SCIENCE NEWS of the week

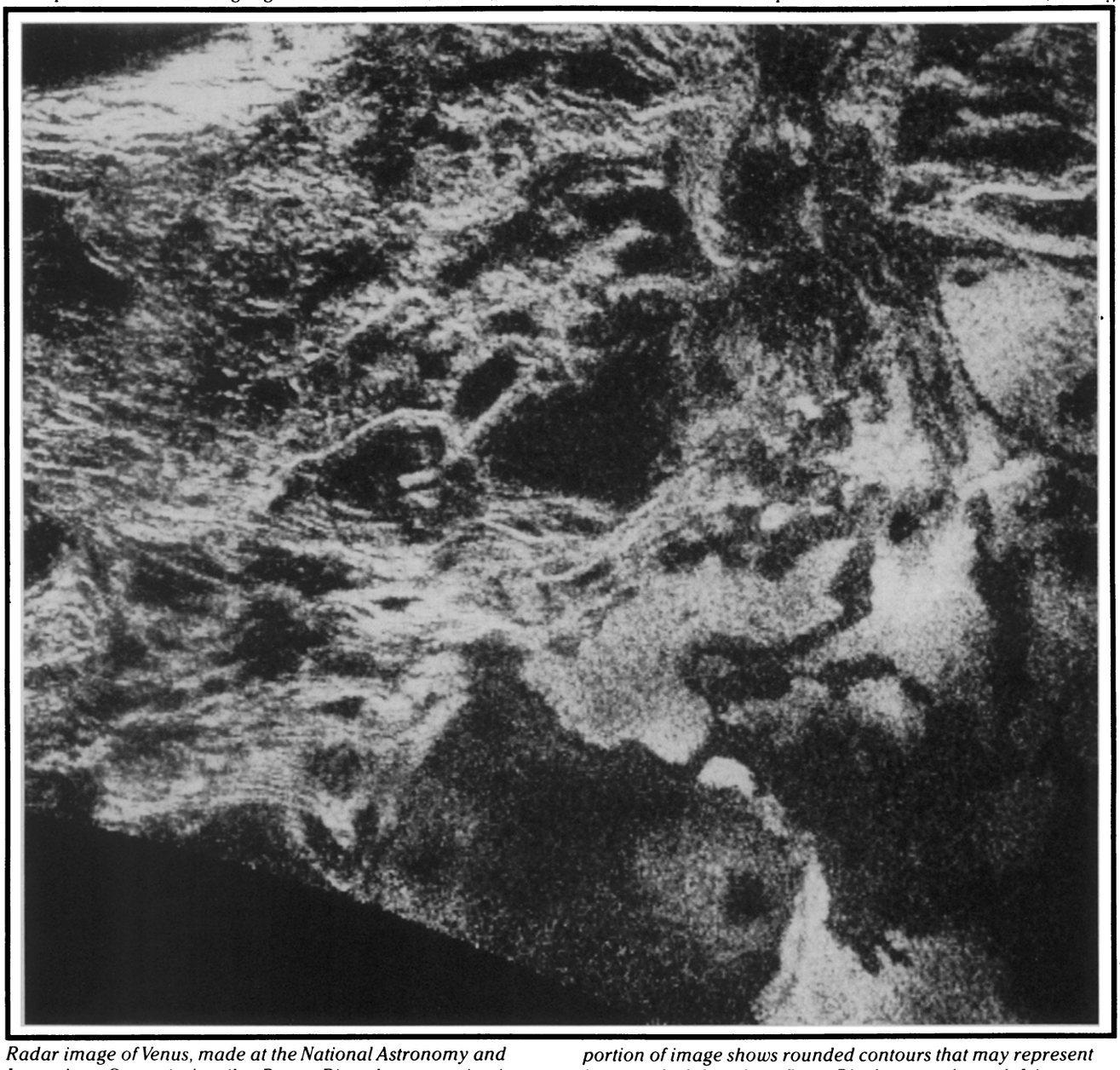
Rock Around the Solar System

The annual event has been informally known as the "Rockfest" ever since it was first held in 1970, when nearly 1,000 scientists from 10 countries gathered at the National Aeronautics and Space Administration's Johnson Space Center in Houston to discuss analyses of the lunar samples brought back by the Apollo astronauts. The Lunar Science Conference became Lunar *and Planetary* in 1978, in response to the growing databank from the Mariners, Vikings and other probes sent to distant worlds, but still it seldom digressed into clouds, magnetospheres and other such phenomena. The highlight of last year's Rockfest, for example, was a session at which several groups of scientists combined to agree that one recently discovered meteorite was the first ever to be firmly assigned to a known source: the moon (SN: 3/26/83, p. 196).

Rock was again the star last week at Rockfest 15, as researchers discussed other meteorites that may be pieces of Mars, a terrestrial chunk that may hold a sealed sample of earth's atmosphere from 3.4 billion years ago, and the latest radar views of the haze-hidden surface of Venus.

The most crowded of the week's 27 sessions, in fact, was one at which two Soviet scientists presented their Rockfest colleagues with their first real look (apart from limited press coverage — see SN: 12/3/83, p. 356) at radar images from the Venera 15 and 16 orbiters that have been circling Venus since last October. Now about halfway through their nominal mission, the Veneras are concentrating on the planet's north polar region, previously unseen even by the radar of the U.S. Pioneer Venus orbiter.

The images shown at the meeting did not extend as far north as the pole itself, but they did encompass some 18 million square kilometers of the terrain, adding



D.B. Campbell/Arecibo

Radar image of Venus, made at the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico, shows a region just south of Lakshmi Planum in the northern hemisphere. Right portion of image shows rounded contours that may represent large-scale, lobate lava flows. Black area at lower left is not part of image.

