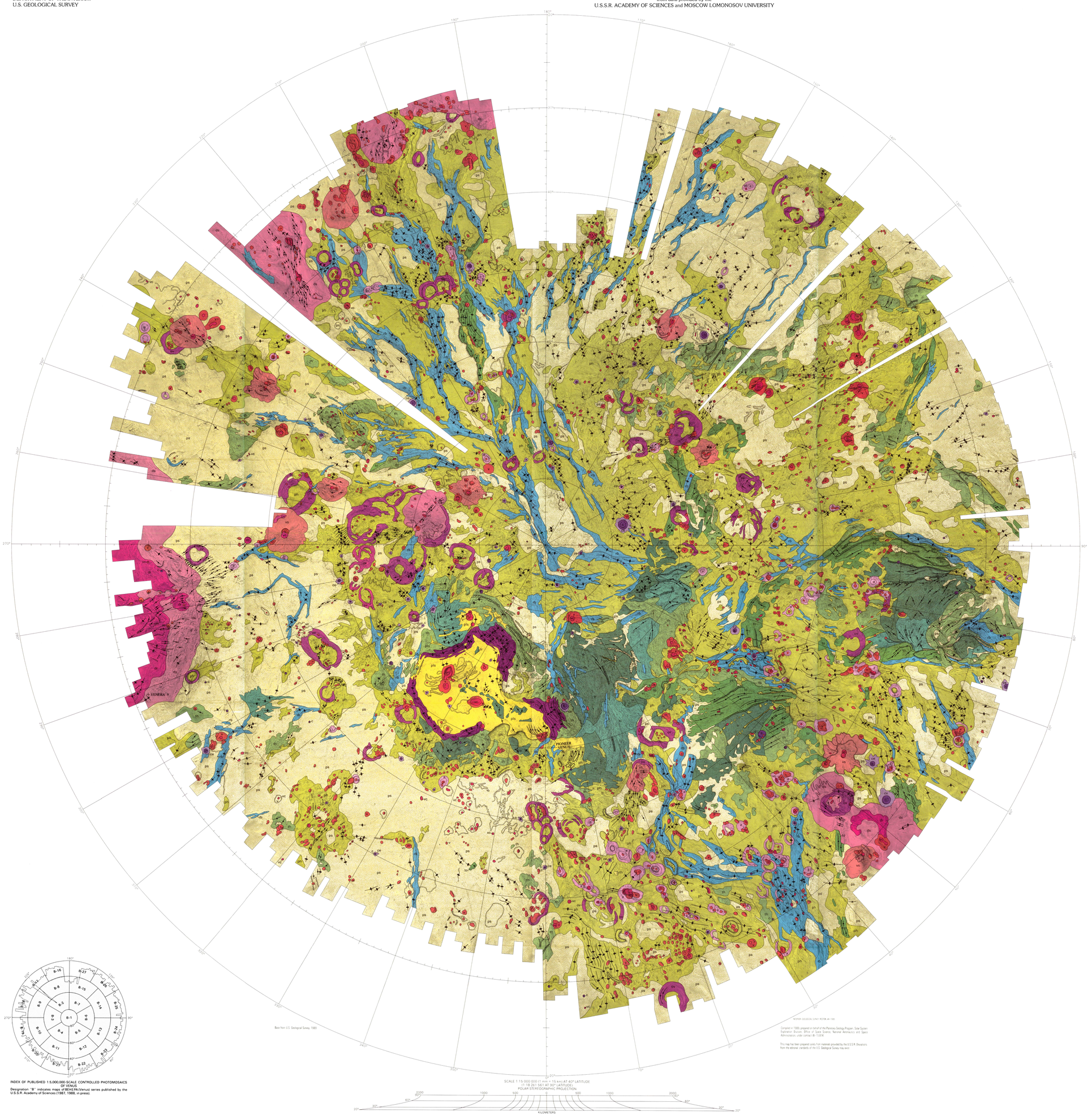
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared for the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
from data provided by the
U.S.S.R. ACADEMY OF SCIENCES and MOSCOW LOMONOSOV UNIVERSITY

ATLAS OF VENUS
1:15,000,000 TOPOGRAPHIC SERIES
NORTHERN HEMISPHERE
V 15M 90/0 G, 1989
I-2059



INDEX OF PUBLISHED 1:5,000,000-SCALE CONTROLLED PHOTOMOSAICS OF VENUS

Designation "B" indicates maps of BENEIPA (Venus) series published by the U.S.S.R. Academy of Sciences (1987, 1988, in press).

