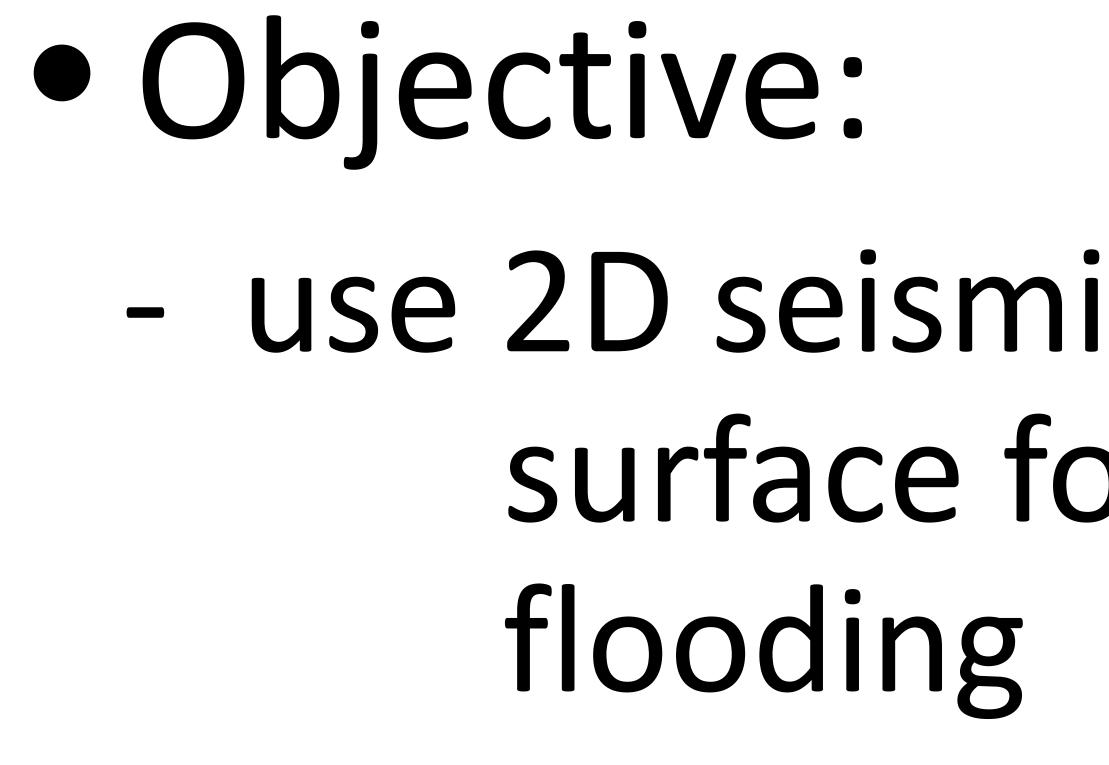
# Processing and interpretation of 2D seismic from Inglewood Park, Calgary, Alberta



