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RENBERGER,D.L. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
Office of Nuclear Reactor Regulation
YOUNGBLOOD,B.J. Licensing Branch 1

SUBJECT: Forwards responses to Questions 360.004 & 360.005,open items from round 1,Set 2.Questions will be incorporated in FSAR,Amend 10.References,prepared by Shannon & Wilson && Woodson-Clyde Consultants,will be forwarded.

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Washington Public Power Supply System
A JOINT OPERATING AGENCY

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Docket No. 50-397

G02-80-111
June 2, 1980

Director, Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

Attention: Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Subject: WPPSS NUCLEAR PROJECT NO. 2
RESPONSES TO ROUND ONE QUESTIONS
OPEN ITEMS FROM SET TWO -
GEOSCIENCES BRANCH (GSB)

Dear Mr. Youngblood:

Attached please find sixty (60) copies of the responses to Questions 360.004 and 360.005, which are open items from Round One, Set Two (Geosciences Branch). Copies of the references prepared for WPPSS by Shannon and Wilson and Woodward-Clyde Consultants, as listed in Question 360.005, have been provided to Burns and Roe and will be sent to you under separate cover.

These questions will be incorporated in Amendment No. 10 to the WNP-2 FSAR.

Very truly yours,

D L Renberger

D. L. RENBERGER
Assistant Director-Technology

DLR:CDT:ct
Attachment
cc: JJ Verderber, B&R, w/o attachment
RC Root, B&R, w/o attachment
RE Snaith, B&R, w/o attachment
J Ellwanger, B&R, w/attachment
A Lageraaen, B&R, w/attachment
JA Tomacheski, B&R, w/attachment
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STATE OF WASHINGTON)
) ss
COUNTY OF BENTON)

WPPSS NUCLEAR PROJECT NO. 2
RESPONSES TO ROUND ONE QUESTIONS
OPEN ITEMS FROM SET TWO -
GEOSCIENCES BRANCH (GSB)

D. L. RENBERGER, Being first duly sworn, deposes and says: That he is the Assistant Director, Technology, for the WASHINGTON PUBLIC POWER SUPPLY SYSTEM, the applicant herein; that he is authorized to submit the foregoing on behalf of said applicant; that he has read the foregoing and knows the contents thereof; and believes the same to be true to the best of his knowledge.

DATED May 23, 1980

D. L. Renberger
D. L. RENBERGER

On this day personally appeared before me D. L. RENBERGER to me known to be the individual who executed the foregoing instrument and acknowledged that he signed the same as his free act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this 23rd day of May, 1980

Reba B. Helgeson
Notary Public in and for the State of Washington
Residing at Richland

Q. 360.004

"In the Weston Geophysical Research, Inc., report, "Qualitative Aeromagnetic Evaluation of Structures in the Columbia Plateau and Adjacent Cascade Mountain Area," March 28, 1978, Figure 13 shows several north to northwest-trending aeromagnetic linears in the vicinity of Badger Mountain and Jump Off Joe Anticline. However, the Weston report does not discuss the origin or interpretations of these particular linears. The north-trending linear crossing the Columbia River at the junction with the Snake River has an apparent offset of the magnetic low defining the Rattlesnake Hills anomaly. Since these aeromagnetic linears trend toward the WNP-2 site, provide: (1) an interpretation of these features, including but not limited to the potential for their continuation of the north to the near site area; and (2) a discussion of the fault parameters, if such an interpretation is proposed."

Response:

The north and northwest-trending aeromagnetic linears referred to in Question 360.4 (360.004) are part of those shown on Figure 13 of the Weston Geophysical Research report entitled "Qualitative Aeromagnetic Evaluation of Structures in the Columbia Plateau and Adjacent Cascade Mountain Area" and on Figure 2R I-14, Amendment 23, WNP-1/4 PSAR. These linears are interpreted by Weston as being primarily a manifestation of topography and not the result of any single throughgoing fault-related structure.

Figure 360.4-1 shows each of the three linears referred to in Question 360.4 plotted on a 1:250,000 scale topographic map along with an estimate of the degree of correlation between the magnetic linear and topography as proposed by Weston Geophysical Research, Inc. It is Weston's opinion that the correlation of these linears with topography appears to be best illustrated along the middle portion (1/3 to 1/2) of each linear. Weston's definition of the linear as well as its correlatable topographic cause appears to decrease northward and southward. It is WPPSS' position that these linears as defined are spurious.

