An Experiment on the Erosion Rates of Rocks

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ABSTRACT

Some evolutionists claim that the erosion of mountains is balanced by uplift. This paper argues that this 'uplift/erosion 'balance is not sustainable, because erosion rates determined by laboratory and uniformitarian-based field measurements do not agree. Abrasion rates were determined using a cement mixer on eight groups of rock samples: three types of granites, a hard metasediment, limestone, ironstone, scoria and sandstone.

INTRODUCTION

Erosion of the Earth's surface is a continuous and ubiquitous process. For example, despite dam construction and other water control structures for irrigation,

> *'the San Joaquin is carrying away the Sierra at the rate of an inch per thousand years. Compare this with the Eel River of northern California, which is removing the Klamath Mountains at the rate of 40 to 80 inches* (101.6 cm to 203.2 cm) *per thousand years* — (about) *fifteen times as fast as the Mississippi is eroding its borderlands.'*[1]

Harbauger stated:

> *'The exposure of plutons at the Earth's surface implies removal through erosion of greater thicknesses of overlaying rock. There is no simple way of estimating the thicknesses of eroded material, but perhaps it was on the order of 10 miles thick in the Sierra Nevada.'*[2]

Raymo and Raymo also pointed out that,

> *'Given enough time, erosion will level any mountain, flatten every hill, erase every bump and ripple in the land. If it were not for periodic crumplings or liftings of the continents, the land would everywhere be as flat as the sea, at the level of the sea. The average rate at which erosion works over North America is about two inches every thousand years. Mount Washington, in New Hampshire is presently our region's highest mountain; it rises 6288 feet above sea level. If erosion cuts Mount Washington down at the continental average, in 30 million years the mountain will be gone. If uplift ceased, in 30 million years the Northwest would be as flat as Kansas.'*[3]

Harris and Tuttle noted that,

> *'Erosion rates in the Badlands are among the highest known. When photographs of Badland landforms taken early in the century are compared with recent photographs of the same features, it is apparent that marked changes inform and height have taken place.'*[4]

> *'The rate of erosion varies with location and rock type. Spires in loosely consolidated ash may lose half a foot of height per year. Tops of mudstone mounds may be lowered about one inch per year. Resistant sandstone caprock, on the other hand, may show an erosion rate of an inch in 500 years.'*[5]

> *'Running water, in trickles and in streams, picks up material and moves its load by rolling or jumping fragments, by carrying fine particles in suspension, and soluble matter in solution. Sediments are continuously eroded, deposited, and re-eroded. Fragments and particles become rounded, abraded, sorted, and mixed. They may lie undisturbed in a channel bottom or a river bar for many years or be spread across a valley floor during a flood. But inevitably sediments move downhill and downstream and away from their source area. Estimates of rates of erosion suggest that even high regions may be reduced to lowlands in a few million years. Erosion rates in the national parks .. . are comparatively high because downcutting goes rapidly in regions of sparse vegetation and high elevation. The Grand Canyon, deep as it is, was eroded only within the last one or two million years.'*[6]

Chew noted that,

> *'Today, our mountain elevations seem to be stable: every 600 years, weathering and erosion remove about an inch of material, but gradual uplift from below the earth's surface maintains the mountain area's height.'*[7]

Fiero stated that,

> *'No erosion is as important as water. None even challenges its number one ranking. More than thirty cubic miles of water fall on the land area of the Earth every year. Such an annual deluge, pulled downhill by ubiquitous gravitational forces, is an incredibly powerful agent of erosion. However, even with all the effort involved in the turbulent motion of all the raindrops and rivers of earth, the balance between uplift from earth heat and erosion by water energy is exact. The equation, uplift equals erosion, is a perfect balance of the dynamic pendulum of Earth processes.'*[8]

Continental surface erosion may be caused by heat or cold, water or ice, rain or storm, wind or tornado. However, these processes, though continuous, are sporadic and localised. The net effect of total erosion over the Earth's land surfaces may be much smaller than that performed by a body of fast running water, namely, in the upper sections of rivers. If erosion of mountains is balanced by continuous uplift of mountains as many evolutionists claim, then most, if not all, upper sections of rivers should also exhibit canyons, which would show evidence of down-cutting by fast running water. For no loss of generality, we assume that most riverbeds are composed of sandstone, ironstone, granites, limestone, and some hard metamorphic rock. With this in view, we set out to measure the rates of erosion/abrasion of a typical riverbed. Therefore, we selected samples of these rocks to see how long would it take to erode these rocks to sand, silt, or mud.

EXPERIMENTAL PROCEDURE

An experiment was designed to measure the rate of abrasion/erosion of eight rock types, namely, Norco granite, San Bernardino Mountain (SBM) granite, Box Springs (BS) granite, a metasediment commonly called Mexican beach (MB) rock (black metamorphosed mudstone), limestone commonly called white calcite rock, ironstone commonly called California desert (CD) rock, scoria commonly called lava rock (a porous iron-oxide-stained, volcanic rock), and sandstone.

Five pebbles of each rock type were selected, weighed with Sunbeam digital scales, and photographed (Figures 1 to 8). These rocks were then placed into a cement mixer minus internal regular bars, together with some sand and silt, and about two gallons of water and rotated for 8, 16 and 24 hours. The rotation rate was about 1 revolution per 2.5 seconds, equating to a circumference speed of 60 cm/sec. At the end of eight hours, the water was drained and the samples identified, cleaned, dried and photographed (Figures 9 to 16). The rock samples were dried by sitting outside for eight hours. There was some difficulty identifying some of the pebbles, especially the granites, because many of them looked similar. This was overcome by ranking them in order of size (weight) and assuming that this ranking would be maintained through the various abrasion stages. These steps were repeated at 16-hour and 24-hour intervals. The 16-hour and the 24-hour products are shown in Figures 17 and 18, respectively.

