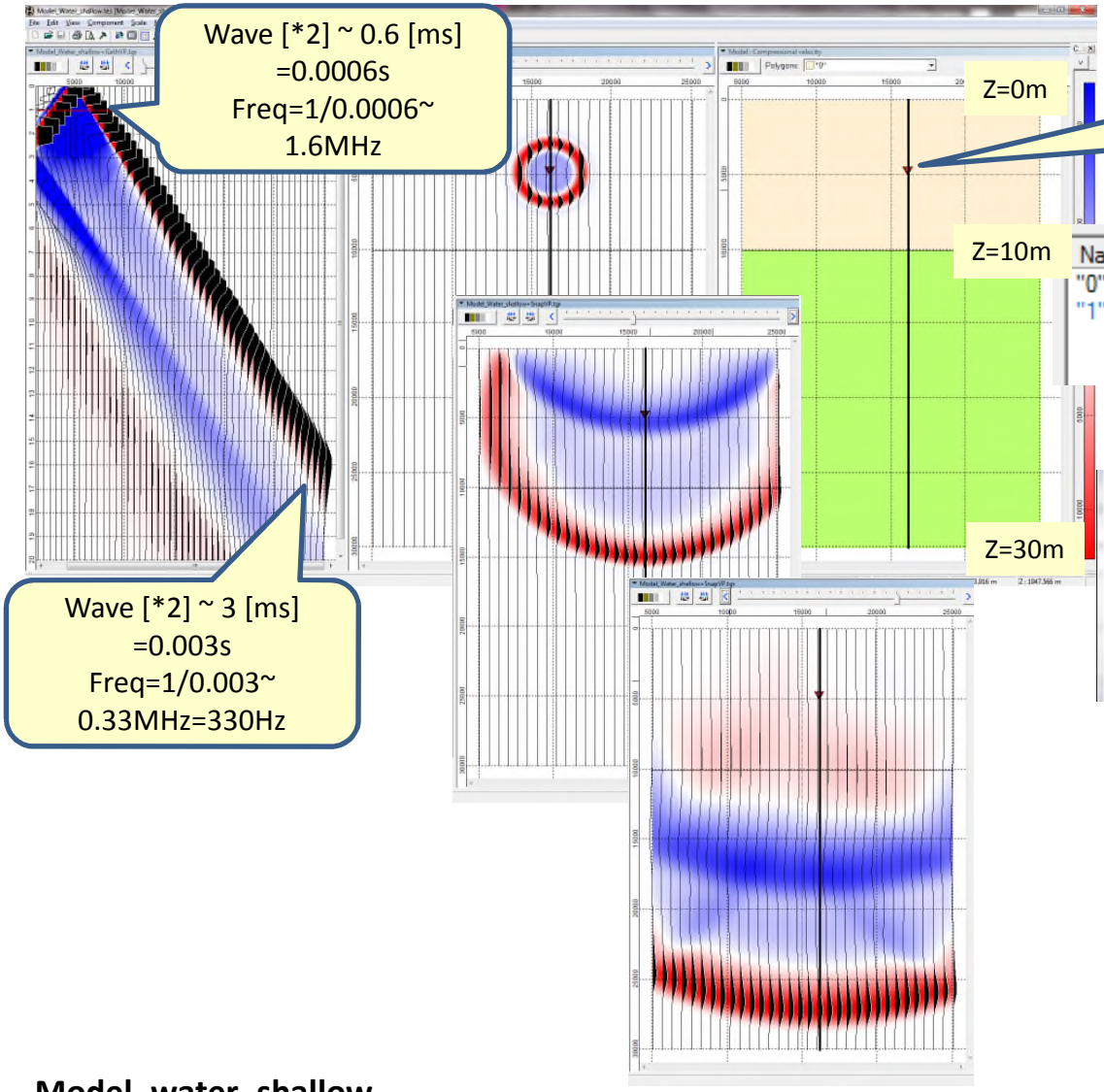
Engineering and Seismic

- ❑ From viewpoint of damping of transmitted waves may be assumed that Air pocket dimensions and content fit to standing wave. In this case the source frequency is about 3.5KHz. Actually from number of computation experiments (2KHz-30KHz – peak source frequency) it looks as best fit.
- ❑ 2. Explosion creates air-water mix and 1155 m/s is a plausible (and optimal from above calculations and assumptions) estimation of Vp (1500m/s – 250 m/s). Q=1 – is an estimation of absorbing property of this mix.
- ❑ 3. Vartically canister is heterogeneous and estimation of its Vp is ~2625m/s (again from considerations of fit to standing wave assumption)
- ❑ 4. Steel upper casing height is ~1/5 of wavelength and does not look as good resonator (is this solid part of casing) ;
- ❑ 5. Steel casing length is ~3 wavelength – OK.



