CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Jason A. Ablott

Project Number
S0801

Project Title
Does Temperature Affect Fluorescence in Minerals?

Abstract

Objectives/Goals
This experiment was conducted to determine how temperature affects the intensity of fluorescence in minerals by building an electronic device to measure the intensity of light produced by 5 different minerals: wernerite, hackmanite, calcite, fluorite and opal, with a series of temperature tests(-20C-100C). By tracking voltage changes with a circuit containing a photoresistor,potentiometer,battery,and multimeter,the amount of light can be measured and the affects of temperature in relationship to fluorescence in each can be determined. The level of resistance is altered by light in a photoresistor and measured in ohms.

Methods/Materials
Assemble ultraviolet light box, light-sensing meter and test. Record multimeter reading without specimen in place. Test each mineral sample at 20C(control) by placing under ultraviolet light and sensor, record reading and photograph. Keep placement of each specimen the same for all measurements. Repeat after bringing each sample to determined temperatures by placing in refrigerator(0C),freezer(-20C),heat lamp(40C,60C)and oven(80C,100C) record data and photograph. The responding variable is the amount of luminescence emitted by each specimen.

Results
3 series of tests were conducted using 7 temperatures, for a total of 105 measurement readings. Results were used to compare each specimen's ability to fluoresce at different temperatures. Data from all 3 series was combined to account for any minor variance in the readings. Fluorite ranging from 1.4 at 20C to 1.7 at -20C, a 17.6% change and wernerite with 2.6 at 0C to 3.0 at 80C with a 13.3% change exhibited the most difference in fluorescence. Hackmanite had a moderate change of 4.8%, opal a 3.8% change and calcite had the least reaction to differences in temperature at 3.7%.The degree of luminescence was dependent on the temperature.

Conclusions/Discussion
From this study (105 readings on 5 different minerals), I have concluded that some minerals' ability to fluoresce is both negatively and positively affected by temperature. Changing levels of emitted luminescence were recorded as stated in my hypothesis "If fluorescent mineral samples are exposed to extreme heat and cold, then the degree of luminescence they emit during fluorescence will change slightly." Physical characteristics and concentration of each specimen's activators are clearly important in the degree of impact varying temperatures had on each minerals' fluorescence.

Summary Statement
This experiments light measurement readings from 5 different fluorescent mineral specimens at 7 different temperatures supports the correlation between temperature and the amount of luminescence emitted by a fluorescent mineral.

Help Received
None

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Caitlin L. Duke

Project Number
S0802

Project Title
The Effect of Geologic Material on Shear-Wave Velocity and Ground Shaking During an Earthquake at Critical Structures

Abstract

Objectives/Goals
The purpose of this experiment was to evaluate the relationship between shear-wave velocity and density of different geologic materials at various critical structures, and how it effects the amplification of the ground shaking during an earthquake.

Methods/Materials
Materials: Seismograph, Geophones, Take Out Cable, Measuring Tape, Hammer with a Trigger, Shear-wave Generating Bar, Battery (for seismograph), Hand Shovel, Scale, Jar of Sand (graduated)

Procedure: The experiment started out by measuring the density of the geologic material twice at each site by collecting a known volume of the material and later weighing them and calculating the densities. Then, once all the seismic equipment was setup, the shear-wave bar was hit twice, once on each side, with a hammer that had a timing trigger that was connected to the seismograph, which recorded the data from the hit. The shear-wave bar was hit on both sides and on both sides of the line, in two different locations on the site to make sure the data was accurate. Later, the seismograms were overlapped to find the arrival time of the shear-wave at each geophone, this created a line and the inverse slope was calculated to determine the velocity of the shear wave. The procedures were then repeated for each of the 4 locations: the beach, Woodbridge High School, San Onofre Nuclear Power Plant, and Syphon Dam.

Results
The beach had the lowest density, 1.29 g/mL, and slowest shear-wave velocity, 124 m/s, but the rock under the Nuclear Power Plant adjacent to the beach had the most dense material, 2.99 g/mL, and highest shear-wave velocity, 476 m/s.

Conclusions/Discussion
The data showed that the material with a lower density allowed the shear-wave to have a slower velocity, while the material with a higher density had a faster shear-wave velocity. This means if a critical structure were to be constructed, it would have lower ground shaking during the same size earthquake on the rock under the Nuclear Power Plant adjacent to the beach as opposed to on the beach.

Summary Statement
This experiment evaluated the relationship between shear-wave velocity and density of different geologic materials at various critical structures, and how it effects the amplification of the ground shaking during an earthquake.