EXPERIMENTAL RESULTS AND ANALYSES

All weights are in grams. Experimental results and analyses are presented in Figures 19 through 26. All data points were plotted using a straight line with its corresponding correlation coefficient. Although some of the data points fit an exponential decay curve better than a straight line, it was found that an exponential decay curve will prolong the time axis by a factor of about 4. It does not alter the main results that show rapid erosion of the rock samples.

The results of the losses of the Norco granite samples are found in Figure 19. The losses were appreciable because of the irregular nature of the initial granite samples. Exponential decay curve fits will extend the time axes by about four times.

The results of the losses of the San Bernardino Mountain (SBM) granite pebbles are found in Figure 20. The losses were also appreciable because of the irregular nature of these initial granite samples. Exponential decay curve fits will also extend the time axes by about four times.

The results of the losses of the Box Springs (BS) granite samples are found in Figures 21. Exponential decay curve fits will again extend the time axes by about four times. The losses were again appreciable because of the irregular nature of the initial granite samples. After 16 hours, one of the BS granite samples broke into two pieces. And after 24 hours, one of the BS granite samples broke into two pieces again.

The results of the losses of the metasediment (Mexican beach rock) samples are found in Figure 22. The losses were the least of all the rocks used in this experiment because of the rounded nature of the initial samples. Notice also that the larger the sample, the smaller is the resultant abrasion. The metasediment appears to be the hardest of the rock samples. However, it is noted that it still only takes less than 300 hours for them to turn to mud or sand.

The results of the losses of the limestone (white calcite rock) samples are found in Figure 23. The losses were the greatest because of the apparent soft nature of the initial samples. Notice again that the larger the sample, the smaller is the resultant abrasion. Notice that after 16 hours, one of the limestone samples disappeared, and after 24 hours only two of the limestone samples were left.

The results of the losses of the ironstone (California desert rock) samples are found in Figure 24. The losses were greater than those of the granites because of the comparatively softer nature of the initial samples. Notice also the larger the sample, the smaller is the resultant abrasion. Some of the ironstone samples look similar to the lava rock (scoria) samples.

