CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the Grover Heinrichs Mining Collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

The anomalies were examined as an overlay on the Arizona state geologic map, which also shows topography and drainage. All morning flight lines flown under calm wind conditions were marked on the overlay. Wherever these flight lines crossed topographically level or low areas, inversion effects were suspected. Figure V-2 shows as shaded the areas in the anomalies that are <u>least</u> suspect of inversion effects and may be considered the <u>most valid</u> indications of surface uranium radioactivity. It must be emphasized, however, that this kind of approach can be used only to cast suspicion on some anomaly(s) and remove it from others. Even the suspect ones could turn out to be completely valid on further examination.

In summary, the following anomalies or portions of anomalies are considered least suspect of inversion effects:

#1	eastern half
#2	western "knob"
#3	eastern "bulge"
#4	western portion
#6	southern portion
#7	eastern and western ends
#11	all
#12	all
#13	all
#14	all
#15	eastern and western ends
#16	all
#17	northern portion
#18	all
#19	all

5. Relationship to Regional ERTS (Landsat) Lineaments

Geomorphic lineaments derived from imagery obtained by the Earth Resources Technology Satellite (ERTS-1; now termed Landsat-1) are used in this analysis as indication of regional structure. Saunders, Thomas et al. (1973)

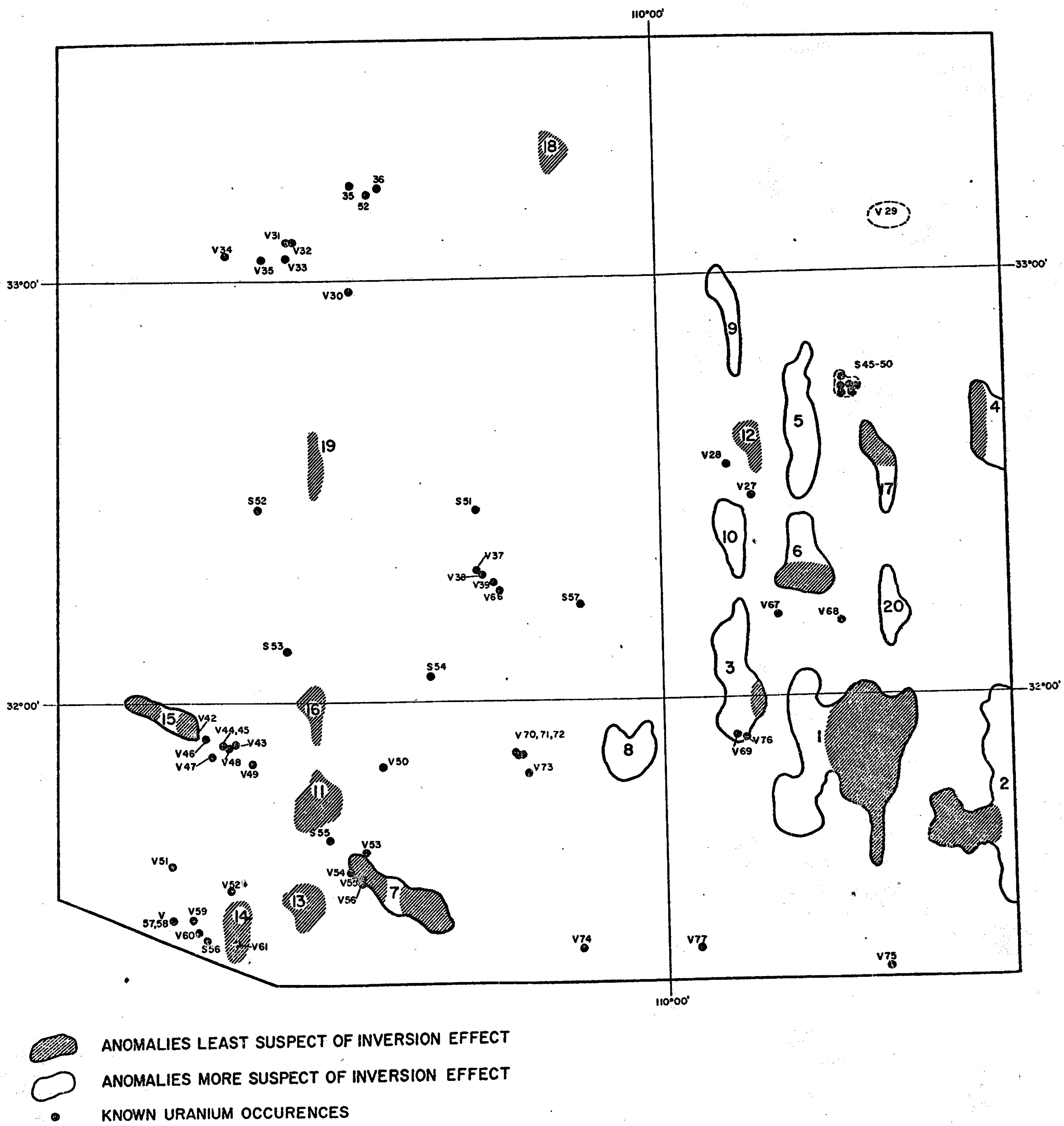


Figure V-2. Anomalies Least Suspect of Being Due to Inversion Effects observed that uranium mining districts in the Colorado Plateau appeared to be "loosely associated" with (i.e., scattered along) regional lineaments which are apparent on ERTS-1 imagery as linear arrangements of topographic features such as linear stream segments or tonal contrasts. These are most easily seen on 1:1,000,000 scale imagery, and on the basis of much recent study, are interpreted to represent major planes of weakness in the earth's crust. It is believed that many of these "geosutures" or shear zones have been present since the Precambrian and were active at various times throughout the earth's history, exerting influences on sedimentation processes as well as folding, faulting and the emplacement of intrusives and associated lode mineralization (Saunders, Thomas et al., 1973; Saunders, 1974; Freden, 1974).

The general association of Laramide lode mineralization (including uranium veins) in the western U.S. with northeast trending vein systems and shear zones has been pointed out by several authors (Saunders, Thomas et al., 1973; Landwehr, 1967, 1968; Stokes, 1968; and Tweto and Sims, 1963). Many mineral deposits (again including uranium veins) have been observed to occur along the well-known Texas and Lewis and Clark lineaments (Wertz, 1970; Hobbs and Fryklund, 1968), both of which strike generally west-northwest. Even though the exact mechanisms of possible lineament control on mineral deposition are not yet understood, it may be reasonable to use the observed empirical relationships as one of the guides in future prospecting operations.

The regional lineaments shown in Figure V-3 were prepared from ERTS mosaics obtained from the USDA Soil Conservation Service, Hyattsville, Maryland, using the techniques developed by Saunders, Thomas et al. (1973) and Saunders (1974). Relatively strong reliance was placed on major drainage features when annotating these lineaments on the satellite imagery. Linear arrangements of tonal features supplemented the drainage in defining these features.

Figure V-3 shows the known uranium mines and occurrences, the anomalies, and the ERTS-derived lineaments.

Inspection of Figure V-3 shows that many of the known uranium localities lie scattered along the lineaments or in bunches near their intersections. Note particularly the Ocotillo, Papago, Canelo Hills, and Helvetia lineaments.

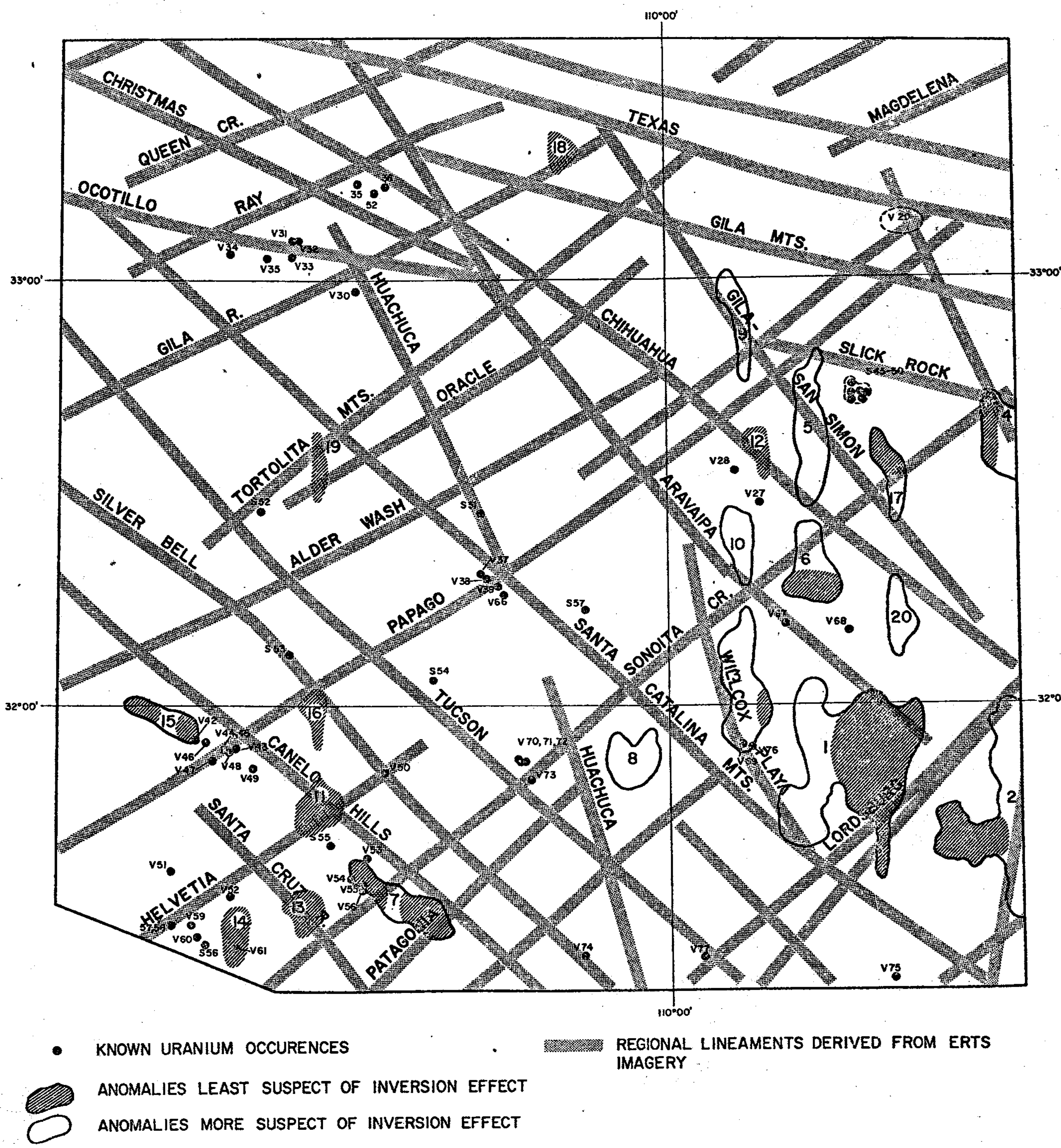


Figure V-3. Relationship of Uranium Anomalies and Known Occurrences to ERTS Lineaments

The uranium anomalies thought to be least suspect of inversion effects (shaded) appear to occur frequently on or adjacent to the regional lineaments.

