(Final Exam – Questions missing)
INST 400
Marc Helfer
Final Exam
Professor Jackson

Question 1

Some people consider soils to be our most important resource, but understanding how that resource works is a different issue. Generally speaking, soils differ in thickness, composition, nutrient value, permeability, erosion, and age. But just how is this difference reached?

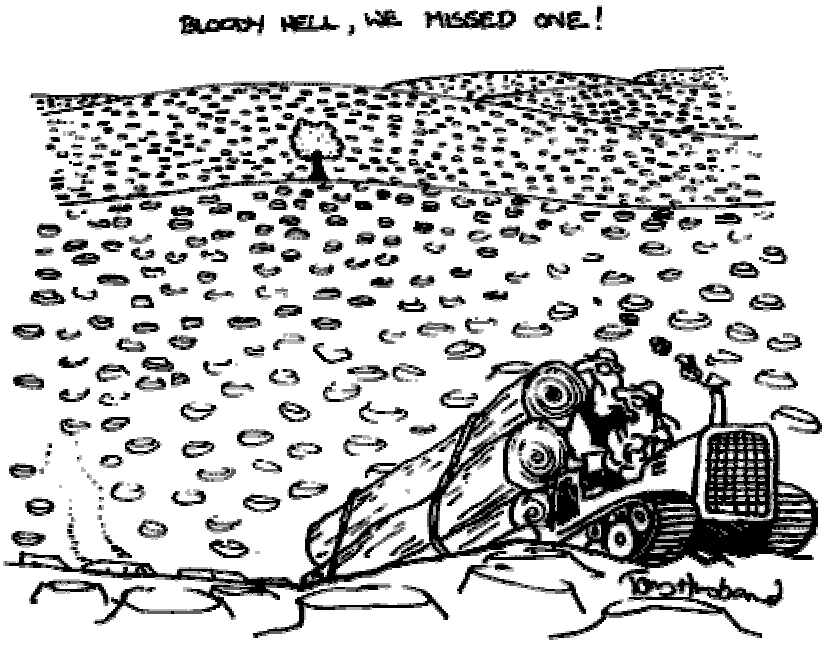
Soils are composed of two main layers, topsoil, subsoil, and bedrock.. Bedrock is typically the underlying foundation for the topsoil. Topsoil and subsoil are the more interesting and versatile layers. They have either developed in place over time, or their 'raw' material was deposited by streams and glaciation. Over centuries, chemical and physical processes have turned this 'raw' material into the nutrient soils that we know. Generally, the more organic matter that was deposited, the more nutritious the soil will be. But why is soil in the Congo so much different from the one in central Ohio?

First, due to glaciation, a better variety and a more nutritious material has been deposited in Ohio. But the warm and moist climate of the Congo should make for a faster and well-irritated soil composition, so what else is the problem?

The answer lies in the Laterite, a special type of soil found in very warm and very wet climates in equatorial regions. Due to the heavy rainfall, many nutrients (especially potassium, sodium, and magnesium) are leached from the soil, leaving an aluminum- and iron-rich deposit. Unfortunately for farmers, aluminum- and iron-rich soils due not make good farming soils since they don't contain the elements necessary for plant growth.

Nature itself has solved this problem by forming a rapid nutrient cycle to maximize plant growth on these soils. In this innovative cycle, decaying organic matter was processed by fungi, bacteria, and termites. In turn, they took up nutrients, which were released into the vegetation through waste or death of the host. Thus, the nutrients are not deposited deeply in the soil, but are taking up by the plants at the very top of the ground. For this purpose, the trees have developed a highly specialized and shallow root system.