The results of the losses of the scoria (lava rock) samples

INITIAL SAMPLES

Figure 1. *Initial Norco granite samples.*

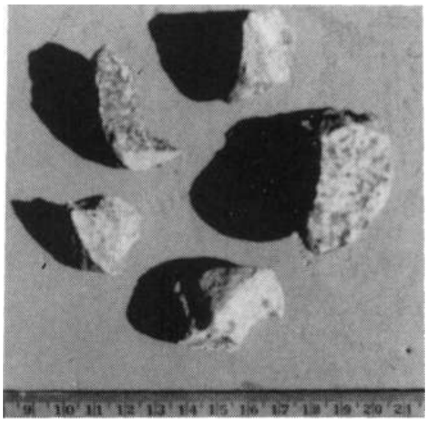

Figure 2. *Initial San Bernardino Mountain granite samples.*

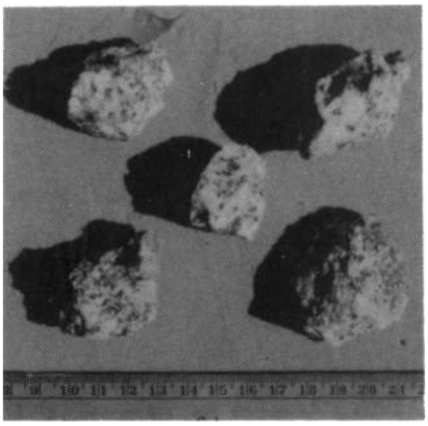

Figure 3. *Initial Box Springs granite samples.*

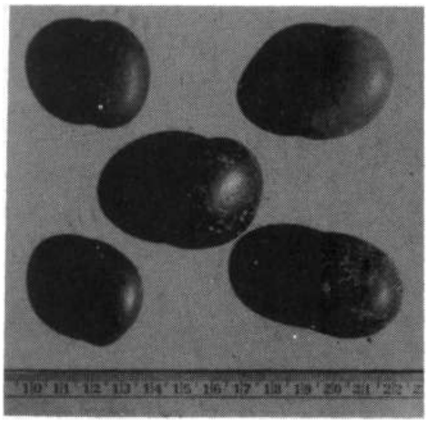

Figure 4. *Initial metasediment (Mexican Beach Rock) samples.*

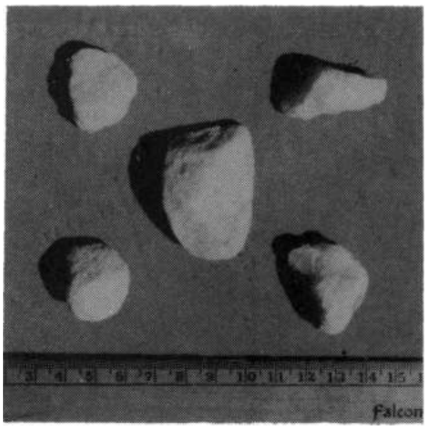

Figure 5. *Initial limestone (white calcite rock) samples.*

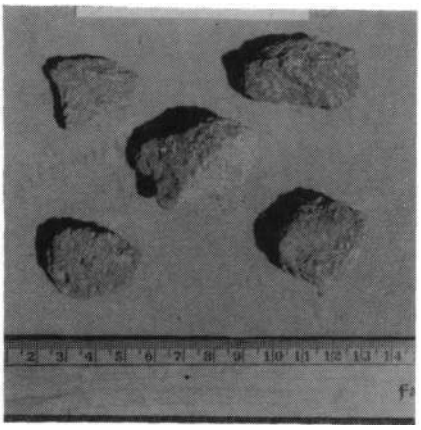

Figure 6. *Initial ironstone (California desert rock) samples.*

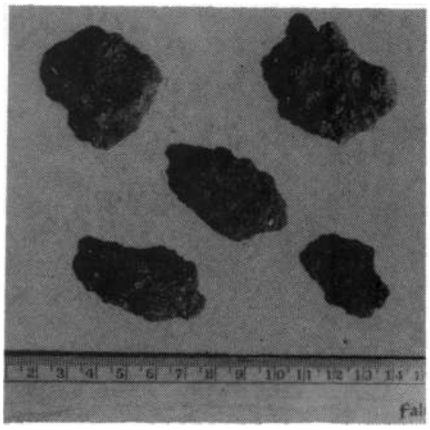

Figure 7. *Initial scoria (lava rock) samples.*

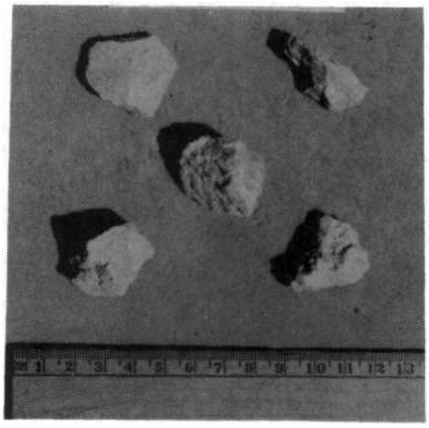

Figure 8. *Initial sandstone samples.*

are found in Figure 25. Exponential decay curve fits will extend the time axes by about four times. The losses were greater than those of the granites and the ironstone samples because of the susceptible nature of the lava samples due to their porosity (holes left by gas bubbles) and chemically weathered state (iron-oxide staining). Notice again the larger the sample, the smaller is the resultant abrasion. Some scoria samples look similar to the ironstone samples. Note

AFTER EIGHT HOURS OF EROSION

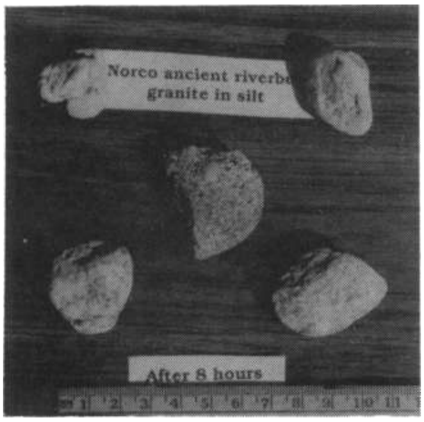

Figure 9. *Norco granite samples after 8 hours of erosion.*

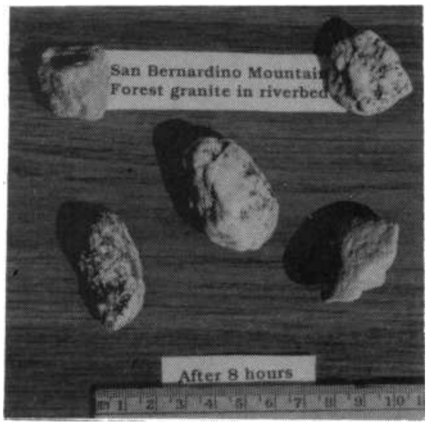

Figure 10. *San Bernardino Mountain granite samples after eight hours of erosion.*

Figure 11. *Box Springs granite samples after eight hours of erosion.*

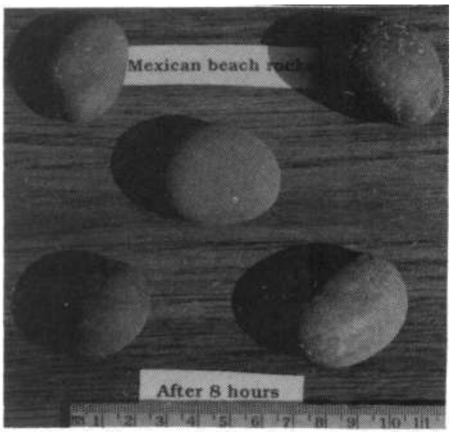

Figure 12. *Metasediment (Mexican Beach Rock) samples after eight hours of erosion.*

