NOTE: This is a SAMPLE syllabus/itinerary and may not be the most up-to-date version. Please contact the faculty leader of this course for more recent information.

NASC 130 – 4 cr -- Syllabus
Fire and Ice: Principles of Geology in Iceland – May 13-26, 2017

Three pre-departure meetings: 6:30-9:00 pm, March 22, April 5, and April 19 -- 112 Jennison

Instructor: Robert P. Ackert
Spring Semester Office Hours:
106 Jennison Hall email: rackert@fas.harvard.edu
Weds. 11:30 am – 3:00 pm, and by appointment

Course Description: Geology is the study of the Earth, its origin and structure, the materials that comprise the earth, and the internal and surficial processes that shape its surface. In this course we will explore the foundations of Earth Science through pre-department classroom meetings and field-based activities in Iceland in order to understand the dynamic nature of the earth. We will learn first hand about Earth processes, Earth materials, and the human impact on Earth's climate. We will also learn about some of the methods that scientists use to investigate the geologic record of Earth evolution.

Course Goals: The overall goal of this course is to introduce non-science-major undergraduate students to fundamental principles of Earth Science and to build and apply that knowledge through hands-on field-based and classroom activities. An additional goal is to increase Earth science literacy of students, citizens, and future business leaders so that they can make more informed decisions about Earth resources, natural hazards, and the relationship between humans and their geologic environment.

Special emphasis for Bentley Abroad version of this course in Iceland will be volcanic activity related to plate boundaries and hot spots, glacier fluctuations and related jökulhlaups, stream flow processes, geysers, geothermal energy, and global climate change on a variety of time scales.

Learning Objectives of the Course *(Many of the points below were taken from Earth Science Literacy Principles: www.earthscienceliteracy.org)*

Knowledge:

- Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
- Earth is 4.6 billion years old.
- Earth is a complex system of interacting rock, water, air, and life.
- Earth is continuously changing.
- Life evolves on a dynamic Earth and continuously modifies Earth
- Humans depend on Earth for resources.
- Natural hazards pose risks to humans.
- Humans significantly alter the Earth.

Skills:

- Think critically in the analysis of geologic problems.
- Be able to apply macro-scale techniques in the identification of landforms and rocks in hand specimen and in the field.
- Conduct a scientific experiment; make observations, and collect data associated with Earth processes.
- Be able to plot, analyze, and interpret quantitative data associated with geologic

processes.

Perspectives:

- Appreciate that Earth is a continuously changing planet.
- Awareness that landforms and landscapes evolve through time.
- Acknowledge that Earth materials (mineral and energy resources) are finite.

Readings

The following textbook is one of many available introductory geology textbooks available in the Bentley library for reference: *Essentials of Geology*, 3rd edition (2009), by Stephen Marshak. W.W. Norton & Co., New York.

Relevant research topics will be summarized by individual students for a short PPT slide presentation and discussion (about 10 minutes each) during the third pre-trip class meeting on 19 April; these assignments will be chosen at the second pre-trip class meeting on 5 April 2017.

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Site Visits

We will construct our own field trip guidebook for Iceland that emphasizes the geological processes and locations that will be examined at a variety of sites during an 11-day bus tour. At the second class meeting on 5 April 2017, students will select two topics (one location and one geologic subject) to research and present to the group during the course, with the assistance of the instructor and assistant. In addition to studying outcrops and glaciers first-hand, we will conduct stream flow measurements in order that the students experience data collection in the field, as well as data reduction and analysis. The itinerary that follows at the end includes some of these sites.

We also will visit many science exhibits and museums in Reykjavik, the world's most northerly

capital (latitude 64°08' N; longitude 21°56’ W). Reykjavik not only lies in an interesting geological setting, but also has a remarkable cultural history going back over a millennium. Norse legend suggests that Reykjavik (meaning smoky bay for the rising steam from hot springs) was founded around AD 870 by a Viking named Ingólfur Arnarson. The geothermal springs provide almost all the water and heating for Reykjavik today.

Reykjavik’s history began only with a few farm houses, but then became a trading center beginning in the mid-1700s, was founded as a town in AD 1786, and grew to become Iceland’s center of commerce and government, with a population of about 120,000 (over 200,000 for the greater metropolitan area). By the end of World War II, Iceland gained full autonomy from Denmark and Reykjavik became Iceland's capital city. Although Reykjavik may still feel like a provincial town, with its lack of skyscrapers and brightly painted houses, three out of five Icelanders live in the greater Reykjavik area. Although the economic crises of 2008-20009 hit Reykjavik very hard, Iceland remains a popular tourist destination.