what Soviet and U.S. researchers alike felt to be yet additional evidence that the surface of Venus has undergone an extremely active evolution. It has been estimated that about 16 to 20 percent of the surface of earth's moon has been resurfaced by lava flows, and perhaps as much as two-thirds of Mars. Judging from the Venus radar maps so far, says Alexei T. Basilevsky, chief of the laboratory of comparative planetology at the Vernadsky Institute of Geochemistry and Analytical Chemistry in Moscow, the original face of Venus may have been even more dramatically covered. In that 18 million square kilometers, he told the scientists, only 57 obvious craters have been identified down to the mapping resolution of about 2 to 4 km. Based on ideas of how many craters ought to have formed in such a large expanse, and when, Vernadsky director Valeriy Barsukov suggested the vast, now-smooth plains in the region could be as young as a billion years. Expected traces of meteorite bombardment, he said, "are almost completely erased by this tectonic-magmatic activity."

Almost—but not quite. The craters that remain come in a wide variety of morphologies, suggesting different degrees of weathering or other modification that could be related to differences in their ages. Basilevsky showed clear blow-ups of some craters whose rims are still surrounded by haloes of what appears to be the material thrown out when they were formed. Others have lost their blankets of "ejecta," while still others — presumably older still — barely even preserve their rims. Some show radar-bright floors indicating them to be rough, others seem smooth.

In general, says Basilevsky, the differing crater types seem similar to those on other bodies such as the moon and Mars, despite the vastly greater temperature and atmospheric pressure of Venus. In fact, he admits, he expected to find that the dense atmosphere would prevent a crater's ejecta from spreading more than about a tenth of the crater diameter beyond its rim. Instead, it ranges far in some cases, near in others. Basilevsky did show one unusual ejecta pattern, however, that he says would be "practically impossible" on earth or the moon. It is in the shape of a gaint teardrop, which apparently flowed outward through a break in its crater's wall. On the moon, he says, the molten ejecta created by a large impact typically contains about 10 to 30 percent solid fragments, whose presence speeds up the cooling of the overall "melt" (determined from crystallization studies) and brings the flow to a halt. On Venus, he suggests, the high surface temperature contributes fragments that are hotter themselves, sustaining the flow so that it can extend into such shapes as the teardrop.