When in Rome, do as the Romans do; or so we've heard. But when missionary farmers tried to cultivate the land, they were successful for only a few years. After that, their land clearing and strip farming has cut off nutrient formation by its very source.



http://www.sln.org.uk/geography/enquiry/images/rainwebcartoon.gif

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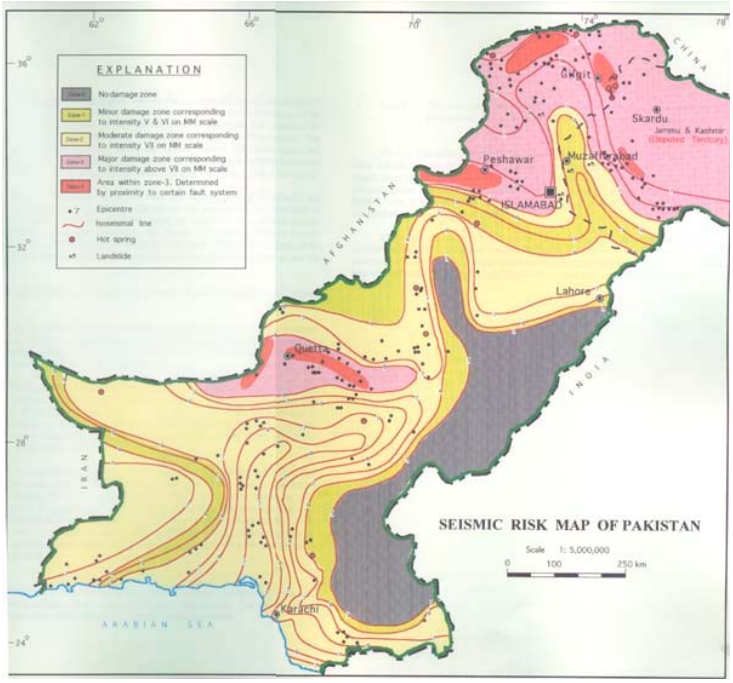
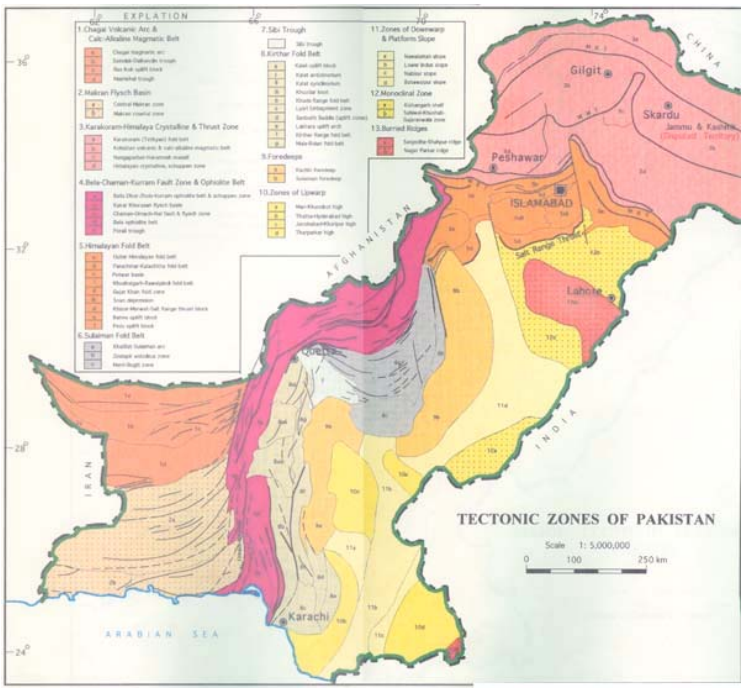
Question 2

My first concern is the fact that I am hiking around in a valley. Where there's a valley, there are mountains, or so I've learned in Yellowstone. The fact that there are mountains (or even just hills) indicates that some geological forces must have been present in the past. Earthquakes typically occur along fault lines due to moving plates on which our ground is based upon.

I am also a little worried about the coexistence of the brook and the wide, wet, flat spot of ground. How did it get there and why is it just where it is? With a high percentage, the wide, wet, flat spot of ground is due to a previous flooding. Deposits of the flood turned the spot into what it is today. I relay my worries to the Grand Duchy of the Swat Kingdom and he asks me to conduct further research.

