The University of Texas at Austin

A Study of the Oil and Gas Zones in Hunt County, Texas

Jackson School of Geology



Terrance Wickman 12/7/2009

I. Over View of Problem

Fossils fuels are a huge source of energy that is used around the world. This make them valuable. Oil and Gas are the two fossil fuels that this paper attempts to locate in Hunt County, Texas. In order to have oil and gas you need a source rock, resevoir rock, and a trap rock. Once the source rock has reached the gas or oil window of temperature and pressure, it begins to produce oil and gas. These liquids then migrate towards the surface because they are less dense than the water in the rock. They will migrate until they have reached a non porous rock where they are trapped in the rock beneith it, known as the reservoir rock. Because gas is less dense than oil, the mixture will settle until the oil is benieth the gas. Two maps were produced. One map that shows a surface of the bottom of the trap rock, and another map shows the areas which which are likely to have either gas or oil based on the properties of petroleum systems. These areas will be compared with the location of Wickman Farms to dtermine if there is a possibility of drilling for oil under the property.

II. Data Provided

- An excel file from Dr. Tim Meckel that contains thedecimal degree location of the 341
 producing and non producing wells in Hunt County, Texas in the North American Datum 1983
 coordinate system. Each well has a description of the status of the well in the form of an
 abbreviation that is described in a side table. If the well is producing, the perforation depths are
 given in feet with a perforation top and a perforation bottom.
- 2) A layer filefrom Lab 1 with county boundries of Texas in North American Albers coordinate system.
- 3) A layer file from Lab 1 containing the surface geology with accompanying attributes of Texas in North American Albers coordinate system.
- 4) A survey of Wickman Farms containing the corordinates in degrees, minutes and seconds in the WGS 1984 coordinate system.

III. Construting a GIS

 Starting with a blank ArcMap document, the the layer file with Texas county boundrys was added. Since the file was originally constructed in Albers coordinate system, the layer was then reprojected in North American Datum 1983 by clicking on the geodatabase and changing the projection. The end result show the Texas counties as shown in FIGURE 1.



2) To help understand the subsurface geology the layer file was added to the map. Once added to the map, no further work was created, as ArcMap automatically projected the layer into the North American Datum 1983 as shown in FIGURE 2.



[FIGURE 2]

3)

Looking at the geology in Hunt County it can be determined that there is an older unit of rock outcropping in the middle of a younger unit as circled in FIGURE 2. This indicates there there is a domal structure localized in that area.

4) In order to establish a study area of Hunt County, another layer file had to be created. In ArcCatalog, a new polygon file was created and labeled Study Area. Then, in ArcMap, the layer file was added to the geodatabase. Using the Editing tool, a polygon was constructed as shown in FIGURE 3.



5) In order to add the wells to the document, the excell file must be converted to a point file. In ArcMap, the well locations and their attrinutes were added to the map by using the Add XY Data functin. In the wizard, the proper excell file was selected the x-coordinate column and the y-coordinate column. Because the excel file contained the decimal degree locations in NAD83, this coordinate system was selected in the wizard. The resulting file created in ArcMap was then saved as a layer file in order to access its attribute table which is shown if FIGURE 4.

