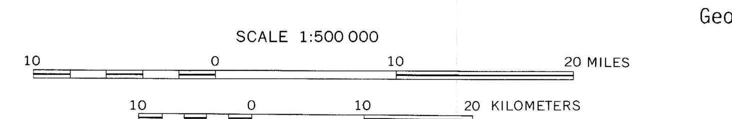
Geology generalized from Steven and others (1978)



MAP A. COPPER IN THE NONMAGNETIC FRACTION OF HEAVY-MINERAL CONCENTRATES

EXPLANATION

SAMPLE LOCALITIES FOR COPPER

○ Strongly anomalous value

△ Moderately strong anomalous value

✳ Moderately anomalous value

× Moderately weak anomalous value

+ Nonanomalous value

ISOPLETHS--Areas where samples contain anomalous concentrations of copper; contours at 20, 30, 50, 100, 300, 700 parts per million

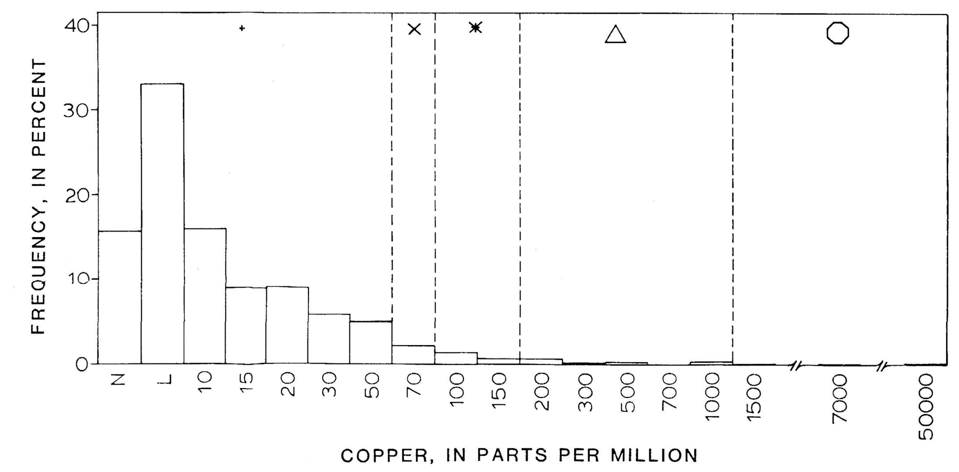
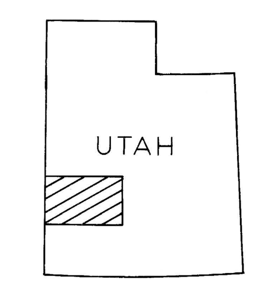