My first step is to connect to a seismic risk map of Pakistan on the Internet. It indicates that there are indeed high-risk earthquake zones in Pakistan. Even if the Swat valley is not located near the high-risk epicenters, damage from underground wave movements is still possible.



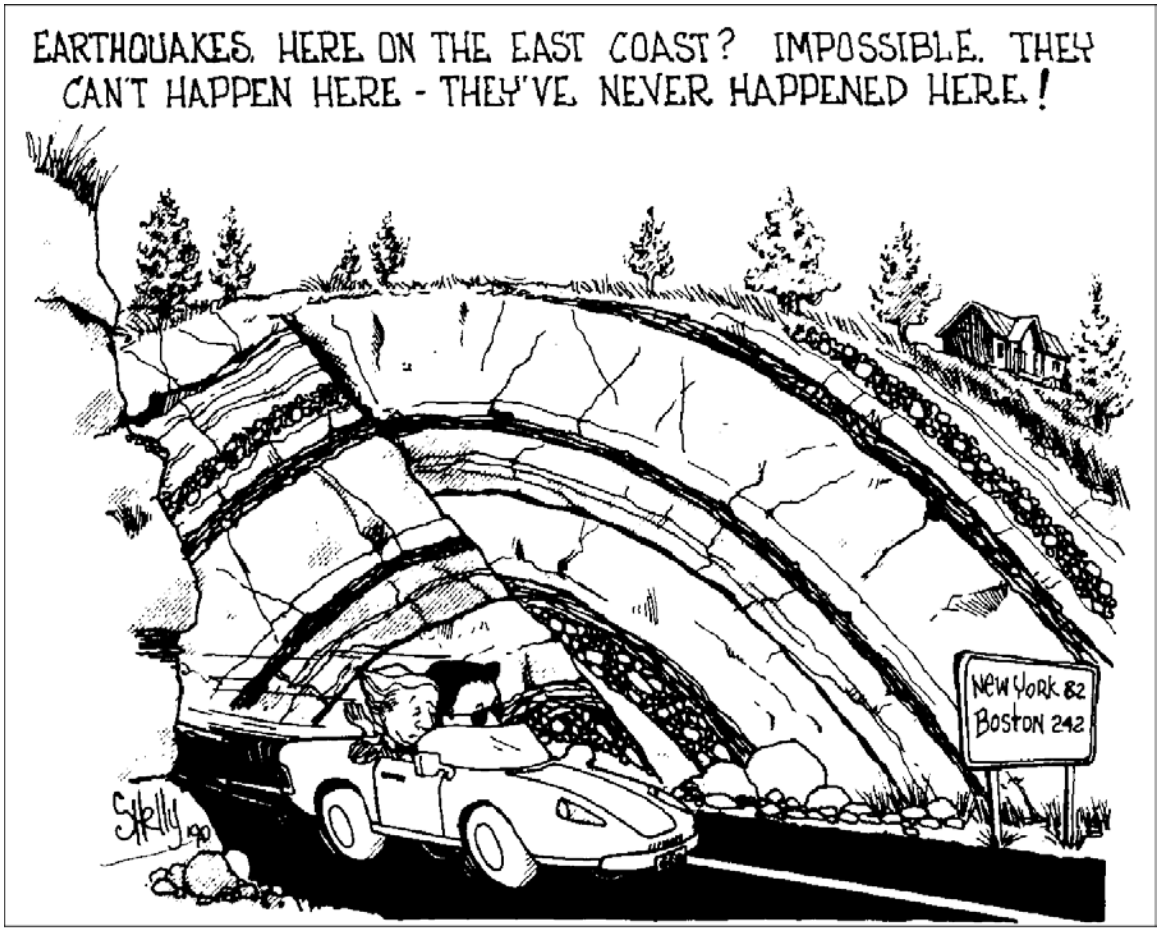


(Sources for both: Geological Survey of Pakistan www.gsp.gov.pk)

Conducting further research, I find a map of tectonic zones of Pakistan as well. Since this worries me very much, I kindly ask to the Grand Duchy to ask to travel the

surrounding valley with me. Together, I will show him geologic fault lines exposed in uncovered parts of the face of the mountains.