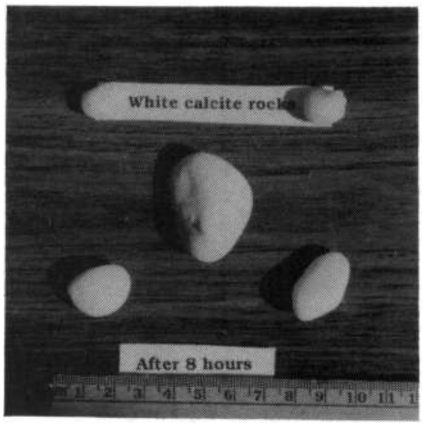

Figure 13. *Limestone (white calcite rock) samples after eight hours of*

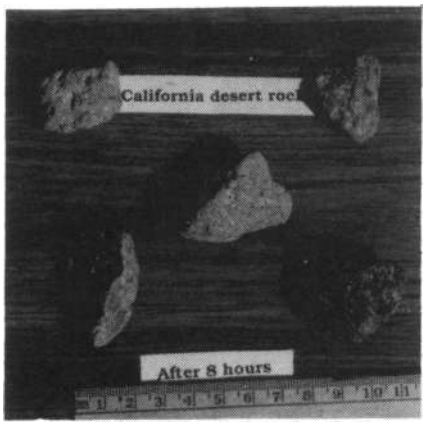

Figure 14. *Ironstone (California desert rock) samples after eight hours of erosion.*

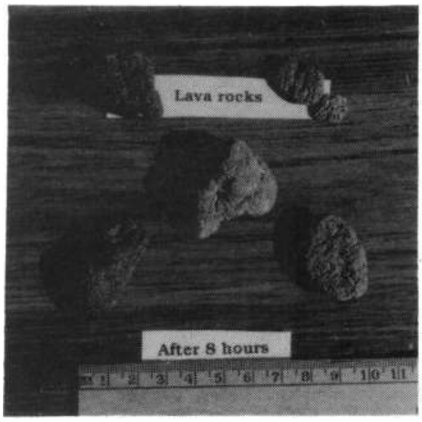

***Figure** 15. Scoria (lava rock) samples after eight hours of erosion.*

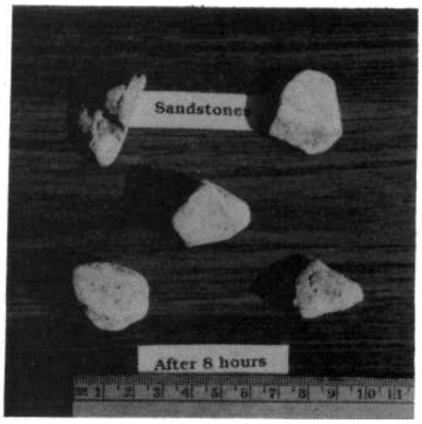

Figure 16. *Sandstone samples after eight hours of erosion.*

that one of the scoria samples broke up into two pieces.

The results of the losses of the sandstone samples are found in Figure 26. Exponential decay curve fits will again extend the time axes by about four times. The losses were greater than those of the granites and the ironstone samples because of the apparent softer nature of the sandstone samples. Notice also the larger the sample, the smaller is the resultant abrasion. The sandstone samples are brown