EID																													
	snape -	UWI_API	SURFLAT	SURFLOII	SYM	PERFTOP	PERFBASE	17	DHSO	Dry_Hole_w	F10	F11	F12	F13	F14	F15	F16	E FO	7 19	1 F1	9 E	20 1	21 1	122	F23	F24	F25	F26	(
	Point	42231000000000	33.279702	-96.260076	DRY				DHSO	Dry Hole with Show of Qas																			
1	Point	42231000000000	33.296977	-96.214237	DHSG				JWK	Junked																			
	Pont	4223100000000	33/29/21/24	-96,294763	URY				JERGA	Junked Gas Well	_				-	-	-	-		_	_	-	_						
- 1	Port	4223100000000	33.359276	-96.121072	DEV				JPPIOS TA	Jurked Of and Gas Hell	_		-	-	-	-	-	-	-	-	-	-	-					-	
- 3	Doint	42231000100000	22 210402	-00.110703	DRY				0110	Currended Mell	_		-	-	-	-	-	-	-	-	-	-	-		-			-	
1	Boint	42231000100000	33 311173	-90.120010	DEV				ARON	Abandoned Med	_		-	-	-	-	-	-	-	-		-	-						
	Point	42231000100000	33 296465	.95142373	DRY												-	-					-						
1	Point	42231000100000	33,293144	-96.138292	DRY								-	-	-	-	-	-	-	-		-							
	Point	42231000100000	33,290827	-96.129734	DRY																		-						
10	Point	42231000100000	33 209911	.95130729	DRY												-												
11	Point	42231000100000	33.3416	-96.091412	DRY								-	-	-	-	-	-	-	-	-	-							
12	Point	42231000100000	33,382909	-96.038752	DHSO	1789	1822																						
1	Point	42231000100000	33,303	.95.039	DHSO	2164	2174									-	-												
14	Point	42231000100000	33.363972	-95.910359	JNK																								
15	Point	42231000200000	33.37591	-95 921028	DRY																								
10	Point	42231000200000	33.336809	-95.930249	DRY																								
11	Point	42231000200000	33.311203	-95.969302	DRY																								
18	Point	42231000200000	33.312638	-95 968827	DRY																								
11	Point	42231000200000	33,256162	-95.945837	DRY																								
20	Point	42231000200000	33.258527	-95.941471	DRY											-													
21	Point	42231000200000	33,256527	-95.941471	DRY								-	-	-	-	-	-	-	-	-	-	-						
23	Point	42231000200000	33,262599	-95.000003	DRY																								
23	Point	42231000200000	33,210666	-95,96443	DRY																								
24	Point	42231000200000	33.226311	-95.925563	DHSO								-	-	-	-	-	-	-	-		-	-						
25	Point	42231000200000	33.223274	-95.92121	DRY																								
25	Point	42231000300000	33,219367	-95.91934	DRY											-	-	-				-	-						
27	Point	42231000300000	33.227107	-95.899756	DRY								-	-	-	-	-	-	-	-		-	-						
28	Point	42231000300000	33,238429	-95.894986	DRY																								
2	Point	42231000300000	33,247818	-95.887992	DRY																								
- 30	Point	42231000300000	33.23978	-95.878697	DRY																								
31	Point	42231000300000	33,235932	-95.882867	DRY																								
33	Point	42231000300000	33,207659	.95 922851	DRY																								
3	Point	42231000300000	33.196231	-95.922021	DRY																								
34	Point	42231000300000	33.196231	-95 922021	DRY																								
35	Point	42231000300000	33,204199	.95.914113	DRY																								
3	Point	42231000300000	33 181 094	-95.92184	DRY																								
37	Point	42231000400000	33.192543	-95.923734	DHSO																								
3	Point	42231000400000	33.104744	-95.951047	DRY																								
35	Point	42231000400000	33.183125	-95.948115	DRY																								
4	Point	42231000400000	33.18546	-95.943101	DRY																								
41	Point	42231000400000	33.179965	-95.940127	DRY																								
4	Point	42231000400000	33.18181	-95.946997	DRY																								
43	Point	42231000400000	33.195056	-95.937589	DRY																								
44	Point	42231000400000	33.183153	-95.947332	DHSO	2968	2971																						
4	Point	42231000400000	33.184901	-95,936979	DRY																								
- 4	Point	42231000400000	33.171146	-95.953195	DHSO																								
47	Point	42231000500000	33.170835	-95.964782	DRY																								
- 41	Point	42231000500000	33.172381	-95,969004	DHSO																								
4	Point	42231000500000	33.164391	-95.965264	DRY																								
50	Point	42231000500000	33.157009	-95.935177	DRY																								
51	Point	42231000500000	33.158159	-95.977096	DRY																								
53	Point	42231000500000	33.158376	-95.973097	DHSO																								
53	Point	42231000500000	33.162035	-95.97224	DRY																								
54	Point	42231000500000	33.164879	-95.901137	Of.	4361	4366																						
55	Point	42231000500000	33.163659	-95.976433	JNK																								
99	Point	42231000500000	33.165021	-95.983744	DRY																								
57	Point	42231000600000	33.164822	-95.977166	OFL	4340	4352																						
58	Point	42231000600000	33.16677	-95,974503	DRY																								
91	Point	42231000600000	33.166207	-95.978807	DHSO																								
60	Point	42231000600000	33.161188	-95.981547	DRY																								
61	Point	42231000600000	33.175314	-95,978648	DHSO																								
63	Point	42231000600000	33.169462	-95.973652	DRY																								
63	Point	42231000600000	33.154467	-95.991641	DRY																								
64	Point	42231000600000	33.146189	-95.981218	DRY																								
65	Point	42231000600000	33.140451	-95.987218	DRY																								
65	Point	42231000600000	33.151982	-95.974821	DRY																								
67	Point	42231000700000	33.1373	-95.980844	DRY																								
D	cond: 14 4	ابداع ت	Show	Al Selecte	a 1	Records (0.0	ut of 340 Selec	ted)		Options +																			
			stow.)		cherry a															_				
1.0	aut 2	6 N 18					1.000			A contra ton																			0.00
U SI	art 👔	C Graden	cestor (Imper	0	40.000	49000-012	Pro	year o	0.8	raminap - Arch	æ*	90	ocurrier	a - M	eresor.													- C.	