Despite my attempts, he still insists on spending all of his money on earthquake-safe building construction. I take him back to his wide, wet, and flat spot and make him stand with his bare feet in an especially wet and sandy area of his dream spot. I tell him to wiggle his feet to simulate an earthquake. To his surprise, the ground underneath him gives way and he looks at me amazed. “Liquefaction,” I explain to him non-chalently. He is finally convinced of my knowledge and asks me for the name of my teacher to erect a statue in his honor ☺



http://www.state.nj.us/dep/njgs/enviroed/cartoon.gif

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Question 3

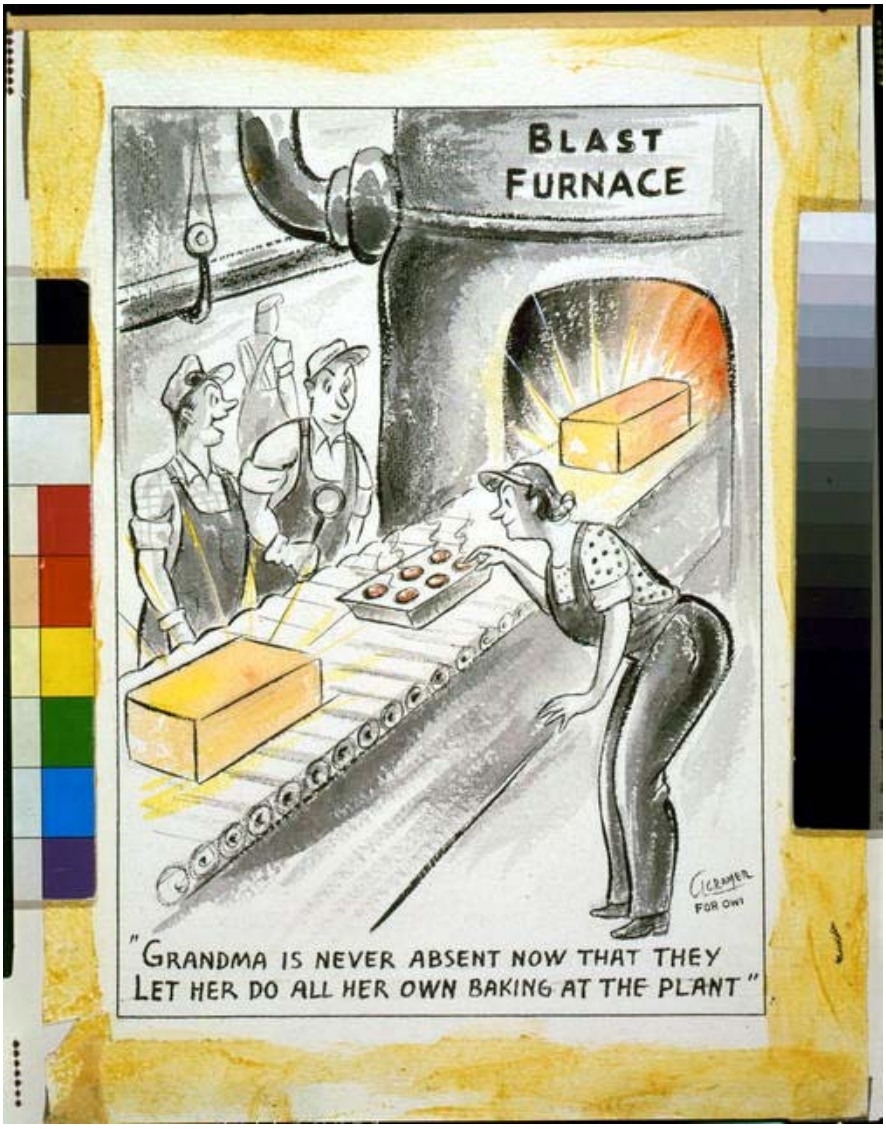
When operating a blast furnace, the raw materials that are required are iron ore, coke, and limestone. The iron comes from Hematite (Fe_2O_3) or Magnetite (Fe_3O_4). The coke is produced from a mixture of coals, which were formed when old vegetation was buried in swampy areas and transformed into coal by heat and pressure. The limestone's main mineral is limestone calcite ($CaCO_3$), a form of calcium carbonate.

