

# GEO-105 Oil and Gas Exploration Project

Modified from: Friedman, G.M., Johnson, K.G., 1982, Exercises in Sedimentology, John Wiley, p. 208 (via Reames and Carrigan at Olivet University)

## Student Learning Objectives

At the completion of this project, students will be able to: 1) contour a geological horizon; 2) identify simple structural petroleum traps; 3) determine coordinates using the Township and Range system; 4) synthesize basic geological data to target a potentially productive oil and gas well.

## Introduction

The oil and gas industry is booming. As a consequence of this, many of the students graduating from the Department of Geological Sciences are getting excellent jobs in the oil industry. In this exercise we attempt to simulate the geologic, economic, and competitive business environment in which many of our ex-students are now working. Note that what we will be doing during this lab in real life can take upwards of ten years – there is thus a degree of simplification. You are now a geologist with your own exploration and production corporation. You are competing to find oil and gas resources in the map area provided. Oil companies have drilled many of the section in this quadrangle in the past. Everyone agrees there must be oil and/or gas here, but no one has been successful in bringing in a producing well. Apparently none of the companies bothered to hire a geologist to analyze the data (weird!). They have gone bankrupt and the leases are all available for sale. Suddenly several corporations with geologists (you) appear on the scene, but with limited capital. The principal goal is to make as big a profit as possible for your corporation; therefore you must find the most oil and gas possible in a limited amount of time. To find oil and gas deposits, there are essentially 3 steps:

1. Gather information about the geology of the area and determine areas that are potential traps
2. Make bids on the land that you determine has high potential
3. Drill wells to see if you are correct

## Geological Data

You are given a base map of the area of interest. It is divided into the township and range system. Within this map area, a potential reservoir rock exists at depth, but it has been folded into structures (domes and basins) and faulted in various places. As you know, oil and gas will only accumulate in the reservoir rock if a structural or stratigraphic trap exists. (Please refer to lecture notes, Figure 1, and <http://www.fettes.com/orkney/Geology/Oil/OIL%20petroleum%20system.htm>). Oil and gas fields in this area are mainly structurally controlled, i.e., you will search for structures that might serve

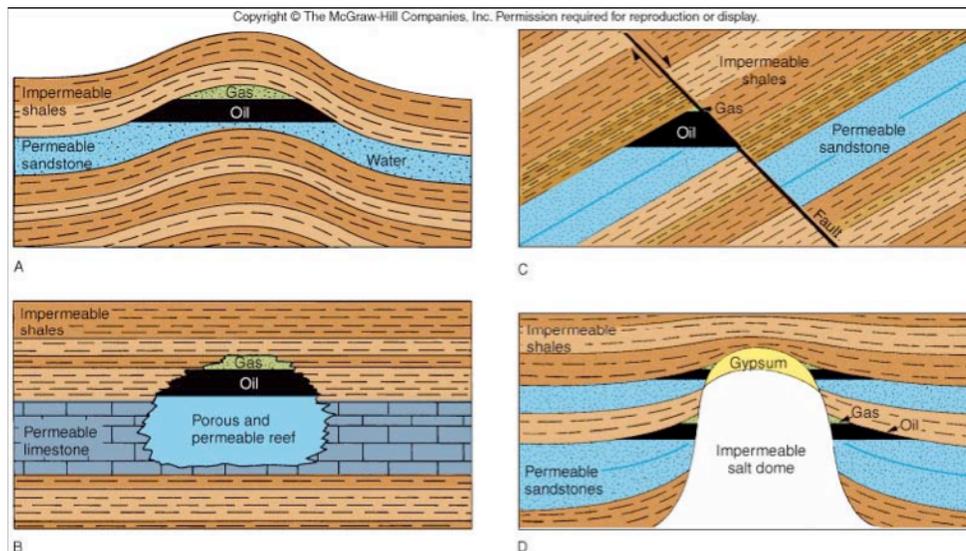


Figure 1: Common structural and stratigraphic hydrocarbon traps. From Tarbuck, Lutgens, and Tasa [2004].

as traps for oil and gas. Note that not all structural highs (for example, Figure 1A) are productive. Your primary task in exploration then is to determine the structure of the reservoir rock. To determine the structure of the reservoir rock, you must know the depth to it in numerous places.