6) The majority of the wells are dry, and the data needed to be filtered to make a layer with only producing well data. Another layer file was created using the process described in step 3 and called Producing Wells. The attribute table was then viewed. In order to delete all of the dry wells in this layer, the selection query wizard was used, and all the points were selected that had [Perftop] = [Perfbase]. Once editor was turned on, these points were then deleted resulting in the attribute table shown in FIGURE 5. The two well point files were then symbolized to differentiate between them as resembling FIGURE 6.

FID Shape'	UWI_API	SURFLAT	SURFLON	SYM	PERFTOP	PERFBASE	F7	DHISO	Dry_Hole_w	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
0 Point	42231000100000	33.382909	-96.038752	CHSO	-1789	-1822	1								_										
1 Point	42231000100000	33.382909	-96.038752	DHSO	-2164	-2174				_															
2 Part	4,2231000400000	33.183153	-45.947332	LHS0	-2968	-2971				_		-													
A Daird	42231000500000	33.1648/9	-95.981137	OL.	-4361	-4360				-															
5 Point	42231001000000	33.165041	-96.025465	DHSO	-2464	-2716																			
6 Point	42231001100000	33.17497	-96.031102	CHSO	-2114	-2114						-													
7 Point	42231001300000	33.092361	-96.060815	DHSO	-790	-053																			
8 Point	42231001300000	33.092351	-96.068815	DHSO	-793	-873																			
9 Point	42231001400000	33.090287	-96.029712	DRY	-2784	-2792																			
10 Point	42231001400000	33.000287	-96.029712	DRY	-3110	-3120				-															
11 Point	42231001400000	33.030287	-96.029/12	DRY	-4308	-4316				_															
13 Paint	42231001400000	33.019433	-96.043044	OL.	-2101	-2105				_															
14 Point	42231001400000	33.021073	-96.044751	OL	-2752	-2764																			
15 Point	42231001400000	33.020539	-96.042332	OL.	-2760	-2776																			
16 Point	42231001400000	33.010093	-96.04495	OL.	-2704	-2776																			
17 Point	42231001400000	33.020123	-96.045285	OL	-2759	-2761																			
10 Point	42231001400000	33.010091	-95.044838	OL.	-2761	-2763																			
19 Pont	42231001500000	33.024737	-06.03981	OL.	-2762	-2770		+ + +		-															
21 David	42231001500000	33.023403	-96.041502	01	.2752	-2782																			
22 Paint	42231001500000	33.02219	-96.0397	OL.	-2752	-2766																			
23 Point	42231001500000	33.024142	-96.040389	OL.	-2757	-2771																			
24 Point	42231001600000	33.014941	-96.044688	DHSO	-2773	-2783																			
25 Point	42231001600000	33.012181	-96.047798	DHSO	-2773	-2782																			
26 Point	42231001600000	33.012181	-96.047798	DHSO	-2770	-2782																			
27 Parts	42231001600000	33.012181	-96.047798	DHSO	-2760	-2795				-															
20 Paint	42231001700000	33.017761	-96.047113	OHS0	-3897	-2897				-															
30 Paint	422310017	33.0177R1	-96.047113	DHSO	-2781	-2785		+ +				-													
31 Paint	42231001700000	33.015168	-96.040066	OL	-2775	-2781																			
32 Point	42231001700000	33.019062	-96.046387	0L.	-2772	-2774																			
33 Point	42231001700000	33.020138	-96.046459	OL	-2764	-2768																			
34 Point	42231001700000	33.021872	-96.044912	DRY	-2764	-2766																			
35 Point	42231001700000	33.022323	-36.043224	OL	-2748	-2766				_		-													
30 Pull	42231001900000	33109624	-99.04295	DHEO	-4751	-2750				-															
38 Point	42231001900000	33.109674	-96,18735	DHSO	-4731	-4738																			
39 Point	42231001900000	33.109624	-96,10735	CHISO	-4692	-4595																			
40 Point	42231002500000	32.984693	-96.002824	OL	-3310	-3316																			
41 Point	42231002500000	32.963628	-96.03468	OL	-3300	-3304																			