### Presented by Bobby Gunning February 6 2014







### • Process: - acquisition (within the City of Calgary) processing (Vista/ProMAX processing software)

- interpretation

# • Future work:

- currently reprocessing

- S CREVIES

## Project overview

### - use 2D seismic from Inglewood Park to analyze the near surface for fluvial geomorphology and evidence of

# - inclusion of other lines from survey - adding geological constraints to aid interpretation









### Bow river flooded in June 2013 - damage estimates up to \$5B

### Flooding prevented the traditional field school at Castle Mountain

### City allowed field school to be done within city limits (Inglewood/Shouldice parks)



## The Bow River flood

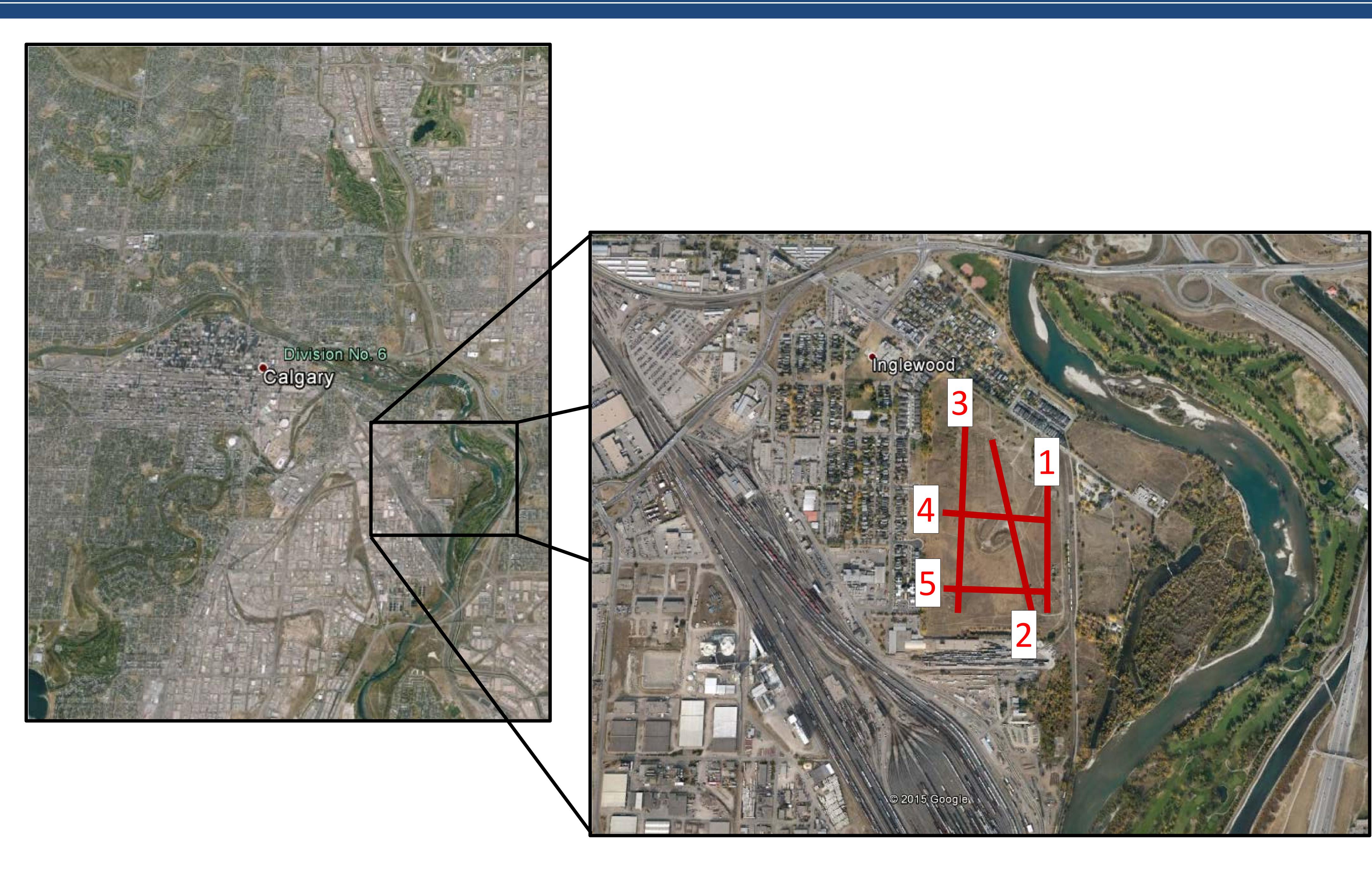








# Project area: Inglewood Park, Calgary





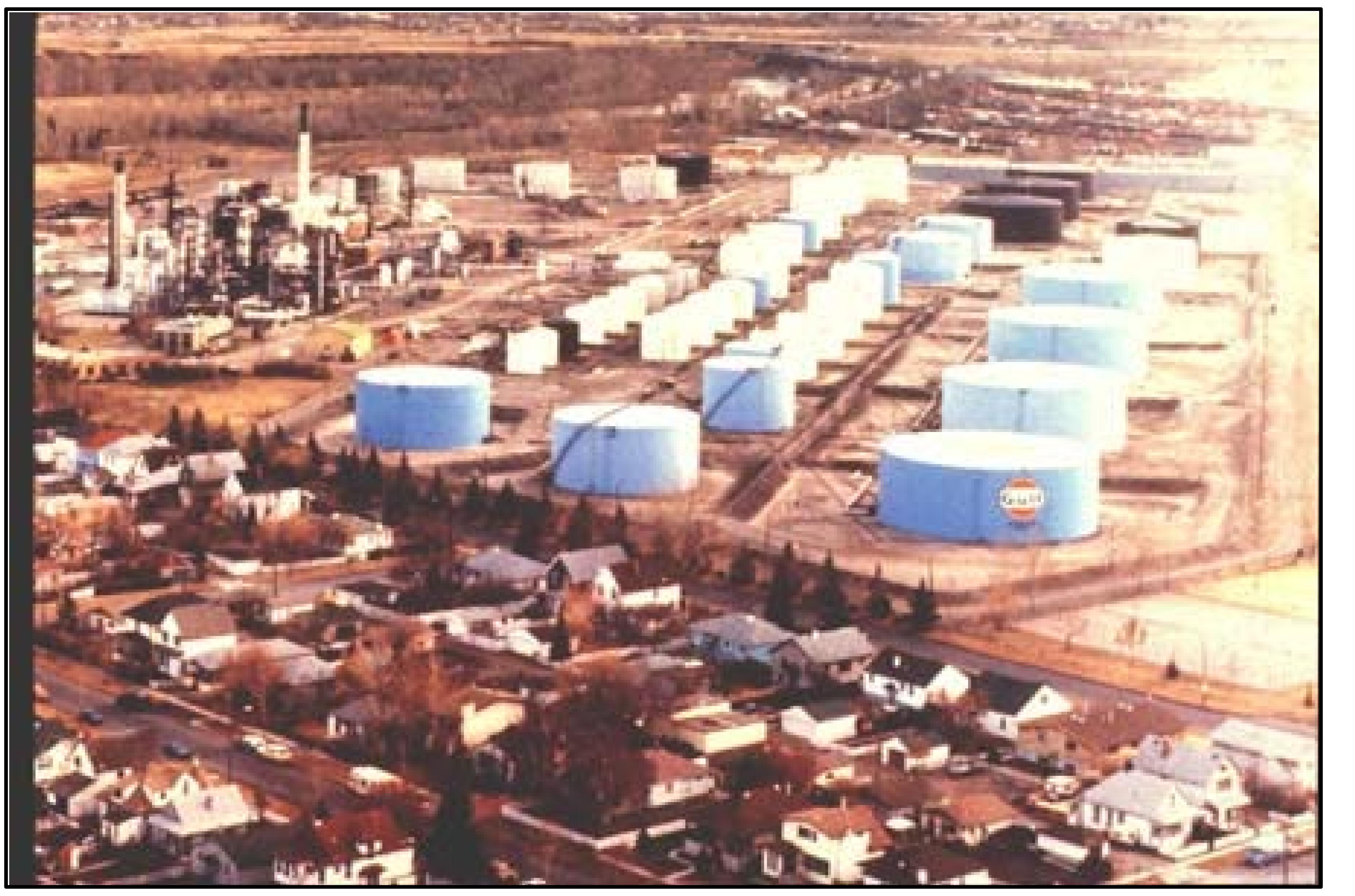
www.crewes.org

### \*Images from Google Maps 2015



# Project area: Inglewood Park, Calgary

### Inglewood Park, 1973. Gulf Oil Refinery





www.crewes.org

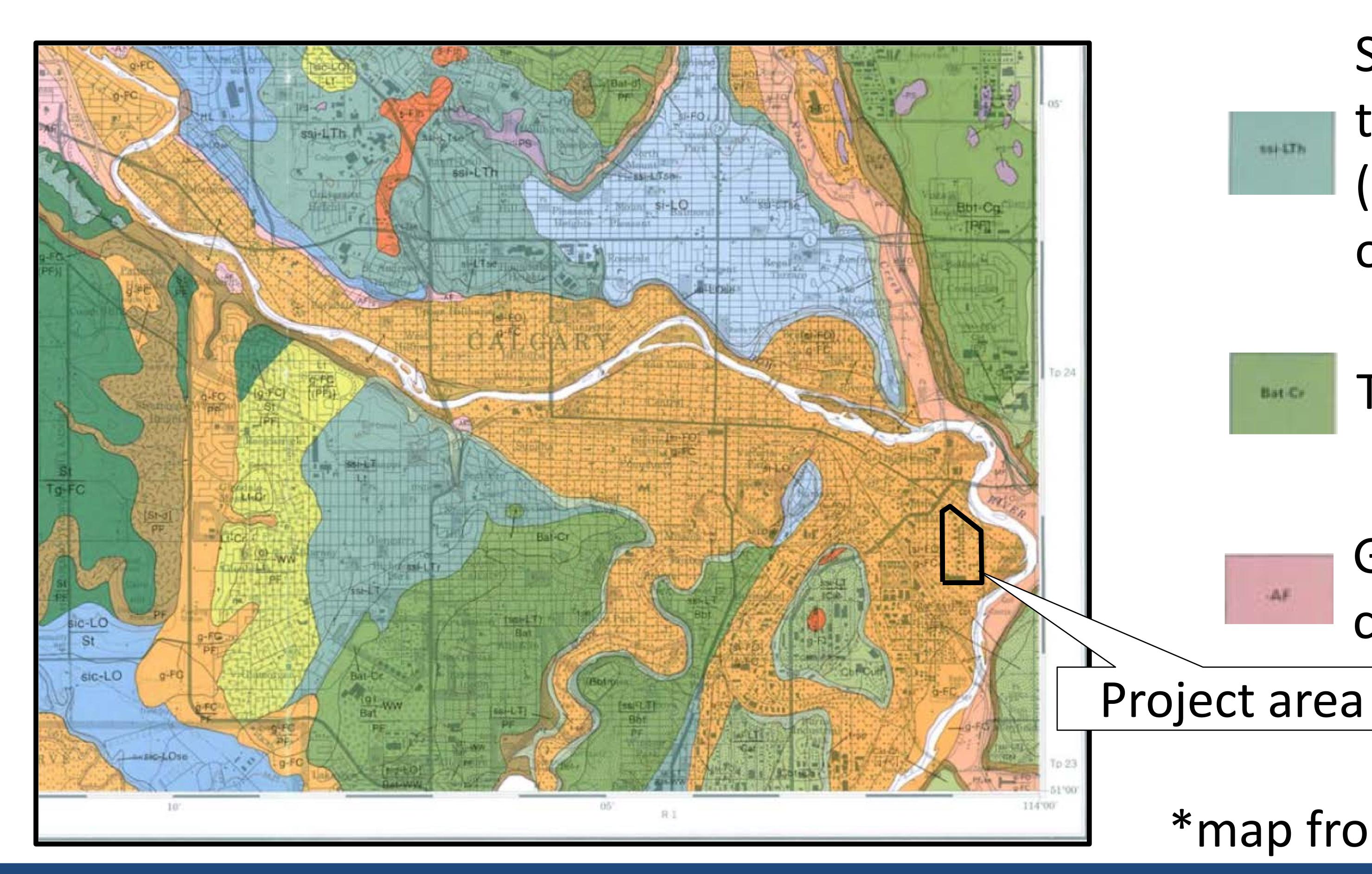
### \*inglewoodwildlands.ca





### Inglewood surficial geology: - sandy gravel overlying silt -fluvial channel sediment overlying lacustrine offshore sediment

### • The Bow river surficial rock type correlates to flood risk







www.crewes.org



Sandy gravel overlying silt, fluvial channel sediment overlying lacustrine offshore sediment



Silt and clay, lacustrine offshore sediment

ssi-LTh

Silt and clay, lacustrine traction-load sediment (resulting from deposition on ice)



Till, glacial sediment



Gravel and sand, fluvial channel facies

### \*map from Alberta Geological Survey







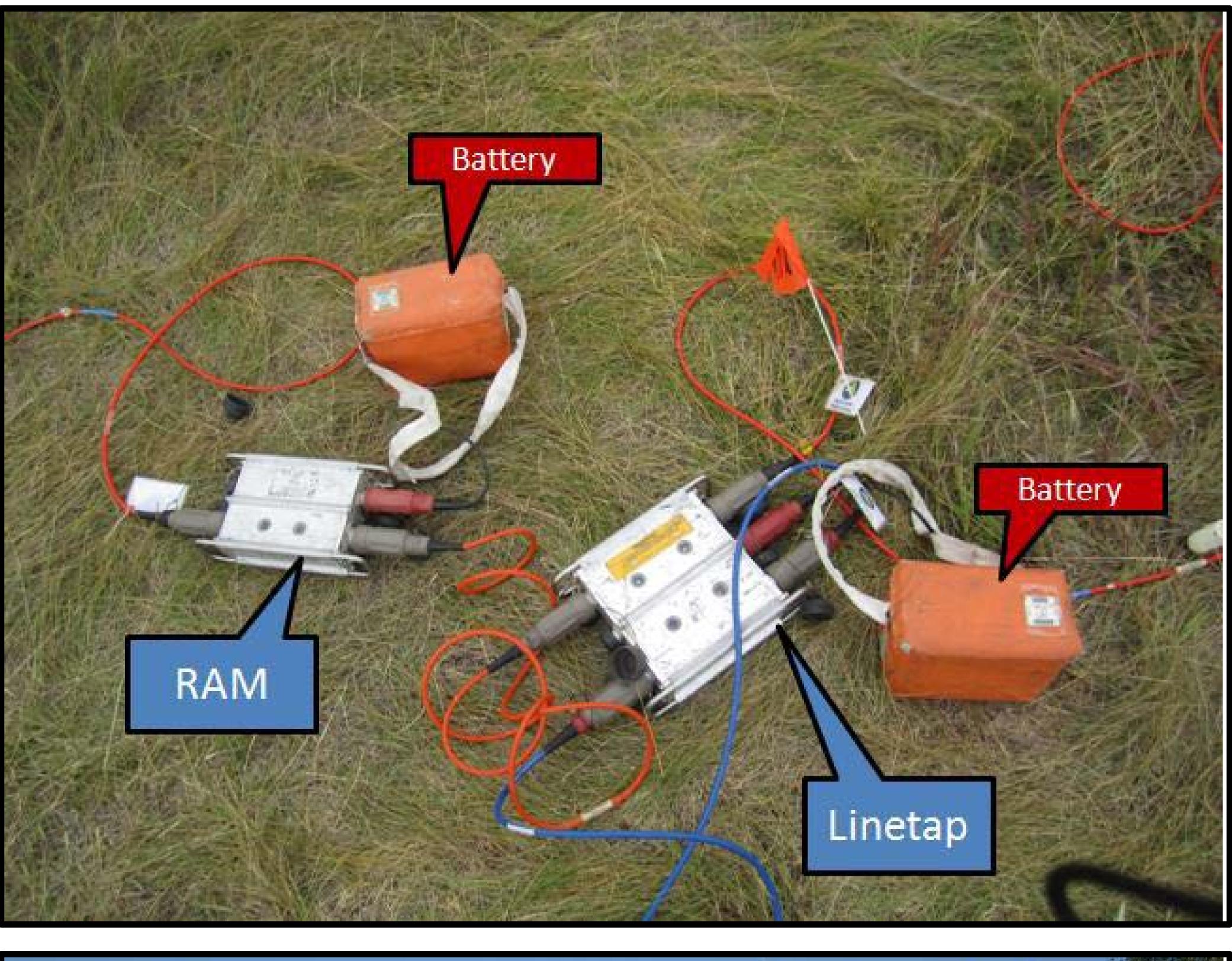
### Aries acquisition system

- Leaflet drop
- Single component acquisition
- Line 3 (600m)
  - 120 channels
  - 5 meter receiver interval
  - 5 meter shot interval (vibe)
  - 18 shot points missed
  - 1 ms sampling
- Field noise sources - train tracks
  - power lines
  - urban environment
  - -aircraft