The raw materials are dropped into a huge furnace. Hot air comes in at the bottom of furnace to combust with the coke to produce even more heat. Carbon monoxide flows up through the blast furnace to remove oxygen from the iron ore to leave iron. In addition, the intense heat melts the iron and it is able to flow out of the furnace. The limestone combines with impure coke and ore to form a slag, which can be removed from the iron.

The are two main reasons why Ohio has such a good steel industry. Fist, Ohio has rich deposits of coal and iron. Second, it is located between the Great Lakes and the Ohio River, two major routes of infrastructure for steel transportation.

Even though steel has secured its place in history, there are still some problems associated with the process. First, mining an iron ore will not only scar the landscape, but disrupt the ecological environment as well. A possible solution is the restoration of mined ores close to their original look and function. Second, limestone quarries are often viewed as nuisance, especially with growing sprawl. Possible solutions include underground mining and restricted mining operation. Last but not least, the coal used in the blast

furnace emits pollutants into the air. This can be solved by filtering the air or improving blast furnace efficiency (the more heat retained, the less coal needed).



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Question 4

Within the last five years, we've seen gas prices skyrocket, electric outages, and oil spills threaten the environment. While all three issues seem to be non-connected, they share one underlying problem: our growing need for energy. After all, energy is vital to our lives and to our economy. Giving up email seems to be as horrendous as showering in cold water.

Prediction for our energy crisis run from moderate to grim, but no one can pinpoint what will happen. However, if we approach the problem with reason and a cool head, then we are likely to master this worldwide problem too.

Right now, the majority of the energy that we use comes from non-renewable sources. The problem with non-renewable sources is just that – they are not renewable and will eventually run out. No matter how complicated our formulas, statistics, and predictions get, and no matter how realistic or unrealistic they are, eventually our 'traditional' resources will be gone.

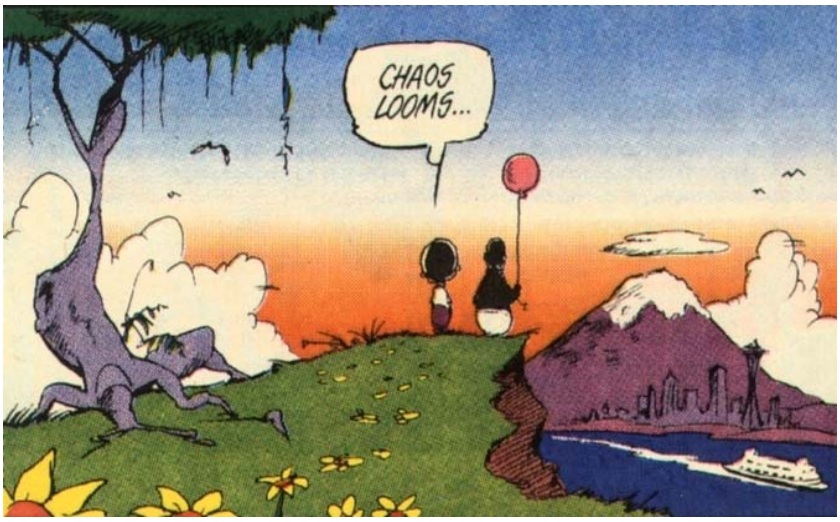
One doesn't need to be a philosopher to see that one of the best solutions is to change from non-renewable energy sources to renewable sources. If I have to predict what 30 years into the future looks like, then I can come up with two prediction.