GEOMORPHIC/GEOLOGIC MAP OF PART OF THE NORTHERN HEMISPHERE OF VENUS

By

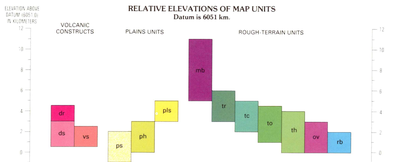
A.L. Sukhanov, A.A. Pronin, G.A. Burba, A.M. Nikishin, V.P. Kryuchkov, A.T. Basilevsky,
M.S. Markov, R.O. Kuzmin, N.N. Bobina, V.P. Shashkina, E.N. Slyuta, and I.M. Chernaya

V 15M 90/0 G

1989

RELATIVE ELEVATIONS OF MAP UNITS

Datum is 6051 km.



NOTES ON BASE

This map of part of the northern hemisphere of Venus has been prepared to support planning and operations of the Magellan Mission to Venus. The data used to compile the base were obtained as a result of a joint American and Soviet Venus mapping project (Basilevsky and others, 1989), conducted under the auspices of the U.S.-U.S.S.R. Working Group on Solar System Exploration. Image information was taken almost exclusively from Venera 15 and 16 synthetic aperture radar (SAR) image mosaics provided by the U.S.S.R. (Rzhiga, 1987; Alexandrov and others, 1988). Ancillary data included Pioneer Venus radar altimetry (Pettengill, 1977; Pettengill and others, 1979), Venera 15 and 16 radar altimetry (Kotelnikov and others, 1984, 1985) and Earth-based radar images provided by the Arecibo Observatory (Campbell and Burns, 1980; Stofan and others, 1987).

ADOPTED FIGURE

The figure of Venus used for computation of this map projection is a sphere with a mean radius of 6051.0 (Kotelnikov and others, 1985).

PROJECTION

The Polar Stereographic projection is used for this map, with a scale of 1:15,000,000 at lat +40° and 1:18,261,561 at lat +90°. Due to the retrograde rotation of Venus, longitudes increase from west to east in accordance with usage of the International Astronomical Union (IAU, 1983).

CONTROL

Planimetric control is taken from the radar image mosaic provided by the U.S.S.R. that is based on the tracked position of the spacecraft (Akim and others, 1986; Tyuflin and others, 1989). According to current IAU convention, the 0° meridian passes through the center of a crater/lake feature, Eve (lat 32° S.), located within Alpha Regio, a feature of the southern hemisphere that is outside the area of this map (Masursky and others, 1980). No simple statement for accuracy can be given, but discrepancies as great as 10 km (0.1°) are likely to exist (Alexandrov and others, 1985; Tyuflin and others, 1989).

NOMENCLATURE

To avoid obscuring features on this sheet, place names are omitted. They are shown on the topographic map sheet I, U.S. Geological Survey, 1989).

V 15M 90/0 G: Abbreviation for Venus; 1:15,000,000 series; center of sheet, lat 90° N., long 0°; geology (G).

GEOMORPHIC/GEOLOGIC MAP

Radar images and semicontrolled and controlled radar image mosaics were provided by the Institute of Radioengineering and Electronics and the Central Institute of Geodesy, Aerial Survey, and Cartography, Moscow (Alexandrov and others, 1985; U.S.S.R. Academy of Sciences, 1987, 1988; Burba, 1989b).

This map was compiled in 1989 from unpublished, Venera 15- and 16-based, 1:5,000,000-scale, preliminary geologic maps prepared by several authors from the Vernadsky Institute and the Geological Institute, U.S.S.R. Academy of Sciences, and from Moscow Lomonosov University. Several geologic units of the larger scale maps have been combined and revised to provide consistency of portrayal.

