New Mexico Science and Engineering Fair 2004
New Mexico Bureau of Geology and Mineral Resources Excellence in Geoscience Award

On April 2 and 3 over 500 middle and high school students from across the state participated in New Mexico's 52nd annual Science and Engineering Fair on the campus of New Mexico Tech. New Mexico Bureau of Geology and Mineral Resources is proud to be among the more than 50 organizations, companies, and individuals sponsoring special awards. The bureau's "Excellence in Geoscience" Award is presented to a student in the junior division (grades 6 through 9) and a student in the senior division (grades 9 through 12; ninth graders may choose the division in which they wish to compete). *New Mexico Geology* is pleased to acknowledge the junior and senior winners of the bureau's Excellence in Geoscience Award as well as a runner up in each division, to print the abstracts of their research, and to list their other special awards and their placement within the junior and senior divisions of the 13 science fair categories.

This year's winners and runners up of the bureau's Excellence in Geoscience Award are Shandiin Copeland and James Burton in the junior division and Katie Schultz and Kristin Nichols in the senior division. The bureau's junior division award winner, Shandiin Copeland, also placed second in her division in the research paper competition sponsored by the New Mexico Academy of Science. She received an award from the New Mexico Network for Women in Science and Engineering as well. The bureau's runner up in the junior division, James Burton, placed third in the category Earth and Space Science, junior division.

All photographs by Gina D'Ambrosio

The bureau's senior division award winner, Katie Schultz, placed second in the category Earth and Space Science, senior division. She also received certificates of achievement from the U.S. Army and from the Association for Women Geoscientists. The bureau's runner up in the senior division, Kristin Nichols, received first place honors in the category Environmental Science. She received additional cash awards and certificates of merit from the U.S. Army, the New Mexico Network for Women in Science and Engineering, and the New Mexico Garden Clubs. Kristin also received Intel's Excellence in Environmental Health and Safety Award in the senior division.

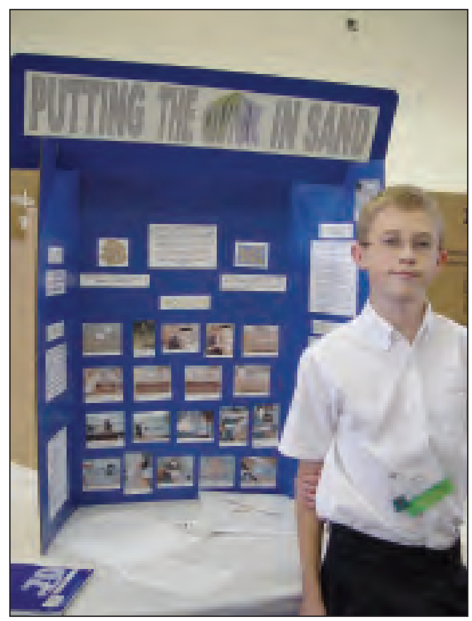
"Cool clear water??" (Spring water quality in the oil and gas field)

by *Shandiin C. Copeland*
Kirtland Middle School, Fruitland
Winner, Junior Division

The purpose of this project is to analyze springs in the oil and gas field south of Navajo Lake and to test the hypothesis that there will be contamination in the spring water. To test this hypothesis, water samples were collected and tested for benzene, toluene, ethylbenzene, and xylene (BTEX), a collection of pollutants that are related to oil and gas activity. To characterize the overall health of the water, other tests were completed that included alkalinity, salinity, pH, conductivity, dissolved oxygen, and temperature.

The BTEX results proved to be negative, and only a little toluene was found. The toluene was at levels well below national EPA standards. All other tests were in the normal range for EPA drinking water standards and suitable for wildlife and livestock.

In conclusion, the spring water appears to be very clean. The hypothesis is not supported by the data. Current oil and gas development practices for protecting the integrity of water aquifers that feed the springs seem to be adequate, at least in these seven springs (San Rafael, Star, Labato, Hero Twins, Sarah's, Devil's, and Swallow Springs). Future studies that monitor these and other springs over a longer period of time would demonstrate more conclusively the health and pollution status of spring water in the oil and gas field.



Putting the quick in sand

by *James L. Burton*
Lincoln Middle School, Rio Rancho
Runner up, Junior Division

My question was could solely adding water to sand create quicksand. I believed that I could just add water to sand, and it would become quicksand. I started my experiment by adding fine sand to a small fish tank and adding water in small amounts. I put washers on the mud, and they did not sink. I stirred the mud, and the washers sank a little. Then I replaced the sand with coarse grains of sand. I then repeated the process of adding water. To make the washers sink I had to stir the sand vigorously and then quickly put on the washers. The previous experiments made me believe that I would need water flowing from underneath to part the sand grains to make it into quicksand. Then I built a model with a pump attached to a hose to let the water flow from underneath like a spring. After some modifications I was successful at creating a quicksand model.