The consistency of this relationship is believed to be beyond mere coincidence, and suggests lineament control of the uranium mineralized areas. This is reasonable because regional ERTS lineaments are usually found to represent zones of high angle faulting and jointing which could provide vertical paths for migrating mineralizers, regardless of whether the source of the mineralizers was in overlying volcanic tuffs or magmatic fluids at depth. Optimum vertical permeability would be expected to be developed at lineament intersections, and this could explain the apparent rough correlations of known uranium occurrences and some of the uranium gamma-ray anomalies with lineament intersections.

In any case, the observed relationships may be useful in helping to guide exploration efforts on an empirical basis, while awaiting results of the needed studies of the mechanisms behind them.

6. Smoothed Uranium Data

Figure V-4 was prepared by contouring the ratios of the number of statistically high uranium values to the number of statistically low values in each 15-minute quadrangle. These smoothed data tend to emphasize broad areas where the high values (positive significance factors) predominate. No weighting was given to values on the basis of their degree of significance, i.e., all values were treated as significance factors of plus or minus one. Figure V-4 also shows the uranium anomalies and, as would be expected, the smoothed data centers on the anomaly groups. From this generalized viewpoint, the survey area is indicated to have five uraniferous provinces; two along the eastern side and three in the southwest portion of the map area. The southernmost of the eastern pair is centered on the Chiricahua Mountains, and the northernmost one is centered in the San Simon Valley. Those in the southwestern corner cover portions of the Pajarito Mountains, Tumacacori Mountains, Santa Cruz Valley, Santa Rita Mountains, Sierrita Mountains, and Altar Valley.

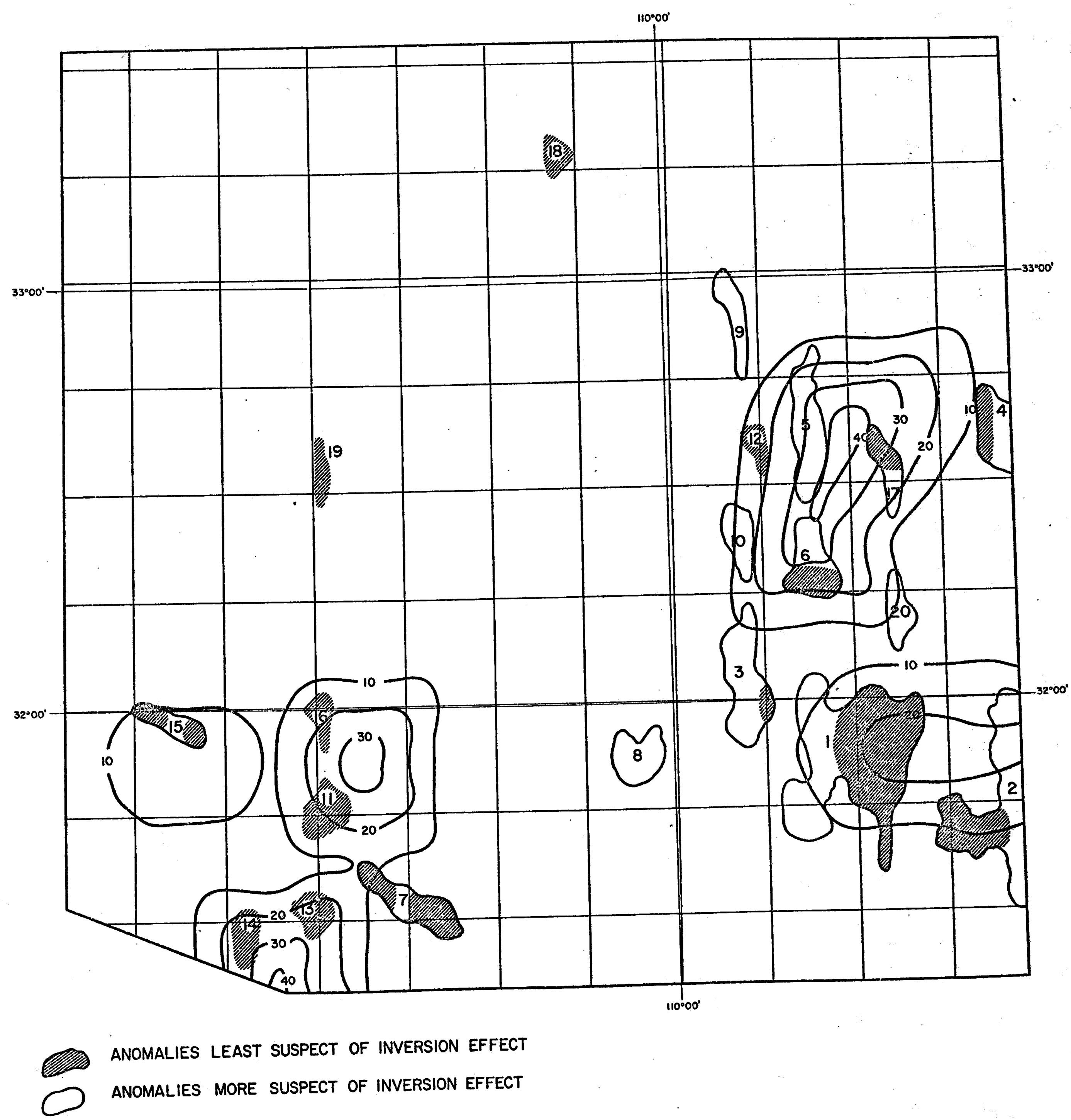


Figure V-4. Contour Map of the Ratios of Numbers of Statistically High Uranium Values to Statistically Low Uranium Values

C. USE OF THORIUM TO POTASSIUM RATIO (Th/K) MAPS IN COPPER PROSPECTING

1. General

Davis and Guilbert (1973) and Moxham et al. (1965) presented surface gamma spectrometer data over porphyry copper deposits, showing enriched potassium in the alteration zones but relatively constant thorium values and irregular uranium distributions. Moxham et al. (1965) suggested that: "The K/Th ratio could be a valuable means of distinguishing between intrinsically high potassium intrusives and extrinsically potassium-rich alteration zones."

The Arizona survey includes some twelve porphyry copper deposits, and one of the standard products is the Th/K ratio data. A brief study was done to investigate the possible relationships between low Th/K areas (i.e., high K/Th areas) and the porphyry deposits to see if the data might be useful in reconnaissance for new potential porphyry copper mines.

2. Relationship to Copper Deposits

Figure V-5 shows the anomalously low Th/K areas outlined and shaded where they lie over rocks other than alluvium and related materials. Also shown are the copper mining districts adapted from Kinkle and Peterson (1962) and Velasco (1966).

Examination of the figure shows that 6 out of 12 of the porphyry copper deposits (solid circles) within the survey area are associated with anomalously low Th/K areas, as are 5 out of 14 of the other copper districts. This preliminary examination of the data suggests that the gamma-ray data may be useful as one of the parameters employed in reconnaissance for potential new copper resources, particularly the disseminated variety.

3. Relationship of Porphyry Copper Deposits to ERTS-Derived Lineaments and Low Th/K Areas

Figure V-6 shows the data in Figure V-5 plus the regional ERTS-derived lineaments. All the porphyry copper deposits both in the survey area and several others nearby are located on or adjacent to the lineaments and