AFTER 16 HOURS OF EROSION

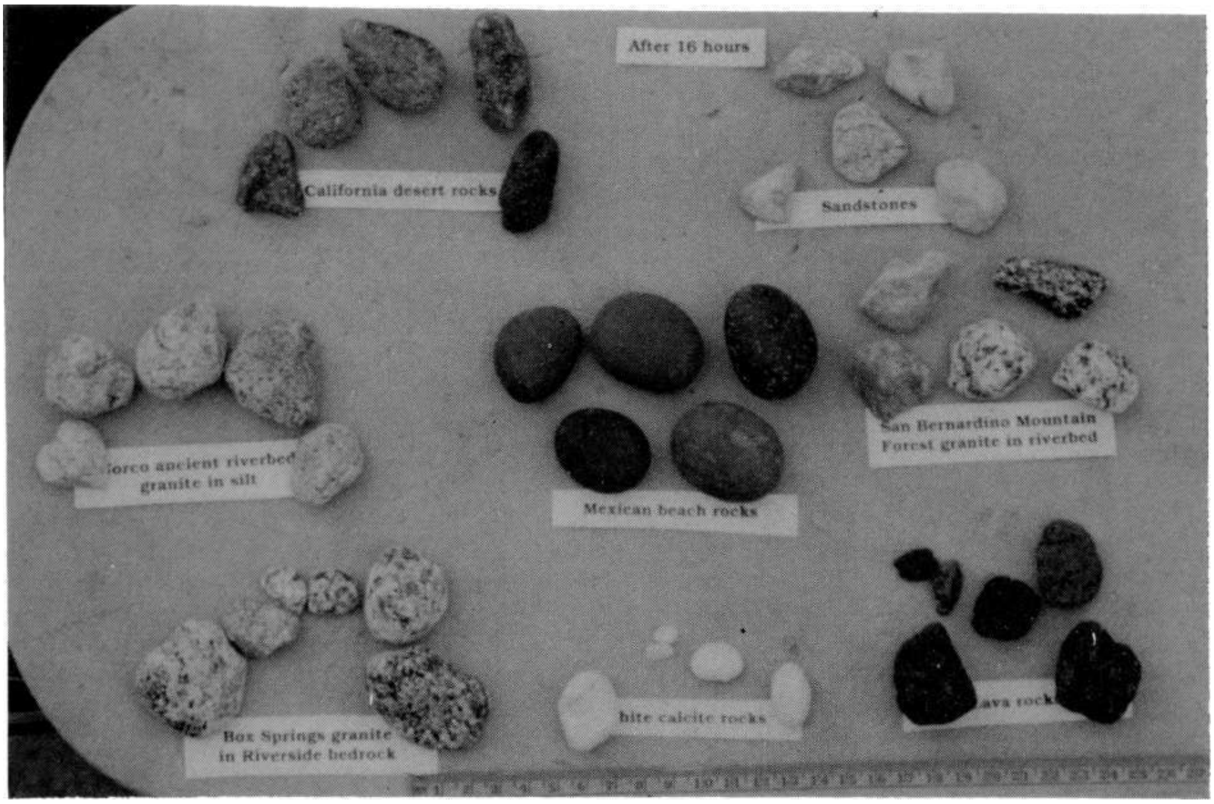

Figure 17. *Rock samples after 16 hours of erosion.*

AFTER 24 HOURS OF EROSION

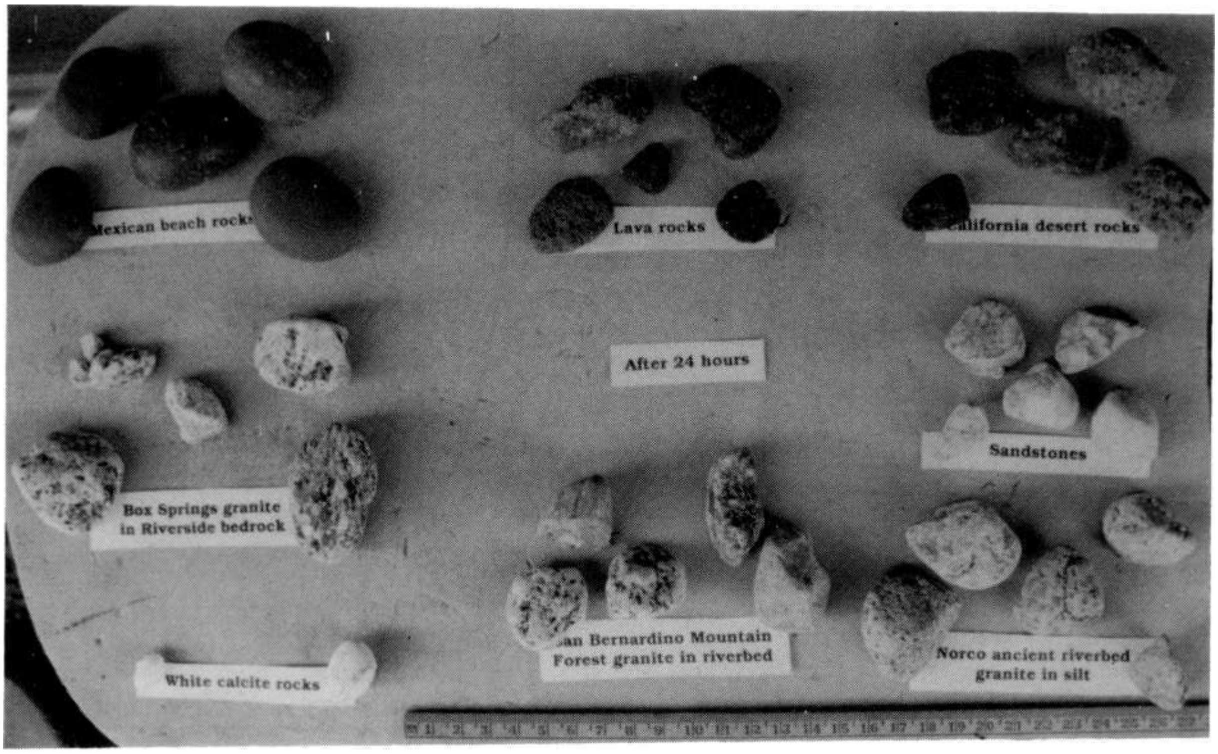

Figure 18. *Rock samples after 24 hours of erosion.*

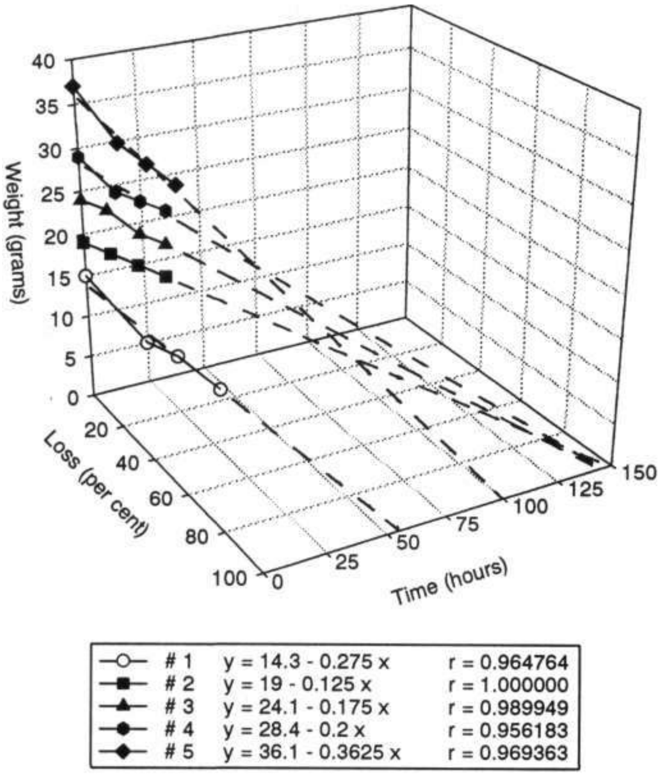

Figure 19. *Norco granite samples.*

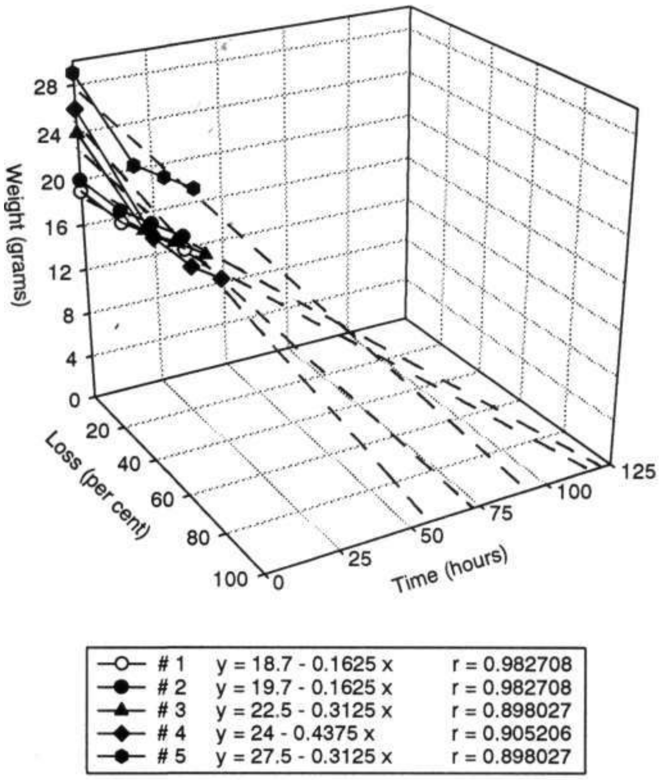

Figure 20. *San Bernardino Mountain granite samples.*

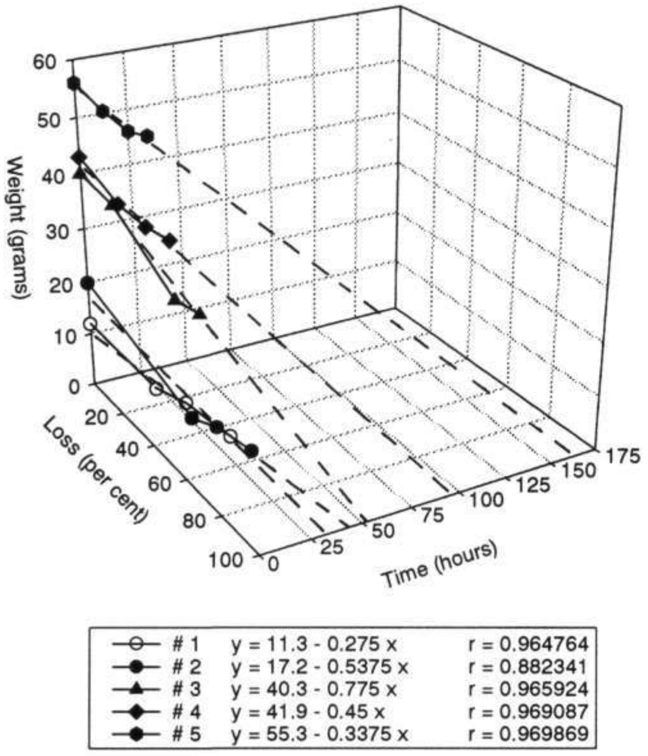

Figure 21. *Box Springs granite samples.*

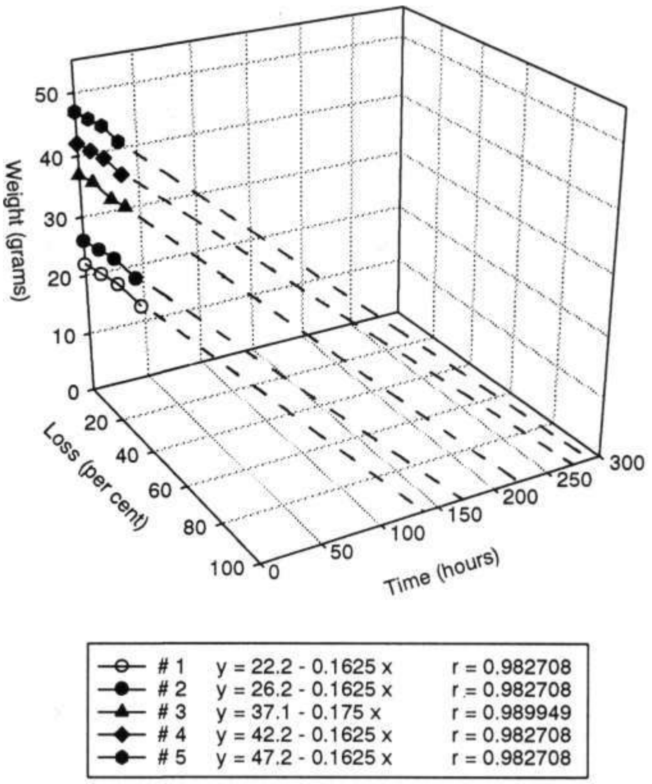

Figure 22. *Metasediment (Mexican Beach Rock) samples.*

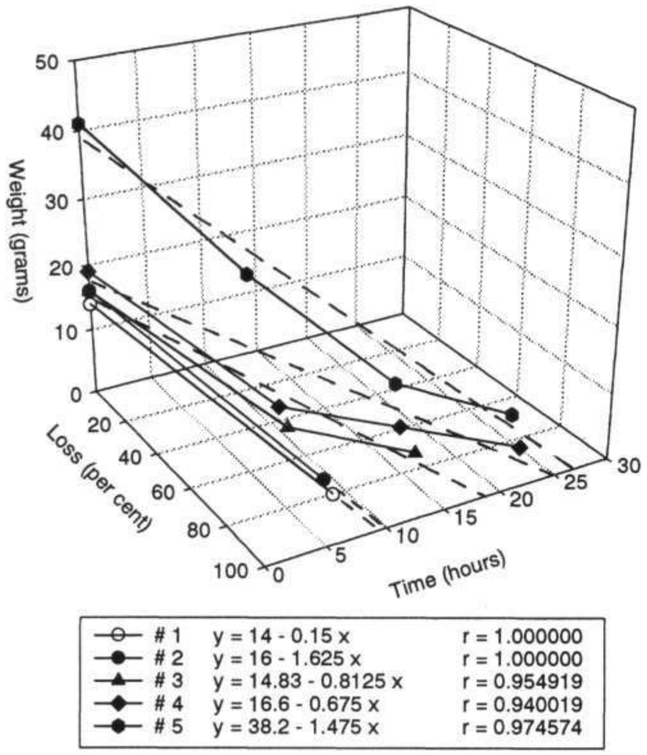

Figure 23. *Limestone (white calcite rock) samples.*

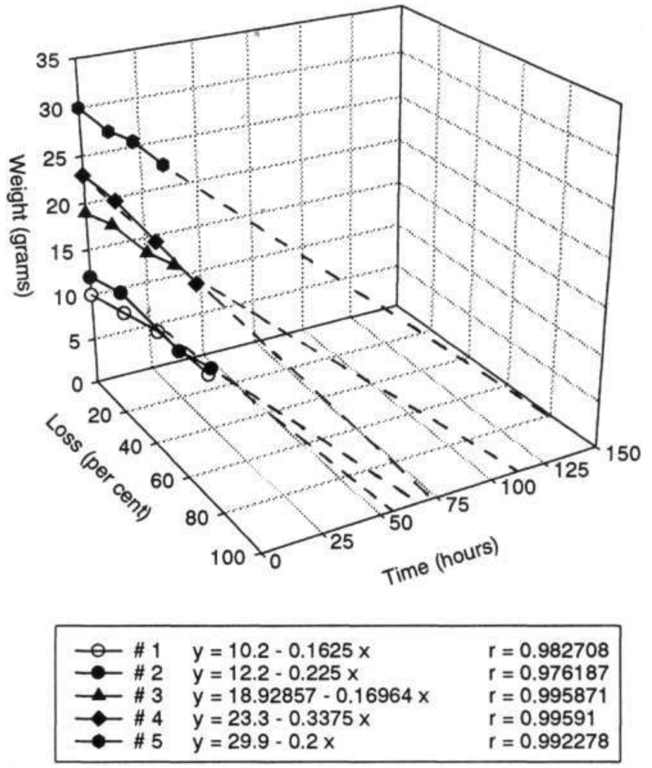

Figure 24. *Ironstone (California desert rock) samples.*

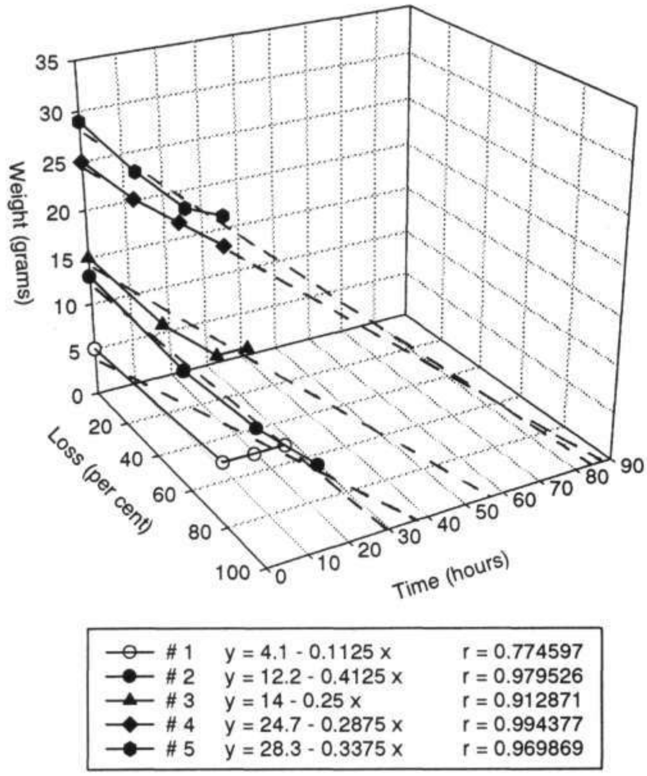

Figure 25. *Scoria (lava rock) samples.*

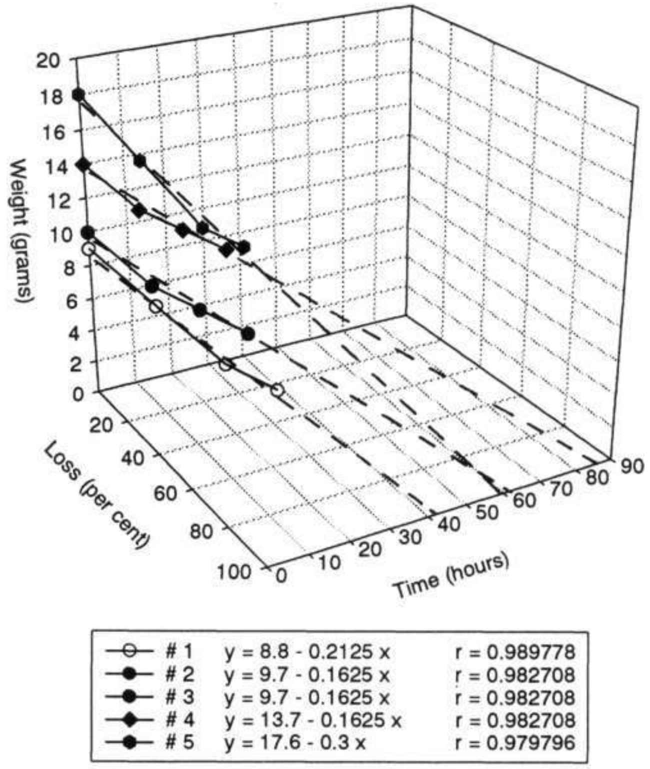

Figure 26. *Sandstone samples.*

irregular rocks of varying hardness, no doubt due to the softer nature of the cement binding the hard quartz sand grains. Their abrasion rates are similar to that of the scoria (lava rock) samples.

DISCUSSION

It is reasonable to assume that the rock types of typical river beds are similar to those under study in this experiment. It could also be assumed that the rate of abrasion inside the cement mixer is similar to that found in the upper sections of streams and rivers. If so, it may be concluded that the age of streams and rivers must be as young as