

Reservoir Characterization in Leming Lake, Alberta

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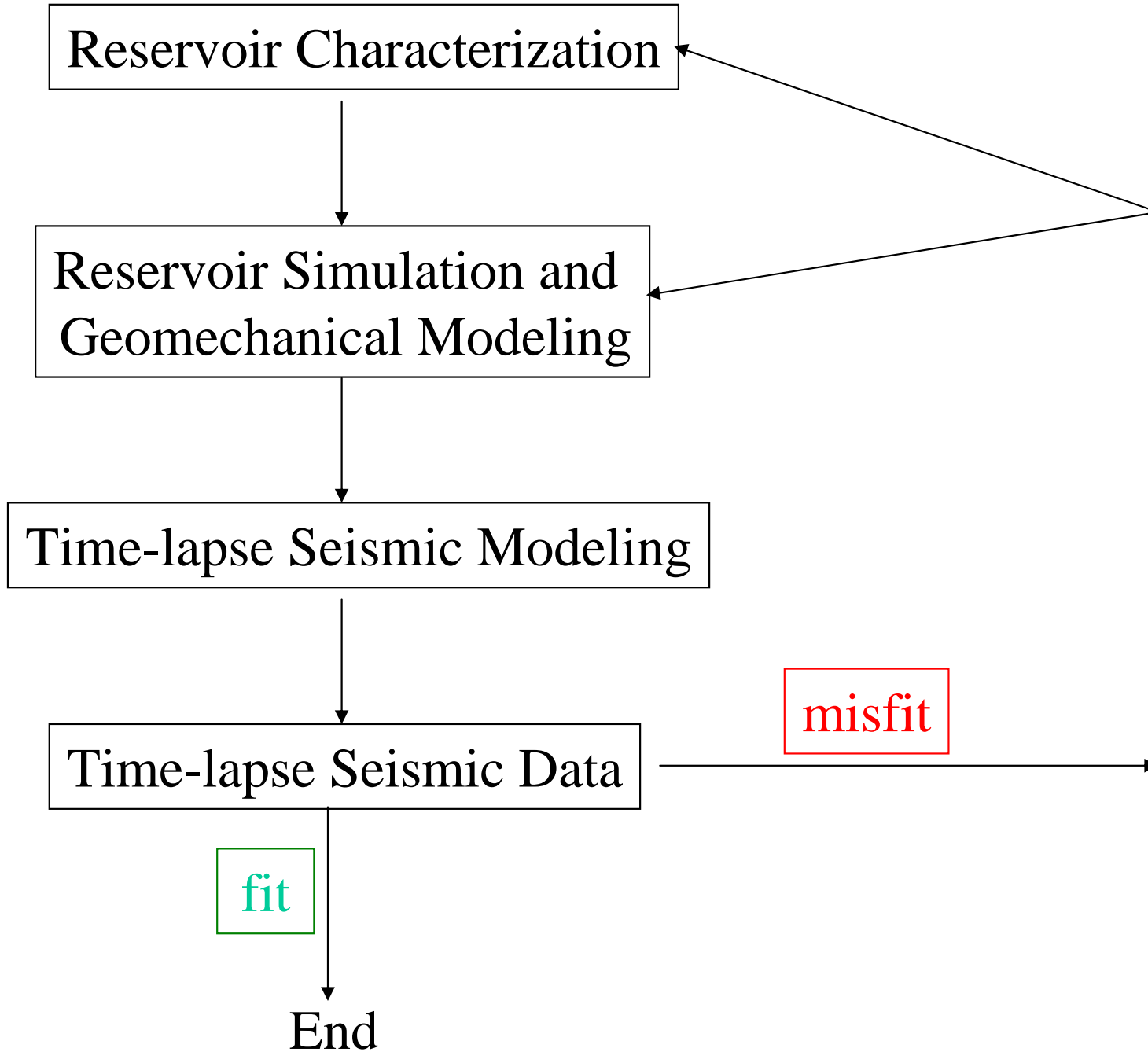
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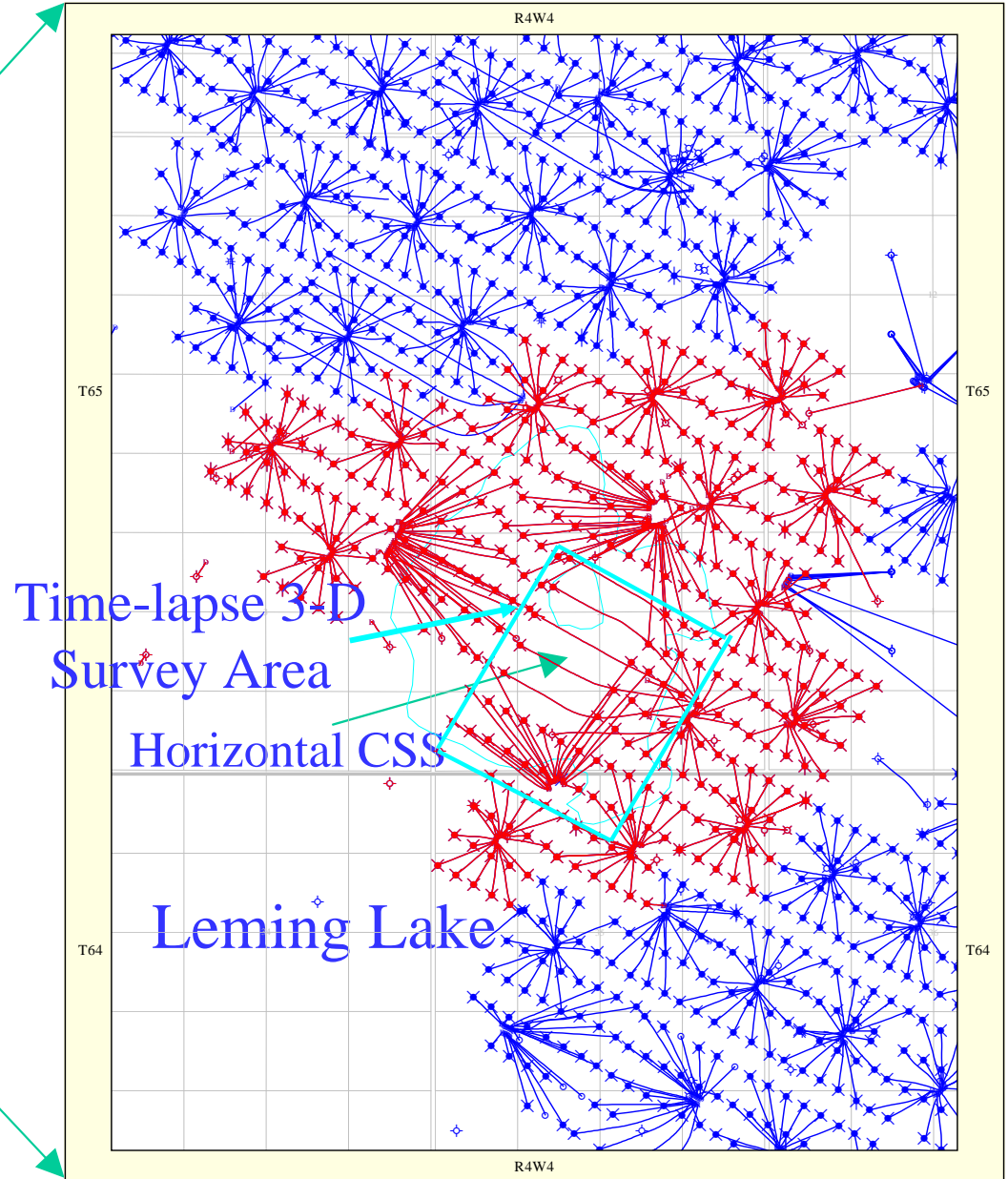
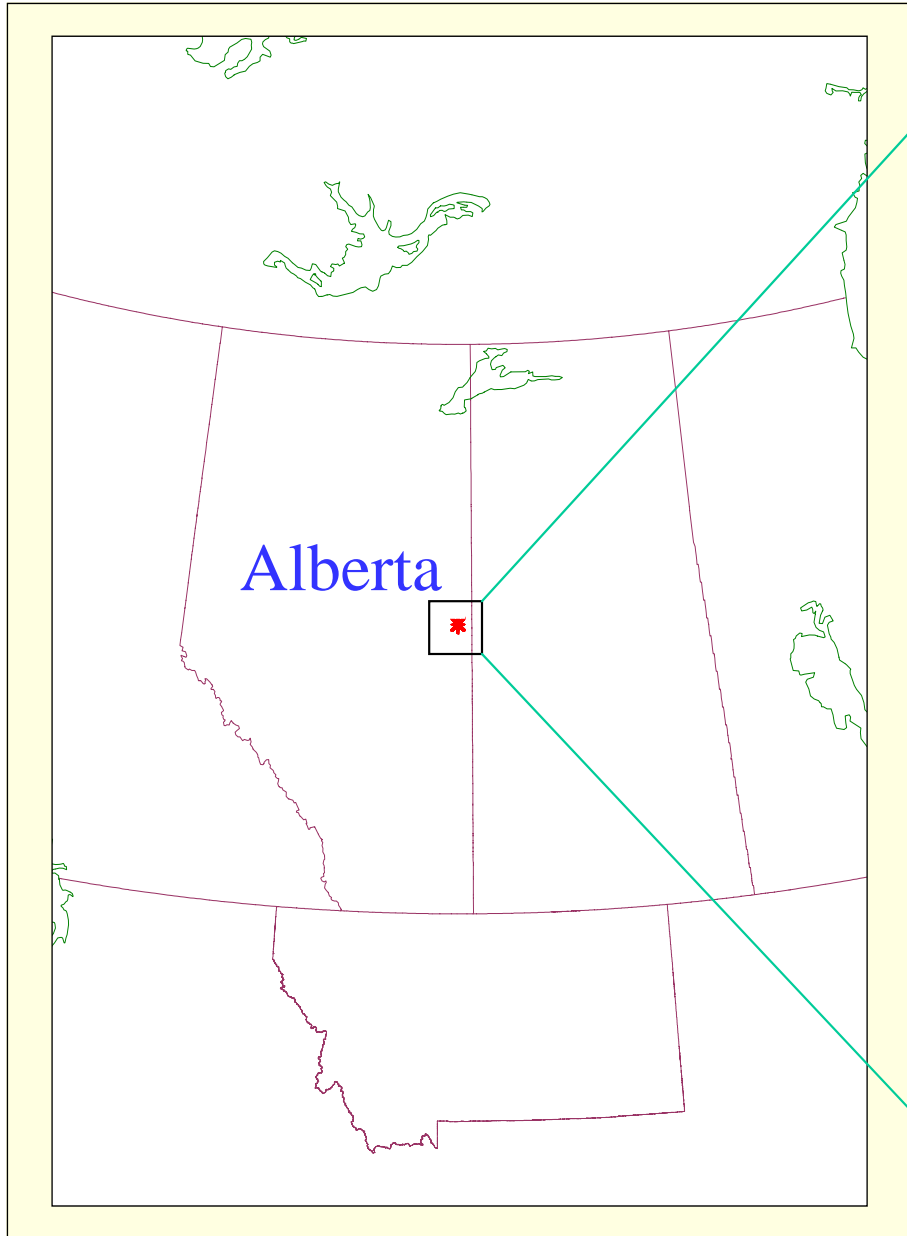
Outline