If our society has accepted the fact that we have to change, then my first prediction is a happy one. We will have used the 30 years wisely, to switch from fossil fuels to solar and wind power. Our car manufactures will have finally followed European suit, and make fuel efficiency one of their top priorities. The homes that we live in will

energy-efficient and be mostly self-sufficient. The need for coal or nuclear energy plants will be for public and private institutions only, such as hospitals, government buildings, and schools. Even these institutions will eventually be powered by clean geothermal and wind power plants.

But if our society refuses change and sticks to their old ways, then I will have to paint a make grimmer picture. Private transportation will be luxury for the rich & famous, since the average citizens can't afford the high price of gas anymore. Since public transportation has been out-of-fashion for too long, and people are still too lazy to ride bikes, the average Joe will sit at home in his outage-struck home. But Joe has no need to get to work, since the economy has crashed anyhow. Due to the rising transportation costs, the prices for goods and services have skyrocketed. Consumers have nothing left to do but remember the time 30 years ago, when life seemed so good. Still unaware of their own fault, they will accuse God, the government, and their neighbors, until Mexico buys us.

Reflecting on my predictions, I have to admit that inevitably, change is on the way. But it's up to us to be active or to be made active.



http://www.geo.mtu.edu/volcanoes/humor/

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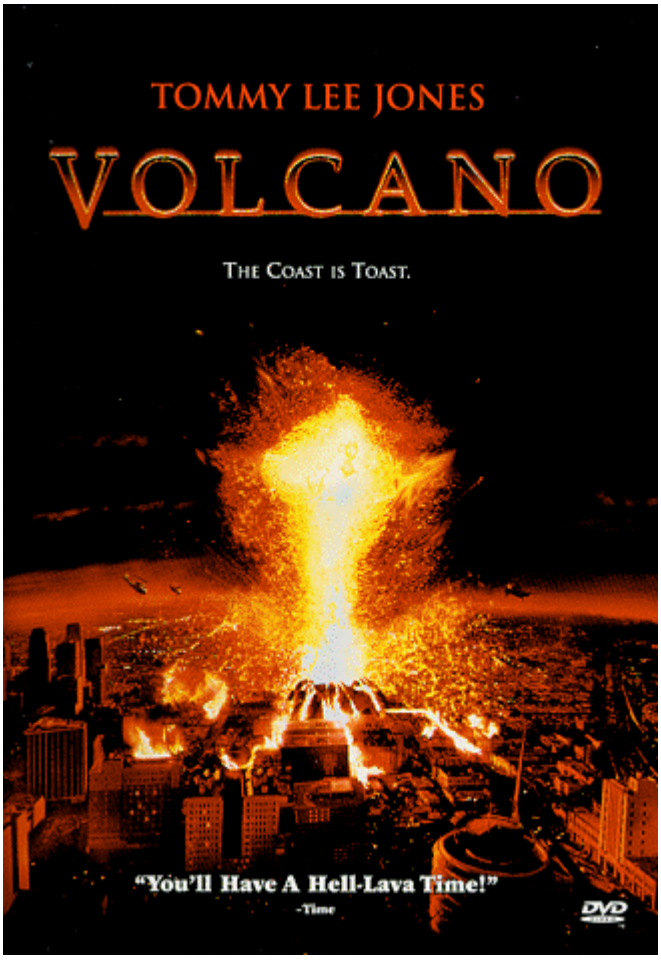
Question 5



In the movie Volcano, the conflict between public policy and geologic prediction is quite evident. After geologists find convincing evidence for volcanic activity, city officials find themselves in a bind. Should they ignore the possible activity and endanger the public (if the threat is real), or should they inform the public, shutdown part of the public transportation, and cause a widespread panic?