To the frustration of many Rockfesters (including a few journalists), no "hard copies" of the Venera images were made available even to NASA officials, because, said Barsukov and Basilevsky, they had not yet been publicly released in the Soviet Union. Several U.S. researchers nonetheless praised the Soviet scientists for previewing the images (whose computer-processing was completed only the week before), and for other aspects of cooperation in the study of Venus.

Arecibo radar image of possibly active Beta Regio on Venus shows the two large, bright areas—complex Rhea Mons (top) and more symmetrical Theia Mons (bottom)—both believed to be volcanic features, separated by the parallel linear features of Devana Chasma, a possible rift system.

Other radar studies of the planet have been conducted by U.S. researchers using the huge Arecibo radioastronomy facility in Puerto Rico. The most recent Arecibo results were presented at the meeting by Donald B. Campbell of Arecibo, along with James W. Head and colleagues from Brown University in Providence, R.I. One striking image offered 2-km resolution of an area known as Beta Regio, thought by some researchers to be possibly the youngest spot on Venus—perhaps even volcanically active to this day. The two most prominent features on Beta are known as Theia Mons

— an almost surely volcanically constructed peak some 700 km across with a summit rising 10 km above its surroundings and complete with an apparent central depression — and, to the north, Rhea Mons, rough-surfaced but with a far less classically formed peak. The Arecibo image extends about 2,500 km from south to north, and clearly reveals a family of parallel, linear features running between Theia and Rhea and known as Devana Chasma. Altimetry measurements from the Pioneer Venus orbiter indicate a linear trough running down the region, and when combined with the Arecibo image, the total picture is of a vast rift zone, as much as 350 km in width.

A further display of the planet's apparently widespread volcanism shows in an Arecibo image of an area southeast of a vast highland known as Lakshmi Planum. Numerous complex patterns (variations in surface roughness) bedeck the northwest portion of the image, but most exciting, says Head, are the "lobate" shapes to the southeast, strongly resembling the contours of great basaltic flows.

But there was far more to the Rockfest than the rock of Venus. The consensus at last year's meeting that at least one meteorite has come to earth from the moon, for example, renewed the question of whether certain others have come from Mars. And with no known Marsrocks for comparison, the issue last week was still two-sided.

Nor was the meeting limited to extraterrestrial items. One earthrock from northwestern Australia, according to three researchers from NASA's Johnson Space Center, contains tiny, sealed pockets of gas and liquid — "fluid inclusions" — which may hold traces of earth's atmosphere just as it was more than 3 billion years ago. Such inclusions are common in some kinds of rock, but many contain fluid that merely happened to leak in along fractures in, say, a piece of quartz. There are also sealed inclusions, but the likeliest kind is simply a bubble of volcanic gas from the magma in which the rock formed, rather than a bit of the ambient atmosphere itself.

The Australian rock, however, says NASA's Everett K. Gibson Jr., is not a volcanic rock at all, but an evaporite (formed of barite crystals that replaced the original gypsum with no heat involved) — and the fluid in some of its inclusions may have been trapped as the crystals grew, rather than let in by leakage. The rock has been dated at 3.4 billion years, and the possibly ancient fluid, analyzed by a sophisticated laser microprobe/gas chromatograph, seems to contain no oxygen, no nitrogen — just carbon dioxide, the expected principal constituent if, as some researchers believe, the earth originally had a reducing atmosphere. What changed the atmosphere to an oxidizing one? Life — without which earth's atmosphere might more closely resemble that of, well, Venus.

— J. Eberhart

Magnesium plays a role in hypertension

Ask most people what causes high blood pressure and they will probably accuse dietary sodium and salt. Within the medical community, however, the answers tend to be more complex and controversial; research points to a number of culprits including other nutritional factors and genetic makeup. Now, a study linking hypertension to magnesium deficiency in the diets of rats secures the membership of magnesium in the club of agents that may play a role — perhaps as important as sodium — in blood pressure regulation.