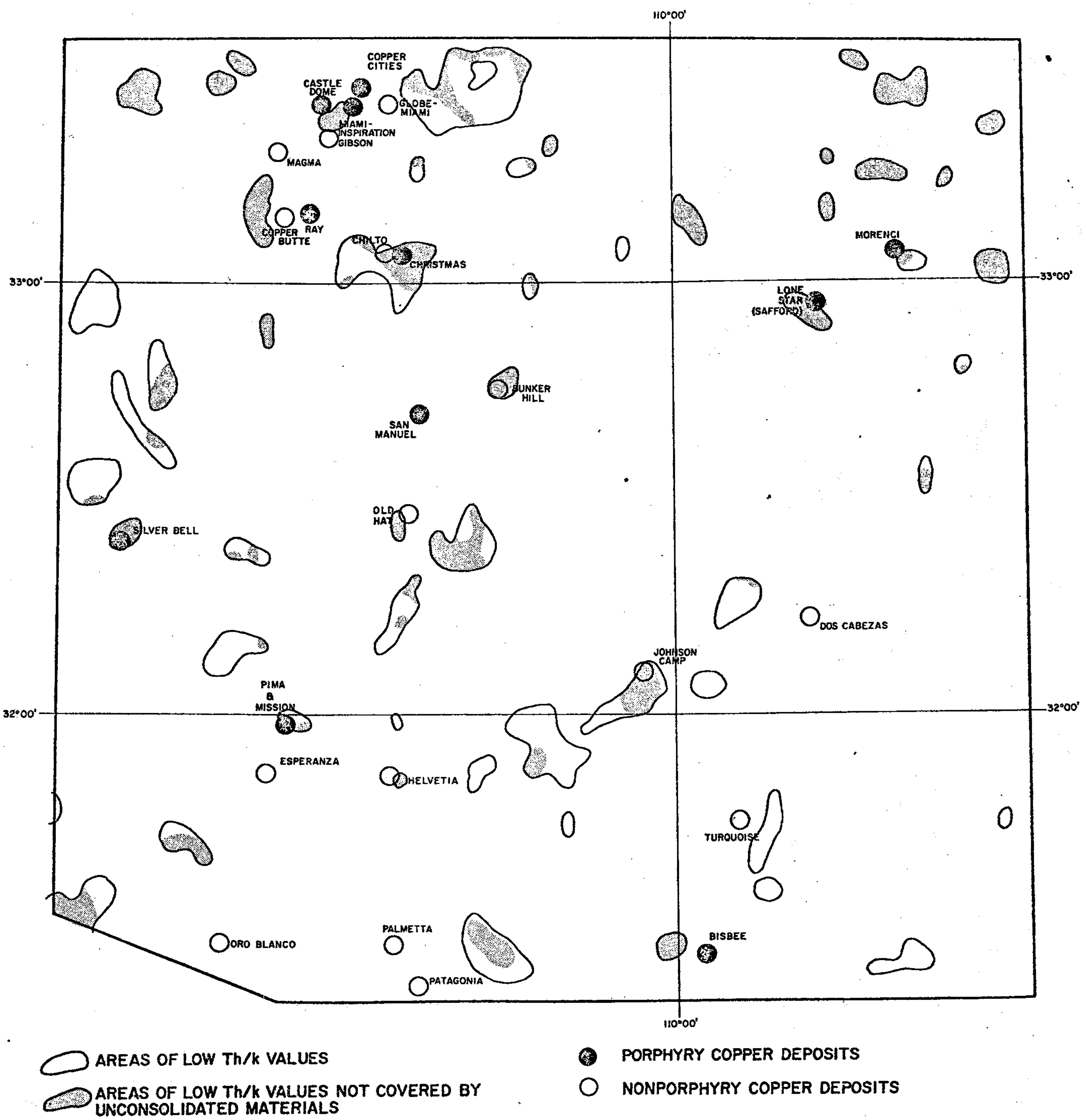


Figure V-5. Relationship of Anomalously Low Th/K Areas to the Locations of Copper Mining Districts many of them are on or near intersections of NE- and NW-trending lineaments. This is typical of findings elsewhere: Saunders (1974) observed similar relationships for the Bingham, Ely and Bagdad deposits, and Brewer et al. (1974) reported "...prophyry copper deposits associated with NE- and NW-trending (lineaments) fault systems." Saunders, Thomas et al. (1974) pointed out the apparent relationship of the Cananea, Bisbee, Lordsburg, Tyrone, and Santa Rita deposits with the NE-trending Lordsburg lineament (see Figure V-6) which is similar in trend to mapped local structural trends in all of these deposits except for Cananea. The lineament and copper deposit map in Figure V-6 was extended slightly beyond the boundaries of the AGR survey area to include these deposits and to show a more regional view of the Texas lineament system. Examination of the figure shows the Texas lineament to be a major break between the lineament systems to its north and to its scuth, with an apparent left lateral displacement of about 50 miles based on correlation of lineament patterns on either side. The Texas lineament is traceable on ERTS imagery to the Santa Barbara coast in California (Saunders, 1974) where the coastline shows an apparent offset of similar sense and approximate amount. Wertz (1970) observed that many mineral deposits occur along or adjacent to this major structural zone, which had been defined rather loosely on the basis of evidence available prior to the ERTS-1 studies. Now, on the basis of all available evidence, it is believed that the probability of finding new porphyry copper deposits is much higher along or adjacent to the regional lineaments and their intersections, especially in the case of known mineralized lineaments with trends similar to the mapped local structures along them. The probability should be greater still when searching in statistically significant low Th/K areas indicating possible zones of alteration to be present.

The correlation between ERTS-derived lineaments and aeromagnetic data is discussed in Section VI.D.

SECTION VI
MAGNETOMETER DATA INTERPRETATION

A. GENERAL

The magnetic field of the earth approximates that of a dipole with its axis along the line joining the north and south magnetic poles. This primary field, acting on magnetic minerals in the earth's crust, induces a secondary field which reflects the distribution of these minerals. Therefore, an understanding of the effects of changes in the intensity and direction of the primary field are important in the interpretation of magnetic anomalies.

The unit of intensity of the earth's magnetic field is the gamma (1 gamma = 10^{-5} gauss, equal to the force of 1 dyne exerted on a unit magnetic pole in a field of 1 gauss). The primary field varies from about 75,000 gammas in a vertical direction at the magnetic poles to about 30,000 gammas in a horizontal direction at the magnetic equator.

The study of magnetic anomalies and the rocks which cause them shows that the anomalies are due chiefly to the presence of the mineral magnetite which occurs as an accessory mineral in igneous and metamorphic rocks. In general, the greater the amplitude of a magnetic anomaly, the higher the magnetite content of the rock causing the anomaly. It is also likely to have a relatively basic composition. Sedimentary rocks are essentially nonmagnetic except for iron formations.

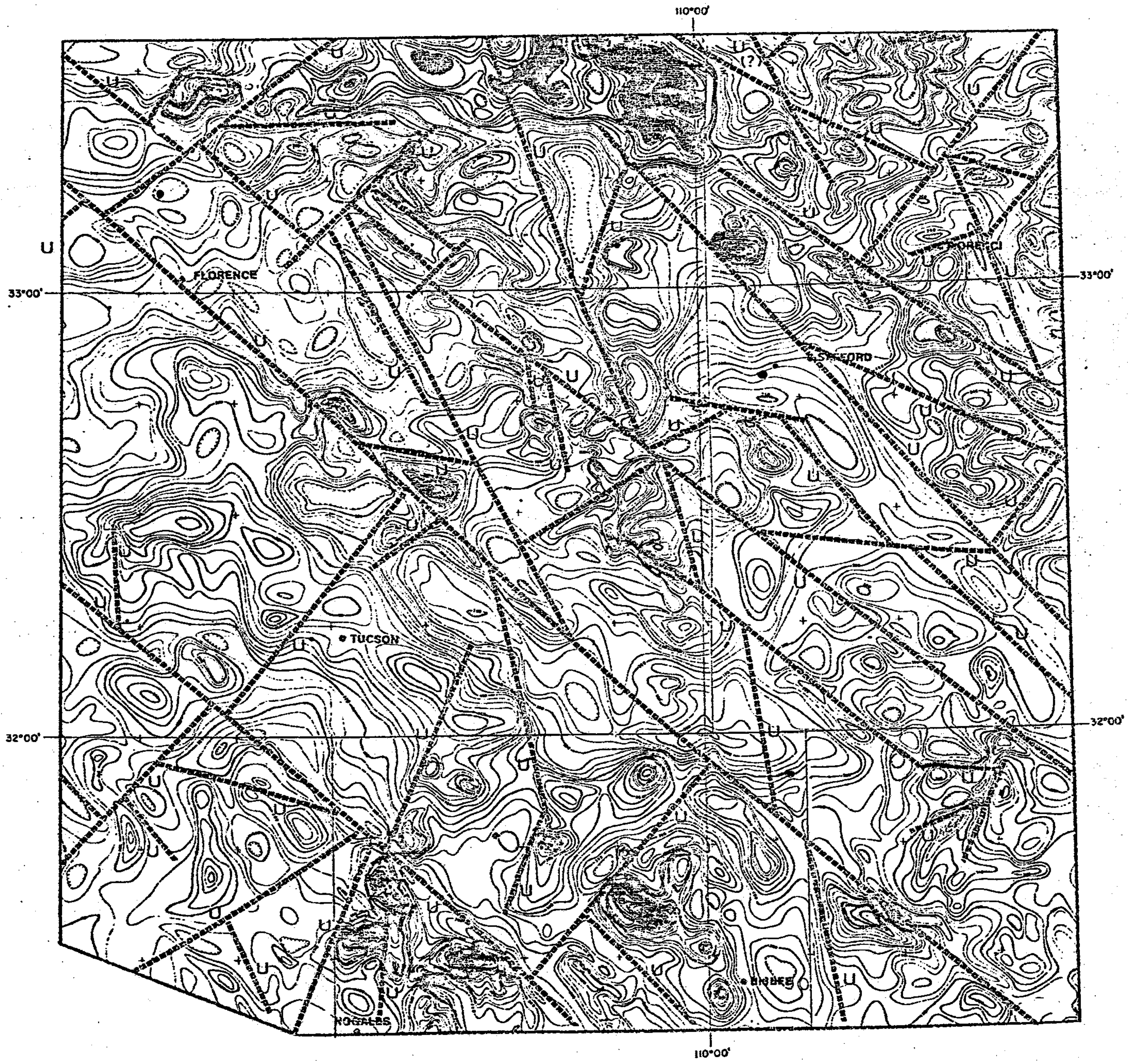
The interpretation of airborne magnetometer data usually consists of the qualitative recognition of structural and petrologic units and the quantitative analysis of anomalies or groups of anomalies with regard to depth, dimensions, and susceptibility. Major rock units can be differentiated on the basis of variations in the frequency, areal extent, shape, orientation, local amplitude, and general intensity level of their corresponding magnetic anomalies. Faults are displayed magnetically by disruptions in magnetic pattern or by persistent gradients or pattern changes over long distances; plugs, dikes, and related igneous intrusions can be detected by the shape and intensity of their magnetic expression. Techniques have been developed for the quantitative analysis of magnetic anomalies with regard to the depth, dimension, shape, and susceptibility contrast of their sources, but these techniques are far more complex that the qualitative assessment of variations in the magnetic pattern. The quantitative analysis of even relatively simple geometric forms representing geologic bodies such as dikes involves complex computations.

B. STRUCTURAL ANALYSIS

Two approaches have been used to qualitatively interpret the aeromagnetic data over the surveyed area. First, the published contoured residual aeromagnetic map of Arizona (Sauck and Sumner, 1970) was used to interpret major inferred faults as shown in Figure VI-1. Then the aeromagnetic profiles from this survey were used to identify smaller scale faults, many of which are expressed by anomalies as small as 20 gammas. These are shown in Figure VI-2 along with anomalies (shaded) interpreted from the profiles and, the major inferred faults from Figure VI-1.