The study of olivine crystal zoning in Selden Basalt utilizing electron probe microanalysis

by *Katie Schultz*

Deming High School, Deming

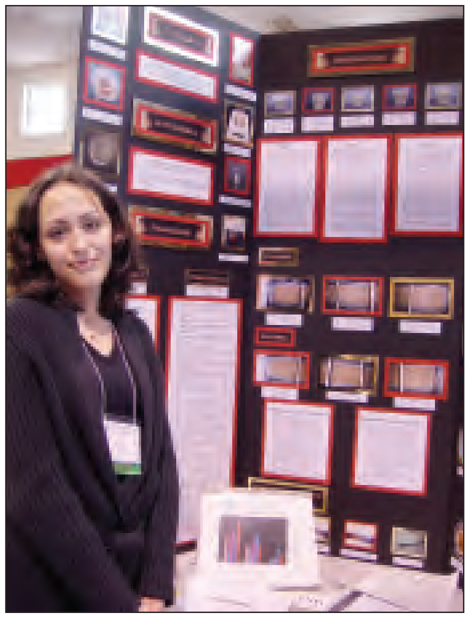
Winner, Senior Division

The purpose of this experiment is to determine if the crystals found in an igneous rock formed in the same environment. It focuses on the analysis of individual crystals within the sample, rather than on the composition of the entire rock. In this study, olivine, $(Mg,Fe)_2SiO_4$, crystals in Selden Basalt (9.8 Ma) were analyzed. It was hypothesized that the olivine crystals in the Selden Basalt sample would show different types of zoning, meaning that the crystals formed in different respective environments.

Thin sections of the Selden Basalt sample were made. Crystals of interest were found and analyzed every 15 micrometers (μm) using an electron probe microanalyzer (EPMA). A total of eight crystals were observed for their forsterite contents, and results were determined in terms of crystal zoning.

The crystals showed zoning, supporting the hypothesis. Olivine crystals number one, two, three, and seven were unzoned, indicating little or no movement between magma chambers. Olivine crystals four and six were normal zoned, indicating that the crystals may have formed deep in Earth's magnesium-rich mantle and moved upward. Olivine crystals five and six were reverse zoned. This indicates that the crystals may have formed higher in the mantle and then moved downward.

The different compositions and zoning profiles suggest that the olivine crystals formed in more than one environment. By analyzing the individual crystals, further information about these environments may be obtained. Tests using more EPMA studies and trace element studies conducted by laser ablation inductively coupled plasma mass spectrometry may yield this information.



"Post fire" biosynthetic remediation

by *Kristin M. Nichols*

Taos High School, Taos

Runner up, Senior Division

Forest fires are one of nature's most devastating and damaging occurrences. These fires have left much of our land barren and dry, with little hope of regaining the vegetation it once possessed. Countless efforts have been implemented to restore the plants and trees that once thrived in these areas, but these attempts are quickly being shut down due to natural incidences such as erosion. This dilemma was what prompted the following experiment to be conducted.

This science project was performed to determine if a polymer (polyethylene oxide) would enhance the adhesion of seeds to a burnt slope, while continually promoting seed growth. It was hypothesized that the polyethylene oxide polymer would serve as a seed adhesion agent to the slope and enhance plant growth.

The first phase of the project consisted of three tests, made up of five trials each, which were conducted to determine whether it was safe to grow plants using polyethylene oxide. This experiment was accomplished by adding alfalfa seeds, ammonium nitrate (NH_4NO_3), and soil bacteria to the polymer. This solution was then poured over sterile soil in five transparent plastic cups, to determine if the plants would grow.

The first and second tests were performed in the same manner, thus producing the similar results. The results of these tests showed that the plants were able to grow in soil where polyethylene oxide was present. The alfalfa seeds germinated in three days, and continued to grow normally. Although a slight bonding of the soil occurred, the plants were still able to grow normally. After approximately 4 days, a white cotton-like mold developed on the surface of the soil. When the plants came into contact with this mold, they became discolored, weak, and withered. Possible sources for mold contamination may have been excess moisture or contaminated alfalfa seeds.

The third test was performed using a more concentrated form of the polymer solution. The plants took much longer to grow than in prior experimentation. Instead of beginning to grow by the third day, the alfalfa plants did not sprout until the fifth day. This difficulty in sprouting may have been due to the change in the consistency of the polymer. All results of test three were comparable to tests one and two.

The second phase of this project involved a simulated revegetation. An aquarium was elevated at a 15° angle and filled with layers of rock, sand, sterile soil, and ash. The polymer solution was poured onto the slope and was allowed 10 min to absorb into the soil. Nine liters of water were then poured over the surface of the soil to determine if the soil would be affected by erosion. This process (control) was then repeated using water in place of the polymer.

The results of the polymer test revealed that there was a decrease in erosion of the soil and its components. The polymer enhanced seed growth by bonding the soil to the stems of the alfalfa sprouts. The results of the control aquarium showed that without the polymer, much of the soil and seeds were eroded. The alfalfa plants sprouted slower than other experiments. The alfalfa sprouts produced from these tests were identical to the prior tests.

The third phase of experimentation included conducting quantitative analyses of the number of sprouts grown with or without polyethylene oxide. A grid consisting of 5 x 5-cm squares was constructed in order to be able to pull out and count the alfalfa sprouts more efficiently. Alfalfa sprouts were pulled from each square in each aquarium (the one used to grow plants with the polymer, or the control) until both remained completely empty. All of the sprouts were counted in order to receive a more accurate estimate of the resourcefulness of the polymer. After counting all of the sprouts in the aquarium, and comparing results, it was determined that the sprouts grown with the polymer were scattered evenly along the aquarium due to less erosion. The majority of the seeds used in the control aquarium eroded, and grew mainly in a heap at the bottom of the slope.

Based on the data collected and analyzed, it is therefore concluded that the polyethylene oxide enhances the growth of alfalfa sprouts on a burnt inclined slope, and decreases erosion. Therefore, both hypotheses were supported.

The next phase of this project will involve determining the effects of the polymer on living organisms (i.e. insects). Experimentation continues….