While the scenario in the movie is fictitious, we face similar problems in our real world, following, I will briefly analyze the current issues of Yucca Mountain, drilling in Alaska, and global warming.

First, the problem of Yucca Mountain involved the creation of an immense one-of-a-kind nuclear storage facility for the nation's nuclear waste. Pro-Yucca supporters claim the mountain is safe due to low-water levels, little rainfall, and stable geology. In

addition, current nuclear waste is stored in over 60 sites, so the creation of one well-monitored site provides added safety. Yucca Mountain opponents' claim that this kind of threat and experiment is unnecessary and shouldn't even be considered, given that its less then 100-mile proximity to Las Vegas. An additional hazard is seen in the transportation of nuclear waste to Nevada

While the geologic evidences for supporters are true, no predictions can be made whether conditions will stay this way. After all, the nuclear material will remain radioactive for several centuries. We simply don't know if there will be any earthquakes or sudden downpours to pose a threat. Our earth is an ever-changing ecosystem, and our human impact is creating an unprecedented environment.

I am uncertain if there is any good way to resolve this issue, but two arguments come to mind. First, the site is too close to the "mega town" Las Vegas. Even a minor security alarm at Yucca Mountain could threaten away the visitor population for years. Second, we really shouldn't be making any more nuclear waste if we don't have decent storage space for the current amount.

Next, I would like to address the issue of drilling in Alaska. The Arctic National Wildlife Refuge is a unique Eco-environment. It is not only home to an Alaskan tribe, but also to endangered wildlife. Unfortunately, its unique geologic composition has made it the target of oil companies nationwide. They claim that drilling for oil in the refuge will allow us to be at least partially independent from Middle Eastern states. Opponents point out that the amount of oil is by no means sufficient for a real independence.

The scientific dilemma is that nobody knows just how much oil can actually be found. Estimates from supporters and opponents differ greatly, and science can only produce predictions, but present no proof.

Thankfully, Congress has already resolved the issue and prohibited drilling. However, the decision is based on sound reasoning. Even if the best estimates had come true, the amount of oil would have made little impact on current gas prices or our independence from the Middle East. Furthermore, the best estimates did not take a profit from the oil into consideration. It makes little sense to refine oil when the cost will rise to $ 50 per gallon since nobody could afford it.

Last, I would like to discuss the problem of global warming. Just in the last week, Europe has been tormented with gigantic floods that caused severe financial and human losses. Environmentalists are quick to point out that such flooding might become common place due to the problem of global warming. The problem is that humans have altered the atmosphere through emissions and produced a greenhouse-like environment. The consequences of this heating are surfacing slowly, but scientists can only offer explanations, but no 100% proof of what is happening. Whether global warming has caused the flooding in Europe is a hypothesis, but not determined fact. Very much like Marc's Volcanic Theory, which states that a rise in atmospheric temperature will cause a rise in volcanic activity, due to the change of the pressure balance between the two.

With human tragedy on the one side, we have a long-established pattern of pollution on the other side of this issue. One of the most dangerous greenhouse gases is carbon dioxide, but our emission of carbon dioxide is closely tied to our way of life.

Burning fossil fuels, production of agricultural waste, and various industrial processes contribute to the emission of greenhouse gases.

The scientific problem is two-sided. As I already mentioned, science has little direct proof of why things are changing the way they do. It is only after an event has occurred, that science offers a possible explanation. Second, fighting emission and controlling global temperature is a new field for science. Many advances are still too expensive and will take years to reach the consumer to make a difference.

Since global warming affects the entire world, public policy making is even worse. Cutting emission in Europe might be a good thing, but is just the tip of the iceberg when other nations are polluting at full-speed.

Education the general public about the consequences of their behavior might offer a small solution. But the real progress will only come when all industrial nations enforce stringent emissions laws and seek a global solution together.

http://www.claybennett.com/pages/yucca.html

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Question 6

The two topics that will cause the most change during my life will most likely be global warming and alternative fuels.