- Introduction
- Reservoir Geometry
- Porosity Distribution
- Tight Rock Picks from Seismic Sections
- Reservoir Characterization Model
- Conclusions
- Future Work
- Acknowledgements

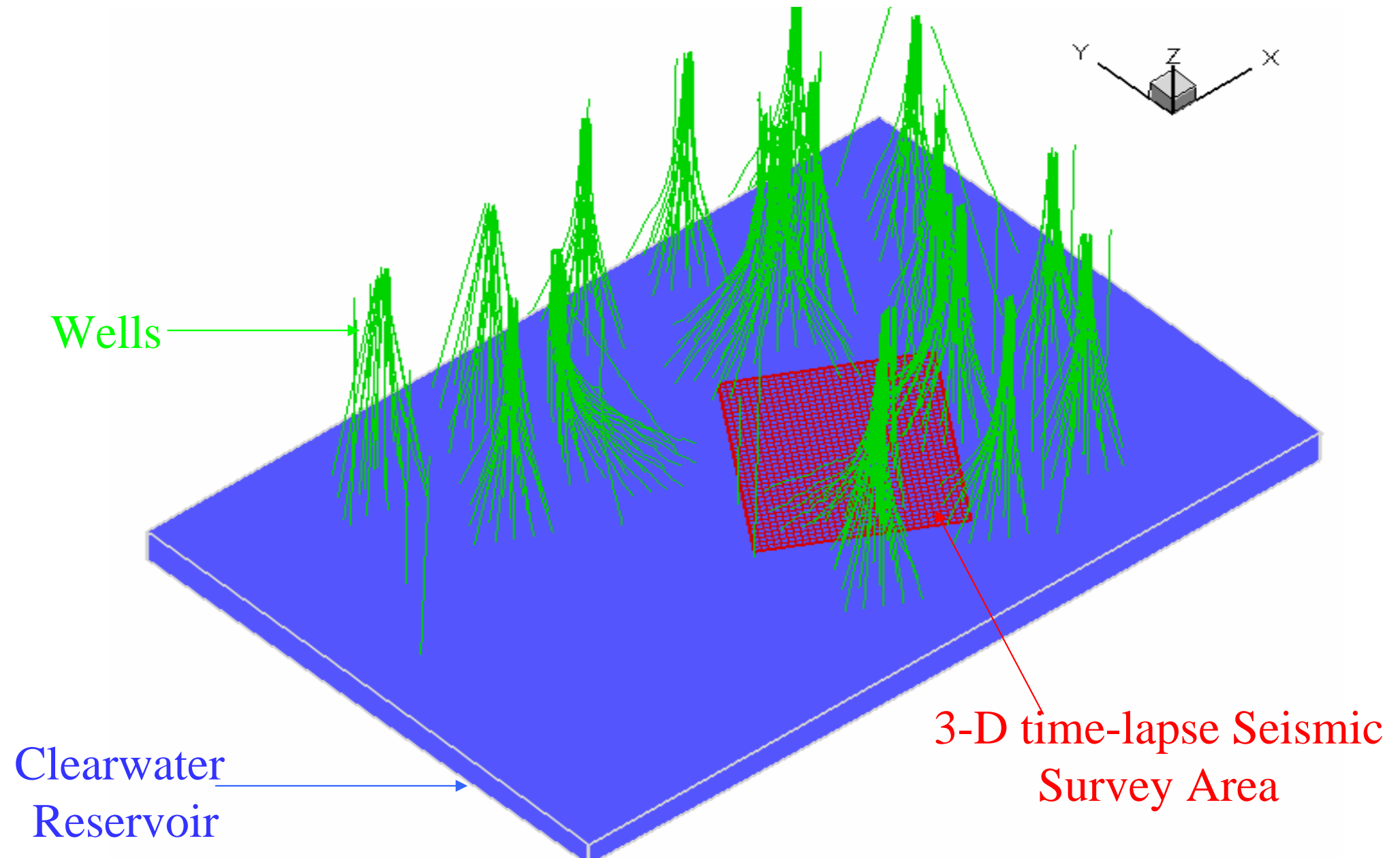
Project Outline



Location of the Leming Lake area

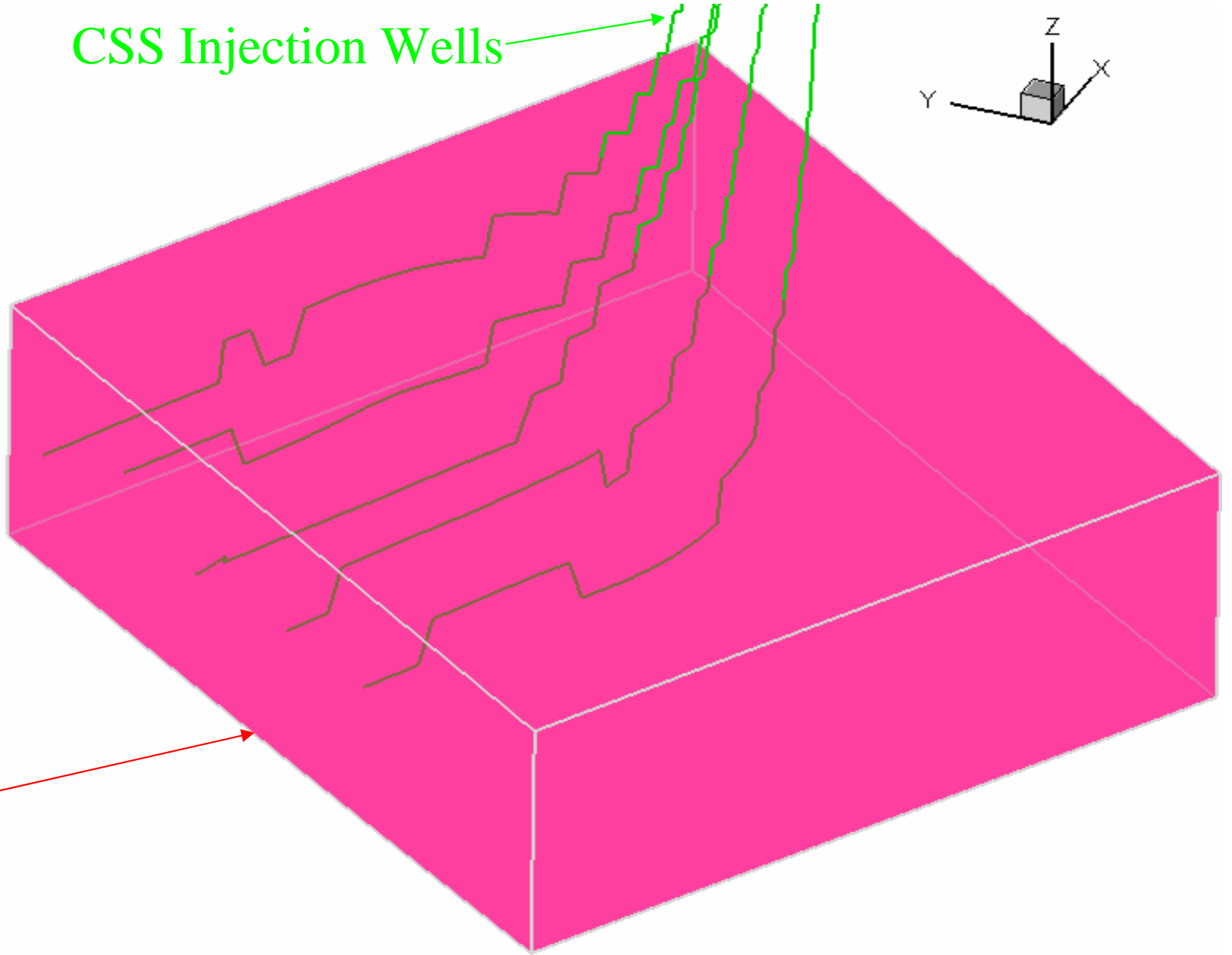
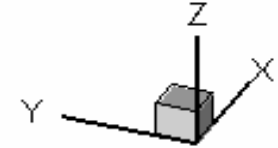