The previous corporations that went under have supplied their data to the Geological Survey, and it is now public information. This information is given on your base map as data points that indicate the depth to the reservoir rock. The data are given in elevations below sea level – so they are all negative numbers, and numbers that are “less negative” indicate higher elevations. Your first task is to contour this information as best as you can with the limited data provided. Use 100 meter contour intervals, and USE A PENCIL!!! You will not be given a second map, so use this one carefully – data of any kind (including maps) is valuable, so treat it with care. Remember, there is a lot of information you don't know, so to deal with your uncertainty, you will need to gather more data and then modify your contour lines. You may want to use 25 m or 50 m contour intervals as you gather more and more data. Your instructor will serve as the source of all geological data and will supply oil and gas production information.

### **The Public Property Map**

Most of your data and information are private, and must be kept strictly confidential. However, some information is part of the public domain. A map of the area will be kept at the front, showing all public information, including

1. The original data provided by the geologic survey
2. All land currently leased, and who the owner of it is; and
3. The location and owners of all productive oil and gas wells.

All corporations should keep their maps up-to-date with this information.

### **Corporate Policy**

Each of you begins with \$2 million in capital, and you will need to supply a name for your corporation (be creative!). Two or more students may combine their efforts, finances, and information and form a merger, but thereafter all profits are divided equally. However, to prevent a monopoly from forming, the government has decided that not more than 3 people may combine into a single corporation. Once a merger is formed, the name of the merged corporation and members of it must be supplied to your instructor, and this will then be made public information. Corporations and operators must treat geological information and structural interpretation as strictly confidential. Each corporation must keep complete records of financial information (all bid purchases, income, sales, costs) and plot and interpret data on the base map. The instructor must authorize all deals between corporations, including the sale of information, and all corporations must learn of the deal and be able to bid on the holdings or information.

### **Profits & Expenditures**

Your corporation may take several steps to further your business:

1. Spend capital on exploration. You may obtain new structural data by requesting an interpreted line at a cost of \$10,000 per mile. You will submit requests for this information by referring to your base map, and use the Township/Range method to identify the lines (see page 74 of the lab manual). Data lines may be taken only along the edges of sections.
2. Submit bids on desired acreage to lease for drilling on a "dollars per acre" basis (must be in multiples of \$1/acre). Identify acreage for the instructor by citing township, range, section and subsection divisions. Bids are accepted only in units of 160 acre tracts (1/4 section). No more than 3200 acres (20 quarter sections) may be bid on per 30 minutes by a corporation. Bids will be compared at the end of every 30 minutes, and winners will be compiled on the public property map and given notification.
3. Wells may be drilled on the leased land at any time at a cost of \$50,000 per well. The corporation that drills a well will be provided data on the depth to the reservoir rock in the well. If it is productive, the corporation will be informed if it is producing oil or gas. Oil producing wells yield \$100,000 per 30 minutes; gas producing wells yield \$50,000 per 30 minutes. Wells begin producing on the

- minute they are drilled.
4. One well every 40 acres (center of a 40 acre tract) is the maximum for most the fields (16 wells per section; 4 wells per quarter section). However, some areas contain tight structure fields, and allow 10-acre spacing (4 wells on a 40-acre tract). Such facts will be indicated only to land-holding operators in these fields after they have brought in one producing well (and will be made public after producing wells are drilled).

### **Grading**

Each person is expected to contribute to his or her corporation. This exercise is worth 220 points. The corporation that has the most profit (averaged between all individuals in the corporation) for the class will receive 220 points. All others will be graded based on their respective profits –

- 2<sup>st</sup> place – 200 points
- 3<sup>rd</sup> place – 190 points
- 4<sup>th</sup> place – 180 points
- 5<sup>th</sup> place – 170 points
- 6<sup>th</sup> place – 160 points
- 7<sup>th</sup> place – 150 points
- 8<sup>th</sup> place – 140 points

**Company Name:** \_\_\_\_\_

**Team Members:** \_\_\_\_\_

**Costs**

Order information by date and list all information by the Township and Range Method

Seismic lines (\$10,000 per mile)

Land leases

Drilling wells (\$50,000 per well)