Help Received
Father helped gather equipment

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Kyra H. Grantz

Project Number
S0803

Project Title
The Effects of Ocean Temperature on Aerosol Particle Absorption

Abstract

Objectives/Goals
Aerosols are liquid or solid colloidal systems suspended in the atmosphere and are crucial in establishing a radiative balance in the atmosphere, yet understanding of aerosols is considered #low# by the IPCC. Aerosols, largely through their role as cloud condensation nuclei, affect surface temperatures, the hydrological cycle, atmospheric heating, global dimming and air quality, This project seeks to study the effect that ocean temperatures may have on aerosol particle absorption and contends that higher temperatures will lead to an increased rate of particle absorption.

Methods/Materials
To study this effect, a chamber was built to measure concentration as a function of time. The pressure in the chamber would be slowly increased and then rapidly decreased to form a #cloud#. The light scattered by the cloud was then measured on a solar cell. Since optical density of a cloud is directly proportional to the concentration of aerosol particles, voltage readings are directly proportional to particle concentration. Meanwhile, water in the chamber was kept at a constant temperature throughout the run. Runs of the experiment were conducted at 13o, 15o, 17o and 19o Celsius for 5 hours.

Results
Three runs were taken at each temperature. At 19o C, the voltage readings dropped most quickly, an average of .3v per 20 minutes in the first hour. At 17o C, absorption was slightly slower, with average decreases of about .2v every 20 minutes. The absorption of particles was more sustained at 13o and 15o C, where the average decrease in voltage rarely exceeded .1v. Another interesting measurement is the first time at which there was no change in voltage between clouds. There was a clear decreasing trend at higher temperatures, indicating faster absorption.

Conclusions/Discussion
The quicker absorption observed at higher water temperatures would theoretically lead to a decreased concentration of aerosol particles in the lower levels of the troposphere, leading to higher surface temperatures, poorer water quality, more light at the surface of the earth and increased flooding and drought. It is important to realize that this project was a simplification of the environment and therefore some error was inherent, particularly in cloud formation. Further research could involve studying the effects on the size of particle absorbed and researching if trends continue at lower temperatures.

Summary Statement
My project studied the effects of rising ocean temperatures on the absorption of aerosol particles by the ocean.

Help Received
I consulted with Dr. Haflidi Jonsson of the Naval Postgraduate School about my experimental design and he provided me with some equipment.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Alexander G. Krolewski

Project Number
S0804

Project Title
Shape, Optical Properties, and Age of Borneo Smoke Plumes Imaged by MISR

Abstract

Objectives/Goals
The purpose of this research was to determine the shape, size, optical properties, and age of Borneo smoke plumes imaged by the MISR instrument between 2001 and 2009. The Multi-angle Infrared SpectroRadiometer (MISR) is an instrument on board the Terra satellite that images the earth using nine different cameras oriented at various angles to the ground.

Methods/Materials
My analysis relied on two precompiled databases of smoke plumes in Borneo, created by the MISR Interactive eXplorer (MINX) software. One database consisted of 388 plumes and was used to analyze plume geometric properties; the other database, with 333 plumes, was a modified version of the first, intended to reduce bias from cloud contamination and used for optical properties. I used the scientific programming language NCAR to analyze and plot the plume data. I primarily considered relative plume shape, in which I adjusted each plume to a standard nondimensionalized length of 1. I also considered various plume optical properties, such as optical depth, single-scattering albedo, and top-of-atmosphere albedo, all of which were measured in the green band (wavelength = 558 nm). To parameterize relative plume shape, I created a plume probability density function by dividing each plume fraction value by the sum of all the plume fraction values, and I evaluated the parameterization using the root mean square error. Lastly, plume age was defined as the age of smoke at the most distant point from the origin, and was approximated by dividing plume length by average down-plume wind speed.

Results
Across the primary database, plume length averaged approximately 40 km, and plumes were aligned about 55° N of due west. Plumes had a roughly ovoid shape, with a width on average 27% of their length. Lastly, I found that smoke at the edge of a plume is on average three hours old.

Conclusions/Discussion
Optical depth increased slightly over the length of the plumes, a result of particulate aging and an artifact of the coarseness of the data. Albedo initially increased before decreasing, a result consistent with ground-feature bias and particulate aging. A four-parameter model of plume density by relative location was constructed; this model could be used in further climatological studies to approximate the probability of finding a plume in a given region. Lastly, wind speed had only a very weak effect on nondimensional plume shape.