Detailed descriptions of the mapped units and their regional settings and geologic history are given in the papers listed below that are indicated by an asterisk. The other papers listed deal with principal questions of Venusian geology as revealed by Pioneer Venus and especially by Veneras 15 and 16.

MAP UNITS

The 13 units were mapped on the basis of characteristics observed primarily on Venera 15 and 16 SAR images, supplemented by data from Pioneer Venus and Earth-based radar images obtained by the Arecibo Observatory. The units represent different terrain types classified by physiographic expression. They are not rock-stratigraphic units and are not assigned to a time-stratigraphic system. Faults not expressed as specific landforms such as narrow depressions (grabens) or scarps are not shown.

VOLCANIC CONSTRUCTS

- **dr** — **Large, rough-surfaced, domical uplift**
- **ds** — **Large, smooth-surfaced, domical uplift**
- **vs** — **Shield volcano with smooth slopes**

PLAINS UNITS

- **ps** — **Smooth plains of lowlands**
- **ph** — **Hummocky plains of lowlands and foothills**
- **pls** — **Smooth plateaus**

ROUGH-TERRAIN UNITS

[Areas of tesserae (parquet) have rugged topography. They contain ridges and grooves that intersect from two or more directions and form diverse structural patterns]

- **mb** — **High mountain belt**
- **tr** — **Rhombic tessera**
- **tc** — **Chevron-shaped tessera**
- **to** — **Tessera containing orthogonal or parallel ridges and grooves**
- **th** — **Hummocky or chaotic tessera**
- **ov** — **Ovoid (corona)**—Circular system of ridges
- **rb** — **Ridge belt**
- **Geomorphic boundary**
- **Boundary, separating radar-bright and radar-dark areas**—Dots indicate brighter side. Interpreted as lava-flow boundary
- **Ridge**
- **Elongated prominence with gentle slopes**
- **Narrow depression**
- **Scarp**—Hachures point downslope
- **Arachnoid**—Circular complex with gently sloping concentric rims and radial lineaments
- **Volcano**
- **Caldera**
- **Impact crater (c) and ejecta (ce)**
- **Venera 9 landing site** (lat 31.7° N., long 290.8°)
- **Pioneer Venus 2 north probe landing site** (lat 59.3° N., long 4.8°)

SELECTED BIBLIOGRAPHY

References by Soviet authors supplied by U.S.S.R. Academy of Sciences. Location of sheets B-1 through B-27 shown on index map, lower left corner of this sheet.

Akim, E.L., Tyuflin, Yu.S., Belenky, E.G., Vlasova, Z.P., Kadnichanskaya, I.M., Reshetova, S.E., and Stepanyants, V.A., 1986, Navigational ensure [control and co-ordinates control of radar survey images from Venera 15 and 16 spacecraft [in Russian]: Geodeziya i Kartografiya, no. 1, p. 38-41.

Alexandrov, Yu.N., Basilevsky, A.T., Kotelnikov, V.A., Petrov, G.M., Rzhiga, O.N., and Sidorenko, A.I., 1988, A planet rediscovered: Results of Venus radar imaging from the Venera 15 and Venera 16 spacecraft: Soviet Science Review B. Astrophysics and Space Physics, v. 6, p. 61-101.

Alexandrov, Yu.N., Zakharov, A.I., Krymov, A.A., Kadnichansky, S.A., Ledovskaya, L.S., Ostrovsky, M.V., Petrov, G.M., Rzhiga, O.N., Sidorenko, A.I., Sinilo, V.P., and Tyuflin, Yu.S., 1985, Compiling of Venus surface photomaps with radar survey images from Venera 15 and 16 spacecraft [in Russian]: Geodeziya i Kartografiya, no. 9, p. 41-48.

Barsukov, V.L., Basilevsky, A.T., Burba, G.A., Bobina, N.N., Kryuchkov, V.P., Kuzmin, R.O., Nikolaeva, O.V., Pronin, A.A., Ronca, L.B., Chernaya, I.M., Shashkina, V.P., Garanin, A.V., Kushky, E.R., Markov, M.S., Sukhanov, A.L., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Alexandrov, Yu.N., Sidorenko, A.I., Bogomolov, A.F., Skrypnik, G.I., Bergman, M.Yu., Kudrin, L.V., Bokshtein, I.M., Kronrod, M.A., Chochia, P.A., Tyuflin, Yu.S., Kadnichansky, S.A., and Akim, E.L., 1986, The structure of the central and eastern parts of Ishtar Terra and some problems of Venus tectonics [in Russian]: Geotektonika, no. 4, p. 42-53, English translation in Geotectonics, v. 20, no. 4, p. 282-288.