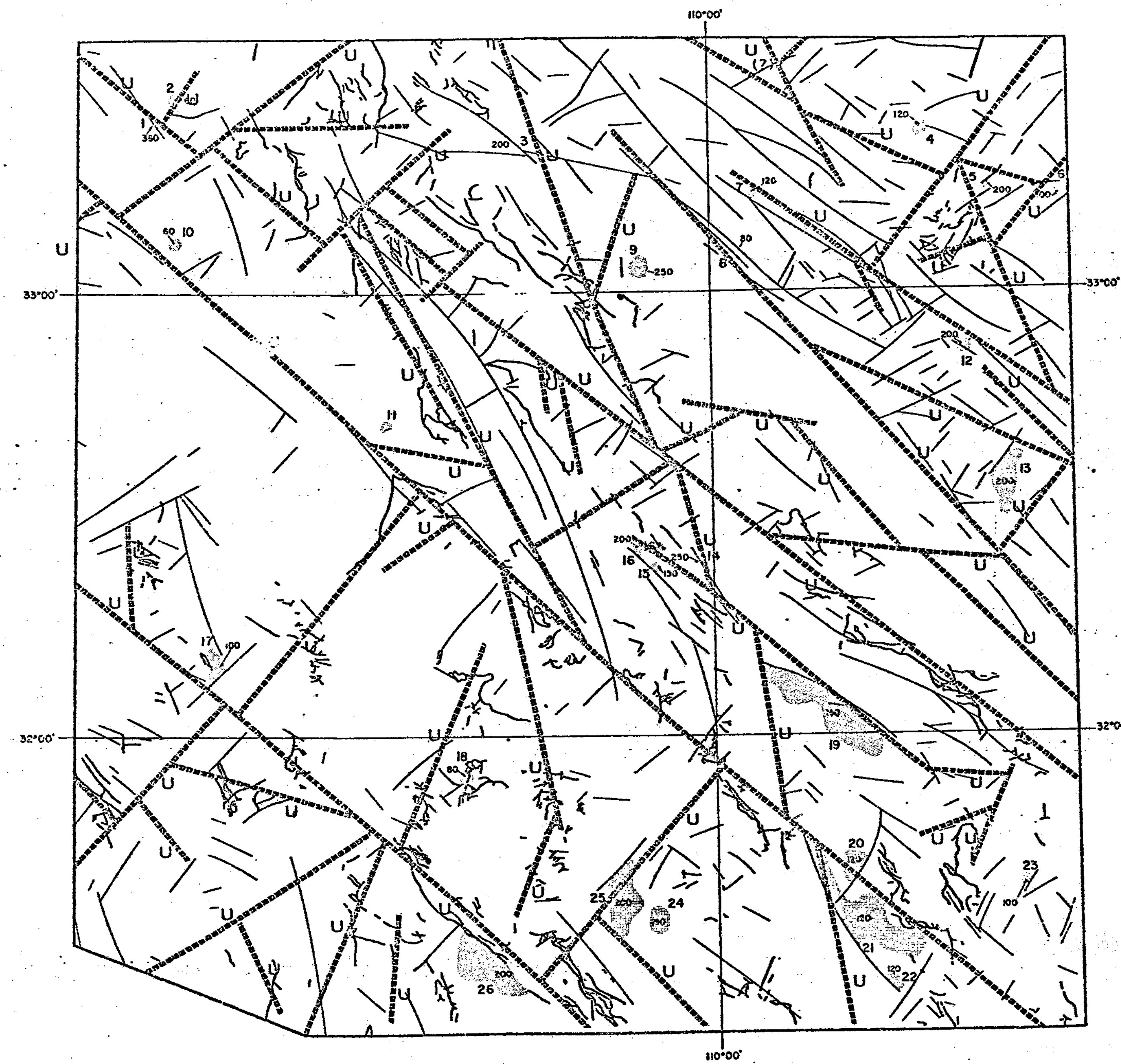
In general the azimuths of the smaller scale faults were obtained by visual correlation of consecutive profiles. Where two or more distinct interpretations were equally feasible, information from the geologic map of Arizona (Wilson et al., 1969) was used as selection criteria. The orientation of outcrops and structures on the geologic map were used to infer the azimuth of those faults which are recognizable only on a single aeromagnetic profile.

A total of 26 anomalies, ranging from tens of gammas to more than 250 gammas, were recognized on the aeromagnetic profiles (Figure VI-2). Many of these correlate with anomalies on Figure VI-1 from Sauck and Sumner (1970), but there are notable differences most probably due to different flight lines and altitudes as well as the nature of the maps. Sauck and Sumner (1970) presents residual magnetic data whereas the data from this survey represents the total magnetic field. In general the structural "grains" of the inferred faults are quite similar for both sets of data.



U FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

Figure VI-1. Major Faults or Magnetic Lineaments Inferred from Sauck and Sumner (1970) Residual Aeromagnetic Map of Arizona



FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

SELECTED MAGNETIC ANOMALIES AND INTENSITY IN GAMMAS WITH IDENTIFICATION NUMBER

FAULT INFERRED FROM PROFILE DATA

KNOWN FAULTS

Figure VI-2. Magnetic Anomalies and Faults Inferred from Magnetic Profile Data with Known Faults from Wilson et al. (1969)

C. RELATIONSHIP TO URANIUM DEPOSITS

Figure VI-3 shows the known uranium deposits and the uranium gamma-ray anomalies as well as the aeromagnetic interpretation.

Many of the vein deposits correlate quite well with either northwest or northeast trending inferred faults, apparently without preference for either particular orientation. The sedimentary or stratiform deposits do not appear to be as closely related to the faults, except for S-51 and S-45 through S-50.

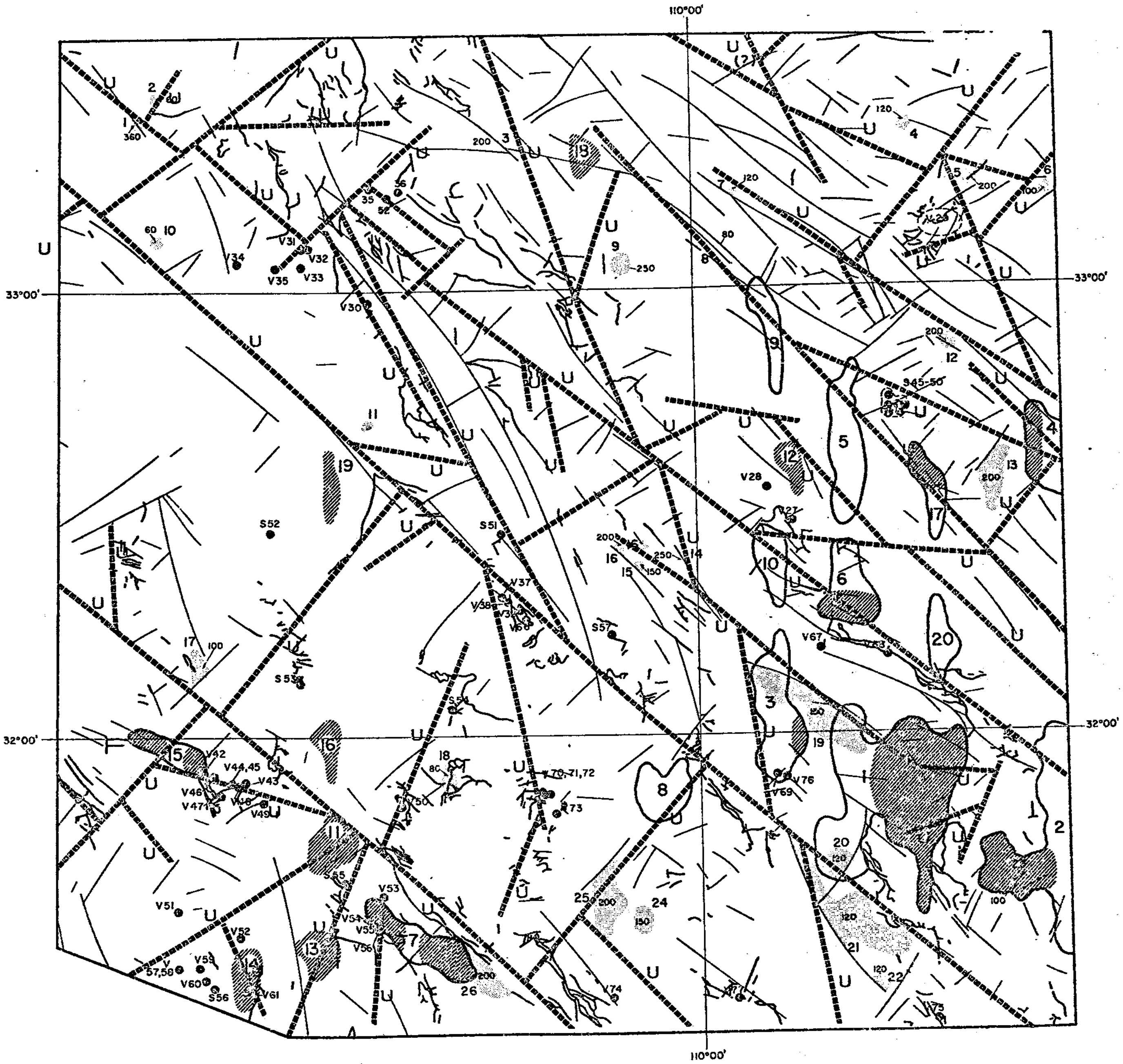
The uranium anomalies which are least suspect of inversion effects generally lie adjacent to or are intersected by one or more major inferred faults. Only #2, #3, #16, #19, and #20 appear to be exceptions.

D. RELATIONSHIP TO REGIONAL ERTS (LANDSAT)-DERIVED LINEAMENTS

Figure VI-4 shows the lineaments derived from satellite imagery superimposed on the contoured magnetic map from Sauck and Sumner (1970). A very good correlation is seen between the major features of the magnetic data and the ERTS lineaments. The Texas lineament system consists of two parallel lineaments in the survey area. The southernmost is the most persistent and is traceable for hundreds of miles (see subsection V.B.5). The northern one is more local in nature. The magnetic data show a series of anomalies bordering the persistent element of the Texas lineament on the north, and the other lineament is less distinctly seen in the magnetic pattern.

Figure VI-5 compares the ERTS-derived lineaments with the major faults inferred from the magnetic data. Many of the ERTS lineaments correlate well with the inferred faults, particularly the Santa Catalina Mountains, Huachuca, Gila-San Simon, Willcox Playa, Canelo Hills, and Helvetia lineaments.

The good correspondence between the magnetic data and the geomorphic ERTS data tends to support the conclusion that many of these lineaments and inferred faults represent fundamental basement weakness planes of major structural significance.



FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

FAULT INFERRED FROM PROFILE DATA

KNOWN FAULTS

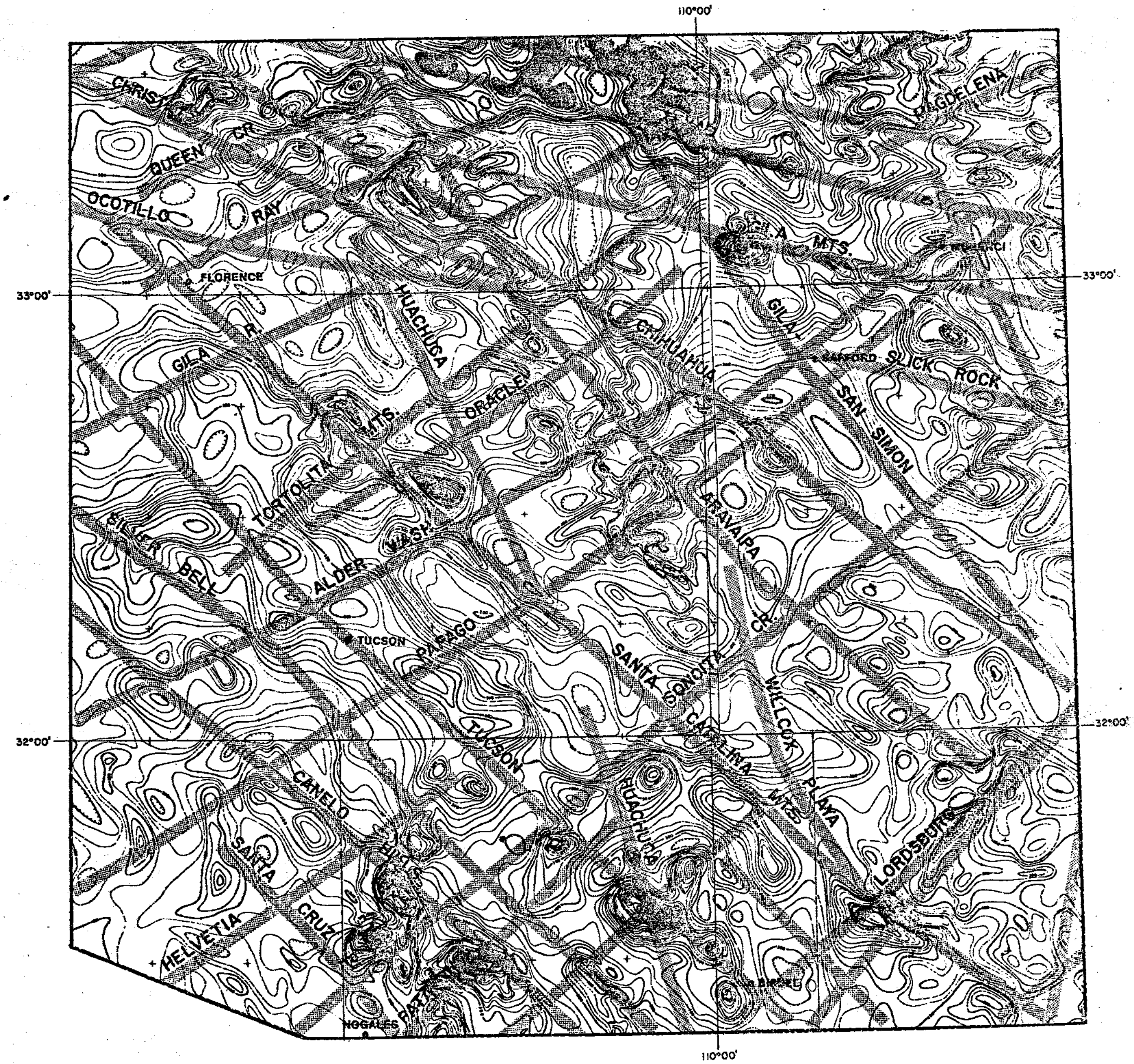
KNOWN URANIUM OCCURENCES

16 200 SELECTED MAGNETIC ANOMALIES AND INTENSITY IN GAMMAS WITH IDENTIFICATION NUMBER

ANOMALIES LEAST SUSPECT OF INVERSION EFFECT

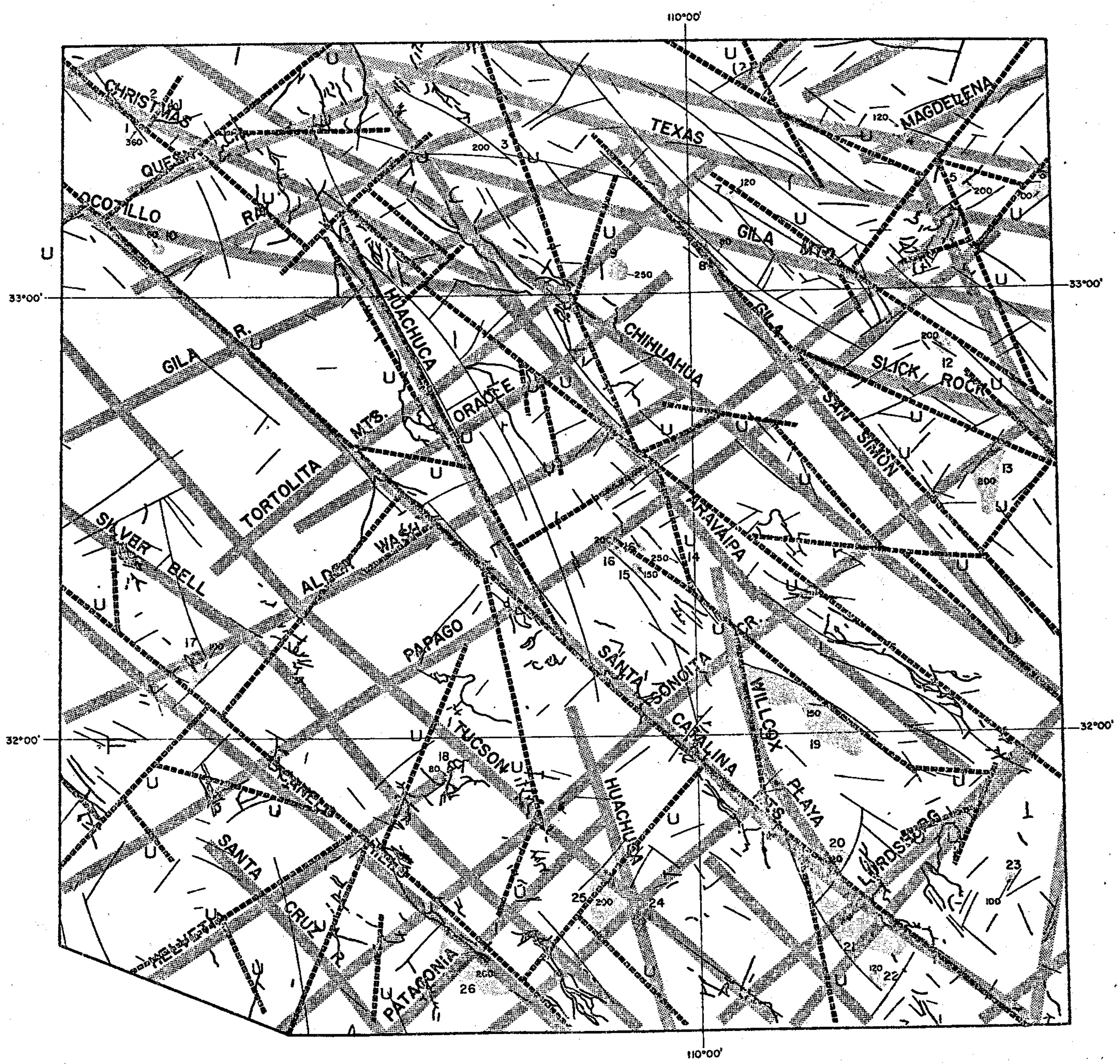
ANOMALIES MORE SUSPECT OF INVERSION EFFECT

Figure VI-3. Relationship of Major Magnetic Lineaments or Inferred Faults to Uranium Occurrences and Anomalies



REGIONAL LINEAMENTS DERIVED FROM ERTS IMAGERY

Figure VI-4. ERTS (Landsat)-Derived Lineaments and Aeromagnetic Data



U FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

FAULT INFERRED FROM PROFILE DATA

KNOWN FAULTS

16 200 SELECTED MAGNETIC ANOMALIES AND INTENSITY IN GAMMAS WITH IDENTIFICATION NUMBER

REGIONAL LINEAMENTS DERIVED FROM ERTS IMAGERY

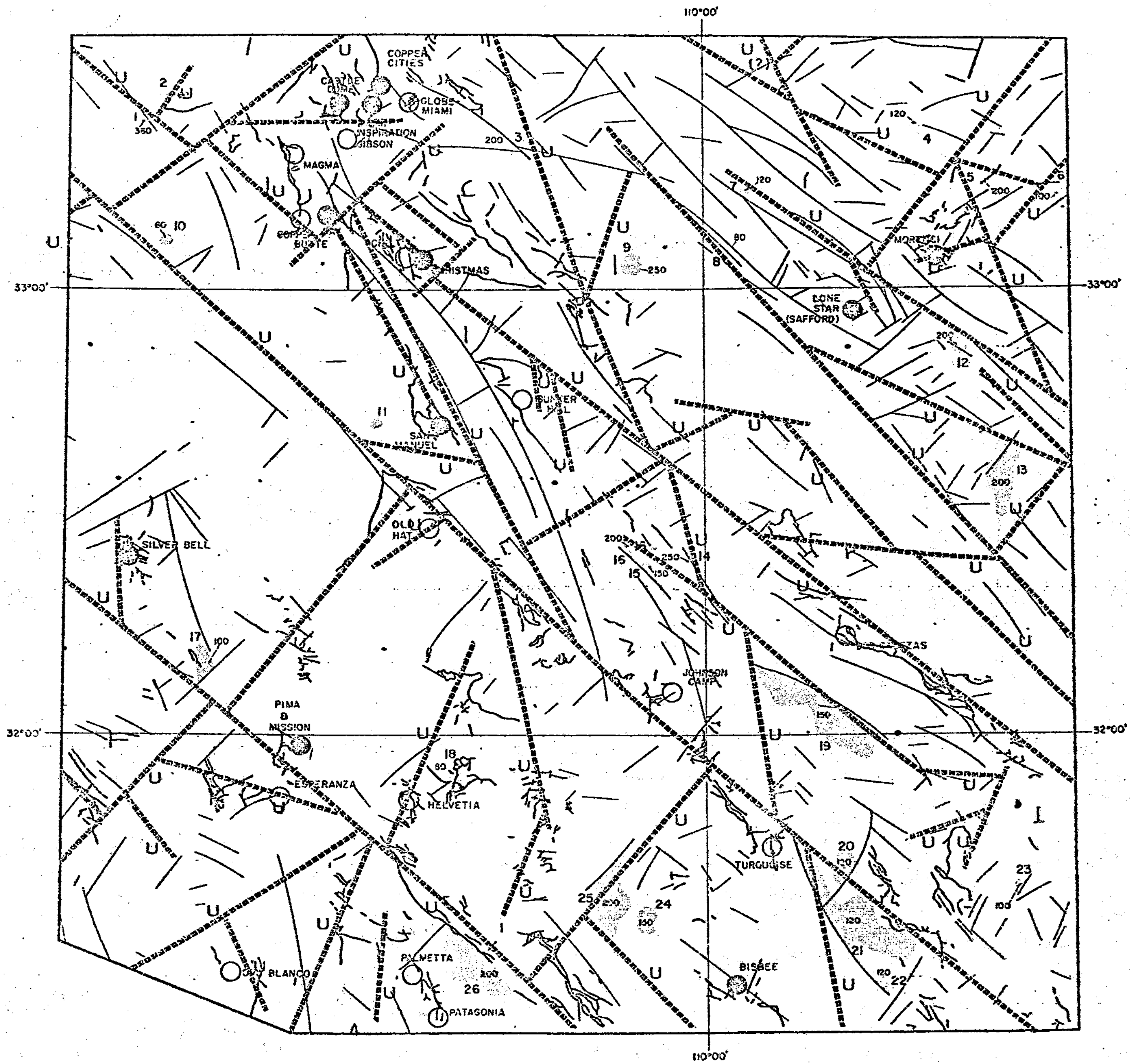
Figure VI-5. Relationship of Major Magnetic Inferred Faults, to ERTS (Landsat)-Derived Lineaments and Copper Deposits

Figure VI-5 also shows the magnetic anomalies and illustrates the close correlation of these anomalies and the inferred faults and ERTS lineaments. The following anomalies may warrant further investigation as they lie at the intersections of regional ERTS lineaments and do not coincide with known uranium or copper deposits.