## Acquisition

# (infrastructure/vegetation)



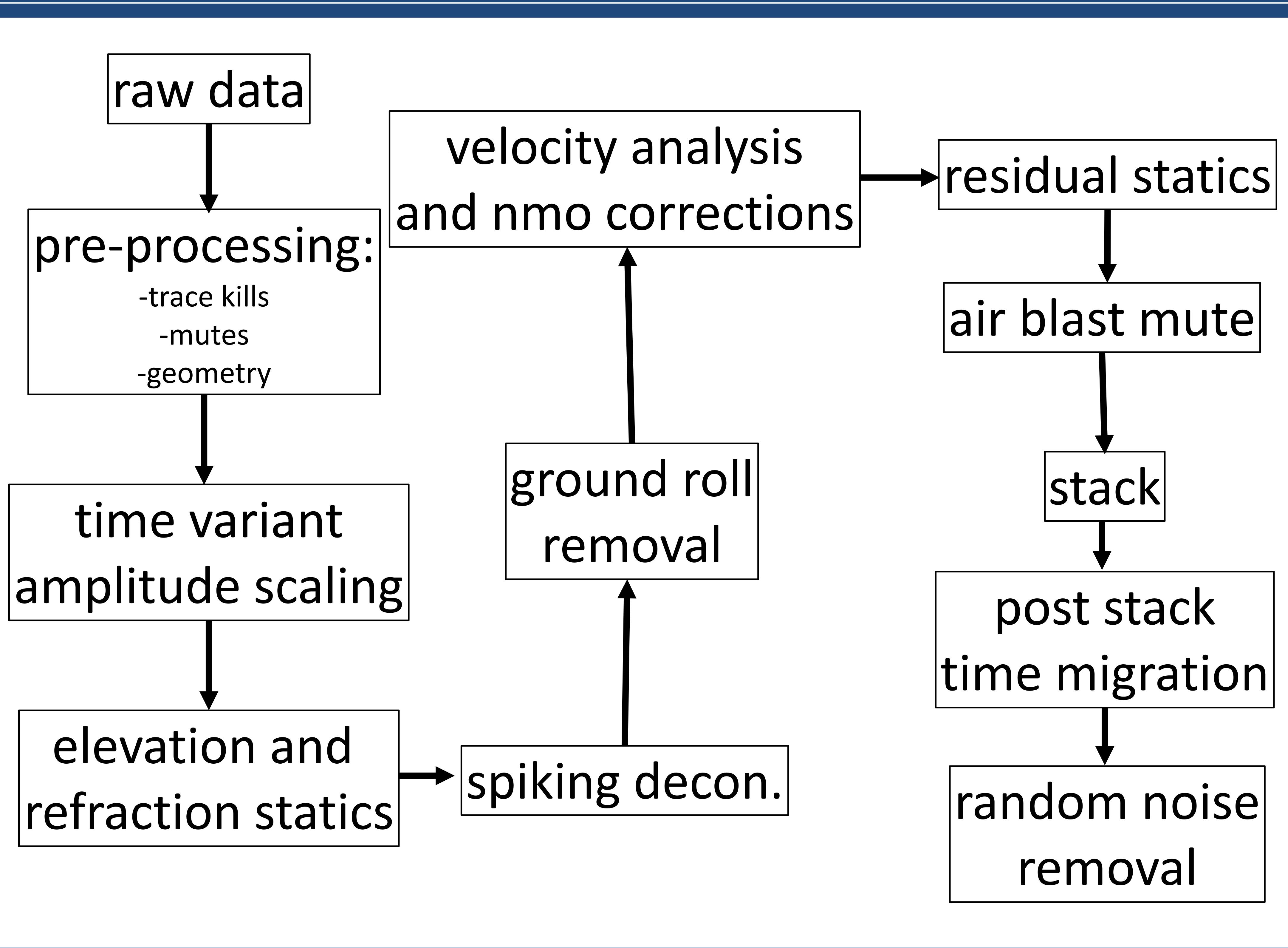














### Processing (Vista)

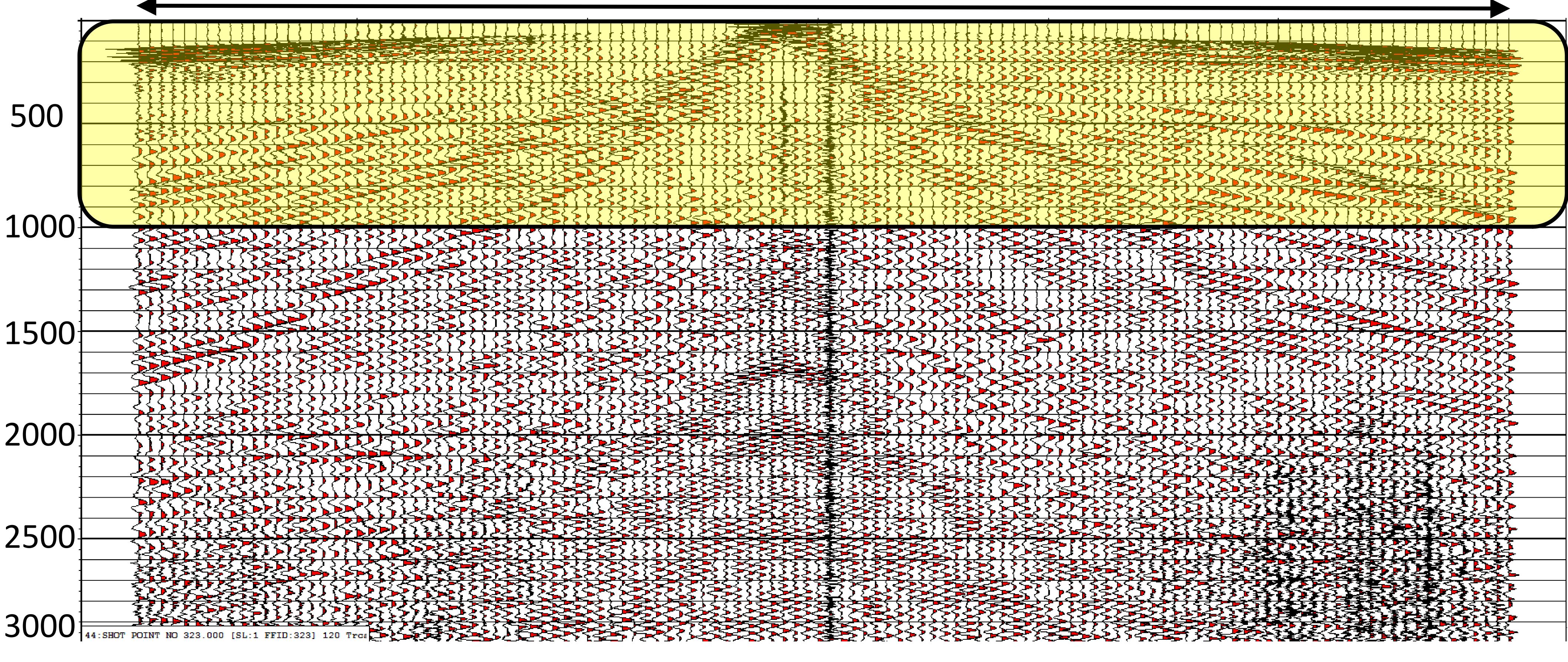








# entire record at shot point near the centre of the line (3s)• timing lines are every 100ms • very noisy, note the dead trace