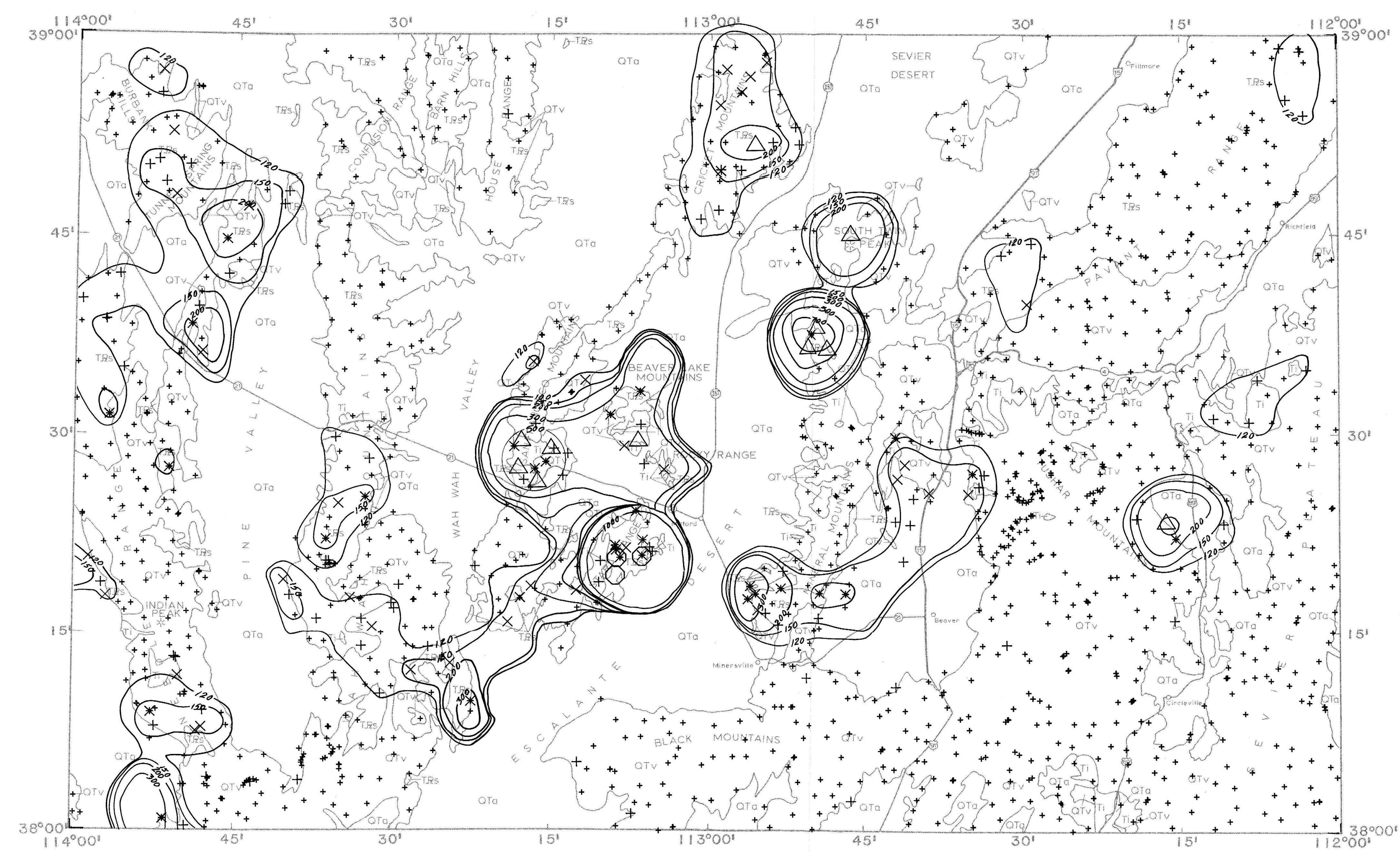
Figure 1.--Histogram showing concentrations of copper in the nonmagnetic fraction of heavy-mineral concentrates from the Richfield 1° x 2° quadrangle, Utah. Number of samples, 1,566; N, not detected at 10 parts per million (ppm); L, detected but less than 10 ppm.

LIST OF MAP UNITS

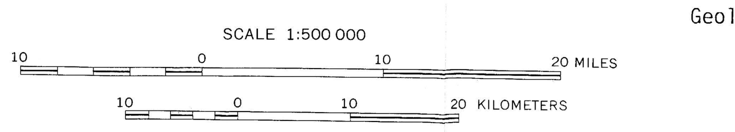
QTa	SURFICIAL DEPOSITS, UNDIVIDED (QUATERNARY AND TERTIARY)
QTv	VOLCANIC ROCKS, UNDIVIDED (QUATERNARY AND TERTIARY)
Ti	IGNEOUS ROCKS, UNDIVIDED (TERTIARY)
TPzs	SEDIMENTARY ROCKS, UNDIVIDED (TERTIARY TO PALEOZOIC)
——	CONTACT



INDEX MAP



Geology generalized from Steven and others (1978)



MAP B. COPPER IN THE MAGNETIC FRACTION OF HEAVY-MINERAL CONCENTRATES

EXPLANATION

SAMPLE LOCALITIES FOR COPPER

○ Strongly anomalous value

△ Moderately strong anomalous value

✳ Moderately anomalous value

× Moderately weak anomalous value

+ Weakly anomalous value

+ Nonanomalous value

ISOPLETHS--Areas where samples contain anomalous concentrations of copper; contours at 120, 150, 200, 300, 500, 700, 1500 parts per million

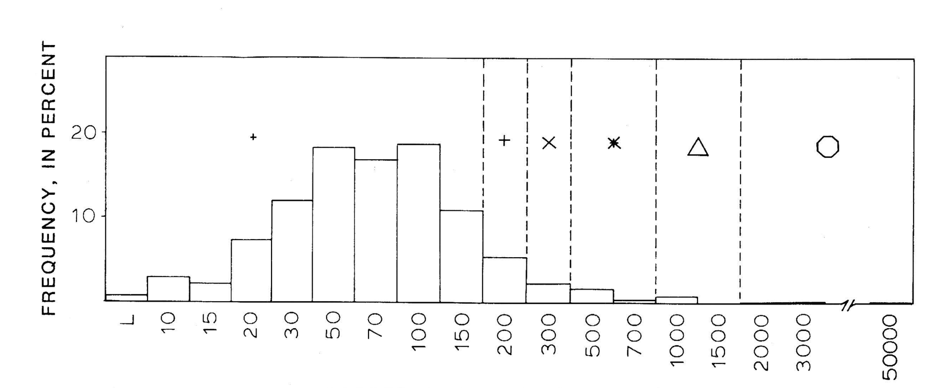


Figure 2.--Histogram showing concentrations of copper in the magnetic fraction of heavy-mineral concentrates from the Richfield 1° x 2° quadrangle, Utah. Number of samples, 1,570; L, detected but less than 10 parts per million.