Magnetic Anomaly #	Intersection of ERTS Lineaments
8	Gila Mountains and Gila-San Simon
20 and 21	Willcox Playa, Lordsburg and Santa Catalina Mountains
24 and 25	Huachuca and Tucson
26	Patagonia and Canelo Hills

E. RELATIONSHIP TO COPPER DEPOSITS

Known copper deposits are compared with the aeromagnetic interpretation in Figure VI-6. It is evident that all deposits are on or near the inferred faults, indicating probable structural control of the mineralization (see also subsection V.C).



U — FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

FAULT INFERRED FROM PROFILE DATA

KNOWN FAULTS

16 200 SELECTED MAGNETIC ANOMALIES AND INTENSITY IN GAMMAS WITH IDENTIFICATION NUMBER

PORPHYRY COPPER DEPOSITS

NONPORPHYRY COPPER DEPOSITS

Figure VI-6. Relationship of Magnetic Data to Copper Deposits

SECTION VII
CONCLUSIONS

A. GENERAL

Based on geology and the kind and extent of know uranium occurrences, this survey area offers only minor promise of developing large important uranium deposits. However, several uranium anomalies were delineated and judged to be valid indications of potential uranium mineralization. Their strength, when compared to the effects seen over the known uranium localities, suggests that these anomalies may hold more promise than the known mineralized areas. However, their real value can be proved only by follow-up detailed prospecting and, hopefully, eventual mining operations.

B. ANOMALY MAPS

Visual inspection may be used to select areas of positive uranium significance factors which indicate relatively broad areas with relatively more radiation from the uranium daughter product Bi-214. These areas may be interpreted to outline regions with good prospecting potential if one accounts for problems such as atmospheric inversion trapping of radon.

It is felt that the ERTS data show enough correlations with the known prospects and anomalous areas to be useful as a supplementary empirical tool in guiding exploration.

It is believed that the aeromagnetic data is useful in roughly outlining the broad compositional and structural features of the basement complex. These features may have had influence on the subsequent structure and stratigraphy which has been of importance in the development of the potential uraniferous areas in Arizona.

The Th/K data suggest that anomalously low values of this ratio can be used to indicate regions of alteration with high potassium and relatively constant thorium that often accompany porphyry copper deposits. In this area six out of twelve porphyry copper mining districts show this kind of relationship, and all of the copper mines fall on or adjacent to regional ERTS (Landsat)-derived lineaments and/or magnetically inferred faults. It is concluded that combining the ERTS (Landsat) data with Th/K lows and magnetic data can serve as a valuable first step in regional reconnaissance for potential porphyry copper deposits.

C. SUGGESTIONS FOR FURTHER WORK

Follow-up uranium prospecting is suggested for the following anomalies: (see Figure V-3).

Anomaly	Potential Type Deposits
#1 (eastern half)	vein and stratiform
#2 (western "knob")	vein and stratiform
#3 (eastern "bulge")	vein and stratiform
#4 (western portion)	stratiform
#6 (southern portion)	vein
#7 (eastern and western ends)	vein
#11 (all)	stratiform
#12 (all)	vein
#13 (all)	vein and stratiform
#14 (all)	vein
#15 (eastern and western ends)	stratiform
#16 (all)	stratiform
#17 (northern portion)	vein
#18 (all)	vein
#19 (all)	vein and stratiform

Specifically, the Gila Group (formation QTs) appears promising for potential stratiform deposits, and the Precambrian granites (p6gr) and silicic volcanic areas (Tvs) look good for potential vein deposits. The data did not indicate a potential uraniferous province associated with the Dripping Spring Quartzite in the surveyed area.

An analysis of the thorium and potassium data and the ratios involving these elements and uranium could provide valuable insight relative to possible geochemical mechanisms in the formation and migration of uranium ores. It is suggested that such a study be pursued.

The most serious problems brought to light during this work involve the effects of atmospheric inversion causing possible false or misleading anomalies. At least limited areas should be reflown in conjunction with surface meteorological and geochemical studies in an intensive effort to clarify these problems so that they may be circumvented in future reconnaissance surveys.

SECTION VIII

REFERENCES

Adler, H.H. 1974. Concepts of uranium-ore formation in reducing environments in sandstones and other sediments, formation at uranium ore deposits. Proceedings Series, International Atomic Energy Agency, Vienna, p. 141-168.

Anderson, R.Y. and E.B. Kurtz, Jr. 1955. Biogeochemical reconnaissance of the Annie Laurie uranium prospect, Santa Cruz County, Arizona. Econ. Geol., v. 50, p. 227-232.

Bowie, S.H.U., M. David and D. Ostle. 1972. Uranium prospecting handbook. the Institution of Mining and Metallurgy, London, 346 p.

Brewer, W.A., MC.C Erskine, Jr., W.T. Haenggi, and R.O. Prindle. 1974. Mineral exploration potential of ERTS-1 data; Final Rpt., NASA Contract No. NAS5-21745. Earth Satellite Corporation, Berkeley, Calif., 94 p.

Butler, A.P., Jr., W.I. Finch and W.S. Twenhofel. 1962. Epigenetic uranium deposits of the United States. Map MR-21, USGS, Washington, D.C.

Darnley, A.G. 1973. Airborne gamma-ray survey techniques-present and future; Uranium Exploration Methods; Proc. of a Panel, Vienna, 10-14 Apr. 1972. International Atomic Energy Agency, Vienna. p. 67-108.

Davis, J.D. and J.M. Guilbert. 1973. Distribution of radioelements potassium, uranium and thorium in selected porphyry copper deposits. Econ. Geol., v. 68, n. 2, p. 145-160.

Everhart, D.L. 1958. Summary of unsolved problems and new trends in uranium geology. Proc. 2nd U.N. Intern. Conf. on Peaceful Uses of Atomic Energy, v. 2, p. 310-314.

Finch, W.I. 1967. Geology of epigenetic uranium deposits in sandstone in the United States. Prof. Paper 538. USGS Washing D.C. 121 p.

Fischer, R.P. 1974. Exploration guides to new uranium districts and belts. Econ. Geol., v. 60. p. 362-376.

Freden, S.C. et al., eds., 1974. Third Earth Resources Technology Satellite Symposium. Vol II, NASA SP-356. Goddard Space Flight Center, Washington, D.C. (Avail. from Superintendent of Doc. U.S. Govt. Ptg. Off., Wash., D.C., 20402 at $3.00/copy).

Granger, H.C. and R.B. Raup. 1969. Geology of uranium deposits in the Dripping Spring Quartzites, Gila County, Arizona. USGS Prof. Paper 595, Washington, D.C. 108 p.

Grutt, E.W., Jr. 1972. Prospecting criteria for sandstone-type uranium deposits. Uranium Prospecting Handbook (S.H.U. Bowie et al., eds), Inst. of Mining and Metallurgy, London. p. 47-78.

Hawkes, H.E. and J.S. Webb. 1962. Geochemistry in mineral exploration. Harper and Row.

Hobbs, S.W. and V.C. Fryklund, Jr. 1968. The Coeur d'Alene district, Idaho; Ore Deposits of the United States, 1933-1967 (J.D. Ridge, ed). AIME, New York, N.Y. p. 1417-1435.

IAEA. 1970. Uranium exploration geology. Int. Atomic Energy Agency, Vienna. 384 p.

IAEA. 1973. Uranium exploration methods. Int. Atomic Energy Agency, Vienna. 320 p.

IAEA. 1974. Formation of uranium ore deposits. Int. Atomic Energy Agency, Vienna. 748 p.

Keith, S.B. 1970. Uranium; coal, oil, natural gas, helium and uranium (H.W. Pierce et al.). Bull. 182, The Arizona Bureau of Mines, Tucson, p. 103-146 plus Appendixes.

Kinkle, A.R., Jr. and N.P. Peterson. 1962. Copper in the United States. Map MR-13, USGS, Washington, D.C.

Landwehr, W.R. 1967. Belts of major mineralization in the western United States. Econ. Geol., v. 62, n. 4. p. 494-501.