# Shot gather plus AGC

### 600m

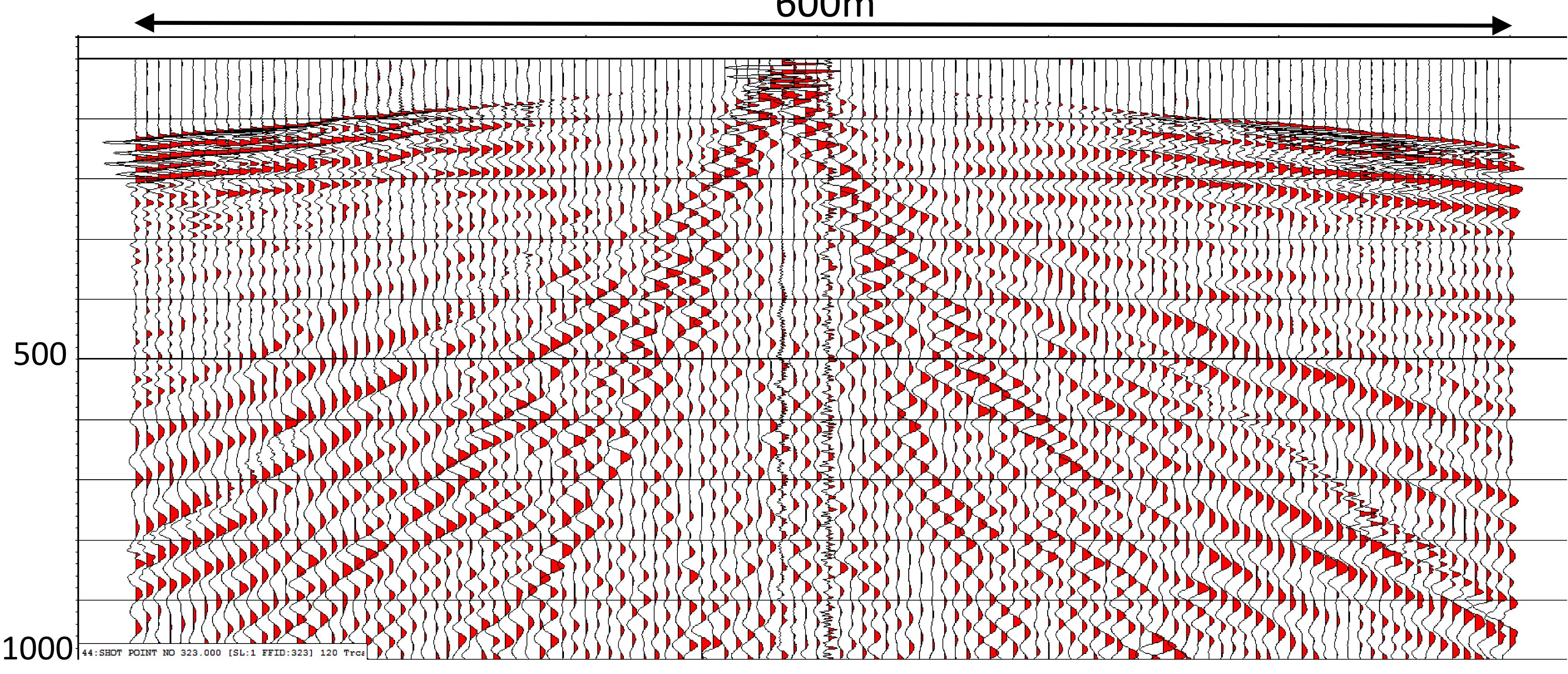
www.crewes.org

### \*All sections are oriented N-S, peaks are red





# first second at same shot interpretable refraction and direct wave • reflections?



# Shot gather plus AGC

### 600m

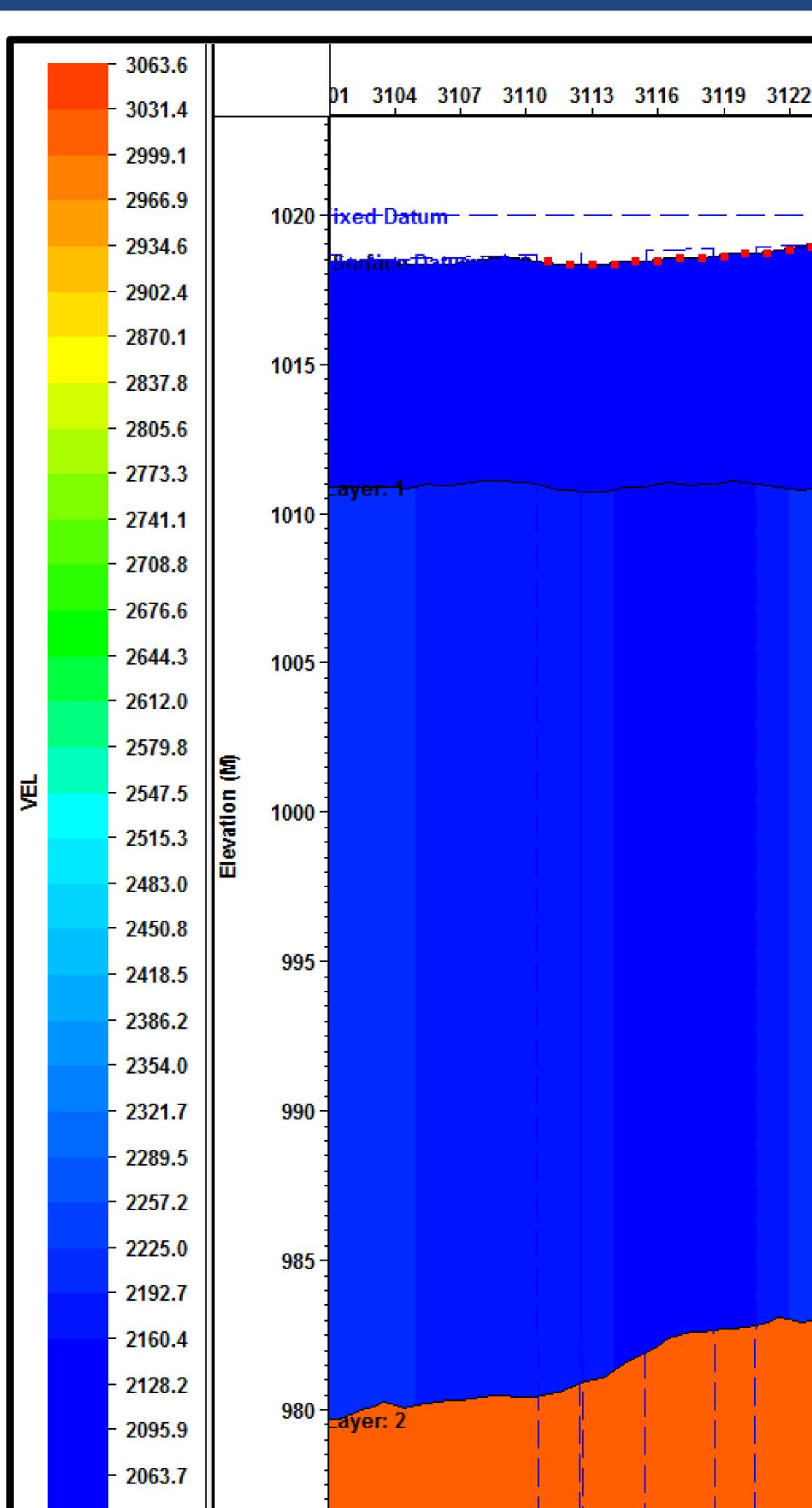






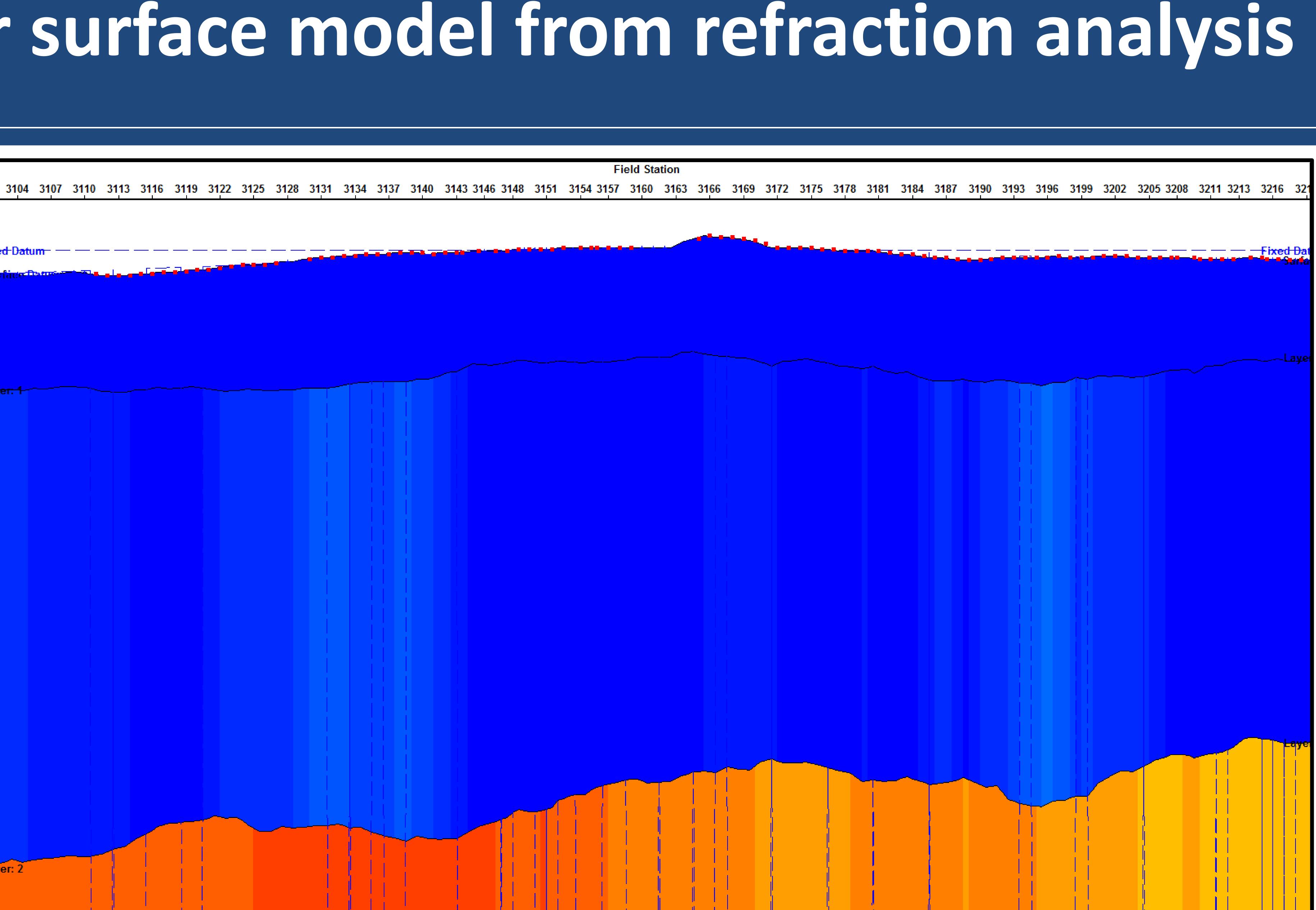


## two areas of velocity change in the near surface - correlate to potential incisions in the lower formation



### Near surfac

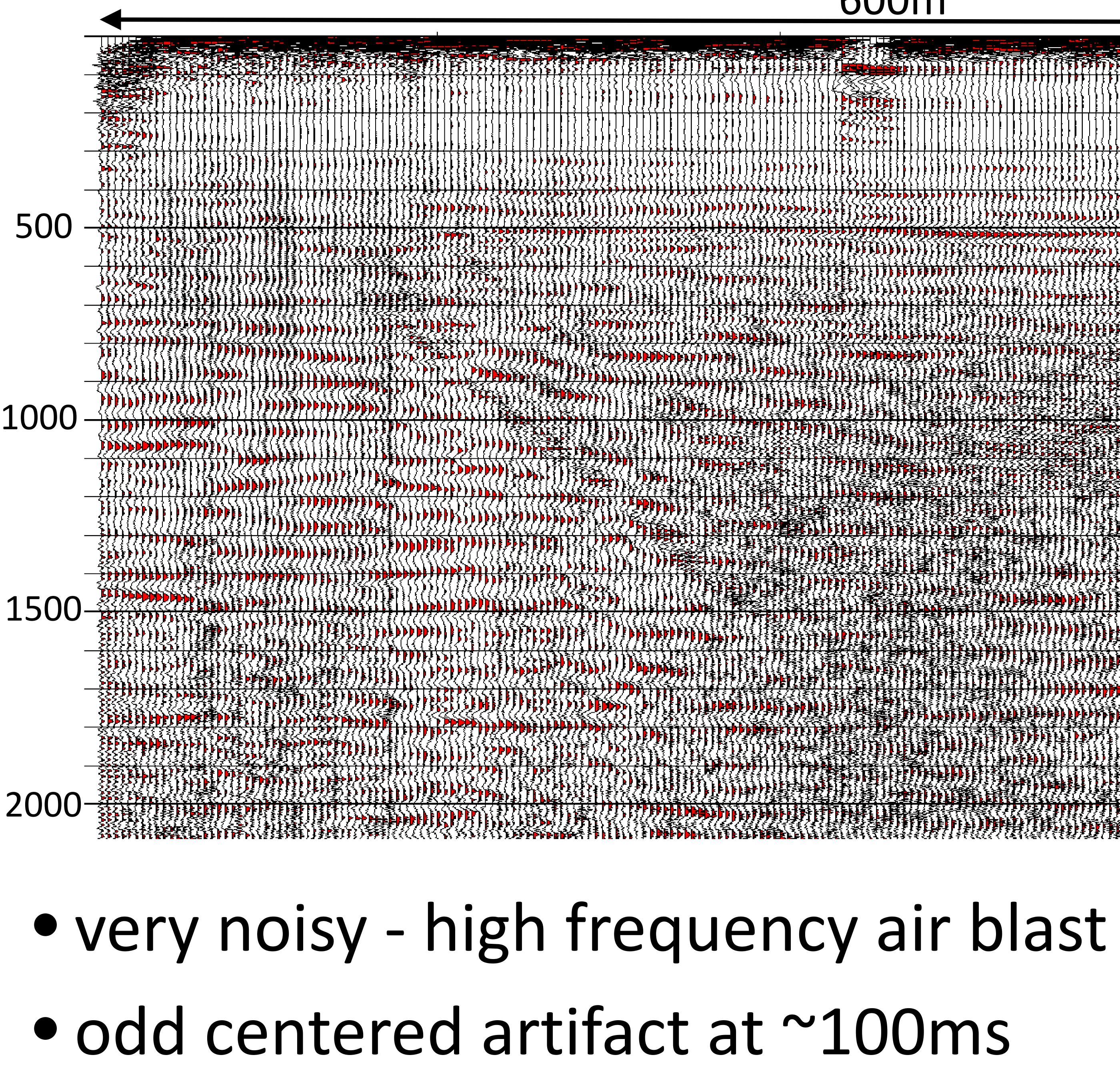
	from













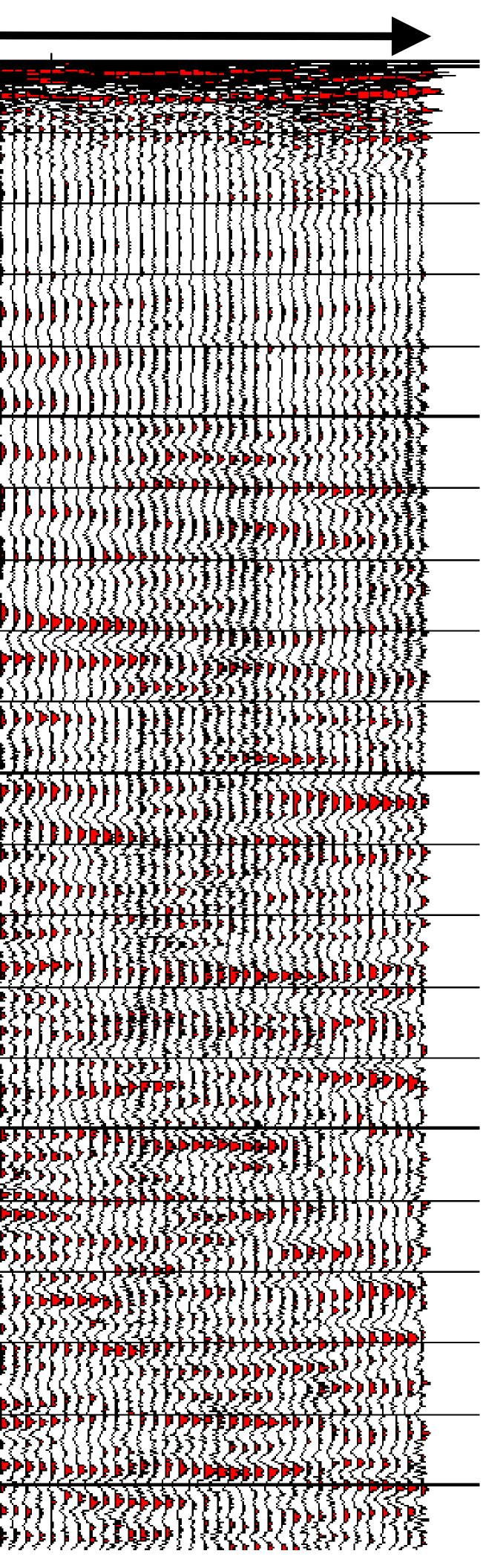
# Brute stack (first 2s)