*_____1988, Northern Beta: Photogeologic analysis of Venera 15/16 images and maps, in Abstracts of papers submitted to the Nineteenth Lunar and Planetary Science Conference, Houston, March 14-18, 1988: Lunar and Planetary Institute, p. 41-42.

Basilevsky, A.T., Burba, G.A., and Banson, R.M., 1989, Maps of part of the Venus northern hemisphere: A joint U.S.-U.S.S.R. mapping project, in Abstracts of papers submitted to the Twentieth Lunar and Planetary Science Conference, Houston, March 13-17, 1989: Lunar and Planetary Institute, p. 46-47.

Basilevsky, A.T., Ivanov, B.A., Burba, G.A., Chernaya, I.M., Kryuchkov, V.P., Nikolaeva, O.V., Campbell, D.B., and Ronca, L.B., 1987, Impact craters of Venus: A continuation of the analysis of data from the Venera 15 and 16 spacecraft: Journal of Geophysical Research, v. 90, no. B12, p. 12869-12901.

Burba, G.A., 1988, The Venus topographic features nomenclature [in Russian]: Moscow, Nauka, 64 p.

_____1989a, Crater density in the northern part of Venus: Areal and topographic patterns, in Abstracts of papers submitted to the Twentieth Lunar and Planetary Science Conference, Houston, March 13-17, 1989: Lunar and Planetary Institute, p. 123-124.

_____1989b, Venera 15 and 16 cartographic products: A review, in Abstracts of papers submitted to the Twentieth Lunar and Planetary Science Conference, Houston, March 13-17, 1989: Lunar and Planetary Institute, p. 125-126.

Burba, G.A., Bobina, N.N., and Shashkina, V.P., 1989, Geologic mapping of the northern Venus: A progress report, in Abstracts of papers submitted to the Twentieth Lunar and Planetary Science Conference, Houston, March 13-17, 1989: Lunar and Planetary Institute, p. 127-128.

Campbell, D.B., and Burns, B.A., 1980, Earth-based radar imagery of Venus: Journal of Geophysical Research, v. 85, no. A13, p. 8271-8281.

International Astronomical Union, 1983, Commission 16: Physical study of planets and satellites, in 18th General Assembly, Patras, 1982, Proceedings: International Astronomical Union Transactions, v. 18B, p. 154, 157.

Ivanov, B.A., and Basilevsky, A.T., 1987, Comparisons of crater retention ages on the Earth and Venus [in Russian]: Astronomicheskiy Vestnik, v. 21, no. 2, p. 136-146; English translation in Solar System Research, v. 21, no. 2, p. 84-89.

Ivanov, M.A., 1988, The results of morphometric study of tessera terrain of Venus from Venera 15/16 data, in Abstracts of papers submitted to the Nineteenth Lunar and Planetary Science Conference, Houston, March 14-18, 1988: Lunar and Planetary Institute, p. 537-538.

Kotelnikov, V.A., Akim, E.L., Alexandrov, Yu.N., Armand, N.A., Basilevsky, A.T., Bogomolov, A.F., Vyshlov, A.S., Dubrovin, V.N., Zherikhin, N.V., Zakharov, A.I., Zimov, V.E., Kaynmer, V.I., Kovtunenko, V.M., Kremnev, R.S., Krivtsov, A.P., Krylov, G.A., Krymov, A.A., Kuchenyashkova, I.L., Molotov, E.P., Petrov, G.M., Rzhiga, O.N., Selivanov, A.S., Sidorenko, A.T., Sinilo, V.P., Skvarya, A.V., Sokolov, G.A., Sorokin, V.P., Sukhanov, K.G., Tikhonov, V.F., Tyuflin, Yu.S., Feldman, B.Ya., Shakhovskoy, A.M., and Shubin, V.A., 1984, Investigations of Maxwell Montes region of the planet Venus by Venera 15 and 16 spacecraft: Soviet Astronomy Letters, v. 10, no. 6, p. 369-373.