**Company Name:** \_\_\_\_\_

**Team Members:** \_\_\_\_\_

**Income**

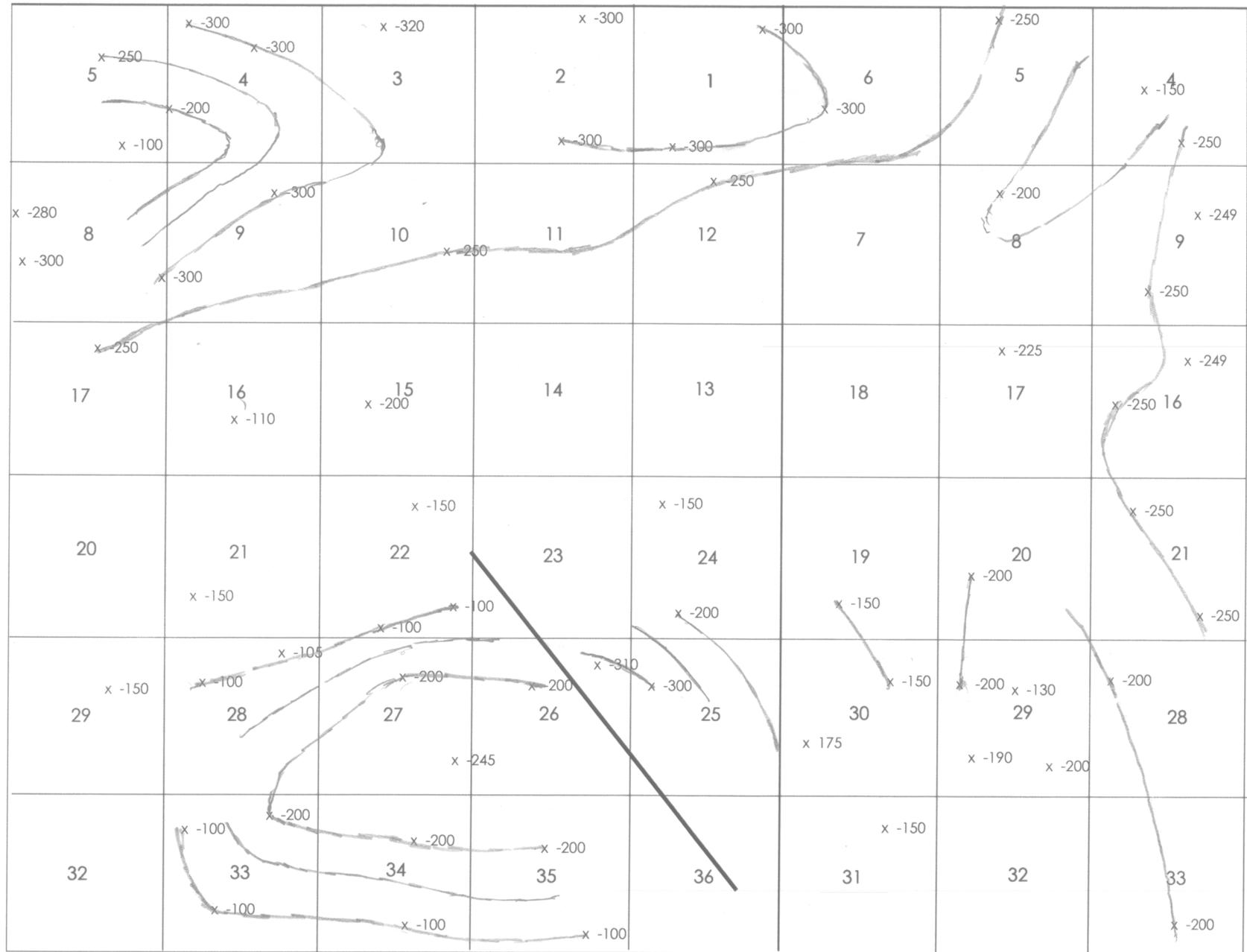
Order information by date and list all information by the Township and Range Method