INTRODUCTION

These maps are part of a folio of maps of the Richfield 1° x 2° quadrangle, Utah, prepared under the Conterminous United States Mineral Assessment Program. Other publications in this folio are listed in the selected references.

Located in west-central Utah, the Richfield quadrangle covers the eastern part of the Plioche-Marysvale igneous and mineral belt, which extends from the vicinity of Plioche in southeastern Nevada east-northeastward for 250 km (155 mi) into central Utah. The western two-thirds of the Richfield quadrangle is in the Basin and Range province and the eastern third is in the High Plateaus of Utah, a subprovince of the Colorado Plateau.

Bedrock in the northern part of the Richfield quadrangle consists predominantly of latest Precambrian and Paleozoic sedimentary strata that were thrust eastward during the Sevier orogeny in Cretaceous time onto an autochthon of Mesozoic sedimentary rocks in the eastern part of the quadrangle. The southern part of the quadrangle is largely underlain by Oligocene and younger volcanic rocks and related intrusions. Extensional tectonism in late Cenozoic time broke the bedrock terrane into a series of north-trending fault blocks; the uplifted mountain areas were deeply eroded and the resulting debris deposited in the adjacent basins. Most of the mineral deposits in the Pioche-Marysvale mineral belt were formed during igneous activity in middle and late Cenozoic time.

The regional sampling program was designed to define broad geochemical patterns and trends which can be utilized along with geologic and geophysical data to assess the mineral resource potential for this quadrangle. These maps of the Richfield 1° x 2° quadrangle show the regional distributions of copper in two fractions of heavy-mineral concentrates of drainage sediments.

COLLECTION OF SAMPLES

Drainage sediment samples were collected throughout the Richfield quadrangle during the summer of 1978. The sample sites were located along small, normally unbranched or first-order stream drainages, which ranged from 1.7 to 3.3 km (1-2 mi) in length and from 1.8 to 3.7 m (6-12 ft) in width. Sample density was 1 sample per 8 km^2 (3 mi^2) within the bedrock areas. Intermountain basins containing sediments were not sampled. Each sample is a composite of material collected at four or five places across and along the active channel. Generally about 4 kilograms (8.8 pounds) of bulk sediment were collected for reduction to a panned-concentrate sample. The geochemical sampling was carried out by W. R. Miller, J. B. McHugh, G. K. Lee, J. F. Guadagnoli, L. DiGuardia, J. D. Tucker, and R. E. Tucker.

PREPARATION OF SAMPLES

Samples of drainage sediments were first panned to eliminate most clay minerals and the common rock-forming minerals, such as quartz, feldspar, and calcite. Most of the drainages were dry so the samples were panned at a field laboratory. About half of the panned heavy-mineral concentrates were prepared and analyzed at a field laboratory set up at Milford, Utah, and the remaining at the U.S. Geological Survey laboratory in Golden, Colorado. The preparation and analyses were done by J. M. Motooka, J. B. McHugh, J. D. Tucker, R. E. Tucker, and J. F. Guadagnoli.

The panned concentrates from each sample were dried and sieved to minus-18-mesh (<1.00 mm), and the magnetite was removed with a hand magnet. The remaining concentrate was separated using bromoform (specific gravity of 2.86) into a light and a heavy fraction. The light fraction, which contained mainly minerals such as quartz, feldspar, and calcite was discarded. The remaining heavy-mineral fraction was separated electromagnetically by a Frantz[1] isodynamic separator with forward and side angle settings of 15 degrees and an ampere setting of 0.2. The magnetic fraction at 0.2 amperes was discarded and the remaining fraction was further separated electromagnetically into a nonmagnetic and magnetic fraction at a setting of 0.6 amperes. These two fractions were hand ground to less than 149 micrometers (microns) and then analyzed.

ANALYTICAL PROCEDURES

Each fraction was analyzed semiquantitatively for 30 elements by a 6-step D.C. arc optical emission spectrographic method. The results of the analyses can be found in Motooka and others (1979). All values are reported within a framework made up of six steps per order of magnitude (1, 0.7, 0.5, 0.3, 0.2, 0.15, or multiples of 10 of these numbers), and represent approximate geometric midpoints of the concentration ranges. The precision is shown to be within one adjoining reporting interval on each side of the reported value 83 percent of the time, and within 2 adjoining intervals 96 percent of the time (Motooka and Grimes, 1976).