Kotelnikov, V.A., Bogomolov, A.F., and Rzhiga, O.N., 1985, Radar study of Venus' surface by Venera 15 and 16 spacecraft: Advances In Space Research, v. 5, no. 8, p. 5-16.

Kryuchkov, V.P., 1987, Analysis of impact crater distribution on the surface of Venus (Venera 15 and 16 SAR imaging data) [in Russian]: Izvestya AN S.S.S.R., ser. geol., no. 6, p. 75-83.

Kryuchkov, V.P., and Basilevsky, A.T., 1989, Radar-bright flow-like features as possible traces of the latest volcanic activity on Venus, in Abstracts of papers submitted to the Twentieth Lunar and Planetary Science Conference, Houston, March 13-17, 1989: Lunar and Planetary Institute, p. 548-549.

* Kuzmin, R.O., Burba, G.A., Shashkina, V.P., Bogomolov, A.F., Zherikhin, N.V., Skrypnik, G.I., Kudrin, L.V., Bergman, M.Yu., Rzhiga, O.N., Sidorenko, A.I., Alexandrov, Yu.N., Bokshtein, I.M., and Kronrod, M.A., 1986, Topography and geology of the northern polar region of the planet Venus [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 3, p. 177-196, English translation in Solar System Research, v. 20, no. 3, p. 110-122.

* Markov, M.S., Shashkina, V.P., Burba, G.A., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Alexandrov, Yu.N., Sidorenko, A.I., Sinilo, V.P., and Rodionova, N.V., 1987a, Geological-morphological description of Tellus Regio area (Photomap of the Venusian surface, sheet B-24) [in Russian]: Astronomicheskiy Vestnik, v. 21, no. 4, p. 286-297, English translation in Solar System Research, v. 21, no. 4, p. 181-188.

* Markov, M.S., Tyuflin, Yu.S., Kadnichansky, S.A., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Rodionova, N.V., Dubrovin, V.M., Burba, G.A., and Shashkina, V.P., 1987b, Geological-morphological description of the Bel Regio (Photomap of the Venusian surface, sheet B-23) [in Russian]: Astronomicheskiy Vestnik, v. 21, no. 1, p. 16-25; English translation in Solar System Research, v. 21, no. 1, p. 8-14.

Masursky, Harold, Eliason, E.M., Pettengill, G.H., Schaber, Gerald, and Schubert, Gerald, 1980, Pioneer Venus radar results: Geology from images and altimetry: Journal of Geophysical Research, v. 85, no. A13, p. 8232-8260.

McGill, G.E., Warner, J.L., Malin, J.C., Arvidson, R.E., Eliason, E.M., Nozette, Stewart, and Reasenberg, R.D., 1983, Topography, surface properties, and tectonic evolution [of Venus], in Hunten, D.M., Colin, Lawrence, Donahue, T.M., and Moroz, V.I., eds., Venus, Tucson, University of Arizona Press, p. 69-130.

* Nikishin, A.M., Kotelnikov, V.A., Rzhiga, O.N., Alexandrov, Yu.N., Sidorenko, A.I., Petrov, G.M., Burba, G.A., Bobina, N.N., Tyuflin, Yu.S., and Ostrovsky, M.V., in press, Geological-morphological description of Akkruva Colles area (Photomap of the Venusian surface, sheet B-14) [in Russian]: Astronomicheskiy Vestnik; English translation in Solar System Research, in press.

Nikolaeva, O.V., Pronin, A.A., Basilevsky, A.T., and Ivanov, M.A., 1988, Are tesserae the outcrops of feldspathic crust on Venus?, in Abstracts of papers submitted to the Nineteenth Lunar and Planetary Science Conference, Houston, March 14-18, 1988: Lunar and Planetary Institute, p. 864-865.