1. Receiver line was put vertically to see 'cross-section" of the outgoing signal;

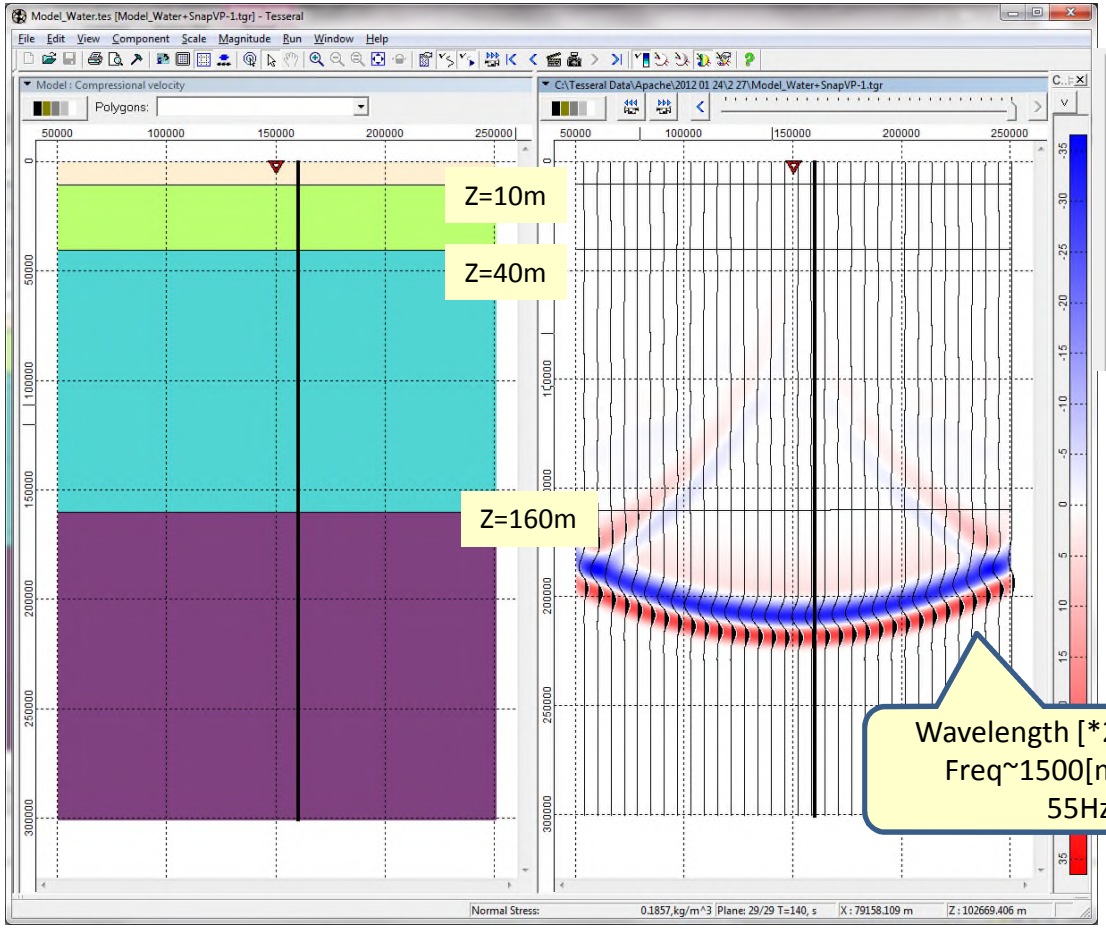
2. "Canister" resonance frequency (from experiments with different source frequencies within range 2-30MHz) is between 1.5-2.5MHz (frequency of generated outside wave). For "optimal" 3.5MHz source frequency – 1.5Mhz frequency of outside (water) wave.



Snapshot for t=0ms (mcs) – starting time (=0) relates to the peak of the signal

Model_water_shallow

1. It is assumed that upper water layer has heterogeneities cased by its disturbances, especially (in proximity of the source) and has relatively ***low Q estimated as Q=5***;
2. Then (here at depth ***10m***) Q is increasing (estimated) as ***Q=10***;
3. In such (above) conditions due to velocity dispersion ***signal frequency*** at ***distance (depth) 25m*** is ***changing from 1600Hz to 330 Hz***



Name	Compre...	Shear v...	Density
"0"	1400	0.25	1000
"1"	1450	0.25	1010
"2"	1500	0.25	1020
"3"	1550	0.25	1030