Physiologist Burton M. Altura at the Downstate Medical Center in Brooklyn, N.Y., and co-workers fed rats one of three diets containing different amounts of magnesium. The researchers report in the March 23 SCIENCE that after 12 weeks the mean arterial blood pressure of rats fed a diet severely deficient in magnesium was 32 millimeters of mercury (mmHg) higher than the near-normal 111 mmHg pressure found in animals fed a magnesium-enriched diet. The pressure of moderately deprived rats measured 131 mmHg.

Lawrence Resnick, an endocrinologist and cardiologist at Cornell University Medical Center in New York, says that the unique aspect of Altura's findings is that he related the increased pressure to actual changes in the size of blood vessels; the vessels were most constricted in animals that were most severely magnesium depleted.

But Resnick and others think that the rat study is not relevant to humans in general because most people get enough magnesium in their diets. (Unprocessed grains and legumes are high in magnesium.) Resnick also contends that the magnesium levels in the blood of most hypertensives fall in the range of people with normal blood pressure.

However, there are two large subgroups of the population, Resnick and other researchers acknowledge, that are magnesium depleted. Altura notes that 80 percent of all alcoholics have very low levels of magnesium. Resnick adds that alcoholics are also predisposed to hypertension, although the cause is still being debated. The other group consists of people taking diuretics — the fifth most widely used prescription drug in the United States, according to a recent JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. While diuretics are used to attenuate hypertension by expelling salts, they also waste magnesium, says Altura. He cites a recent Swedish study in which the pressure-lowering effects of diuretics were enhanced by giving patients supplemental magnesium.

Altura adds to this list people who live in areas with soft water and magnesium-poor soil. He says that epidemiologists have found unusually high incidences of hypertension and cardiovascular disorders in some of these regions. He also notes that magnesium levels in the U.S. diet have been dropping from an average 475 milligrams (mg) per person per day in 1900 to 245 mg today partially because of changes in diet and agriculture.

Altura thinks that magnesium deficiency ties in with theories on salt and hypertension because magnesium, he believes, regulates the sodium-calcium exchange pump of the cells. When sodium levels are high and magnesium is low, he says, the pump is inefficient. Cells become loaded with calcium, which in turn makes blood vessels contract. Resnick tempers this theory by saying that in all likelihood the important ions — calcium, potassium, sodium and magnesium — mutually regulate one another by complex mechanisms that are far from understood. "We're all like the blind men," he says, each describing the whole elephant differently because we're each touching different parts.

What Altura's group has done, says Resnick, is bring attention to a long-ignored ion and entice clinicians to develop techniques for monitoring magnesium metabolism in humans.

Altura thinks that more studies supporting the role of magnesium in hypertension and heart disease will emerge in the next few years. "We're happy that we have been prime movers in bringing a lot of this evidence to the forefront," he says.

—S. Weisburd

New clues to lung hazard in mines

A new animal study suggests how chronic inhalation of low levels of coal dust and diesel exhaust might affect a miner's lungs. A National Institute of Occupational Safety and Health (NIOSH) researcher in Morgantown, W.Va., found that the pollutants both appear to negatively affect alveolar macrophages, although in exactly opposite ways. These scavenger cells are responsible for engulfing foreign bodies to protect the surface of little air sacs deep within the lung.

Large dust particles don't usually travel deeply into the lung, but instead land on mucus lining the lung's larger airways, explains Vincent Castranova, the NIOSH scientist. Because mucus is constantly flowing out of the lung by what he terms the "muco-ciliary escalator," the larger particles usually clear out fairly readily. Smaller ones, however, can enter into the deep reaches of the lung — to the alveoli, or little air sacs. Here, particles "are too deep to be removed by the muco-ciliary escalator," Castranova says, so their only way out "is by macrophages engulfing them." Once a macrophage does that, "it will climb up the airways and get on the