Figure 13 of the report entitled "Qualitative Aeromagnetic Evaluation of Structures in the Columbia Plateau and Adjacent Cascade Mountain Area" and Figure 2R I-14 Amendment 23, WNP-1/4 PSAR, show Weston's identification of some of the magnetic anomalies and less obvious magnetic linears. It is

Weston's position that these magnetic anomalies and magnetic linears may be the manifestation of, or could be interpreted as resulting from one or a combination of hidden geologic features such as folds, faults, dikes, lithologic variations or buried topography.

The origin of all magnetic anomalies and magnetic linears is the spatial distribution of materials with variable magnetic properties, either remnant magnetization or susceptibility. On Figure 13 and Figure 2R I-14 dark and light tones are used to indicate relatively continuous zones of high and low magnetic values. Generally, these anomalies are in an east-west direction and are indicative of the more obvious geologic and topographic structures such as Saddle Mountains and Rattlesnake Hills.

The specific linears referred to in Question 360.4 are shown on Figure 13 and Figure 2R I-14 as dark continuous lines. These particular linears are not due to continuous alignments of high or low magnetic anomalies but instead represent localized disruptions of the normally smooth contours. Because of the large contrast in susceptibility between rocks of the Columbia Plateau and air (approximately 5000 X 10^{-6}, cgs emu), topographic variations can and do produce significant magnetic anomalies. Close examination of the magnetic profile data in addition to the topographic contour maps for the area, which includes the magnetic linears referred to in Question 360.4, reveals that these linears have a variable magnetic signature along their length. An index of the relative degree of correlation with topography as determined by Weston is also shown on attached Figure 360.4-1. The aeromagnetic profiles crossing these linear features are shown on attached Figures 360.4-2 through 360.4-7. These data definitely indicate that the linears are not the result of any throughgoing structure. The linears in question are also shown superimposed on the aeromagnetic contour map (Figure 360.4-8 attached). The degree of certainty used by Weston in constructing each segment of the linears is also indicated.

The "apparent offset" of the magnetic low associated with the Rattlesnake Hills-Wallula structure by the northerly-trending linear crossing the Columbia River at the junction with the Snake River is apparent and does not in our opinion represent any physical offset of the structure. The change in size of the magnetic anomaly at the junction of the Rattlesnake Hills and the Butte is due to a coincidental change in both topography and the distribution of magnetostratigraphic units exposed at this local (see Figure 2R 4.5-1, Amendment 23, WNP-1/4 PSAR. Although a fault has been identified at The Butte, its strike

is parallel to the Rattlesnake-Wallula trend (see response to Q. 360.005) and is therefore incompatible with the hypothesized aeromagnetic linear.

In addition to an examination of selected aeromagnetic profile segments crossing the three linears referred to in Question 360.4, four continuous aeromagnetic profiles crossing the linears were examined in more detail by two dimensional mathematical modeling utilizing specific magnetic susceptibility and natural remnant magnetism data, appropriate for the basalts of this area. Basics of the modeling technique can be found in M. Talwani and J. R. Heirtzler, "Computation of Magnetic Anomalies Caused by Two Dimensional Structures of Arbitrary Shape," Computers in the Mineral Industry, Part I, Vol. IX No. 1, Stanford University Publication, 1964.