3-D visualization of the reservoir geometry



3-D visualization of the reservoir geometry (within the 3-D seismic survey area)

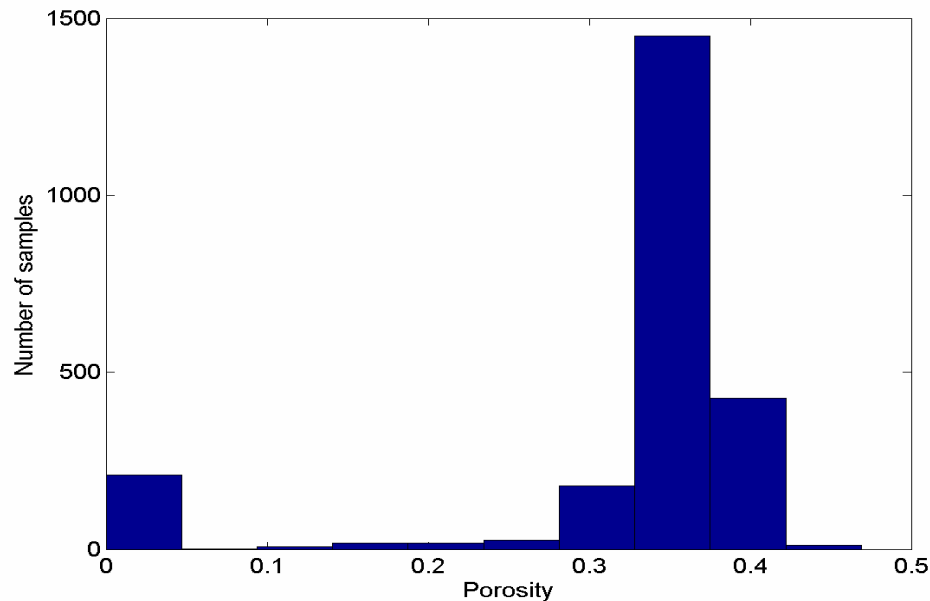
CSS Injection Wells



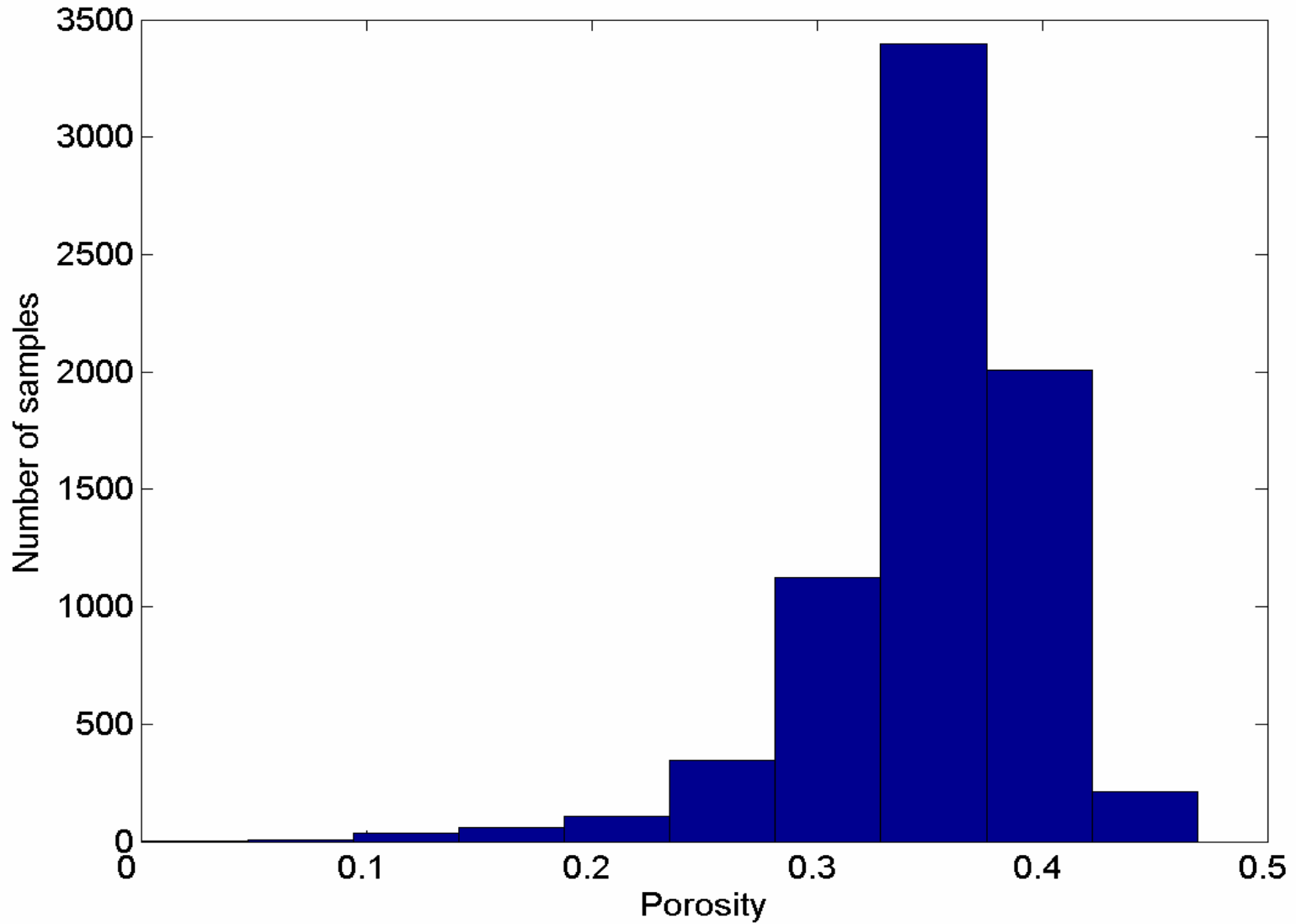
Clearwater
Reservoir

Lab Reports and Porosity Histogram

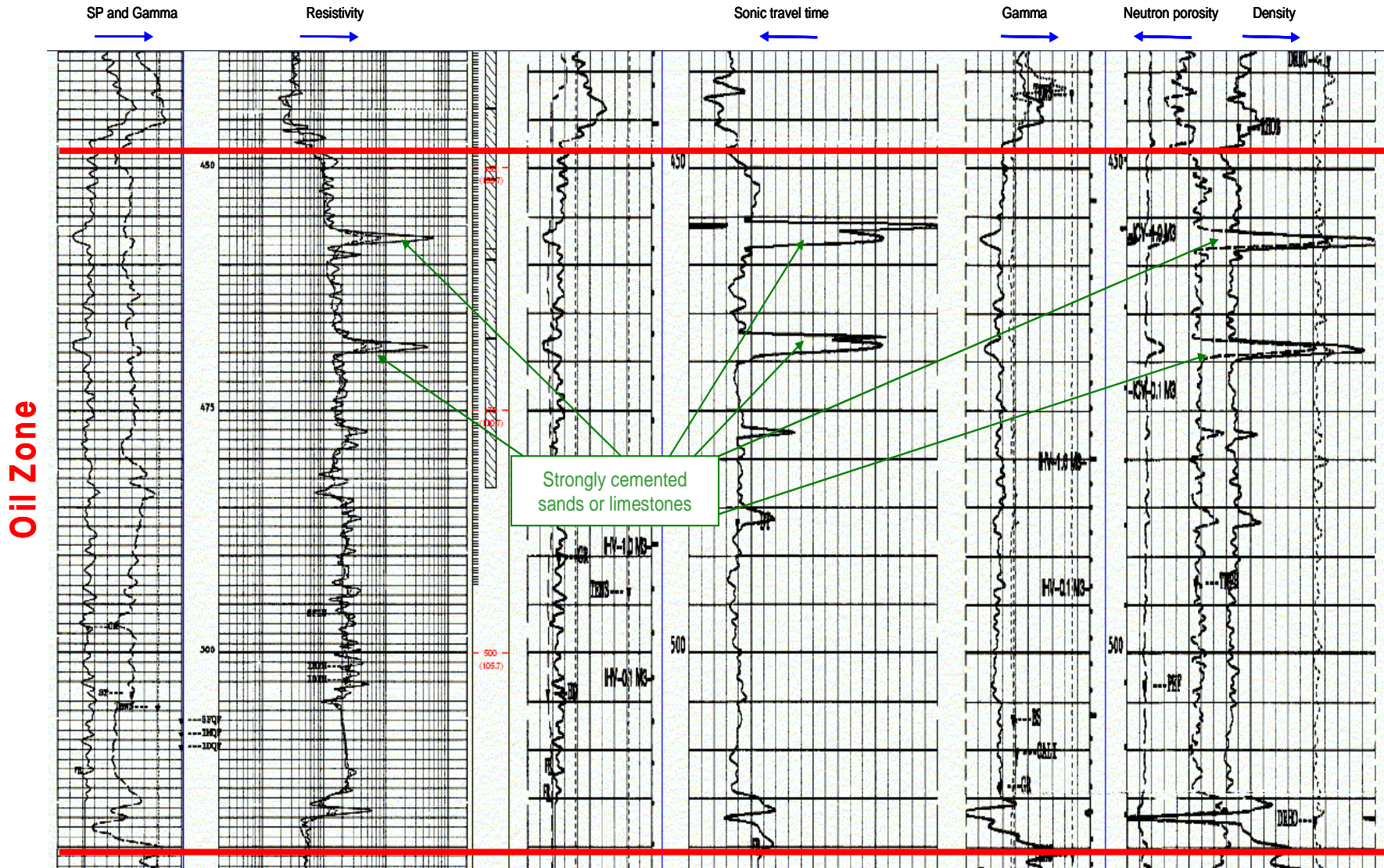
H1392	Lithology										
A	B	C	D	E	F	G	H	I	J	K	L
Location	Sample Ba	Thickness	SampleForms	Sample To	Porosity	KMax (mD)	Lithology	RSat Oil R	RSat Wtr F	Bulk Dens	k90 (mD)
1392	AA/03-02-065-04W4/0	725.71	0.39	CLRWTSD	725.32	0	SS VF SHY LMY	0	0	0	0
1393	AA/03-02-065-04W4/0	726.12	0.41	CLRWTSD	725.71	0.357	SS VF F SSHY	0.776	0.224	0	0
1394	AA/03-02-065-04W4/0	726.67	0.55	CLRWTSD	726.12	0.361	SS VF F SSHY	0.674	0.326	0	0
1395	AA/03-02-065-04W4/0	726.82	0.15	CLRWTSD	726.67	0	SS VF SSHY LMY	0	0	0	0
1396	AA/03-02-065-04W4/0	727.35	0.53	CLRWTSD	726.82	0.362	SS VF F SSHY	0.776	0.224	0	0
1397	AA/03-02-065-04W4/0	727.89	0.54	CLRWTSD	727.35	0.339	SS VF F SSHY	0.726	0.274	0	0
1398	AA/03-02-065-04W4/0	728.38	0.49	CLRWTSD	727.89	0.353	SS VF F	0.718	0.282	0	0
1399	AA/03-02-065-04W4/0	728.88	0.5	CLRWTSD	728.38	0.35	SS VF F SSHY	0.71	0.29	0	0
1400	AA/03-02-065-04W4/0	729.38	0.5	CLRWTSD	728.88	0.346	SS VF F SSHY	0.741	0.259	0	0
1401	AA/03-02-065-04W4/0	729.89	0.51	CLRWTSD	729.38	0.346	SS VF F SSHY	0.712	0.288	0	0
1402	AA/03-02-065-04W4/0	730.39	0.5	CLRWTSD	729.89	0.349	SS VF F SSHY	0.726	0.274	0	0
1403	AA/03-02-065-04W4/0	730.87	0.48	CLRWTSD	730.39	0.361	SS VF F SSHY	0.684	0.316	0	0
1404	AA/03-02-065-04W4/0	731.39	0.52	CLRWTSD	730.87	0.351	SS VF F	0.684	0.316	0	0