Iceland sits astride the Mid-Atlantic Ridge, a divergent plate margin, where molten rock, or magma, wells up through the rifts along the ridge. The Atlantic Ocean has been widening through this process for almost 200 million years, but Iceland only rose from the sea floor about 20 million years ago, and widens by about one inch per year. Iceland is the one place on Earth where a spreading ridge can be observed on land. Over a third of Iceland's 40,000 square miles is volcanically active, as evidenced by lava fields and numerous volcanoes, including, Hekla, Eldgiá, Herðubreið, and Eldfell. The eruption of Laki volcano in 1783–1784 was responsible for a widespread famine that killed nearly a quarter of Iceland's population and created dust clouds and haze that blanketed most of Europe and parts of Asia and Africa for several months. Surtsey volcano rose above the ocean floor between 1963 and 1968 to become one of the youngest islands in the world.

In March 2010, Eyjafjallajökull volcano erupted in southern Iceland for the first time since 1821, forcing hundreds to evacuate their homes and disrupting air travel throughout Europe by large clouds of volcanic ash. Then, in May 2011, the eruption of Grímsvötn volcano, underlying Iceland’s largest ice cap, Vatnajökull, spewed ash about 20 km into the atmosphere, but fortunately wind patterns did not cause as much disruption of air traffic as did Eyjafjallajökull a year earlier. In August 2014 a large fissure eruption north of Vatnajökull began which has covered more than 70 km^2 before ending in February 2015.

In many areas, magma far below the surface warms the rock above, causing heated groundwater to reach the surface as "hot springs." Iceland is home of the type Geysir, from which the English word geyser is derived, as well as Dettifoss, the largest waterfall in Europe by volume (200 m^3/second discharge). The widespread availability of geothermal and hydropower not only provides Icelanders with inexpensive hot water and home heating, but also provides Iceland an opportunity to compete to be the first carbon neutral country. Geothermal heat flow and the warm Gulf Stream surface ocean current also keep Iceland much less covered by ice and snow than Greenland to the west. Although Greenland is too remote and costly to visit during our course, the importance of the Greenland Ice Sheet for global climate and sea level change will the subject of one of the student presentations.

Grading

1)	Evaluation of PPT presentation of research topic	20 %
2)	Evaluation of two 2-page reports for guidebook field site visits.....	30 %
3)	Evaluation of individual journals	40 %
4)	Class participation and preparedness.....	10 %
	Total	100 %

Tentative Itinerary for Bentley Abroad course to Iceland, May 13-27, 2017

Saturday, 13 May
Depart Logan International for Reykjavik in the early evening.

Sunday, 14 May
Arrival at KEF airport at 6:30 AM where we will meet our guide. Breakfast will be in the area. We will then tour the Reykjanes Peninsula with stops at geothermal areas, recent lava flows and where the Mid-ocean ridge emerges on land. We will tour some museums in Reykjavik in the afternoon and have some free time in the evening.

Monday, 15 May
From Reykjavík we will head north. Along the way, we will see two types of lava fields, rhyolite mountains, evidence of glaciation, and classic alluvial fans. We will have lunch in Stykkishólmur, a beautiful fishing village where we will visit the interesting volcano museum owned by the retired and world-famous volcanologist Haraldur Sigurdsson. We will continue through the Dalir "valleys" and tour a Viking long house at Eiríksstaðir where Leifur Eiríksson was born. Next, we will head to Húnaflói and Hóp on the north coast of Iceland. We will drive around Vatnsnes (beaches spits and coastal processes) and arrive at accommodation at Ófur in the afternoon.

Tuesday, 16 May
From Skagafjörður we continue through the glaciated eroded old lava flows of north Iceland, into Akureyri, the largest city in the north. Later, we will hike into a slot canyon and observe lava flows with tree casts. From there we will continue to town of Húsavík where we will spend the night.

Wednesday, 17 May
In the morning we will head north along the Tjörnes Pennisula where we will see Pliocene sedimentary rocks with abundant fossil shells and a transform fault. Weather permitting we will view the island of Grímsey, north of the Arctic Circle. In the afternoon we will have a 3-hour whale watching tour. We will spend a second night in Húsavík.