### 600m

										_		-																										•								
ł			Ţ	7)	7	71	1		1										7	T	7	ì	Ċ		5				ļ	F	Ē		F.	i	3	Ş	P	Į	Ê	Ţ	Γ,		2	7		
	╏		Ļ	Ħ	+	H	+	H	╁	H	┢	H	╈			H	ł	27	ŗ	7		ł	H	-			ł	H	┝╸┣╸	$\mathbf{H}$	衍	Ŧ	H	Ĵ			ļļ	1	Ļ	÷	þ	Ħ	Ý	Į	ł	Ē
{۱		ĮĮ	֛֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬֬	ł	ļį	ł			ĺ	į	į		ţ		ן ויי	}	ł	}	Ì	۱	! ( 	ĺ	()		Ì		ł	١Ş	ł	)	}}	}	}	}}	١,	ļ		╏.	))	ļ	]}		ļ	<b>/                                    </b>	יי {י	
		ļ	Ļ	ļļ	Ļ	ļ		ļĮ	ļ	ļ				ļļ	1	ÞÌ	}	ĺĮ		ł	<b>! !</b>	Ļ	Ц	⊥					•	ļļ			<u>ا</u> لل	ļ	ļļ	ĺ	ļļ			Ì	11	)		ļį	<u> </u>	ļ
Ì						ÌI	׀ ֛						1	׀ ׀	ĺ		ļ			ł	ļł		׀ ׀	ļ	ł		ļ			Í	1	ļ		Į	ίŀ				Įį					Įĺ		Į
				lł		;	Ś	Ś		ļ			ł		ļ	ſ   N N	ł	łł		Į,	ĮĮ	Į.	ļļ		Į		ļ	ļļ	-	ļĮ				Į	Į	ļ	Į		Į	ţ	ļļ	5		<b>)</b>	ł.	Į
ţ	ii	Į	Ţ	[]	Ţ	ŢĮ	Ţ	Ų		Ţ	ŀ		Ī	1	Ţ	┍╌╸ ╽╵╽	<b></b>	$\langle \langle$		1	Ņ	Ţ	Ŋ	Ļ			Ì		Ţ		Į					ţ	Į	ţ		1				ļĮ	ł	ļ Į
   			<b>P P</b>	<b>?</b>	<b>)</b>	PĮ	ļ	]}	]]	]]	ł	}	ł	{	, 	Í	Ś	įį	ij	<u>}</u>	ŀļ	J.	))	ļ	)	5)	•	]}	!	ĴĮ		י∳ וּ	<b>)</b> )	))	]]	ļ	[]	ļ.		ļ	ļļ	ļ	)	<u>}</u>	۱ţ	ŀ
÷	⊦ ∕ ▶∎							ì	Ì	h		ń						Ļ۱ ۱		ł	ŀ	<u>}</u>	Н			ń	, I		 		5 5 6					<b>1</b>		1	Π			$\mathbf{H}$			┊╷ ┿╸ ╞┣	ľ
ł					Į	٦Į	Į		į				Į		Į	「 ∫ ┣ ╽	Ś	ľ	Ľ	<u>ر</u>	)				Ĩ	r F l		Ś	Ś	$\langle \{$	$\langle \langle$	Į			ζ,	$\langle \cdot \rangle$		ł	ļ	l	ίł		2	((	'{<	<b>∦</b> _ { `⊾
Ł		Ľ	4	<u>.</u>		Ľ				2	Ļ		4	2	4			Ş	ľ.				Ų	l	Ļ	Ľ	ļ	į	Ļ	Ų	Ų	l I T		<u>)</u>	Ų		Ų		Ų	1	jj	ţ	Ų	Ц	Ļ	ļ
	<b>PI</b> 7)		5			<del>רי</del> ו רא	3										<b>• •</b> (	<mark>ן</mark>		ľ		ł	<u>ן</u>			╞╶╲ ┣╾╽		'n				╸┍ ┝╺┣	₽₽ ₿₿			']	ļļ	Ì	)	۱ <b>۱</b>	))					•
ł	ļ		įĮ,		Į	Į					<b>(</b>	₽ 7 ► 1	Į.	<u></u>		! / 	<	3		Ç	• •						{ }	{{							h	ł	Ŕ	í		ĺ	({	Į			ί	<b>r</b> :
Ţ	Ņ	Ţ		P	7	Ŋ	Į,	Γ	۶ţ	ļ		ļ			Į	Į	Π	Ţ	Ţ	Ę	Ŋ	P	Ī				Ţ	Ω	]	Į	Į	1		Ņ	Į	7	[]	Ţ	IJ	Ţ	Π		Ņ	IJ		ļ
	))	<u>ו</u>	ļ)		١F			)	ך קוי		₽ F <b>I</b> D			1	1		L.		Ì	<u>ا</u>		ļ		ļ	3		ł	Ì			ŧ							Ì	ĥ					{ ( {   {	ξį	}
ł								H		Ļ			ł		ţ	ĥ	}	ł		$\frac{1}{2}$	h		H				ŋ	Ð		ħ		ĥ		ł	2	ť				Į	<b></b>		Ţ	H		
	Į			IJ							1		1	h			1	ļ	Į	j.	b	ľ		ý	$\mathbf{S}$	É I					2	ļ	ŀ	ļļ	]	<b>)</b>	<u>ן</u>	ו					۽ کار			ر د
4	IJ	Ţ		H	+	ń	Ļ						÷	-			÷	ľ		ł		ł		1			Ļ	įį	Ļ	h		) P	••	ij,	<b>)</b> )	ι¥.	$\left  \cdot \right $	ł		4	4	4	Ţ	7	4	<b>F</b> 7
	IJ	Ļ															Ş	()	1	r	7	r	þ	÷	7			₽Ì		L	ĥ	Ś		}]	])	i 🌶	þ	∳	)		ļļ		))	h	ÞÞ	þ
	H	3		U		Ľ	1	Ľ	1	Ľ			ì	Ĩ	1	ĒÌ		2	1				Ľ	Ċ							2			ú	Ń					ξų L			(i L	$\langle \langle$	$\sum_{i=1}^{n}$	!
	1		h		÷	ń						į	ł	ij	7		2	l		<u>,</u>	Ľ	Ţ	H		ł			Ľ	Į			<b>,</b>	<b>,</b>		Į	{{	<b>,</b>	ļ	ŗ		ļ	Į	<b>ب</b>	IJ	)	ļ
Ę											Į,	ſ,	2	U	Ì	ĥ						7		ļ		ļ	Ţ	$\Sigma$	J,	Į	Į		) 		1	Ĵ	)	ł	))	; <b>)</b>	)	•)				ŧ
T	ij	ł		5				; ;		F,	T										2			Ţ		R	Ż	27	T	ij	) /	Ş				\$				Į					Ņ	•
	Ī,		ų	2			Ţ	I ] ] ] ] ]			5				ł		1	Η	Ļ	Į.						┣╴ <u> </u> , ,	ļ	Į	ł	ļ		]	<b>}</b>	ļļ		Į	Į	(		ĺ	$\{\{$				\{ F	`́ { ┣
-		Ż	••	ļ	-	5	-						ł		Ş			H	H	Ţ		ł	ł	9				5		h		ĥ	h	h	Ð	$\mathbf{f}$	þ	ł	ļļ	ļ	ļ	ł	-	'n	Т	
ļ					1	r i	Ţ	Ŗ							l		7			Ì	IJ	I	Í	Ĩ			Į								ł	Į	,				ij		! <b>∤</b>			)  }
1	4	Ş								⊾₹ ⊢†		H	Ŧ	ĥ	1	Ĥ		IJ	ł		μ	Į	ų			ij	ļ	Ş		įĮ	Į	1		Ц	ļ	Ų,	Ļ	ł	H	Ì	?? 11	<u>ን</u> ]		<u>{</u> ز		
J		J		Ю		H							Ì		ļ				ļ	1				1				<u>}</u>	2	Į			╏╱╡ ┣╸┣					Ļ			Į	Ľ	Ş	<b>;</b> ;	Ś	
Ť			1				ł				Ę	]	j		ł		ì		H	•	l	Y			ł	Z		Į,	ļ	??	X	Į		<b>,</b>	$\langle \langle$	i i	Ę	Į,				J	j	ļ	J,	ŀ
				[]		Ŋ	ł	ļ							ì		-				[]	I			Į		Π			Ţ	1		Ŋ	Π				I			į				Ì	
ļ	ļ														ł														ł		N	•						ſ		Ì			•	$\Sigma$	2	
	h	ł	t)	ħ	Ţ	ļ	Ť	H	•	Ņ	ł	Ņ	ţ	Η		K	ţ	t		í; t					Y			Ť	Ń	Ś			Ţ ₽\$:	ł	Į	•	H	ł	<b> </b>							<u>-</u> }
ļ	i.		1			Ú	Ú	h				h	Ť	Ì	ł	ļ	4			Ę			Į	ļ				ļ		ţ	Į	I		IJ		Į	1)	F	Ņ	ý	<b>;  </b>	•	ŀ	}}		
Ŧ	h		Ť						H	ł				Ц	-			Ļ	E E				٩	H				Ì	Î	Π	ή	ń	Π	Π	ź	ł		ł	h		F		ý	F)	4	Ē
				ļ			ţ				1		T				l		H											<b>}</b>	Į	Ì	Þ)	Į	ł	5	• • • •	ļ	2		~	<u>}</u>	፡ <u>}</u>	<u>}</u>	)` الأنا	
4	Ĥ		Ĥ	Ĥ		í		Ļ			4	4	Ĺ	_	ļ		4	Ę							[		4	H			ĥ	Ĥ	61				2	ľ	<u>)</u>		<u> </u>		<u> </u>	Ų	ų	È
		Į		]		ļ	ļ								IJ		J	ł					Ņ					Ę			3			ļ					<u>}</u>		) ))			?		<mark>ا</mark> م
		Ì				Ē									{				Ĩ					ł						}	H						IJ		)))	•	Ý			}		Þ
	IJ			ņ		Ę		P	2	Ţ			7	ņ			7	ļ	ļ		Į						ľ				ì		5		2						Į	2	<u>í</u>	<b>)</b>	Ņ	
Ţ	1			Ù	U	þ	I	H				þ	Ì				Ĩ			ĺ			ł											[]	ß		h	ŀ	D	ξí γ	Ŋ	4				<u>ት</u> ነ
ţ			1		Ŧ		Ť			Ť	<u>₹</u> î }		ł	ł	Ś			۲ļ		ţ,		Ŧ		1			ŧ	į	Ŧ	ţ	5	ļ							5		ļ	$\mathbf{f}$	ŗ	n		F
[	ļ	ł					Ś					í.											ł						ŧ								ŀ	Į	ß		{}			Śź		
	T T		Ļ	Ę	F <b>F</b>	Ļ	¥.	Ų	ţ	Ē	<u>ب</u> الج		4	<u> </u>	Ļ		÷				┍┎							4		H	Н		Ę.		<b>1</b>			_	1		í.	ų	H	÷ť	÷	E
	ļ	ļ				F I	ļ	Ń					ł	Į			ļ	f	ļ	ļ		ſ					ļ	ļ	1		5		5	Ņ	Ś	• •	)))		•	\$	<u>}</u>	<b>ب</b>	Ś	$\mathbf{\tilde{S}}$	5	[2 ]}
	H			li	1								3									ł				Þ1										j	Þ	2	Ń	· )	2	$\mathbf{P}$		Ŋ		) ) )
						€	ŧ		a she wanted		ľ		[			ų	1	ļ		ļ							1	) ) )			ij			l					ļÌ	Ì		Į	,	ار م ( م	5	)  -
ſ	Ęļ	1	•	ŗ	Ŧ		ł	ŧI		ļ	J	Ŋ	I	Ħ	Į		1			Ŧ			Ĥ	Í			ł			11	T	Ì				ļ	Į	Į		si 2	\$)	ý		<u>}</u>		ŀ