1405	AA/03-02-065-04W4/0	731.88	0.49	CLRWTSD	731.39	0.348	SS VF F	0.691	0.309	0	0
1406	AA/03-02-065-04W4/0	732.48	0.6	CLRWTSD	731.88	0.335	SS VF F SSHY	0.651	0.349	0	0
1407	AA/03-02-065-04W4/0	732.85	0.37	CLRWTSD	732.48	0	SS VF SSHY LMY	0	0	0	0
1408	AA/03-02-065-04W4/0	733.37	0.37	CLRWTSD	733	0	SS VF SSHY LMY	0	0	0	0
1409	AA/03-02-065-04W4/0	733.79	0.42	CLRWTSD	733.37	0.333	SS VF F SSHY	0.462	0.538	0	0
1410	AA/03-02-065-04W4/0	733.98	0.19	CLRWTSD	733.79	0	SS VF SHY LMY	0	0	0	0
1411	AA/03-02-065-04W4/0	734.23	0.25	CLRWTSD	733.98	0.333	SS VF F SSHY	0.349	0.651	0	0
1412	AA/03-02-065-04W4/0	734.28	0.05	CLRWTSD	734.23	0	SS VF SHY LMY	0	0	0	0
1413	AA/03-02-065-04W4/0	734.38	0.1	CLRWTSD	734.28	0.333	AST SS VF F SSHY	0.349	0.651	0	0
1414	AA/03-02-065-04W4/0	734.88	0.5	CLRWTSD	734.38	0.351	SS VF F SSHY	0.642	0.358	0	0
1415	AA/03-02-065-04W4/0	735.38	0.5	CLRWTSD	734.88	0.361	SS VF F SSHY	0.736	0.264	0	0
1416	AA/03-02-065-04W4/0	735.89	0.51	CLRWTSD	735.38	0.337	SS VF F SSHY	0.564	0.436	0	0
1417	AA/03-02-065-04W4/0	736.39	0.5	CLRWTSD	735.89	0.353	SS VF F SSHY	0.766	0.234	0	0
1418	AA/03-02-065-04W4/0	736.89	0.5	CLRWTSD	736.39	0.353	SS VF F SSHY	0.75	0.25	0	0
1419	AA/03-02-065-04W4/0	737.4	0.51	CLRWTSD	736.89	0.347	SS VF F SLTST INCL	0.714	0.286	0	0
1420	AA/03-02-065-04W4/0	737.9	0.5	CLRWTSD	737.4	0.355	SS VF F SSHY	0.755	0.245	0	0
1421	AA/03-02-065-04W4/0	738.4	0.5	CLRWTSD	737.9	0.373	SS VF F SSHY SLTST INCL	0.745	0.255	0	0
1422	AA/03-02-065-04W4/0	738.9	0.5	CLRWTSD	738.4	0.376	SS VF F SLTST INCL	0.789	0.211	0	0
1423	AA/03-02-065-04W4/0										



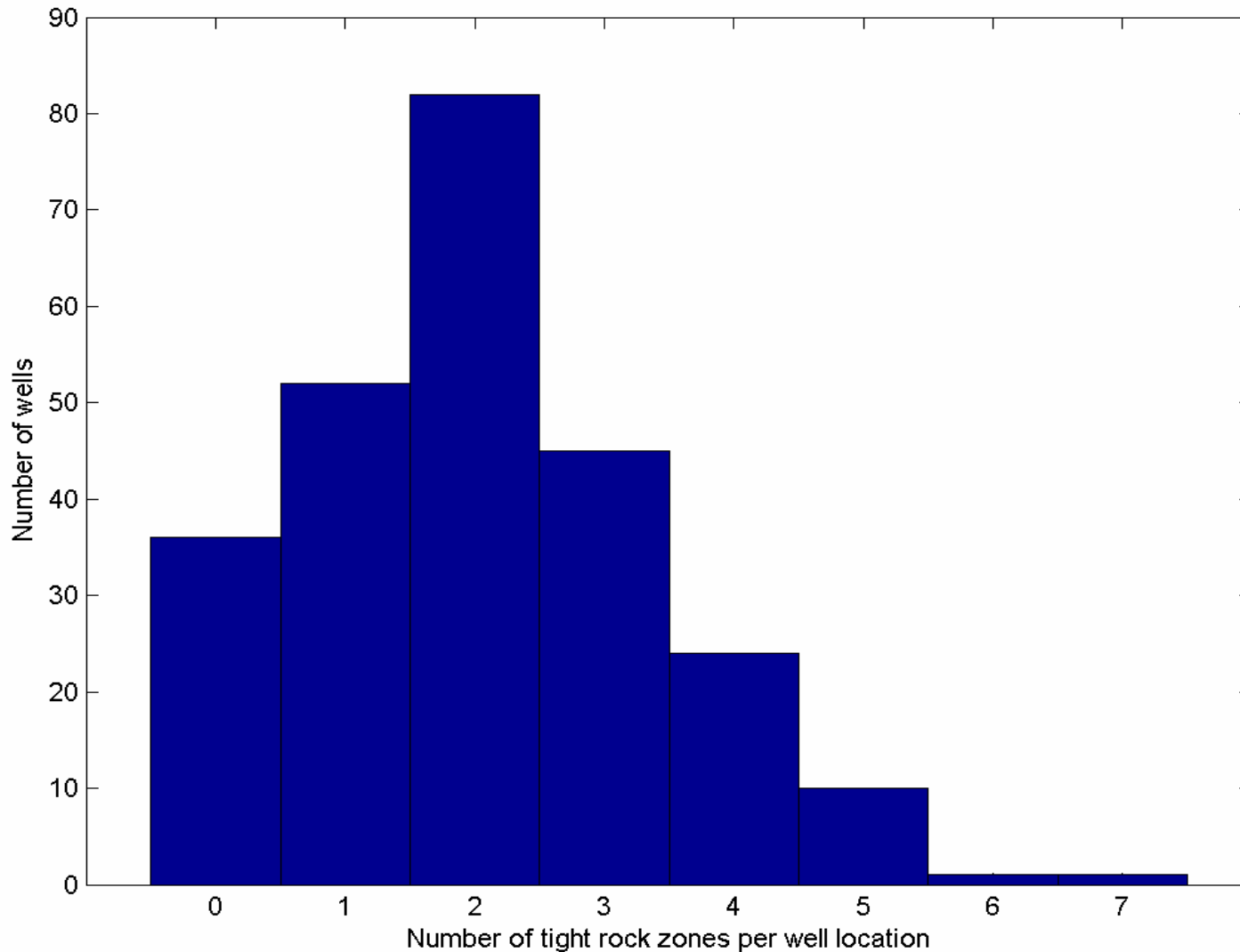
Porosity Histogram (from well logs)