GENERATION OF MAPS

Computer-generated contour maps and point-plot maps for each fraction of heavy-mineral concentrates were prepared using the computer mapping programs within the U.S. Geological Survey's STATPAC system (VanTrump and Miesch, 1977). The contour mapping program STAMAP calculates an average value within a square cell to generate the contours. For these plots, the Richfield quadrangle was divided into 35 square cells (5 km on a side) in the east-west or X-direction and 22 square cells in the north-south or Y direction. The value of a particular cell is the average value of copper of all samples contained within that cell. The cells are then contoured. The contours show regional distributions, but do not show exact locations of anomalous values. In places, the use of an average value of a cell gives misleading information. However, the accompanying point-plots indicate the location and magnitude of anomalous values, in addition to the location of all the sample sites, which facilitates more detailed evaluation of the anomalies. For the point-plot maps, approximately 10 percent of the total number of samples of both fractions are classified as anomalous. These anomalous samples were divided into five classes for both fractions: weakly, moderately weak, moderately, moderately strong, and strongly anomalous.

GEOCHEMICAL IMPLICATIONS OF THE MAGNETIC AND NONMAGNETIC FRACTIONS

The nonmagnetic and magnetic fractions consist of different heavy mineral suites, whose geochemical implications with regard to potential mineral resources differ significantly. The nonmagnetic fraction contains accessory minerals, such as zircon and apatite, and primary and secondary ore minerals. Anomalous copper associated with the nonmagnetic fraction of heavy-mineral concentrates generally indicates surface or near-surface sources and occurs in primary minerals such as chalcopyrite, as a minor constituent in other sulfide minerals, and in secondary minerals such as oxides, sulfides, sulfates, carbonates, and silicates. The magnetic fraction contains mafic-rock minerals (such as biotite, amphibole, pyroxene) and more importantly, both detrital and hydromorphic iron and manganese oxides containing anomalous trace metals. Iron and manganese oxides commonly fill or coat fractures, are abundant along or near mineralized faults, and extend significant distances from related ore deposits. Anomalous trace-metal content of the magnetic fraction could, therefore, indicate possible buried deposits. The use of both fractions aid in the interpretation of geochemical data and provides clues as to the geological environment, and the source of anomalous metals.

Reconnaissance geochemical surveys are valuable tools in mineral exploration, but they should be used in conjunction with data from other earth science disciplines. In particular, outlining exploration targets generally involves considerable additional, more detailed investigations.

SELECTED REFERENCES

Miller, W. R., Motooka, J. M., and McHugh, J. B., 1980, Distribution of molybdenum in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-A, scale 1:500,000.

_______1985, Maps showing distribution of arsenic in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-B, scale 1:500,000.

_______1985, Maps showing distribution of barium in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-C, scale 1:500,000.

_______1985, Maps showing distribution of beryllium in heavy-mineral concentrates and stream sediments, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-D, scale 1:500,000.

_______1985, Maps showing distribution of bismuth in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-E, scale 1:500,000.

_______1985, Maps showing distribution of lead in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-G, scale 1:500,000.

_______1985, Maps showing distribution of thorium in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-H, scale 1:500,000.

_______1985, Maps showing distribution of tin in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-I, scale 1:500,000.

_______1985, Maps showing distribution of tungsten in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-J, scale 1:500,000.

_______1985, Maps showing distribution of zinc in heavy-mineral concentrates, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1246-K, scale 1:500,000.

Motooka, J. M., and Grimes, D. J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analyses: U.S. Geological Survey Circular 738, 25 p.

Motooka, J. M., McHugh, J. B., and Miller, W. R., 1979, Analyses of heavy-mineral fraction of drainage sediments, Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Open-File Report 79-1699, 214 p.

Steven, T. A., Rowley, P. D., Hintze, L. F., Best, M. G., Nelson, M. G., and Cunningham, C. G., compilers, 1978, Preliminary geologic map of the Richfield 1° x 2° quadrangle, Utah: U.S. Geological Survey Open-File Report 83-602, 1 sheet, scale 1:250,000.

VanTrump, G., and Miesch, A. T., 1977, The U.S. Geological Survey RASS-STATPAC system for management and statistical reduction of geochemical data: Computers and Geosciences, v. 3, p. 475-488.

[1]Use of brand names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

MAPS SHOWING DISTRIBUTION OF COPPER IN HEAVY-MINERAL CONCENTRATES, RICHFIELD 1° X 2° QUADRANGLE, UTAH

By
William R. Miller, Jerry M. Motooka,
and John B. McHugh
1985

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