thousands of years. This assumption is most likely not true to the current natural order due to the fact that the rocks are forced to erode inside the cement mixer, whereas in nature the erosion of rock is due to the velocity of stream action and also the volume and mass of water in the stream. This subject has been studied by many investigators in the field. Some of their work is quoted as follows:

A typical range of stream velocity is about 15 cm/sec (low) to 900 cm/sec (high).[9]

Reineck and Singh presented in the book an informative graph relating the average velocity of a stream in cm/sec against the diameter of rock samples in mm.[10] The graph shows the criteria for erosion, transportation, and deposition. Generally speaking, if the pebble sizes are less than 100 mm and the average velocity of a stream is less than 100 cm/sec, then deposition of pebbles dominates. If the pebbles have diameters less than 10 mm and the stream velocity is less than 10 cm/sec, then deposition of pebbles will dominate. If the pebble diameters are about 100 mm, stream velocity must exceed 500 cm/sec for erosion to occur, otherwise only transportation of pebbles will result. Nevertheless, this transportation mechanism will result in the abrasion of the pebbles.

According to Reineck and Singh, transport and therefore erosion only occurs when stream velocity exceeds 100 cm/sec for particle sizes greater than 1 cm in diameter. In this experiment the rock sample diameters ranged from 10 to 50 mm. Therefore, erosion