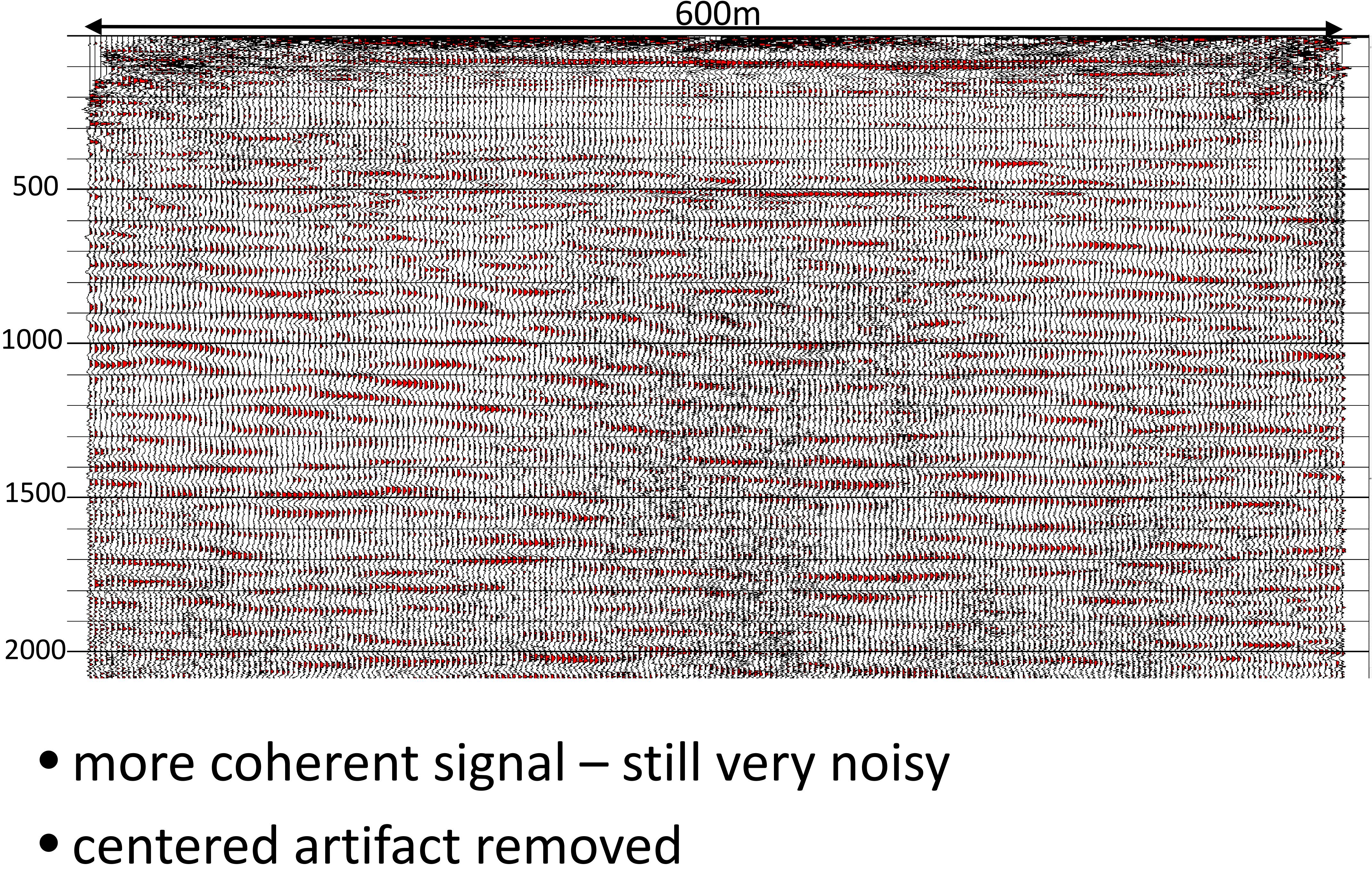








# Stack with muted airblast (first 2s)









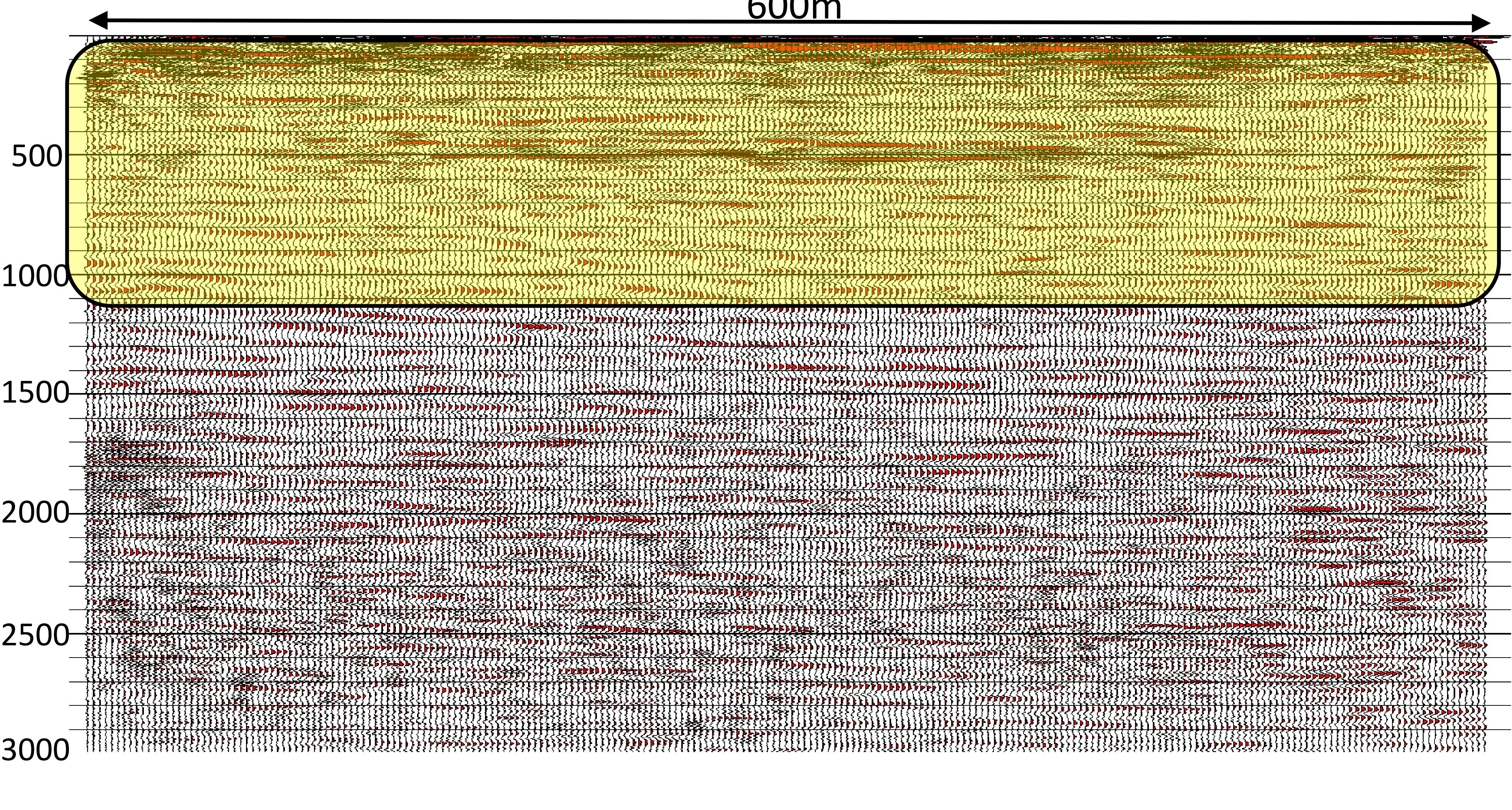








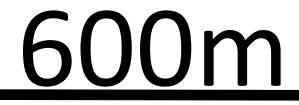


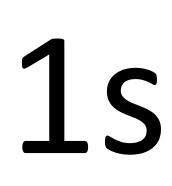


### pervasive reflections to about 1s



# Migrated stack (entire record)



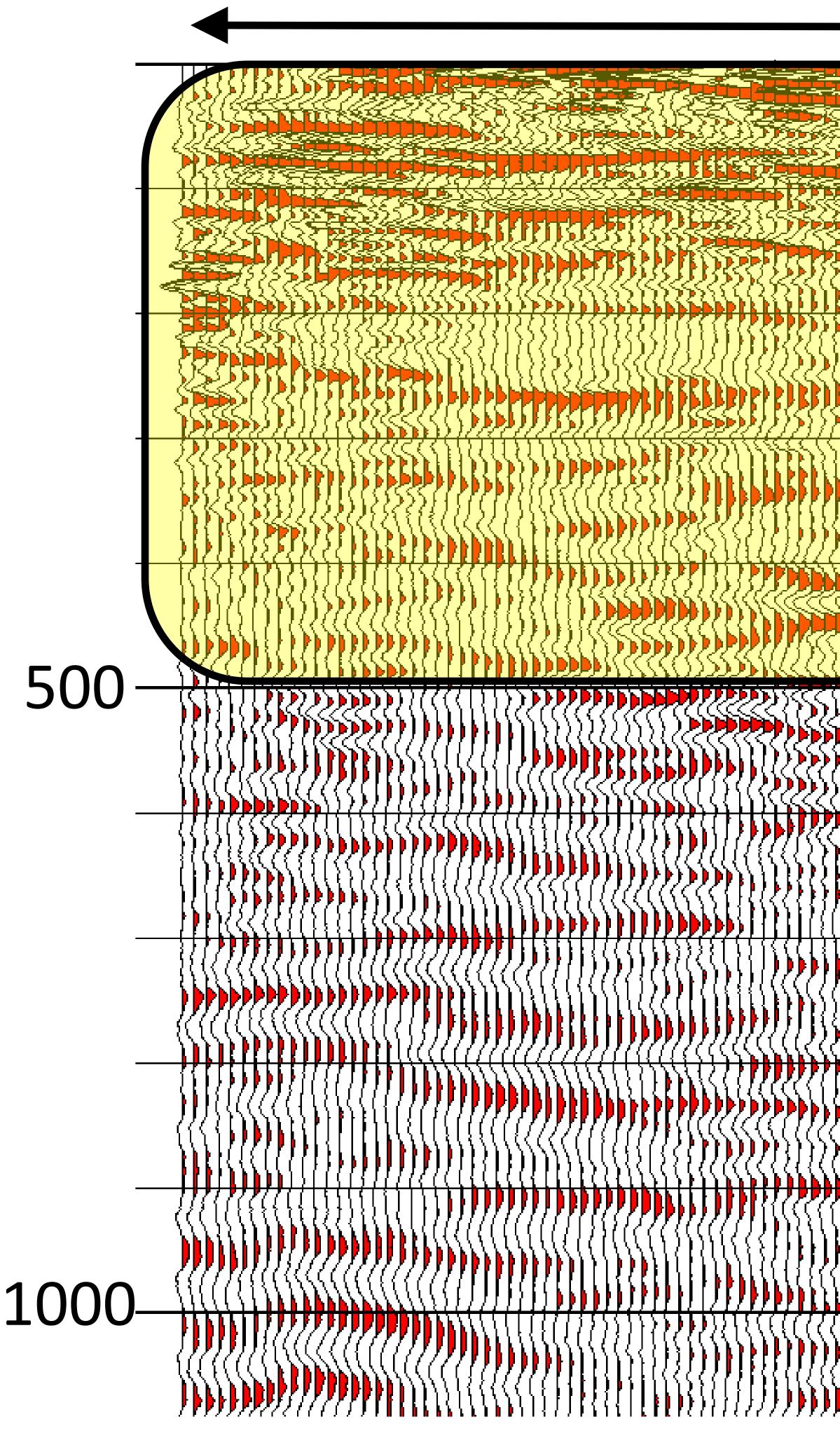