They are both slowly changing our lives whether we want to or not. They don't necessarily give me pessimism about the future, but it's sometimes frustrating to see that changes could be made quicker, if the governments of this world would work together.

I am convinced that the people are ready. We have flooding in Europe, and droughts and wildfires in the U.S. If there is a God, he must have quite a sense of humor.

Some people complain that growing up is not what it used to be. Teenagers grow up too quickly with too many responsibilities. Unfortunately, it seems true. The Tom Sawyer childhood reminds us of the good old times when life was simple. But we are no longer born into a local community, a city, or state. We are born into a global community and our actions have immediate consequences on other. One can blame it on population growth or industrialization, but all blame can't shake of our growing responsibilities.

On the brighter side, our global community has advantages too. We can travel to foreign countries, communicate globally and in space. Nonetheless, human impact on our planet is so immense, that we have to find scientific solutions for our problems.

Honestly, I don't really think <u>we have to find</u> solutions. Our planet has sufficient self-regulatory processes that we are nothing but nuisance to him. A couple of earthquakes, volcanoes, flooding, tornadoes, and a killer virus will keep us human in check.

I feel likewise about the energy crisis, we don't have to find an alternative to fossil fuel, and we don't really have to change our energy use. We can always go the "It's the End of the World As We Know It" way. I don't mean this in a pessimistic way. A simpler life without cars and computer isn't necessarily worse. *(See PBS's Frontierland for example)*

However, if we want to enjoy our time on earth the way we do now, then we should really look for scientific solutions and accept the good with the bad. In summarizing this part, I think that global warming and alternative fuel give me the most pessimism, but also the most optimism for the future.

But the course has also influenced me in a direct, more personal way. It should come as little surprise that one of my biggest expectations in going into INST 400 was to learn more about volcanoes. Though, I would like to point out that my fascination with volcanoes began way before the movie Volcano – but with my first visit to Yellowstone in 1994.

Learning about volcanic activity was certainly one of the highlights of the course. I'd already read books such as *Windows Into the Earth: The Geologic Story of Yellowstone and Grand Teton National Park* (which is an excellent book, by the way, I've included some sample pages at the end of this essay). Nonetheless, I was still able to clarify some 'unsolved mysteries'. For example, what exactly is silica and why is it in mudpots? Why is sulfur so present in Yellowstone? The answer required more than just sitting in class, but with our textbook and our exploration into rocks, minerals, and soils, I was able to get a much better understanding of what's really going on. In this particular way, the course has had the most impact on my future. The next time I will be with a

group in the backcountry of Yellowstone, I can pass on some new information about soil types, how obsidian is formed, and what the lines in the mountain or rock mean. Even more important, I was able to learn how land- and mudslides occur and which factors influence slope stability. (I think we covered it briefly in class, but the book had an entire chapter devoted to it.) This might seem trivial to most students, but when travelling on a single-track trail with nineteen horses and eleven people on a path that's 'somehow' beaten into the steep talus of a previous debris slide – then it can be life saving.

So from me to you, thank you for a great course. I didn't think anyone could make soils, rocks, and minerals interesting, but you certainly did.

Best wishes and happy trails, Marc

WINDOWS INTO THE EARTH

THE GEOLOGIC STORY OF YELLOWSTONE AND GRAND TETON NATIONAL PARKS

ROBERT B. SMITH AND LEE J. SIEGEL

SCIENCE

US $29.95

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Robert B. Smith is a professor of geology and geophysics at the University of Utah, a fellow and past president of the Seismology Section of the American Geophysical Union, a fellow of the Geological Society of America. He has spent his career studying the Yellowstone-Teton region. **Lee J. Siegel** has written about science since 1976, most recently as science editor of *The Salt Lake Tribune*. He contributed to the Pulitzer Prize-winning coverage of the 1980 Mount St. Helens eruption by *The Daily News* of Longview, Washington, and has served as a science writer for The Associated Press.

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