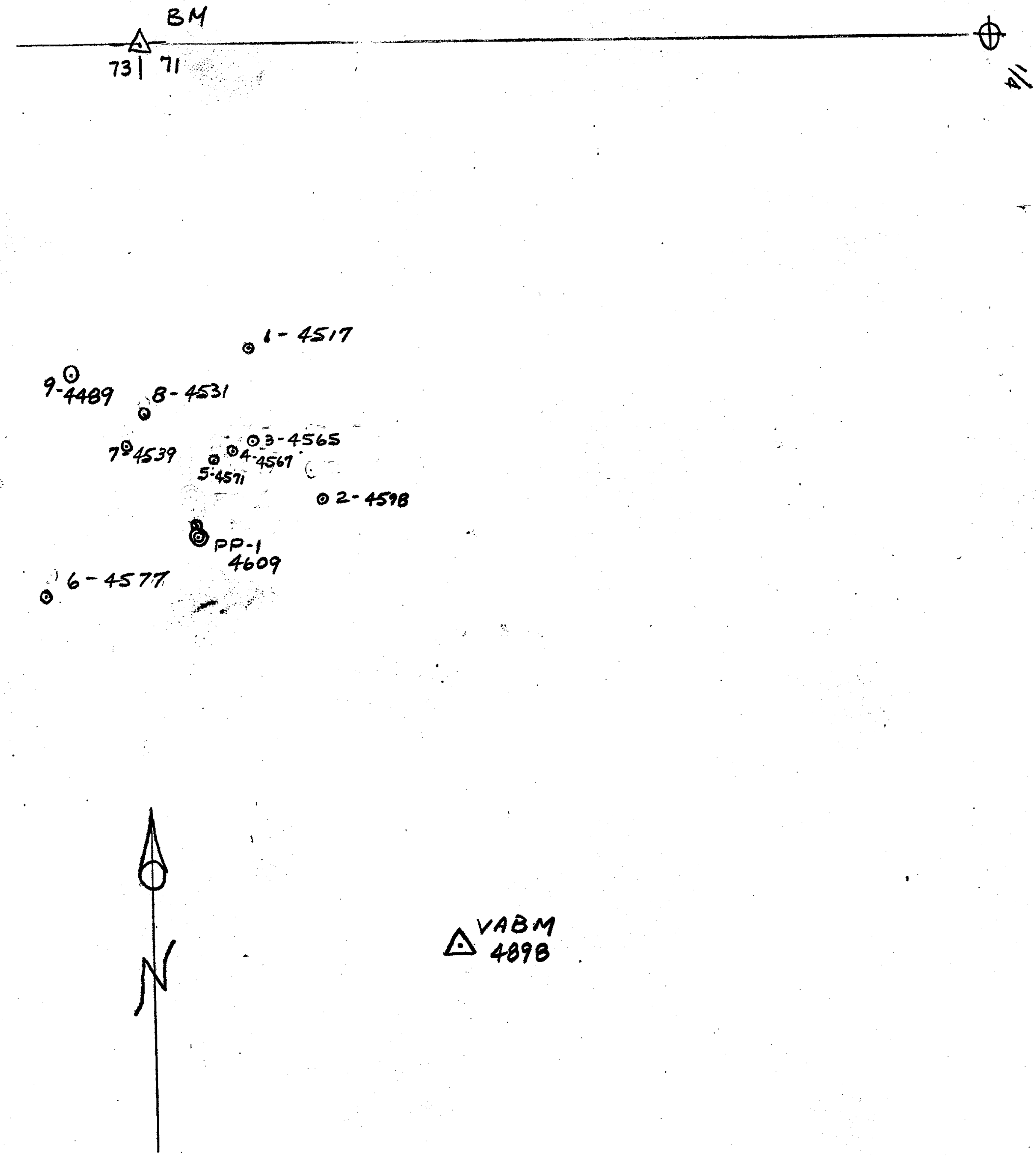
Malan, R.C. 1972. Distribution of uranium and thorium in the Precambrian of the western United States. Rpt. AEC-RD-12, United States Atomic Energy Commission, Grand Junction, Colo. p. 59.

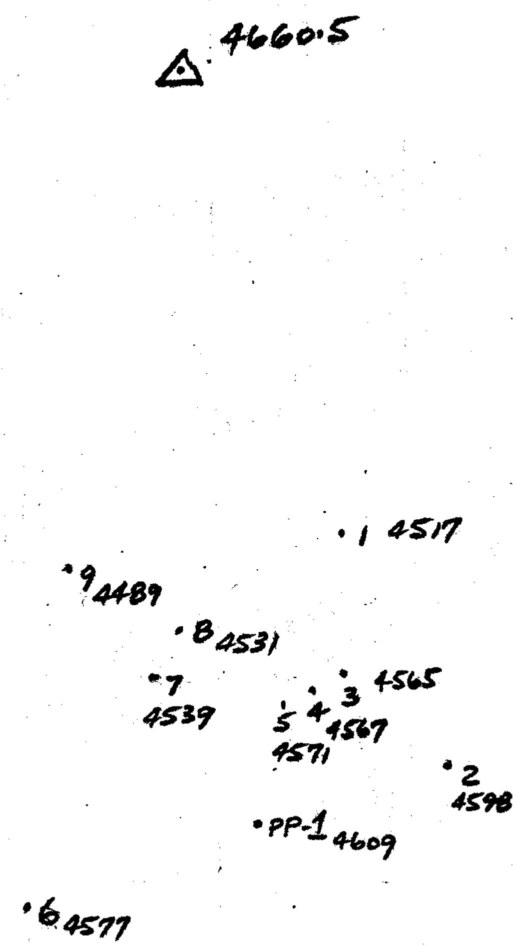
Moxham, R.M., R.S. Foote, and C.M. Bunker. 1965. Gamma-ray spectrometer studies of hydrothermally altered rocks. Econ. Geol., v. 60, n. 4, p. 653-671.

Sauck, W.A. and J.S. Sumner. 1970. Residual aeromagnetic map of Arizona; 1:1,000,000 scale. Geosciences Dept., University of Arizona, Tucson, Ariz.

Saunders, D.F., Thomas, G.E., F.E. Kinsman and D.F. Beatty. 1973. ERTS Imagery Use in Reconnaissance Prospecting; Final Rpt., Contract NAS 5-21796; NASA Goddard Space Flight Center. Texas Instruments Incorporated, Dallas, Texas, (Avail. from National Technical Information Service, U.S. Dept. of Commerce, P.O. Box 1-53, Springfield, Va. 22141, as Doc. No. E74-10345 at $11.45/paper copy or $2.25 microfiche).

Saunders, D.F. 1974. ERTS Data Interpretation in Petroleum and Mining Exploration; ERTS-Based Nonexclusive Morphostructural Analysis Map Services (map area 14; Wyoming-Montana). Geophoto Services, Texas Instruments Incorporated, Dallas, Texas).


BM
73 | 71
1/4
1-4517
9-4489
8-4531
7-4539
3-4565
4-4567
5-4571
2-4598
PP-1
4609
6-4577
N
VABM
4898


4660.5
1 4517
9 4489
8 4531
7 4539
3 4565
4 4567
5 4571
2 4598
PP-1 4609
6 4577

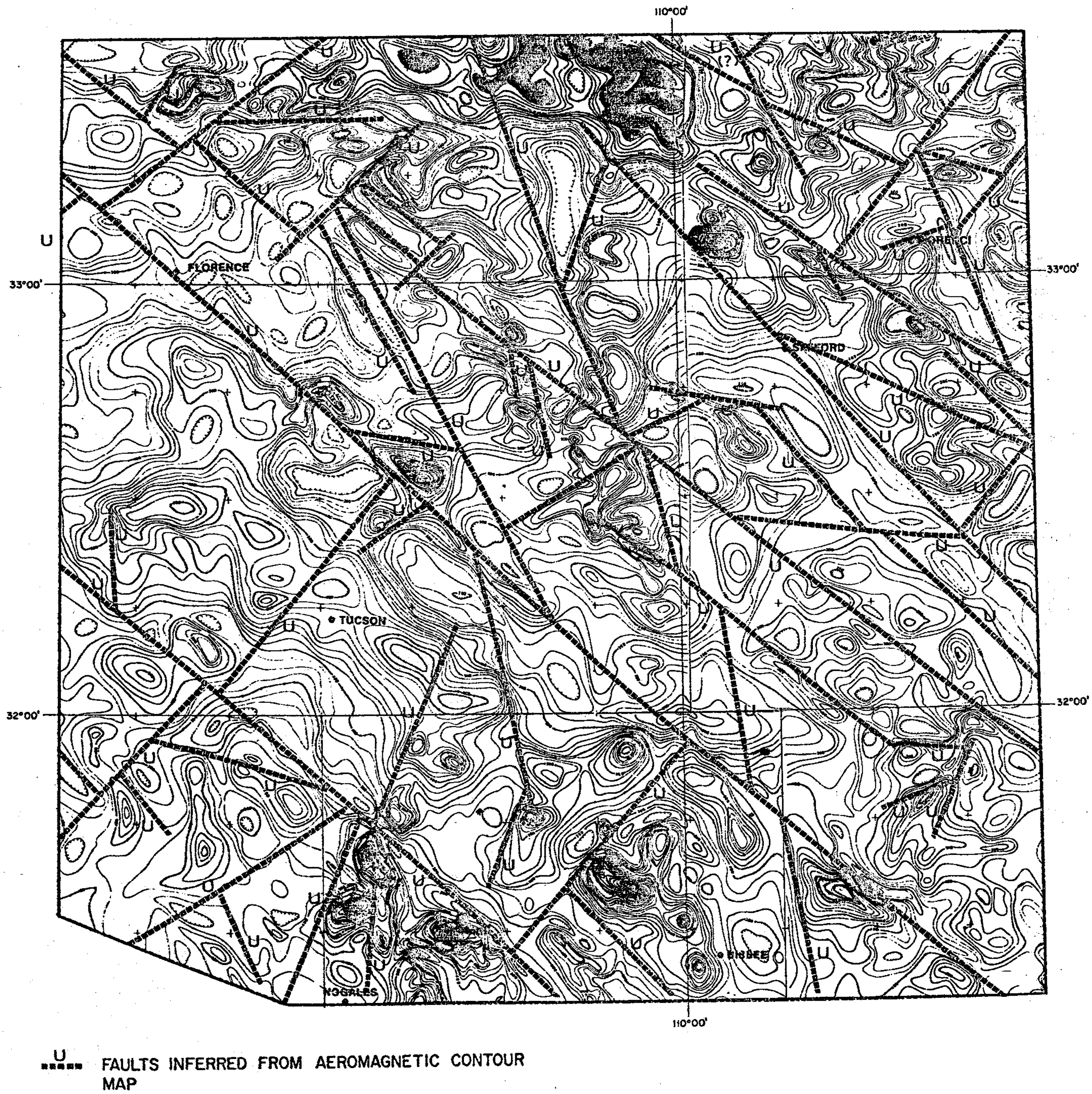
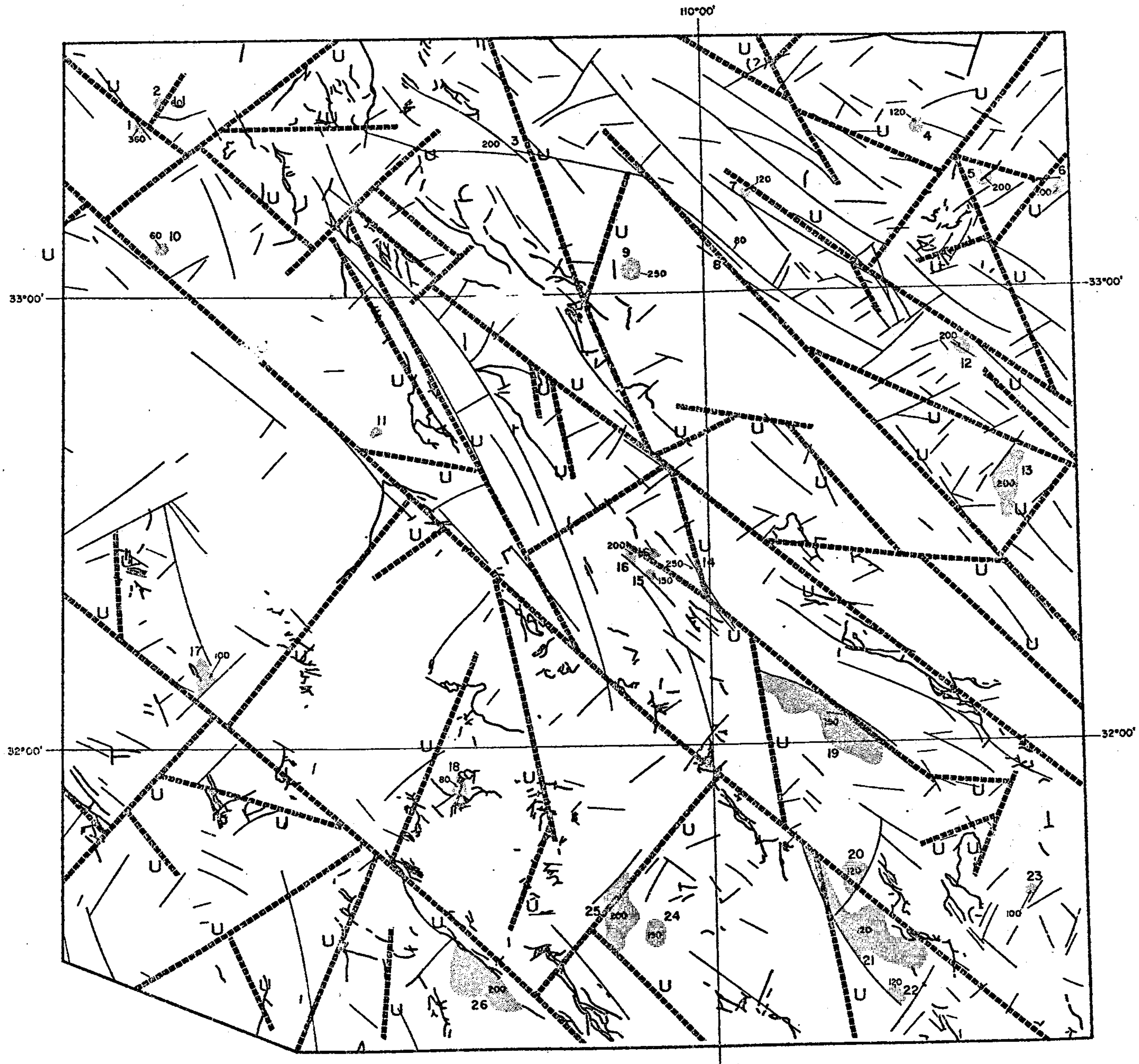