should occur if stream velocity exceeds 100 cm/sec. The cement mixer's rotational speed was earlier determined to be about 60 cm/sec, although due to tumbling the pebble samples travelled at highly variable speeds of about 60 cm/sec. Such a velocity should only result in transportation or deposition of rock samples in the real world. Why does this experiment clearly show such dramatic erosion? The answer lies in the fact that the cement mixer forced erosion to occur, because the rock samples actually abraded each other, together with the sand and mud. Actually, if the rocks in a river bed travel along with the raging stream waters, they will certainly grind against each other. That is why all pebbles in streams are rounded. Furthermore, if the pebbles are small enough, they will disintegrate into sand, silt, and/or mud.

If our assumption is off by a factor of a thousand, then the average erosion percentage per day in Figures 19 to 26 would be rescaled to the average erosion percentage per three years. If our assumption is off by a factor of 100 thousand, then the average erosion percentage per day would be rescaled to the average erosion percentage per 270 years. Under these more realistic assumptions, the erosion rates are still far greater than what evolutionists have stated. For example, if the rate of loss is 10 per cent per day, then the rock sample will be gone in about 10 days. Extensive curve fitting analyses have been performed to determine the approximate time for the rock samples to disappear as sand, silt, or mud, and these fitted curves are shown on Figures 19-26.

FUTURE EXPERIMENTS

The accuracy in grams will be improved by obtaining a more precise electronic digital scale. Furthermore, experiments will be designed to investigate linear erosion and transportation of rocks.

CONCLUSIONS

A simple experiment has revealed that rocks can be abraded/eroded rapidly. This rapid erosion challenges the evolutionists' claim that the erosion of mountains was balanced by the uplifting of the mountains so that the net result is that there is no appreciable rise of the mountains. It has been argued here that this 'uplift balances erosion' scenario is not true, because if it were true, then most, if not all, rivers in the world would form canyons in their upper sections, because erosion rates are so rapid in fast running streams. For example, based on uniformitarian assumptions, part of New Guinea has been shown to have risen from sea level to 3000 m elevation since marine Pliocene sediments were laid down, possibly inferring a rate of rise of 1.5 m/ 1000 years. If river down-cutting works as rapidly as this present erosion experiment has shown, then we would expect to see canyons about 3000 m deep in the upper sections of those New Guinea rivers. The fact is that we do not see canyons of that magnitude in the region. This implies that the uniformitarian assumptions are questionable and/or the time-frame of 2 million years is in error.

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