Pettengill, G.H., 1977, Orbiter radar mapper experiment, in Colin, Lawrence, and Hunten, D.M., eds., Pioneer Venus experiment descriptions: Space Science Reviews, v. 20, no. 4, p. 512-515.

Pettengill, G.H., Horwood, D.F., and Keller, C.H., 1979, Pioneer Venus orbiter radar mapper: Design and operation: Institute of Electrical and Electronics Engineers Transactions on Geoscience and Remote Sensing, GE 18, p. 2-32.

Pronin, A.A., 1986, Structure of Lakshmi Planum as indication of horizontal asthenospheric flows on Venus [in Russian]: Geotektonika, no. 4, p. 26-41; English translation in Geotectonics, v. 20, no. 4, p. 271-280.

* Pronin, A.A., Burba, G.A., Bobina, N.N., Tyuflin, Yu.S., Sidorenko, A.I., Kadnichansky, S.A., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Alexandrov, Yu.N., Shubin, V.A., and Rodionova, N.V., 1986a, Geological-morphological description of the Sedna and Guinevere Planitiae on Venus (Photomap of the Venusian surface, sheets B-11, B-20, and B-21) [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 3, p. 163-176; English translation in Solar System Research, v. 20, no. 3, p. 101-109.

* Pronin, A.A., Sukhanov, A.L., Shashkina, V.P., Burba, G.A., Kotelnikov, V.A., Rzhiga, O.N., Alexandrov, Yu.N., Sidorenko, A.I., Petrov, G.M., Krylov, G.A., Krymov, A.A., Tyuflin, Yu.S., and Ostrovsky, M.V., 1988, Geological morphological description of Vinmara and Ganiki Planitiae area (Photomap of the Venusian surface, sheet B-8) [in Russian]: Astronomicheskiy Vestnik, v. 22, no. 1, p. 13-22; English translation in Solar System Research, v. 22, no. 1, p. 8-13.

* Pronin, A.A., Sukhanov, A.L., Tyuflin, Yu.S., Kadnichansky, S.A., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Krivtsov, A.P., Sinilo, V.P., Burba, G.A., and Bobina, N.N., 1986b, Geological-morphological description of Lakshmi Planum (Photomap of the Venusian surface, sheet B-4) [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 2, p. 83-98; English translation in Solar System Research, v. 20, no. 2, p. 53-63.

Rzhiga, O.N., 1987, Venera 15 and 16 spacecraft: Images and maps of Venus: Advances In Space Research, v. 7, no. 12, p. 269-278.

Slyuta, E.N., Nikolaeva, O.V., and Kreslavsky, M.A., 1988, Distribution of small domes on Venus: Venera-15, -16 radar data [in Russian]: Astronomicheskiy Vestnik, v. 22, no. 4, p. 287-297; English translation in Solar System Research, v. 22, no. 4, p. 180-186.

Stofan, E.R., Head, J.W., and Campbell, D.B., 1987, Geology of the southern Ishtar Terra/Guinevere and Sedna Planitiae region on Venus: Earth, Moon, and Planets, v. 38, p. 183-207.

Sukhanov, A.L., 1986, Parquet: Regions of areal plastic dislocations [in Russian]: Geotektonika, no. 4, p. 60-76; English translation in Geotectonics, v. 20, no. 4, p. 294-305.

* Sukhanov, A.L., Bobina, N.N., Burba, G.A., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Sidorenko, A.I., Petrov, G.M., Alexandrov, Yu.N., Shubin, V.P., Zimov, V.E., and Kucheryavenkova, I.L., 1988a, Geological-morphological description of Louhi Aralaena area (Photomap of the Venusian surface, sheet B-7) [in Russian]: Astronomicheskiy Vestnik, v. 22, no. 2, p. 99-111; English translation in Solar System Research, v. 22, no. 2, p. 63-70.

* Sukhanov, A.L., Bobina, N.N., Burba, G.A., Tyuflin, Yu.S., Ostrovsky, M.V., Ledovskaya, L.S., Kotelnikov, V.A., Rzhiga, O.N., Sidorenko, A.I., Alexandrov, Yu.N., Petrov, G.M., Zakharov, A.I., and Krivtsov, A.P., 1987a, Geological-morphological description of the Lama Tessera, Tellus Regio and Leda Planitia (Photomap of the Venusian surface, sheet B-13) [in Russian]: Astronomicheskiy Vestnik, v. 21, no. 3, p. 195-206; English translation in Solar System Research, v. 21, no. 3, p. 121-129.