Figure VI-1. Major Faults or Magnetic Lineaments Inferred from Sauck and Sumner (1970) Residual Aeromagnetic Map of Arizona



FAULTS INFERRED FROM AEROMAGNETIC CONTOUR MAP

FAULT INFERRED FROM PROFILE DATA

KNOWN FAULTS

SELECTED MAGNETIC ANOMALIES AND INTENSITY IN GAMMAS WITH IDENTIFICATION NUMBER

Figure VI-2. Magnetic Anomalies and Faults Inferred from Magnetic Profile Data with Known Faults from Wilson et al. (1969)

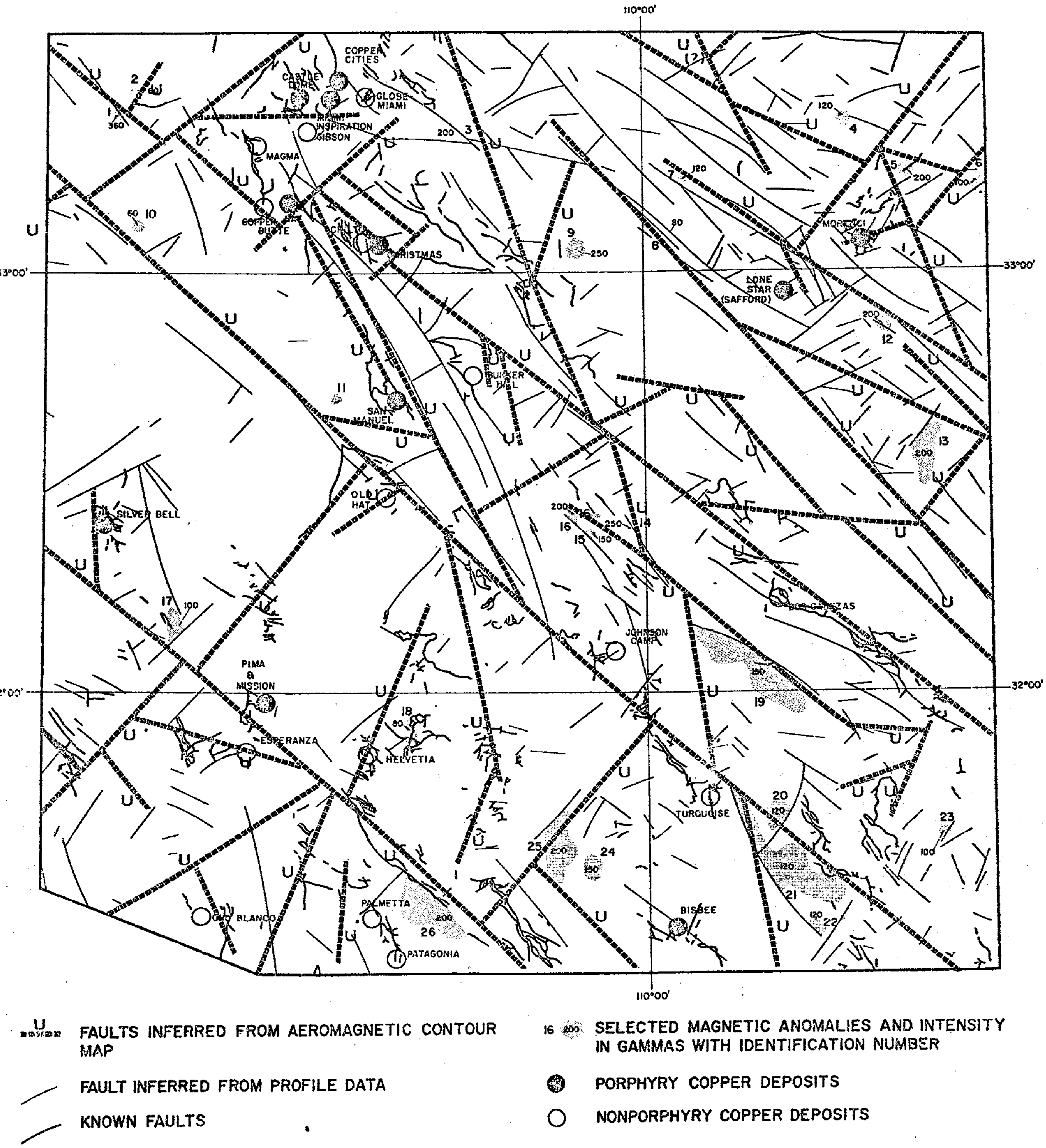


Figure VI-6. Relationship of Magnetic Data to Copper Deposits

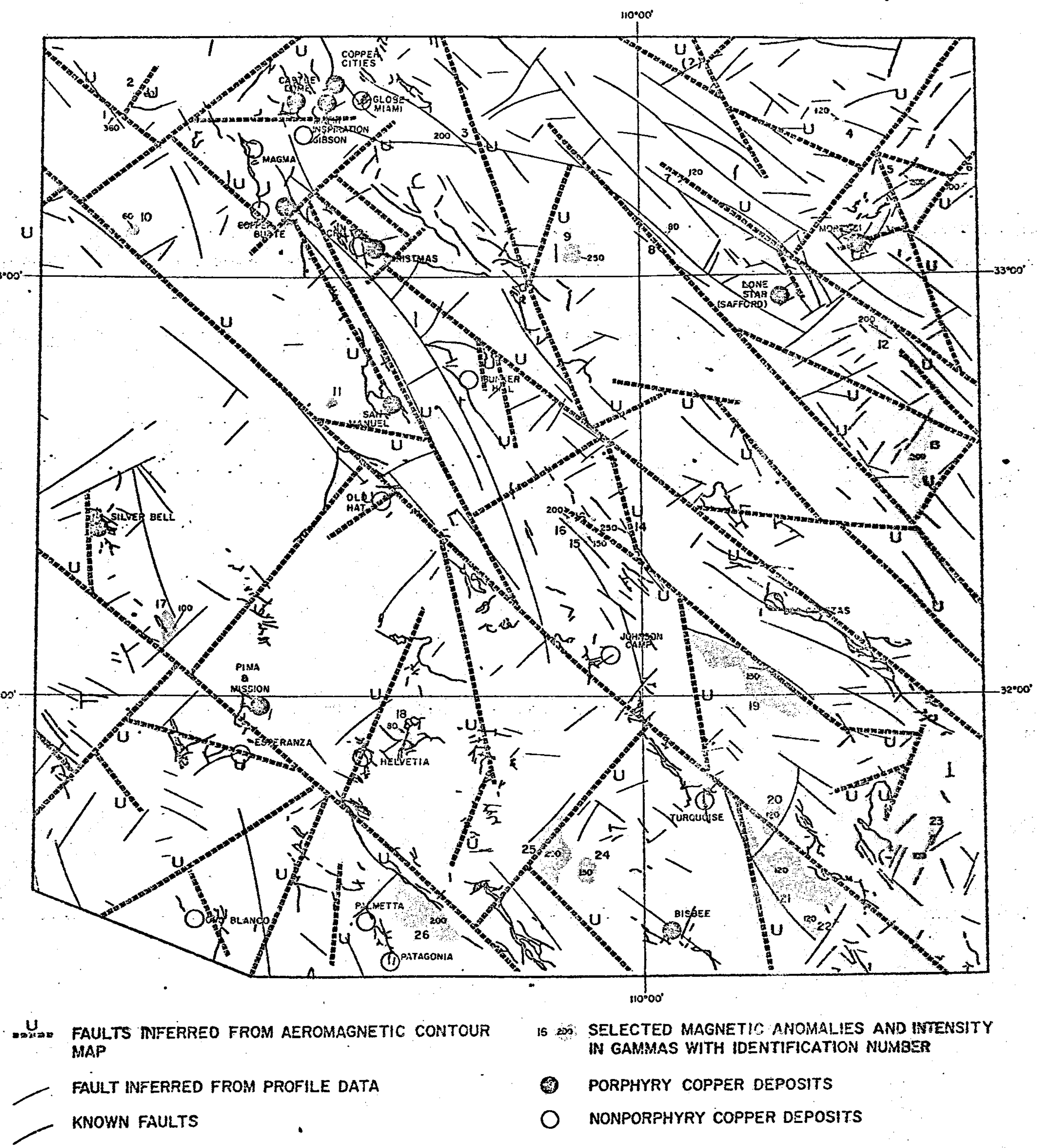


Figure VI-6. Relationship of Magnetic Data to Copper Deposits