Summary Statement
I analyzed the shapes, sizes, ages, and optical properties of smoke plumes created by fires in Borneo, which will allow climatologists to better understand the climate effects of smoke plumes.

Help Received
Worked under the supervision of Professor Charlie Zender in the UCI Department of Earth System Sciences; I worked independently and met with Professor Zender once a week to look at my results and plan what I would do next.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Connor S. Valentine

Project Number
S0805

Project Title
The Effects of Lateral Compression on the Folding of the Earth's Crust

Abstract

Objectives/Goals
The purpose of this experiment was to test the effects of lateral compression on the folding of the Earth's Crust. The Earth's Crust is made of plates that are in constant motion. When these plates collide, an extreme amount of lateral compression is exerted onto the rock. Under the right conditions this enormous pressure can create folds in the layers of strata . The goal of this experiment was to find out if these folds are created at a linear rate or not.

Methods/Materials
For the purposes of this experiment, layers of colored sand were compressed to observe the folding that can occur in the Earth#s crust. First a sandbox was built with a piston at one end. This piston was used to create the compression needed to create the distinct folds in the layers of sand. At every one cm. interval, the number of folds was counted (specific definitions of a fold were defined).

Results
It was found that the lateral compression created folds in the sand at linear rate. The average deviations of each interval never exceeded 1.3 folds. The deviations for more than half of the intervals were even as low as 0.4 folds. Overall the data was very consistent. The consistent data made analysis very easy. A linear pattern of creation was clearly shown across all of the data collected.

Conclusions/Discussion
The hypothesis that folds would be created at a linear rate was supported by the data collected. This meant that the sand could only hold up against a set amount of pressure before a fold was created to relieve some of the strain. This could mean that folds in the Earth's crust form at a predetermined rate as well. If scientist could develop a way to determine this rate, a huge step towards earthquake prediction would be made. If the northen cities of Japan had known an earthquake of that magnitude was imminent, maybe the destruction would not have been so devastating.

Summary Statement
The pupose of this project was to discover a trend in the way folds form in the Earth's crust.

Help Received
Father helped with construction of sandbox; Mother helped organize pictures taken; Mr. Antrim helped with experimental design

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Hannah Washburn

Project Number
S0806

Project Title
Will the Addition of Polyacrylamide to Hydrophobic Soil Affect Its Ability to Allow Water Percolation?

Abstract

Objectives/Goals
The purpose of my science project is to determine if the addition of polyacrylamide (PAM) will help water percolate through a hrydophobic layer of soil. This is important because hydrophobic soil causes greater water runoff which contributes to post fire mud slides. My goal is to find and speed up the rehabilitation process of hydrophobic soil.

Methods/Materials
I collected coarse, upland soil and covered it with dried leaves and wood. With supervision, I burned the organic material for 8 hours and then let it cool. I then did a WDPT test to determine if the soil was hydrophobic. I had 5 test soils: untreated soil, hydrophobic soil,hydrophobic soil & linear PAM, hydrophobic soil & crosslinked PAM, and hydrophobic soil with both linear & crosslinked PAM. I placed 1 cup of test soil into clear tube that is standing on wire mesh with a measuring cup inderneath, then I had 147ml of water rain into the clear tube and measured the amount of water that percolated the soil in 30 minutes. I repeated this test for a total of 10 trials per test soil.

Results
The results show that the addition of both linear and crosslinked PAM actually made the soils water repellency worse. Untreated soil allowed an average of 84.2ml of water to percolate the soil and collect in the measuring cup, hydrophobic soil allowed an average of 42.5ml of water percolation, hydrophobic soil with linear PAM had 28ml of water percolation, hydrophobic soil with crosslinked PAM had 33ml of water percolation, while the hydrophobic soil with both linear & crosslinked PAM had 31.9ml of water percolation in 30 minutes.

Conclusions/Discussion
After completing my investigation I found that the addition of both linear and crosslinked PAM to hydrophobic soil made the soils water repellency worse. These findings are very important because both of these materials are widely used today to prevent soil erosion and to retain water, but applying either type of PAM to a post fire hillside could possibly contribute to a mudslide. I believe that finding a way to rehabilitate post fire hydrophobic soil would be both economically and environmentally beneficial.

Summary Statement
The purpose of my project is to determine if the addition of linear or crosslinked PAM to hydrophobic soil will increase water percolation thereby helping to rehabilitate post fire hydrophobic soil.

Help Received
Dr. Bob Sojka guided me to accurate research; Dr. Rick Lentz supplied the PAM; Peter Wohlgemuth helped with forest fire research; mom photographed the testing process; dad supervised the creating of hydrophobic soil