42 Point	42231002600000	32,970579	-96.090103	GAS	-9016	-9072																			
43 Point	42231002600000	32.983895	-96.085658	OL.	-3224	-3227																			
44 Pont	42231002600000	32.968578	-96.090123	OAS	-05478	-0990				-															
46 Point	42231002500000	32.968578	-96.090123	GAS	-8974	-0094																			
47 Point	42231300100000	32.992799	-95.993077	DRY	-5806	-5812																			
48 Point	42231300200000	33.099948	-95.994234	DRY	-4190	-4194																			
49 Paint	42231302000000	33.020604	-96.044381	OL.	-2763	-2834																			
50 Point	42231302000000	33.164079	-95.976733	OL.	-4380	-4382																			
51 Parts	4223130200000	33.162811	-95.978978	OL	-4381	-4385		\rightarrow		-															
52 Plant	42231302100000	33.023082	-96.041098	OL.	-2757	-2782				-															
54 Paint	422313021	33.348305	-96.004941	DRY	.7878	.7890						-													
55 Paint	42231302300000	33.018371	-96.045526	OL	-2764	-2767																			
56 Point	42231302300000	33.018802	-96.04295	DRY	-2769	-2779																			
57 Point	42231302300000	33.165491	-95.978659	OL	-5450	-5454																			
50 Point	42231302400000	33.162053	-95.901521	OL	-4335	-4337																			
59 Point	42231302400000	33.162973	-95.98374	OL	-5442	-5446																			
60 Port	42231302400000	33.169054	-95.97815	OL	-5440	-5445		\rightarrow		-															
50 Point 59 Point 60 Point 61 Point	42231302400000 42231302400000 42231302400000 42231302400000 42231302500000	33.162973 33.162973 33.169054 33.163063	-86.901521 -95.98374 -95.97815 -85.971244	OL OL NJ	-4335 -5442 -5440 -3206	4337 -5446 -5446 -3292																			





[FIGURE 6]

As wells are being drilled, casing placed down the hole to prevent many thing some of which include wall crumbling, and contamination of fluids into and from other rock layers that are not

of interest. Once the depth at which the layer containing the gas or oil has been exceeded, drilling is stopped and the casing is perforated at the target depth. The goal of the perforation is to allow oil or gas to flow from the reservoir rock into the well. Assumed in this project is that all perforations are in the reservoir, and that the perforations extend the entire length of the reservoir. Also assumed is that the gas perforations do not extend down into the oil, and that the oil perforations do not extend up into the gas. Because the reservoir rock lies just below the trap rock, the top of the perforations is assumed to be the bas of the trap rock.

7) Under these assumptions, a surface was created using the perforation tops of the producing wells using the Spatial Analyst Tool in ArcToolbox. The Interpolation Tool found in the Spatial Analyst Toolbar can only use data found in field that are set to numerical data. First, two new well attribute fields needed to be created that are formatted for long integers, one for the perforation tops, and another for the perforation bases. Then using the Field Calculator, these columns were calculated to equal their given respective columns. Also, all of the Spatial Analyst Tools create rasters only to the extent of the given data unless otherwise specified. So, in the Spatial Analyst Options wizard, under the Extent tab, the extent can be defined by another layer file. The Study Area layer file was selected. It was then possible to use the Interpolation Tool in the Spatial Analyst Toolbar to create spline the data well data. In the Spline wizard, the producing well data file was selected, and the field just created, perforation tops, was set to as the data to create the surface raster. The Trap Rock surface raster result is shown in FIGURE 7.