Thursday, 18 May
We will explore the geology around Lake Mývatn. Volcanic features include table mountains, cinder cones, maar craters, and eruption fissure. Following a hike up a large volcanic cone we will relax in some geothermal pools. In the afternoon we drive over Möðrudalsöræfi plateu and if road conditions allow visit Dettifoss waterfall. We will spend the night in the beautiful seaport village of Seyðisfjörður fjord, which was featured in the film "The Secret Life of Walter Mitty."

Friday, 19 May
We will explore the East fjords today. At Stöðvarfjörður we will stop at the world famous stone collection of Petra. We will measure velocity and discharge in a stream along the way. When close to Höfn, we pass the Eystra og Vestra Horn mountains (rare exposures intrusive rocks formed below a volcano) and the Stokksnes headland. Our accommodation will be in Höfn village.

Saturday, 20 May
We will drive through the impressive mountains of Mýrar and Suðursveit and head up the stunning road to Skálafellsjökull glacier, a tongue from Vatnajökull, largest glacier in Europe. We will take snow mobile tour up onto the accumulation zone of the glacier. We will end our day with a visit to the glacier lagoon Jökulsárlón where we will have a boat tour among the icebergs on the lagoon. The guesthouse for the night is located close by.

Sunday, 21 May
In the morning we will proceed to Skaftafell National Park. On the way we will stop and hike up the massive lateral moraines of Kvíárjökull within site and sound of surf on the Atlantic Ocean. In the afternoon we will head to Svinajökull ice fall and take an ice walk in the ablation zone of a glacier (all ice walking gear and guide provided). Within the park we will check out the visitor center and hike up to Svartifoss waterfall with great views over the Sandur plain. We then will continue further west and visit the Dverghamrar basaltic columns. Our accommodation for the night will be close to Kirkjubæjarklaustur.

Monday, 22 May
From Kirkjubæjarklaustur, we will drive along the south coast with Mýrdalssandur black sand wasteland created by the many eruptions of Katla volcano underlying Mýrdalsjökull glacier. We will visit Vík village, Reynisfjara (coastal geology), the Reynisdrangar pinnacles, and Dyrhólaey barrier island (and perhaps see puffins and other seabirds). We will continue through the area of Eyjafjallajökull which erupted in 2010. We will visit the spectacular Skógafoss and Seljalandsfoss waterfalls. If conditions allow, we will have a dip in the unique Seljavallalaug geothermal pool. We will arrive at our farm accommodation in Fljóthlíð valley, where you will have a splendid view to Eyjafjallajökull, if weather conditions are good.

Tuesday, 23 May
We will make a day trip to the Westman Islands on the ferry boat "Herjólfur." Heimaey, the main island, last erupted in 1973, nearly destroying the town. Weather permiting we will board a local tour boat for a trip around the Heimaey Island, featuring sea caves and puffins. In the afternoon we will take a short hike to Eldfell volcano and have free time in town. After returning to the mainland in the late afternoon, we will drive into Þórmörk, a valley with several glaciers, crossing glacial rivers on the way. Our accommodation will be in a remote Húsadalur mountain hut (sleeping bags and liners will be provided) where we may prepare our own meals.

Wednesday, 24 May
We will spend a full day in Þórsmörk valley. In addition to a spectacular hike, we will explore a slot canyon, and Gigjökull glacier, where kettle holes are forming in the outwash of the jökulhlaup from the 2010 eruption of Eyjafjallajökull. We will discuss surface exposure dating or moraines and the ongoing research of Profs Ackert and Davis to date the recent advances of these glaciers. We will spend a second night in the Húsadalur mountain hut.

Thursday, 25 May
We will drive out of the valley in the morning and tour the well-known "Golden Circle, including the Geysir geothermal area, Gullfoss waterfall, and Þingvellir National Park (with some hiking through a classic rift valley). In the late afternoon, we will arrive in Reykjavík and check in at a hostel down town. We will have our farewell dinner at a restaurant in Reykjavík.

Friday, 26 May
We will visit the Volcano House Cinema and watch a film about recent Icelandic volcano eruptions and hear a slide lecture from a glaciologist or volcanologist. After lunch we will have some free time in Reykjavík before heading out to Keflavik airport for our late afternoon flight, arriving during the early evening in Boston.