Well logs for the Clearwater Formation at well 00/08-03-065-04W4/0

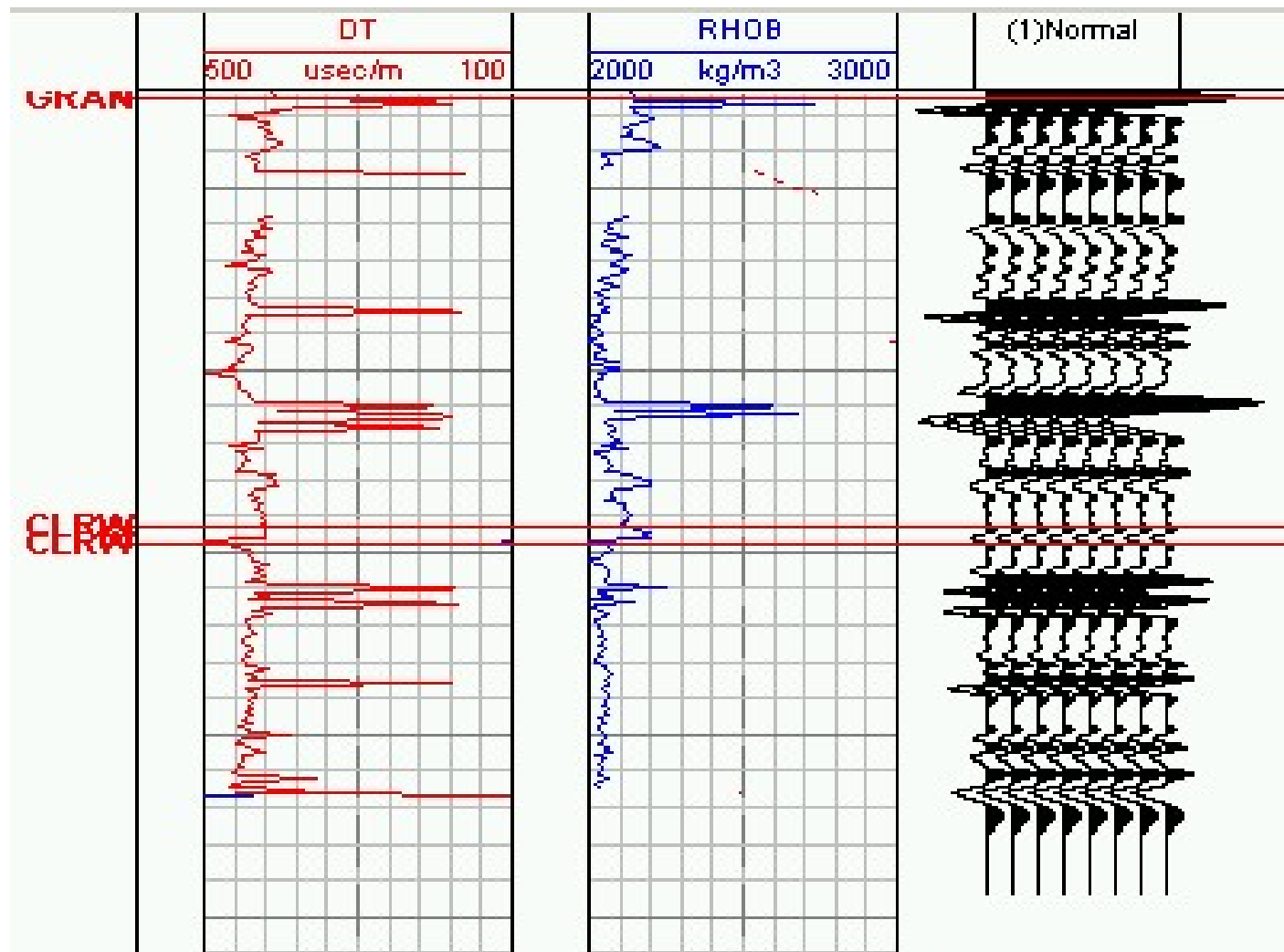


Histogram of number of tight rock zones per well location

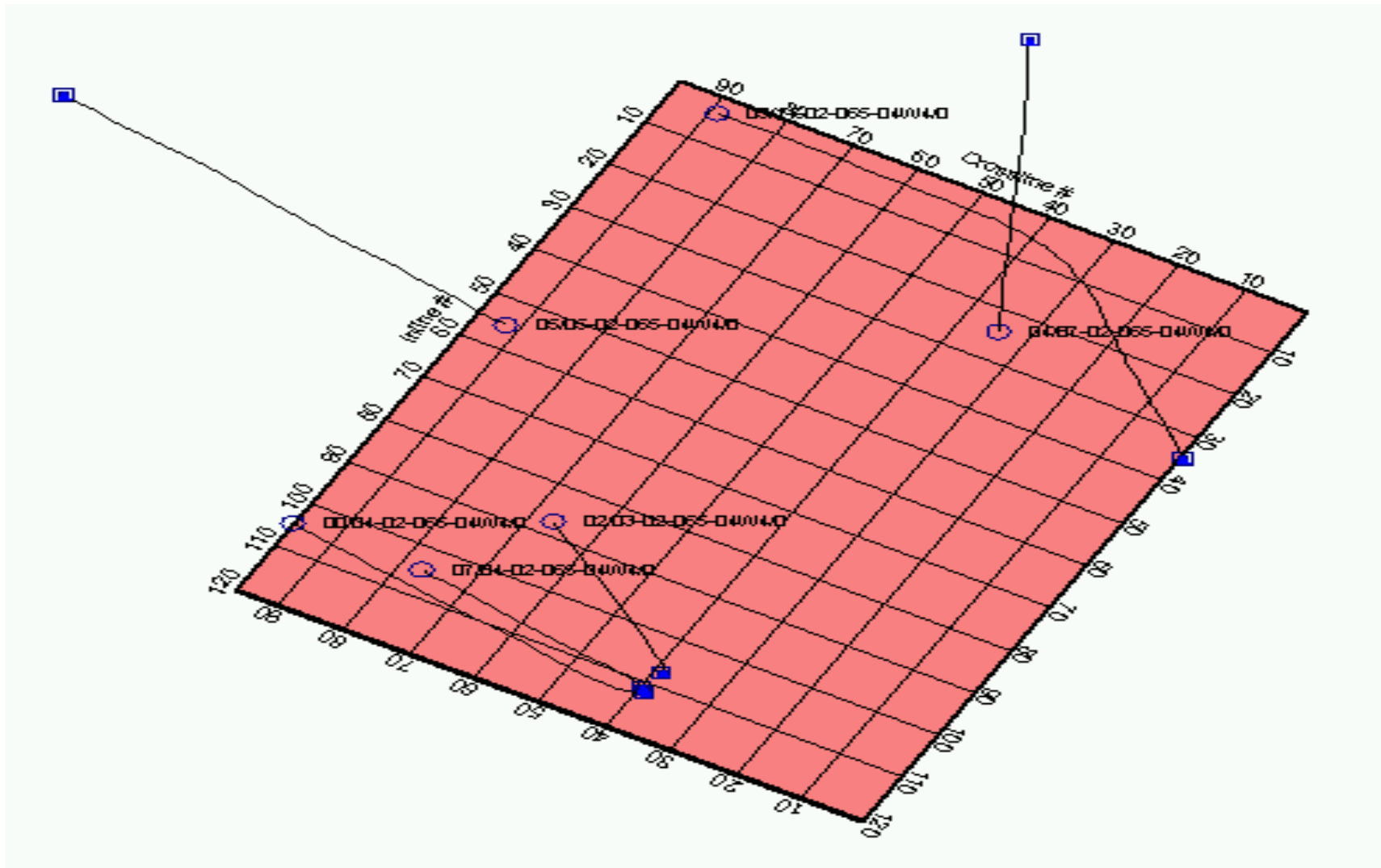


Mean=2.03, Min=0, Max=7, STD=1.37

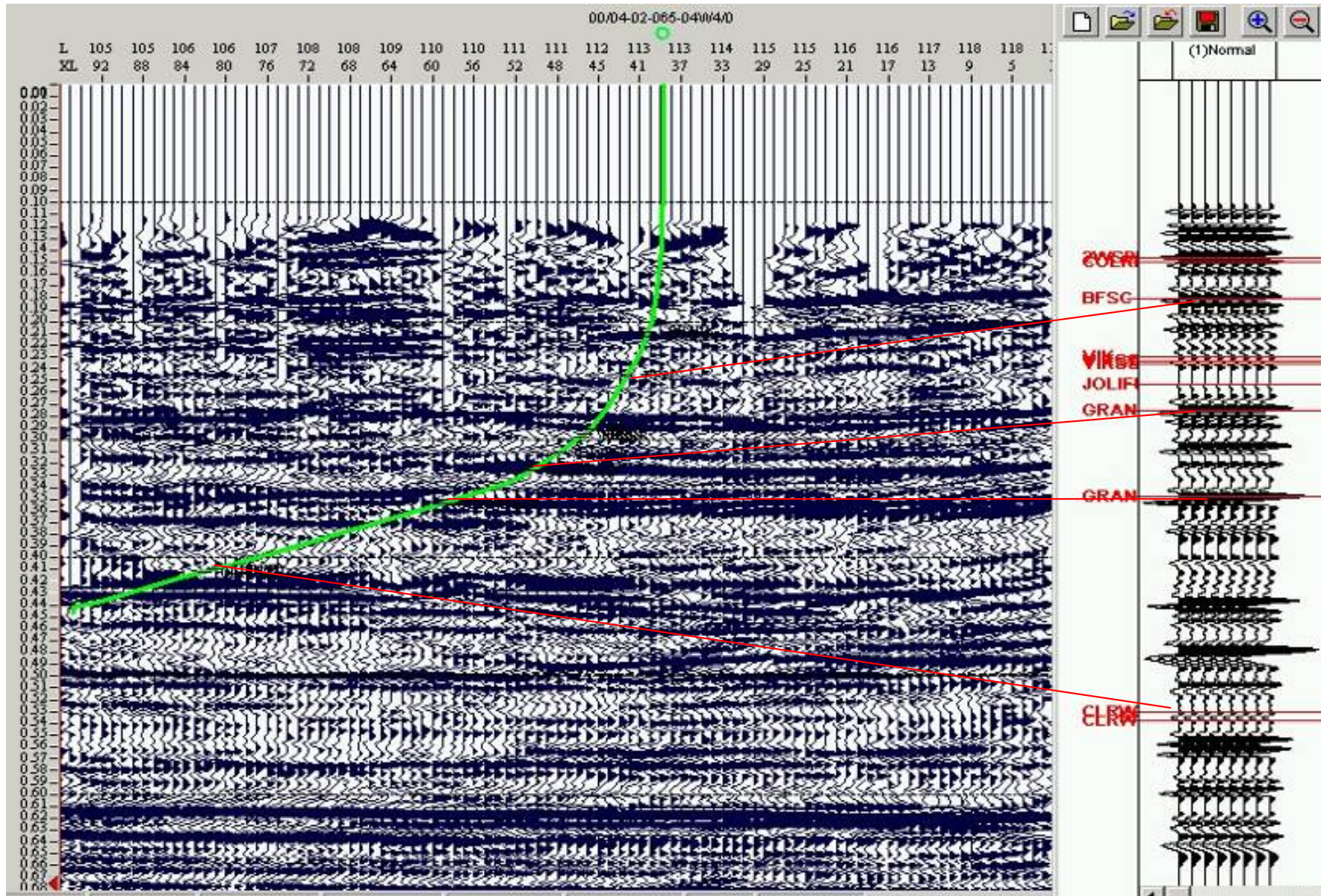
Synthetic Seismic Traces, Sonic and Density Logs at Well 00/04-02-065-04W4/0