As stated earlier, and shown in FIGURE 2, the geology in the areas is in the shape of a dome. Despite the lack of a complete dome being shown, I believe the highpoints shown in white to the east of the map to be an anomaly formed in the splining process to form this raster due to a lack of producing well data in this area.

As stated in the Overview of the Problem, oil is denser then gas, and therefore will sink below it. This creates a surface between the oil and gas. This surface is known as the oil-gas boundary. Also, because water is denser than oil, and in the same way as above, a boundary between the water and oil can be found. I will call this the base of the oil boundary. When these boundaries are view from above, horizontal extents can be seen due to the limit of the source rock to produce oil and gas and the dome like structure of the trap rock.

8) In order to create these boundaries another field needed to be added to the Producing Wells layers file. The field contains the tops of the oil producing wells' perforations as well as the bottoms of the gas producing wells' perforations. This was done in a similar manner as in described in step 6.

Once the proper field was created, it was then possible to create a surface by using the Interpolation wizard and its splining technique using the new field just created for the numerical data. The resulting surface of the oil-gas boundary is shown in FIGURE 8. Keep in mind that for

this step and all further steps, the Spatial Analyst extent was set to the extent of the Study Boundary polygon.





Base of Trap	1.1	7					An
OilGas Ecundy solges2	_	-	-	-	-	-	-
-	/	4	5	6	>	2=	0
	•	1	2	3	<	0	74
< >		(0		1)	Ne
reading the low-	140 2004	11075-1					

[FIGURE 9]



[FIGURE 10]

10) The next step was to create the outer extent of the oil based on the bases of the oil perforations. Done the same way as in step 9, a surface was created using the Interpolation wizard to spline the bases of the oil well perforations. The resulting raster surface shown in FIGURE 11 was then used in the raster calculator to change the area where the Base of the Trap is less than the Base of the Oil Surface Boundary to equal 1. That raster was then exported as a shape file and then the shape file was converted to features and saved as No Oil or Gas Zone. FIGURE 12 shows the newly created shape file on top of the previously created one.







[FIGURE 12]

11) To be able to distinguish the gas zone with oil underneath it, the previously created study area shape file was added and placed beneath these layers, labeled as Oil/Gas Zone as shown in FIGURE 13.



12) The last step was to add the area of Wickman Farms to the map. The given survey points were in degrees, minutes and seconds, and these had to be converted to decimal degrees. An excel file was created and four points were chosen from the survey and added in decimal degrees to the excel file under their respective columns of latitude and longitude. A new polygon layer was created in ArcCatalog and named Farm Area. Then in a new ArcMap, the excel file, XY Data was added using the wizard. Using the editing toolbar, the points were then connected to form a polygon. The file was then saved and added to the database as shown in FIGURE 14. These jagged edges of in this picture are there because the screen capture was taken before the rasters were converted to polygon features.





IV. Conclusion

The finished map shows a good correlation with the given wells. The areas defined to have oil and/or gas are where actual producing wells are found. The "Possible Zones for Fossil Fuels in Hunt County, Texas" map that was created shows this. Because Wickman Farms lies in the No Oil or Gas Zone, it can be concluded that there is not likely any oil or gas under the property. Because my map shows such a large Oil/Gas Zone I can understand why there are so many wells drilled in the area, but this does not explain why so many of them are dry. This relationship is shown in FIGURE 15.

The other map created, "A Map of the Base of the Trap Rock in Hunt County, Texas", shows the relationship between the base of the trap rock and the Oil and Gas Zones.

It is interesting to note that in the middle of the map there is a No Oil or Gas Zone. In the geology of the area shown in FIGURE 2 there is the cropping out of an older rock layer in the middle of a younger rock layer. Because the cropping out and the No Oil or Gas Zone are almost right on top of each other, I can postulate that the rock that is cropping out (Paleocene) is possibly the reservoir rock, and that the rock layer above it (Navarro Group) is the trap rock. This relationship is shown in FIUGRE 16.



[FIGURE 15]



A Surface Map of the Base of the Trap Rock in Hunt County, Texas



A Map of Possible Zones for Fossil Fuels in Hunt County, Texas

