Drilling Proposal

Non Seismic Exploration

Some non-seismic data is already available for ANWR, but it is impossible to know whether scientists will find that they need more data when the time comes to actually undertake the exploration process. Non-seismic data is essential to the exploration process because it provides a unique viewpoint that supplements seismic data. The type of non-seismic exploration techniques that would be most valuable in ANWR would be those involving potential field methods, i.e. Magnetic and Gravitational. Magnetic field methods can be done with an aerial pass of a magnetometer or on the ground using a type of magnetometer called a vertical field balance. These readings tell experts whether there is likely to be oil because there is a correlation between low magnetic readings and rocks that contain oil. Gravitational methods can also be done aerially with a gravimeter or on the ground using a more precise instrument called a gravity gradiometer. The data from gravitational methods is valuable because differences in the gravitational field indicate a difference in the density of the ground which correlates to rocks that contain oil. Both of these methods are relatively low impact because they only involve either not touching the ground at all, or setting up stations on the ground approximately 10 feet apart. In addition, as with virtually all exploration methods, the impact of non-seismic techniques is significantly lower than the impact that would be caused by drilling unnecessary wells. Consequently, we should do as much non-seismic data as is necessary to try and avoid, as much as we can, drilling these extra wells.

Seismic Exploration

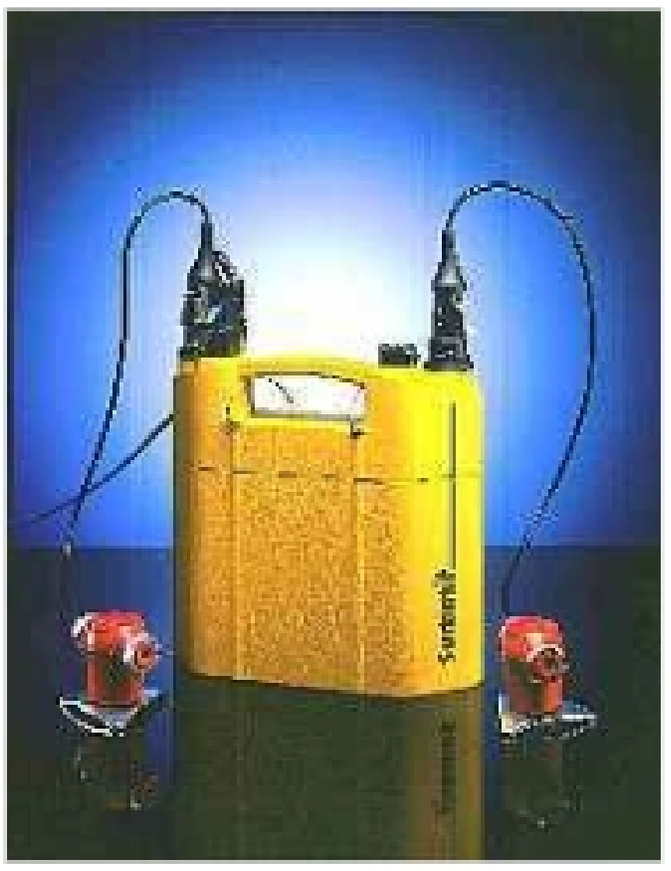
Background

Seismic Exploration is basically the usage of vibrations such as sound waves and shock waves in order to map the different layers of the ground, thus enabling the operator to predict its density in varying depths. It is able to map the subsurface and to show in a 2-D, 3-D or even 4-D maps the explored region thus suggesting the locations of the oil or gas "traps" for drilling purposes.

Seismic surveying uses tools such explosives or vibroseis trucks in order to explore on land, or a tool called the airgun in order to explore offshore (ocean floor).

Here is the explanation of seismic surveying by Utah BLM Stone Cabin:

"Seismic survey methodologies are tools for analysis of geologic formations and features in the subsurface. The process



consists of using a source of energy that is directed into the subsurface and then recorded back at the surface (with geophones) as the energy waves travel through the subsurface and reflect back to the surface. Various types of rock reflect the energy waves differently, and these differences are measured. Data helps show the tops and bottoms of formations, thickness, and structural configurations. It cannot identify pools of oil and gas, but rather, conditions favorable for the possible accumulation of oil and gas."
This can be found at the link:
http://www.ut.blm.gov/stonecabin/Q&As.htm
Geophone by Gisco (http://www.giscogeo.com/)

Explosives

Seismic geophones are able to collect their data from many sources that generate shock waves. Explosives method is one of those sources. By drilling small holes into the ground, approx. 12 meters deep, and packing them with 10 pounds of capped explosives (directed towards the center of earth), followed by detonation of those explosives, the geophones will be able to get sufficient data to map the are underneath the receivers. The grid lines of the explosives vary because of the different ground composure. Computer based software is often used to calculate the distance needed between the location of such explosive holes. Based on the study assembled by USGS, the grid of the explosives used in the seismic surveying that was done in ANWR 1002, was about 300 feet between the charges. Geophones were positioned in groups of 24 geophones per group while the interval between the groups was about 100-160 feet. In overall there were 120 groups in use. Due to the breaking of the ice immediately after detonation of the charges, the geologists encountered many problems, such as picking up wrong vibration data (vibration caused by the breaking and not by the blast) such secondary data affected the precision of the survey.

"Thumper" trucks, Vibroseis

30,000 pounds trucks generate vibrations underneath the ground by elevating themselves above the ground on a short pole, thus concentrating their entire weight on a platter and "shaking" for several second per location, thus sending vibrations through the ground.
The rest of the process is very similar to the explosive process because all that is left is the data

gathering phase. This process is the most precise process as it uses controlled vibrations that are spread over period of time, as oppose to the explosion vibration that is just a giant burst of energy. Those trucks are able to operate even inside major cities because the vibration they are causing is negligible due to the spread of vibration over a period of time.
This is an image of such truck operating in Utah region.

Airgun

Airgun is an excellent example of an offshore method. This exploration technique is used with assistance from a ship that actually carries all the equipment necessary to both send signal and to analyze. Such ship will carry an airgun and many receivers at greater distance that actually read the sound data as it is reflected from different rock formations and layers beneath the ocean floor. Then, just as the land surveys, the data is being processed by a computer which is later on able to generate a detailed map of several layers underneath the sea bottom.

Data Processing

The data is being received by geophones, which are relatively small devices placed on the ground. Those devices are synchronized with computer and placed on the ground using DGPS equipment (more precise than GPS, 2 meters to 30cm precision). This way the computer that analyzes the data has all the variables, the time of the vibrations, the relative distances at which the reflections are measured, and the strength (wavelength) of the vibrations. Different rocks and layers give different reflections of vibration, different changes in frequencies in the wavelength of the vibration. Using this data, gathered from the sensors, the main computer unit is able to constructed a detailed map, thus enabling it's user to analyze the map for possible oil location. It is worth mentioning that the computer is in most cases a dedicated super computer and not just a regular PC/MAC. The computer is able to generate a 3-D map of the subsurface, enabling future analysis of the region by experts and recommending a possible drill site. Another capability is a generation of 4-D map, which is a relatively new concept. Basically 4-D is a 3-D map repeated over time period. This way