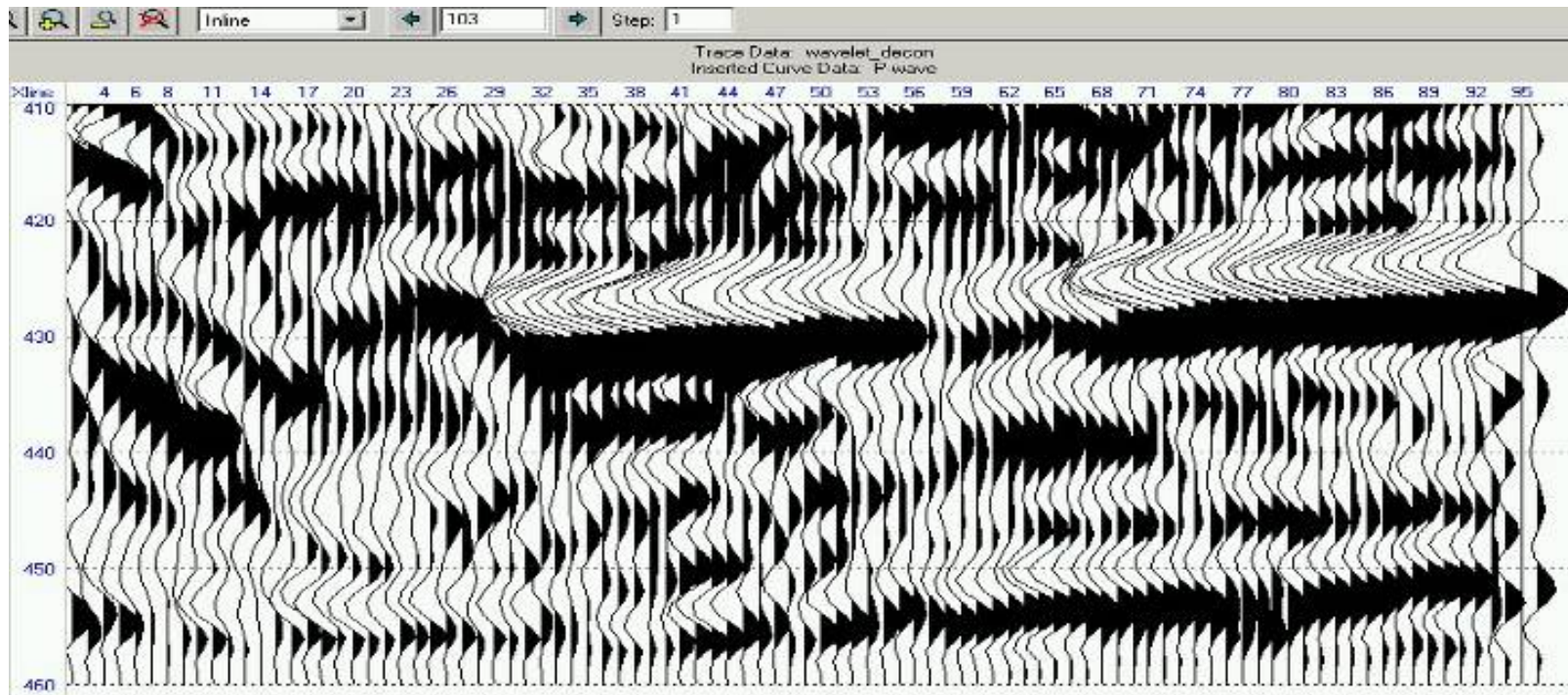
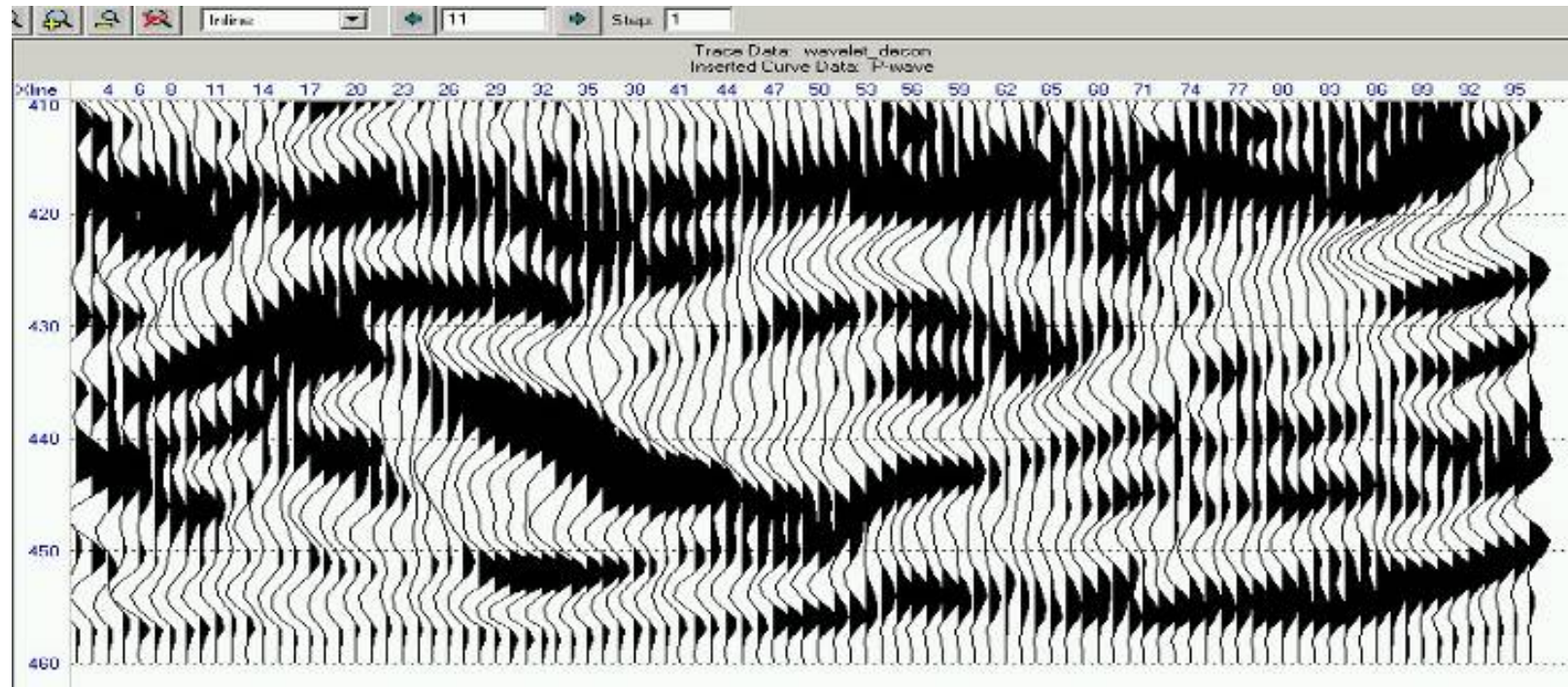
3-D Seismic Survey Area