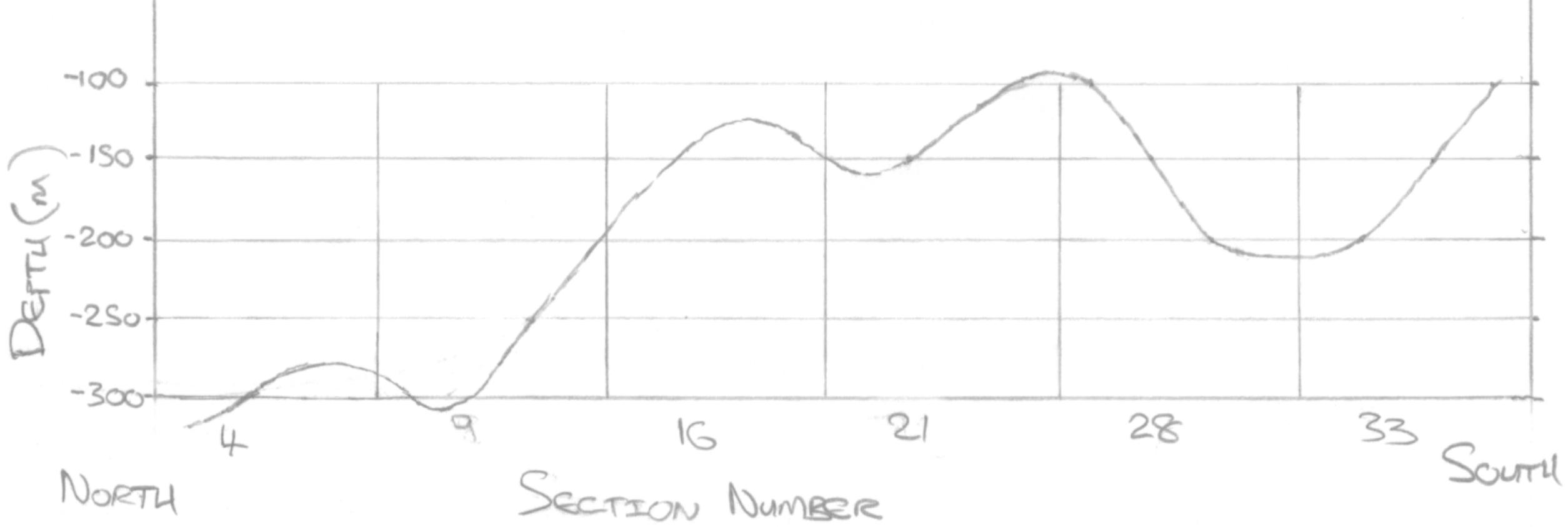
Gas wells (\$50,000 per 30 minutes) Oil wells (\$100,000 per 30 minutes)

<p>x -250 5</p> <p>x -300 x -300 4</p> <p>x -200</p> <p>x -100</p>	<p>x -300</p> <p>x -320</p> <p>3</p>	<p>x -300</p> <p>2</p> <p>x -300</p>	<p>x -300</p> <p>1</p> <p>x -300</p>	<p>x -300</p> <p>6</p> <p>x -300</p>	<p>x -250</p> <p>5</p>	<p>x -150 4</p> <p>x -250</p>	
<p>x -280</p> <p>8</p> <p>x -300</p>	<p>x -300</p> <p>9</p> <p>x -300</p>	<p>x -250</p> <p>10</p>	<p>11</p>	<p>x -250</p> <p>12</p>	<p>7</p> <p>8</p>	<p>x -249</p> <p>9</p> <p>x -250</p>	
<p>x -250</p> <p>17</p>	<p>16</p> <p>x -110</p>	<p>x -200</p> <p>15</p>	<p>14</p>	<p>13</p>	<p>18</p> <p>17</p>	<p>x -249</p> <p>x -250</p> <p>16</p>	
<p>20</p>	<p>21</p> <p>x -150</p>	<p>x -150</p> <p>22</p> <p>x -100</p>	<p>23</p> <p>x -100</p>	<p>x -150</p> <p>24</p> <p>x -200</p>	<p>19</p> <p>x -150</p>	<p>x -250</p> <p>20</p> <p>x -200</p>	<p>21</p> <p>x -250</p>
<p>x -150</p> <p>29</p>	<p>x -100</p> <p>28</p>	<p>x -105</p> <p>x -200</p> <p>27</p> <p>x -245</p>	<p>x -200</p> <p>26</p> <p>x -200</p>	<p>x -310</p> <p>x -300</p> <p>25</p>	<p>x -150</p> <p>30</p> <p>x 175</p>	<p>x -200</p> <p>x -130</p> <p>29</p> <p>x -190</p> <p>x -200</p>	<p>x -200</p> <p>28</p>
<p>32</p>	<p>x -100</p> <p>x -200</p> <p>33</p> <p>x -100</p>	<p>x -200</p> <p>34</p> <p>x -100</p>	<p>x -200</p> <p>35</p> <p>x -100</p>	<p>36</p>	<p>x -150</p> <p>31</p>	<p>32</p>	<p>33</p> <p>x -200</p>

R3W R2W

T8N





PROFILE 2 NORTH

R3W R2W

T8N