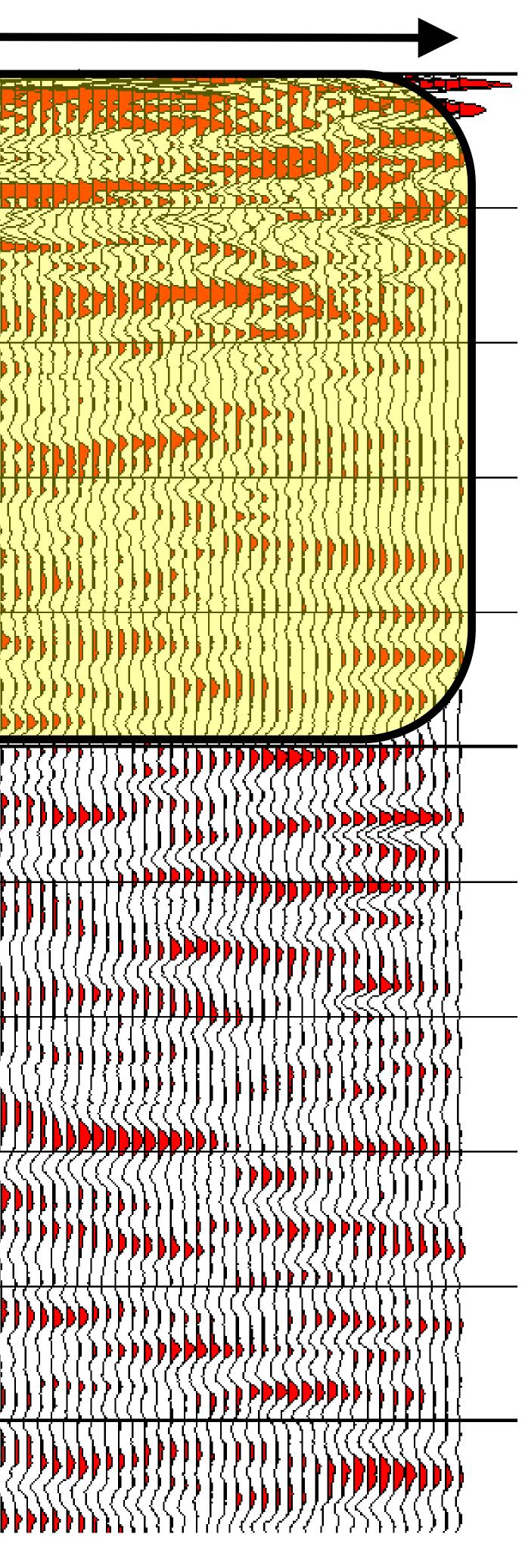
# Migrated stack (first second)

### 600m

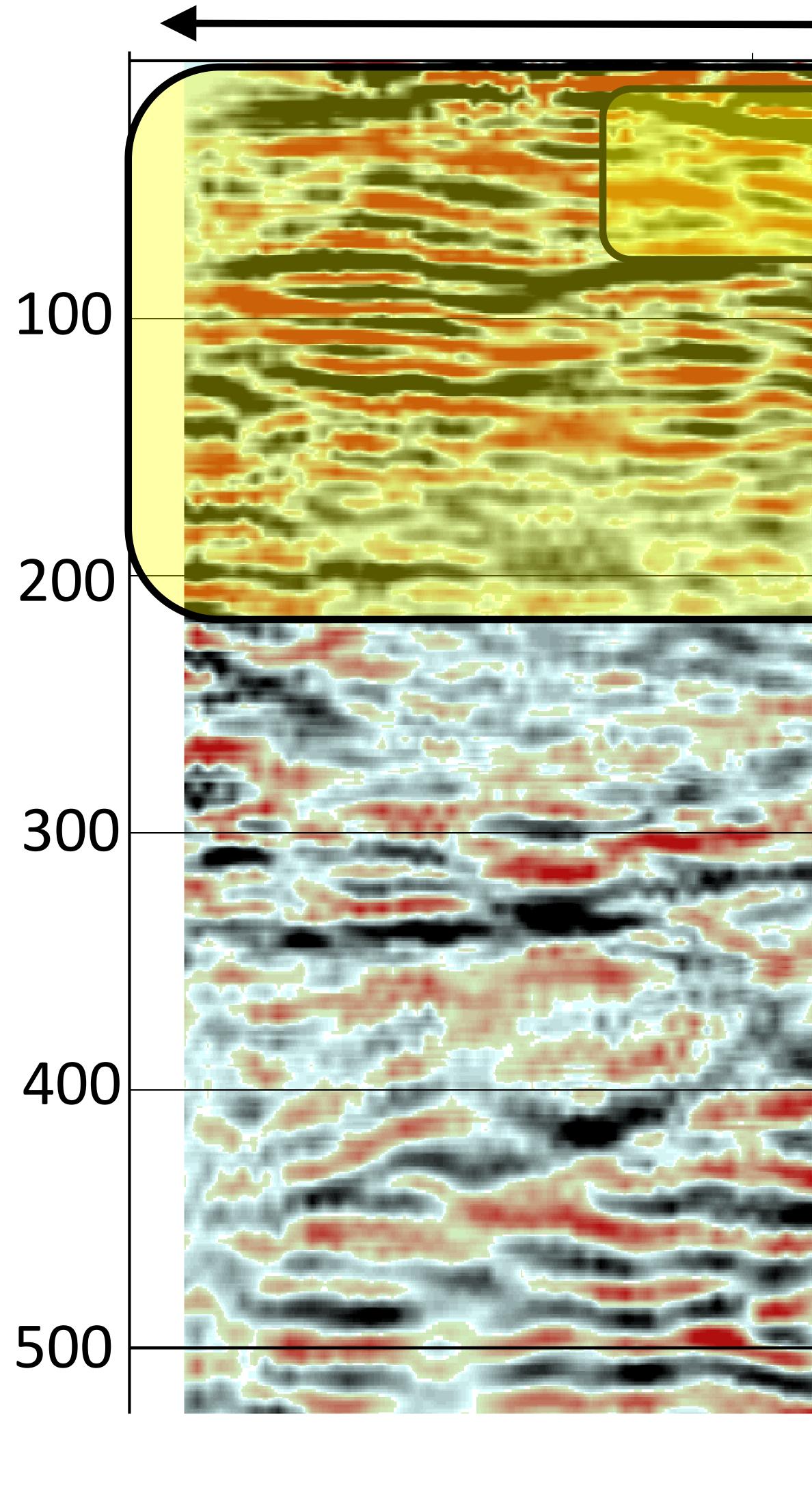
www.crewes.org











### fluvial geomorphology? • what about ties to the refraction model? • drape feature to the north ties well, potential amplitude anomalies further south