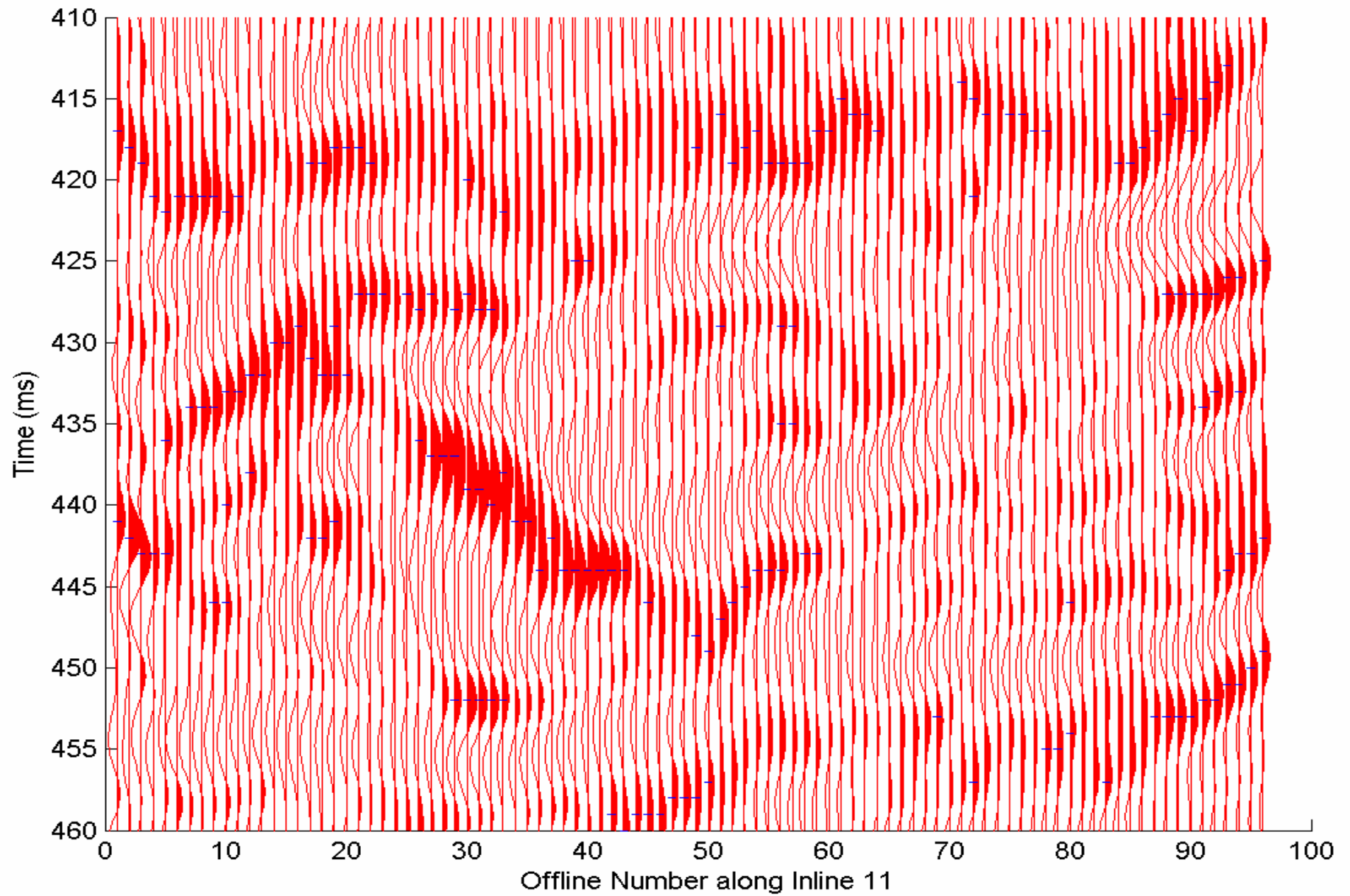
Well Logs Tied to Seismic Section



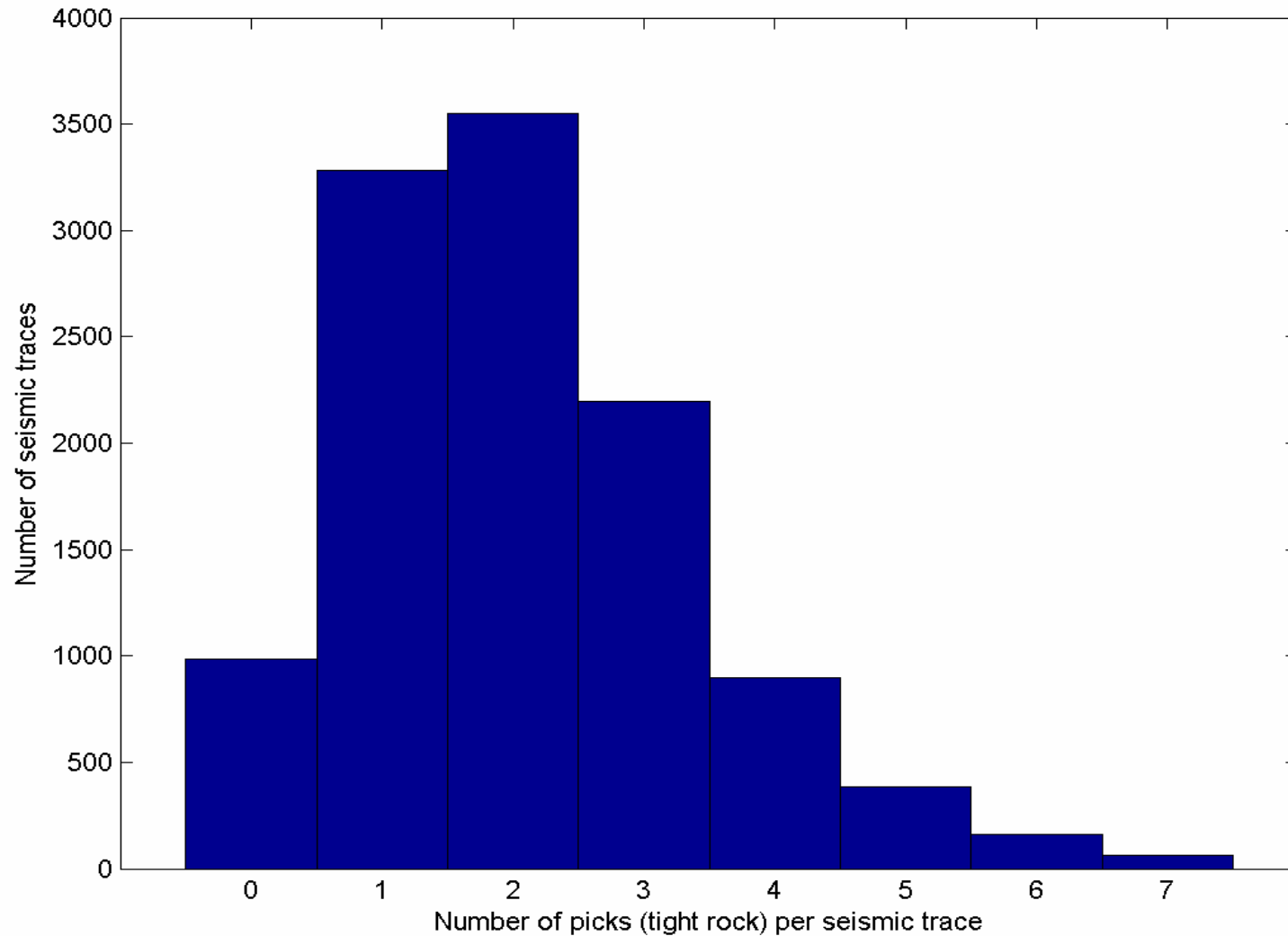
Seismic Reflections from Tight Rocks in Reservoir Zone