* Sukhanov, A.L., Burba, G.A., Shashkina, V.P., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Krymov, A.A., and Zakharov, A.I., 1987b, Geological-morphological description of Tomem and Hera Dorsa area (Photomap of the Venusian surface, sheet B-22) [in Russian]: Astronomicheskiy Vestnik, v. 21, no. 1, p. 5-15; English translation in Solar System Research, v. 21, no. 1, p. 1-7.

Sukhanov, A.L., and Pronin, A.A., 1987, Signs of spreading on Venus [in Russian]: Doklady Akademii Nauk SSSR, v. 294, no. 3, p. 661-664; English translation (as Evidence of tectonic spreading on Venus) in Transactions of the U.S.S.R. Academy of Sciences, v. 294, no. 3, p. 66-70.

* Sukhanov, A.L., Pronin, A.A., Bobina, N.N., Burba, G.A., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikova, V.I., Kotelnikov, V.A., Rzhiga, O.N., Alexandrov, Yu.N., Sidorenko, A.I., Petrov, G.M., Rodionova, N.V., and Zaytseva, O.S., 1988b, Geological-morphological description of Lukelong Okipeta Dorsa area (Photomap of the Venusian surface, sheet B-2) [in Russian]: Astronomicheskiy Vestnik, v. 22, no. 1, p. 3-12; English translation in Solar System Research, v. 22, no. 1, p. 1-8.

* Sukhanov, A.L., Pronin, A.A., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Sinilo, V.P., Krivtsov, A.P., Burba, G.A., and Bobina, N.N., 1986a, Geological-morphological description of Lama Tessera and Bereghinya Planitia area (Photomap of the Venusian surface, sheet B-12) [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 4, p. 272-286; English translation in Solar System Research, v. 20, no. 4, p. 165-174.

* Sukhanov, A.L., Pronin, A.A., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Zakharov, A.I., Krymov, A.A., and Bobina, N.N., 1986c, Geological-morphological description of Ishtar Terra (Photomap of the Venusian surface, sheet B-9) [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 2, p. 99-111; English translation in Solar System Research, v. 20, no. 2, p. 54-65.

* Sukhanov, A.L., Tyuflin, Yu.S., Ostrovsky, M.V., Kotelnikov, V.A., Rzhiga, O.N., Petrov, G.M., Sidorenko, A.I., Alexandrov, Yu.N., Dubrovin, V.M., Zakharov, A.I., Burba, G.A., and Shashkina, V.P., 1986c, Geological-morphological description of Fortuna and Meshkenet Tesserae area (Photomap of the Venusian surface, sheet B-6) [in Russian]: Astronomicheskiy Vestnik, v. 20, no. 4, p. 259-271; English translation in Solar System Research, v. 20, no. 4, p. 157-164.

Tyuflin, Yu.S., Belenky, E.G., Berger, N.Ya., Kadnichanskaya, L.M., Polyakova, E.A., and Reshetova, S.E., 1989, Compilation of Venus control points catalogue with radar survey data [in Russian]: Geodeziya i Kartografiya, no. 3, p. 29-34.

U.S. Geological Survey, 1989, Topographic, shaded relief, and radar-image maps of part of the northern quarter of Venus: Miscellaneous Investigations Series Map I-2041, 3 sheets, scale 1:15,000,000.

U.S.S.R. Academy of Sciences, 1987, Photomap of the Venusian surface, sheets B-7 to B-27 [in Russian]: Moscow, GUGK [Main Administration of Geodesy and Cartography], scale 1:5,000,000.

_____1988, Photomap of the Venusian surface, sheet B-1 [in Russian]: Moscow, GUGK [Main Administration of Geodesy and Cartography], scale 1:5,000,000.

_____in press, Atlas of Venus [in Russian]: Moscow, GUGK [Main Administration of Geodesy and Cartography].

* References containing detailed descriptions of mapped units.