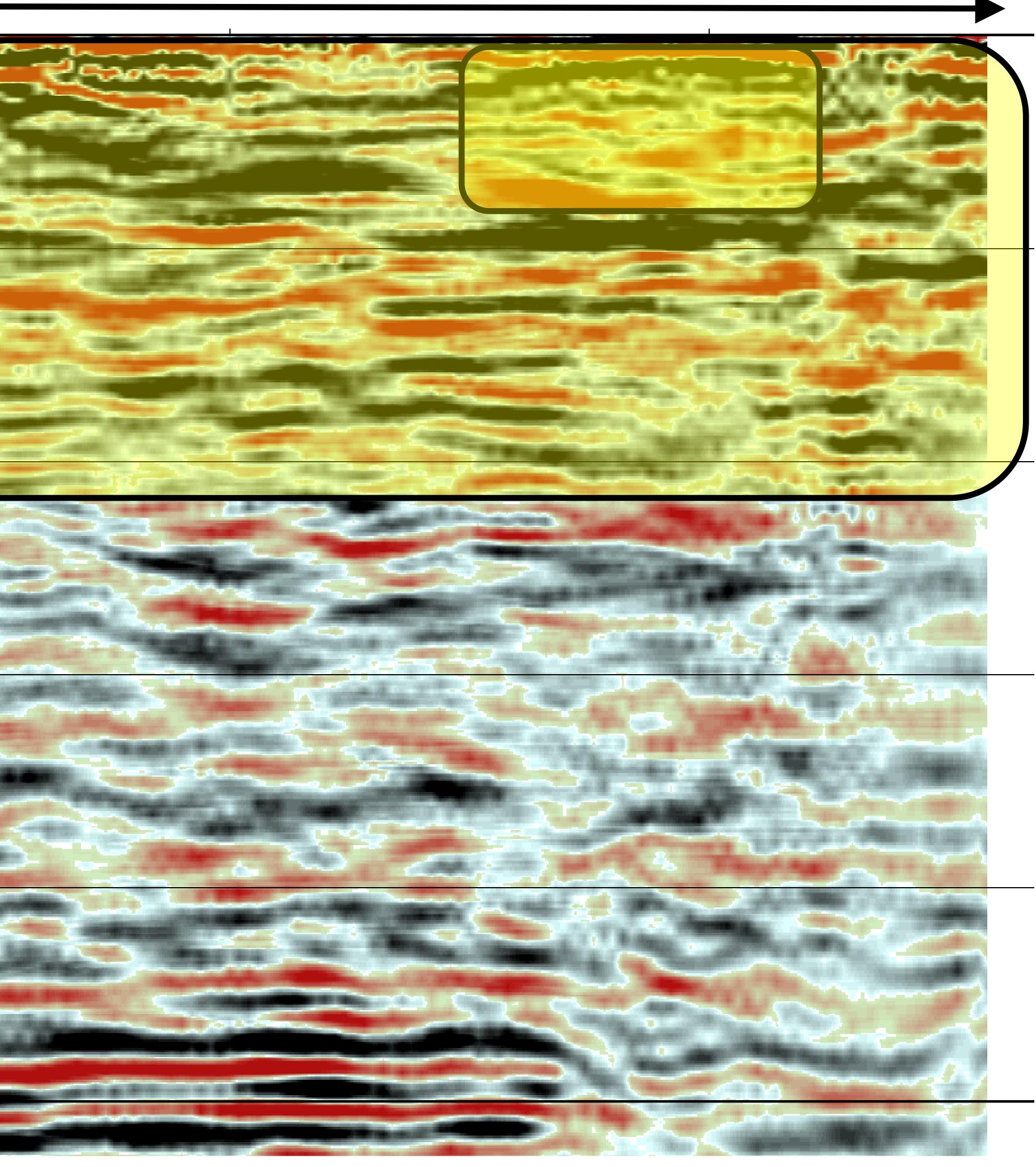
### S CREVIES

### www.crewes.org

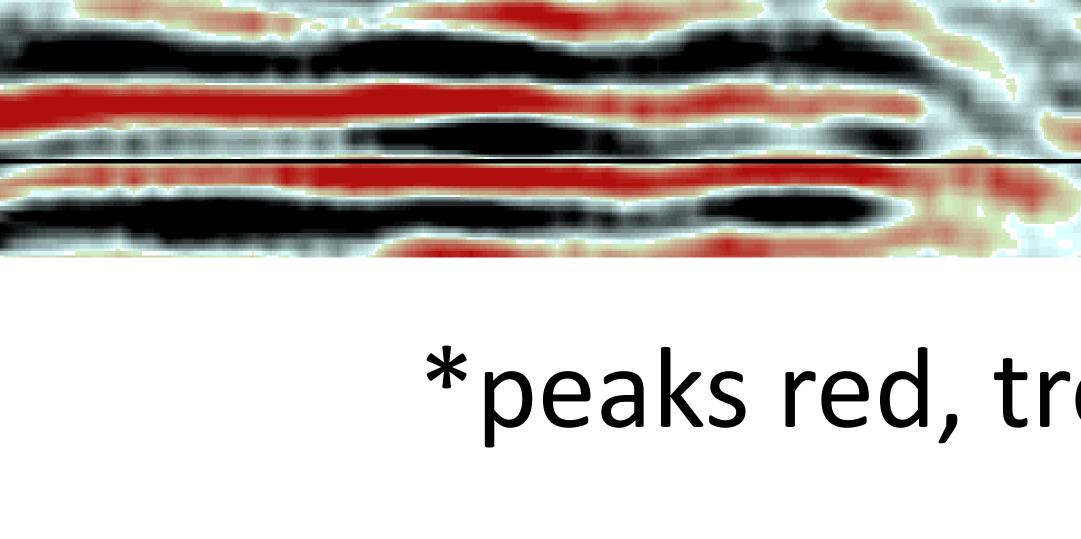
### 600m

## Near surface (first 500 ms)





### \*peaks red, troughs black



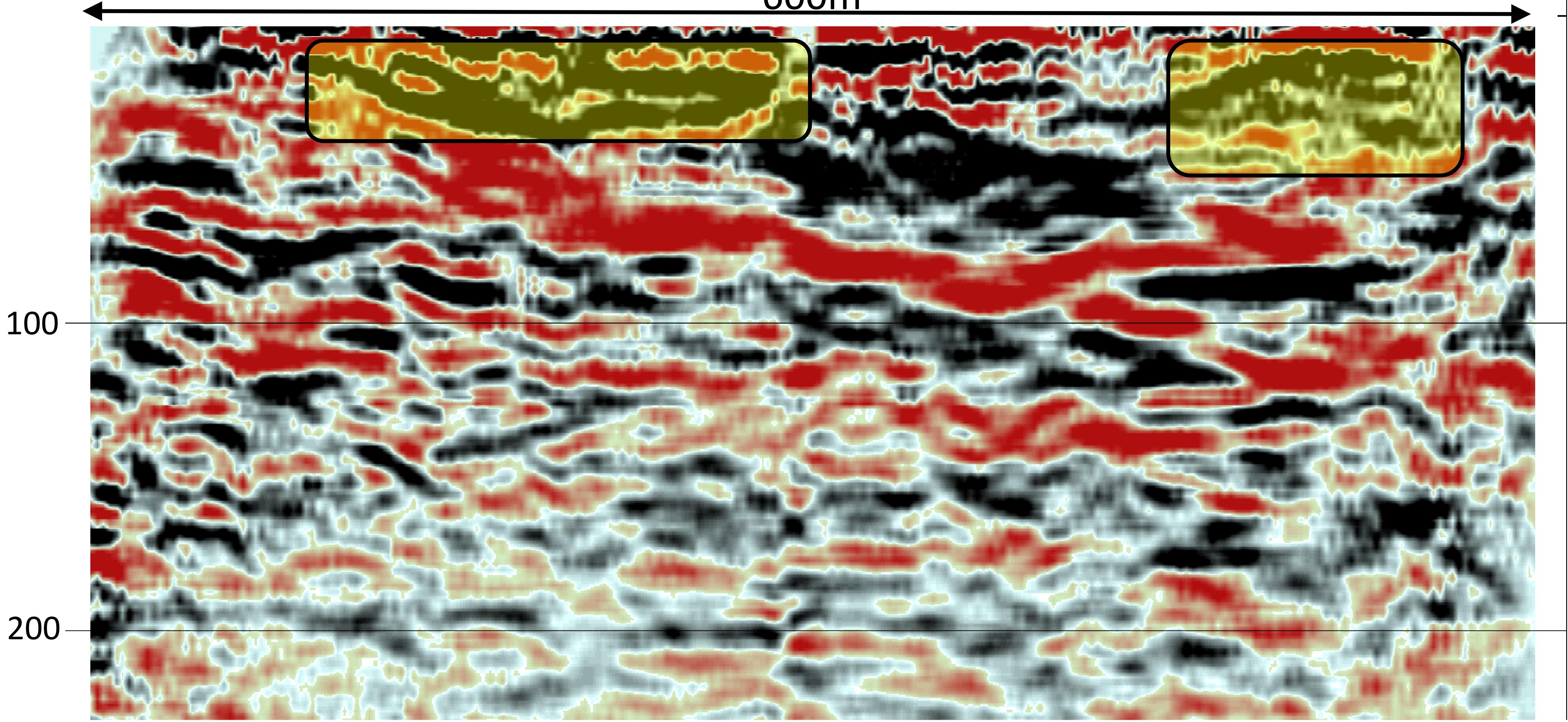














# Near surface (first 200 ms)

### 600m





### • Reprocessing 2D and processing additional lines from the seismic program - more focus on the near surface, noise attenuation. - can we correlate the 2 identified anomalies to the other 2D lines?

2D seismic data. do the seismic/velocity anomalies correlate to expected rock mechanics in the survey area?



### Future considerations

# Acquisition of geologic information to tie together with

www.crewes.org









UNIVERSITY OF CALGARY



### 2D lines recorded in Inglewood Park - best line from shoot was processed and interpreted - lithological anomalies from refraction analysis may be indicative of fluvial systems - two near-surface features were highlighted on the seismic

- section

# • Future work

- reprocessing

### S CREVIES

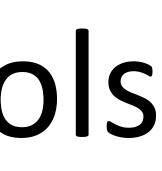
### Summary

### • Field school 2013 moved to urban Calgary as a result of

### » may correlate to refraction anomalies

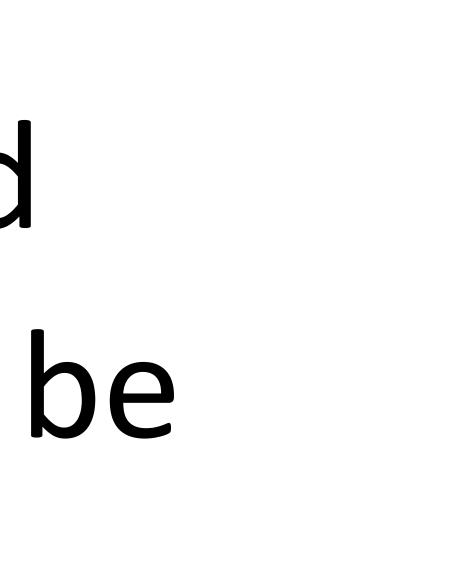
### - integration with geological controls













### Don Lawton

- City of Calgary
- CSEG for field school funding



### Schlumberger

### HALLIBURTON



# Special thanks to

# CREWES sponsors, staff, students Schlumberger/GEDCO for vista processing software Halliburton Landmark for ProMAX processing software



Landmark









# Questions