Tight Rock Picks from Seismic Section

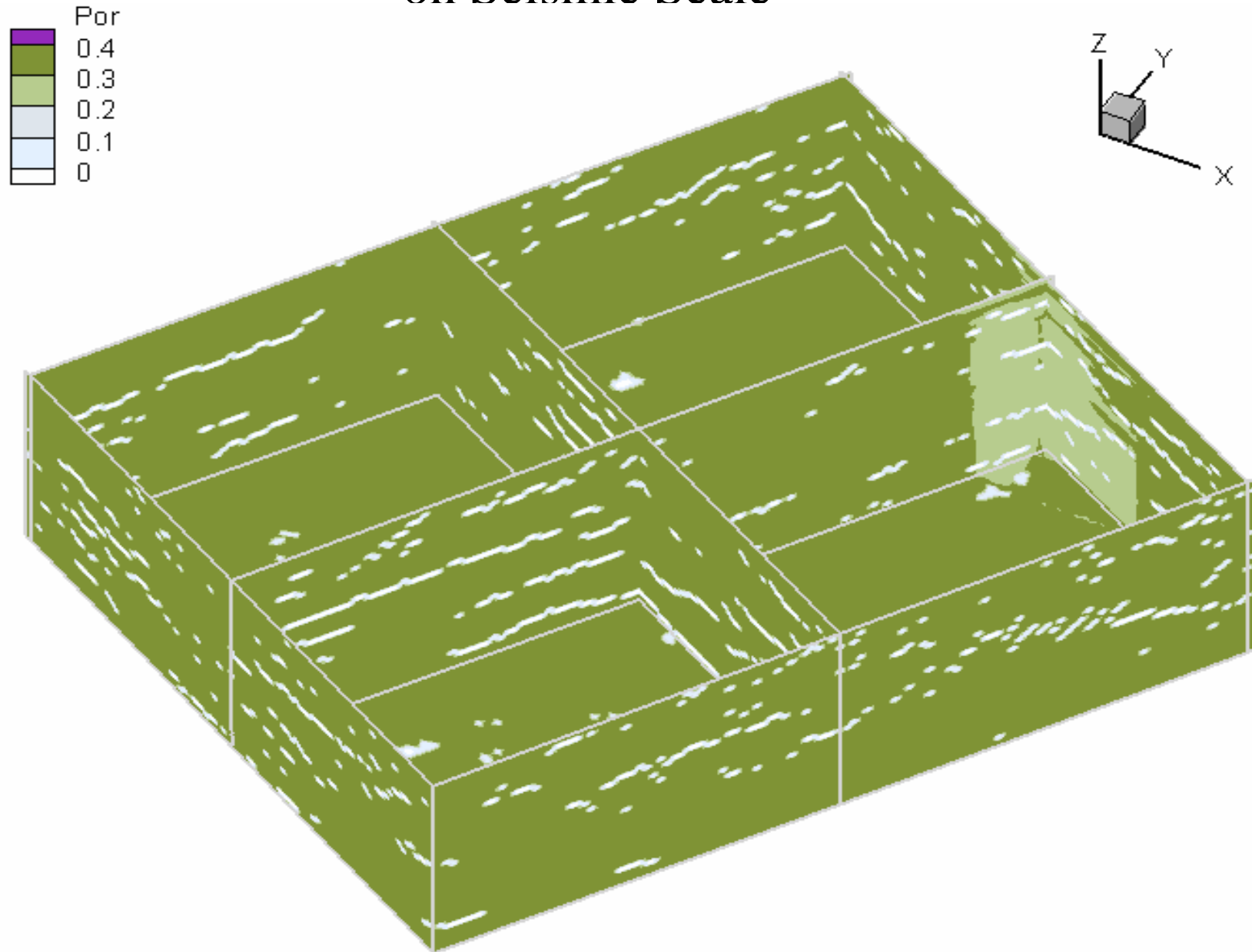


Histogram of number of picks (tight rocks) per seismic trace

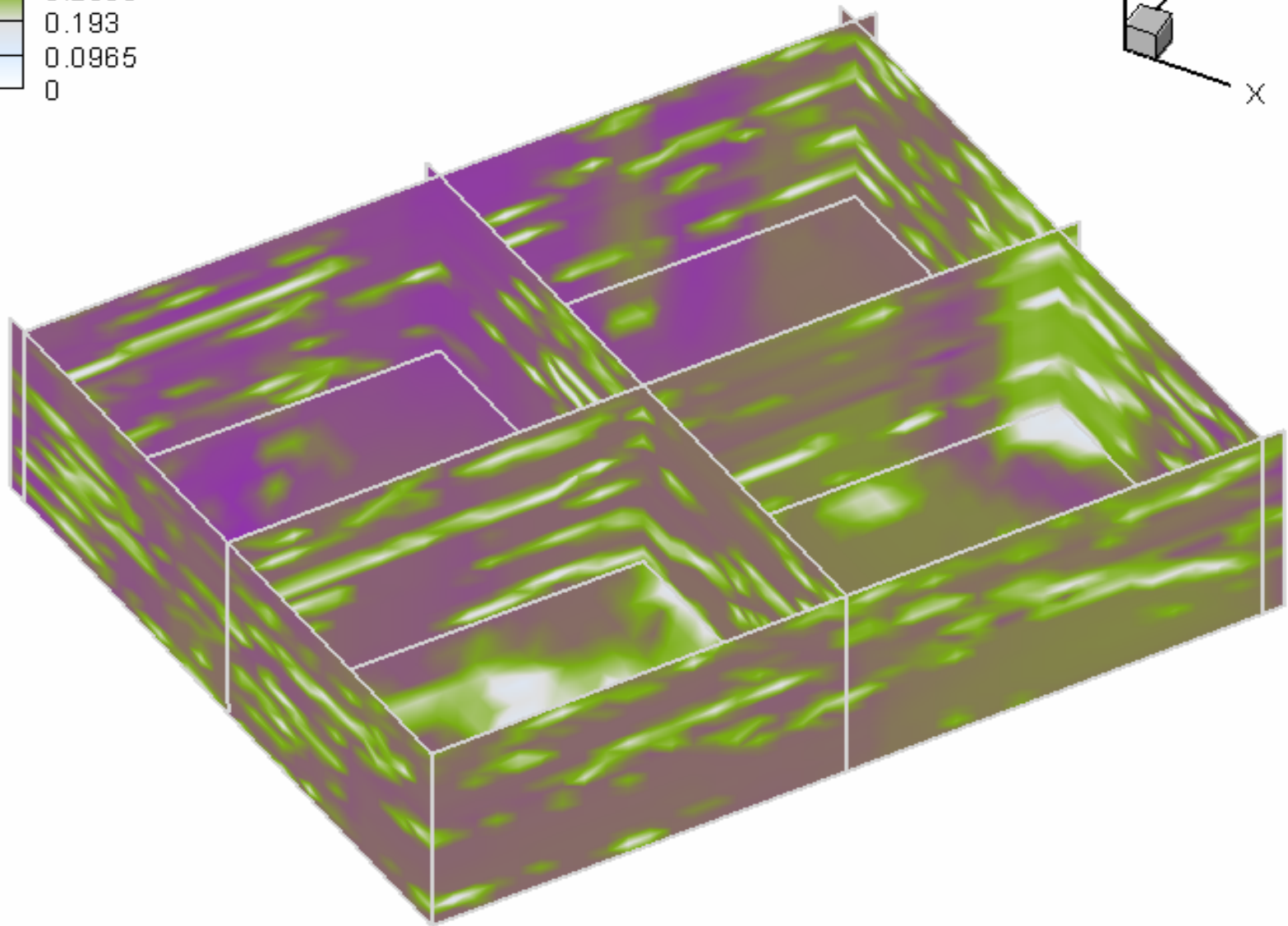
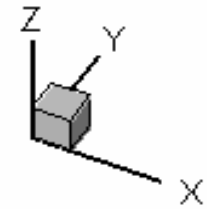
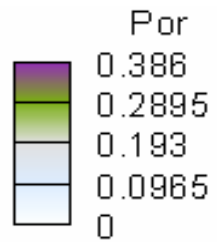


Mean=2.07, Min=0, Max=7, STD=1.34

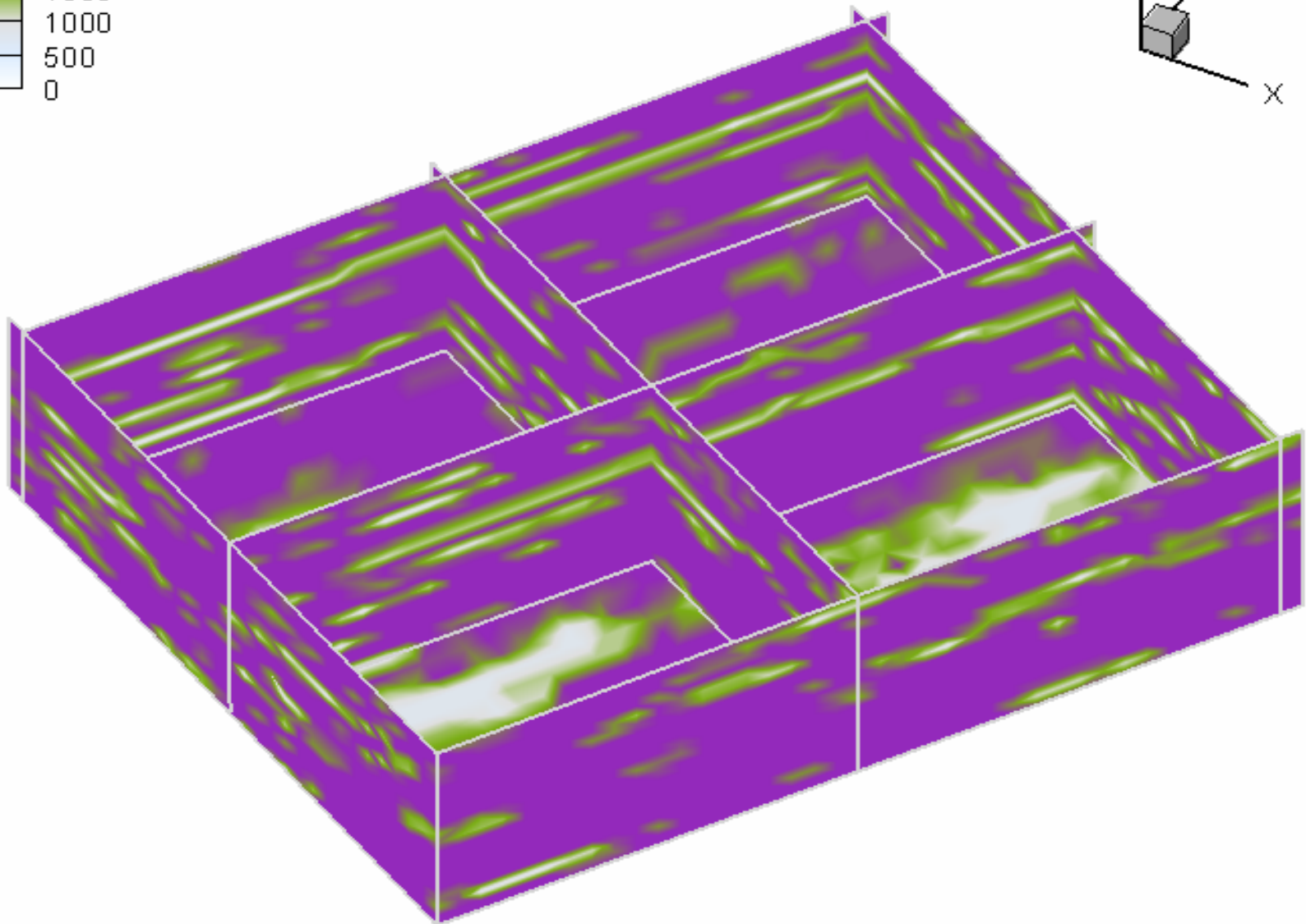
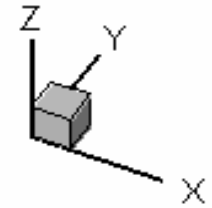
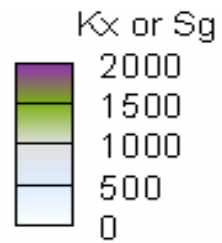
3-D Visualization of the Distribution of Porosity on Seismic Scale



3-D Visualization of the Distribution of Porosity on Reservoir Simulation Scale



3-D Visualization of the Distribution of Permeability on Reservoir Simulation Scale



Conclusions

- The reservoir geometry is relatively flat
- The porosity ranges mainly from 30% to 40%
- Samples of zero porosity represent tight rocks, which are scattered throughout the reservoir
- Tight rocks can be picked from seismic sections
- A seismic reservoir model was established
- The seismic scale model was upscaled to reservoir simulator scale
- The procedure needs to be validated with well logs

Future Work

- Examine more evidence to validate tight rock picks from seismic section
- Validate the upscale procedure
- Evaluate seismic responses to injection and production

Acknowledgements

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