Q=5
Q=10
Q=20
Q=40

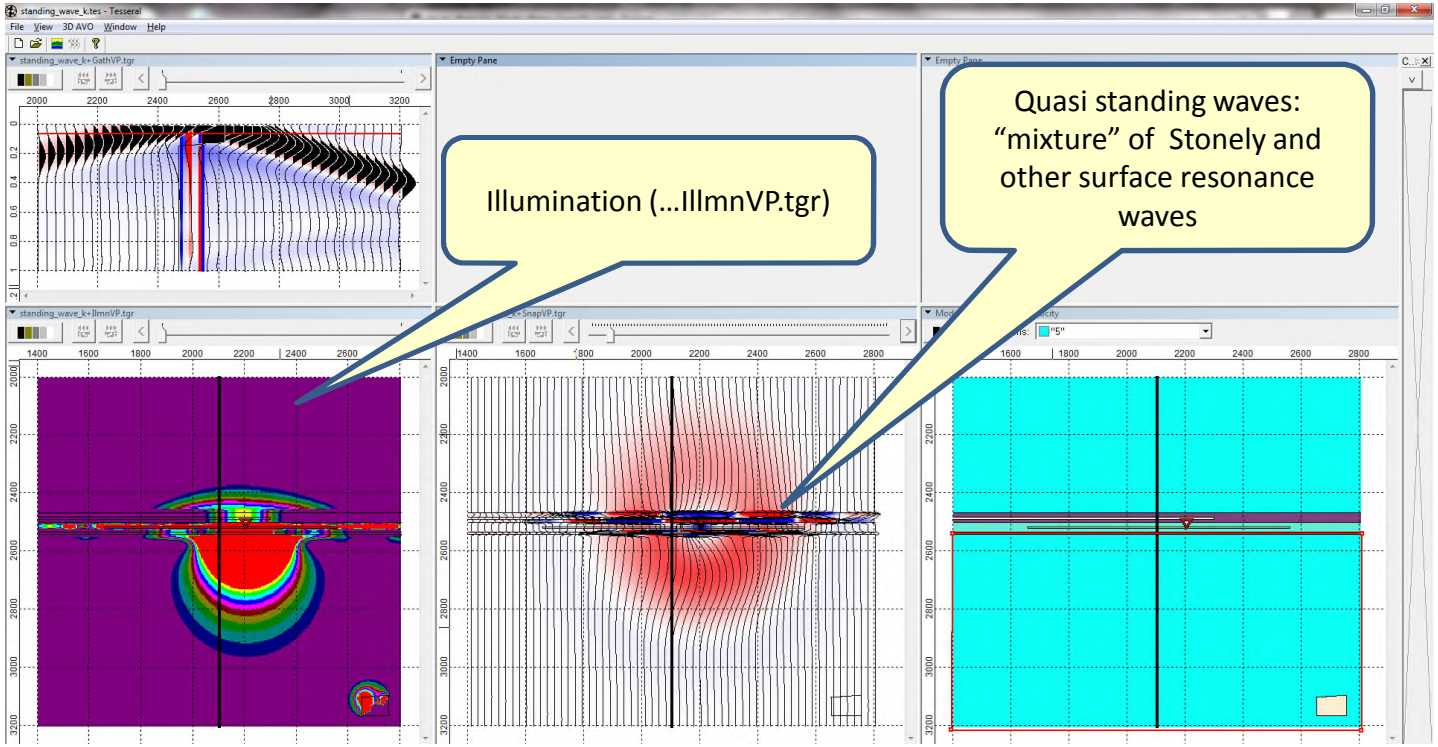
Wavelength [*2] ~ 27 [m]
Freq~1500[m/s]/27~
55Hz

Model_water (in upper part as …water_shallow)

1. It is assumed that to depth of ***160m Q*** is increasing to ***Q=40***;
2. At above assumptions wave frequency at depth ***~ 200m is ~55Hz***

Anyway, ***from modeling experiments it looks like***:

1. Frequency of seismic signal ***in proximity of "canister"*** is within range ***1500-2500Hz***;
2. Frequency of recorded (by hydrophone array) seismic signal ***is decreasing to range 25-100Hz due to velocity dispersion effect within wave transmitting water layer***.



Model_standing_wave (simplified “canster” model) – for experiments with simplifies “canister” model

SUMMARY

1. Visco-elastic 2D approximation (3 damping machanisms) is providing initial guess about “canister” seismic properties along with the source conditions;
2. Tesseral package to be used in more details for such engineering purposes requires some upgrading: capability to use “spread” source(s) (in this case – to model explosive wave), more than one receiver line (all it is already put in specs for the package upgrade for applications for passive and mining seismic), and some other relatively easy fixes;