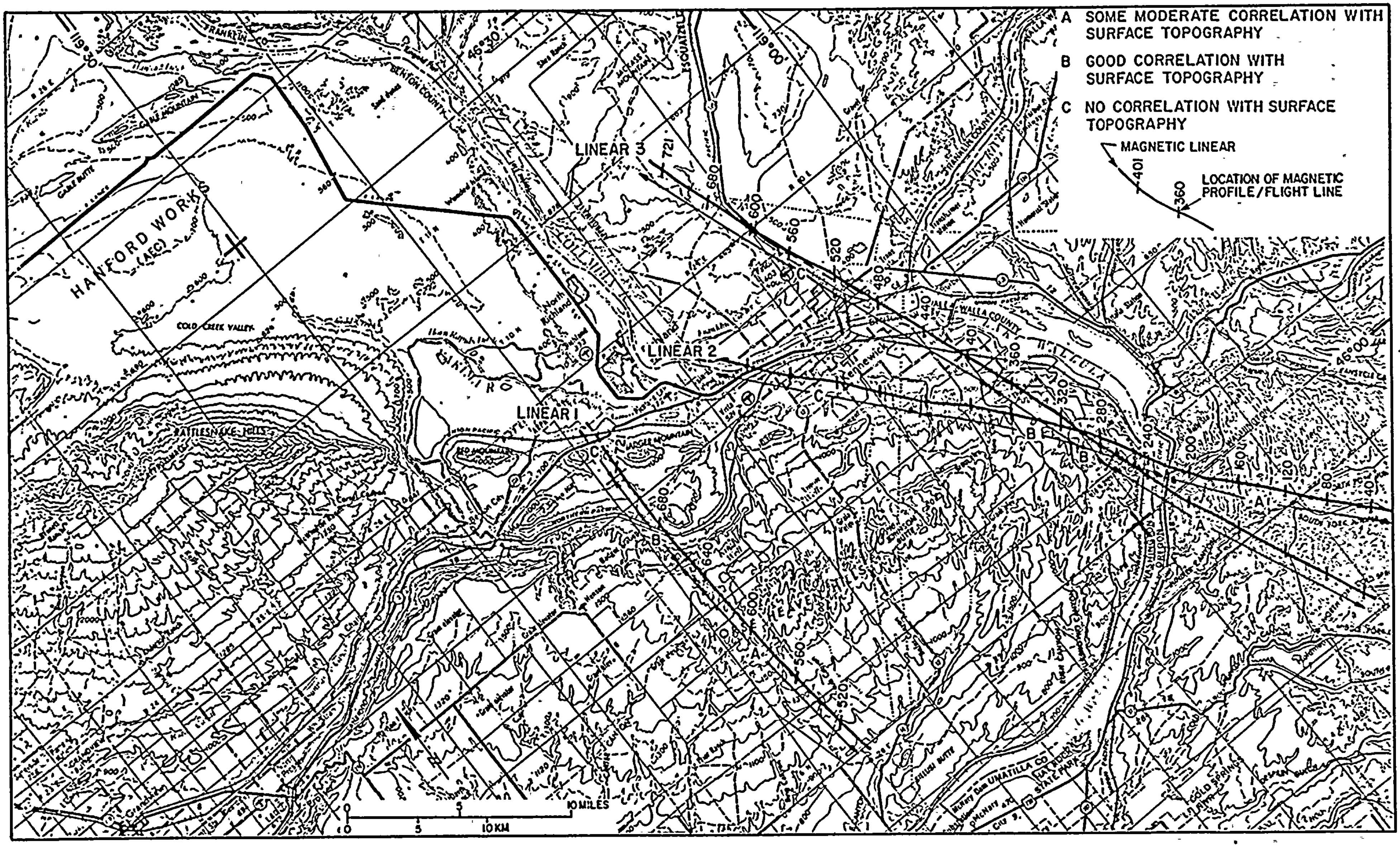
The location of the four profiles relative to the three linears referred to in Question 360.4 is shown in attached Figure 360.4-8. The results of the modeling for profiles 360, 450, 510 and 570 are shown in attached Figures 360.4-9 through 360.4-12.

Profiles 370, 450 and 510 cross aeromagnetic linears 2 and 3, Question 360.4; the Kennewick-Cold Creek linear identified by C. E. Glass, page 2R K-10, Amendment 23, WNP-1/4 PSAR; the Rattlesnake-Wallula trend; and Zintel Canyon. No aeromagnetic anomaly can be observed on profile 370 or 450 in the vicinity of the intersect with the Kennewick-Cold Creek linear. On profile 510, an aeromagnetic anomaly does occur within approximately 5000' of the projected location of the Kennewick linear. Attempts to model this anomaly as a fault, assuming various offsets between 50' to 200' with a fault plane dipping between 45° NE and 70° SE, were unsuccessful. It is Weston's opinion that this anomaly probably represents an erosional feature in the basalt surface.

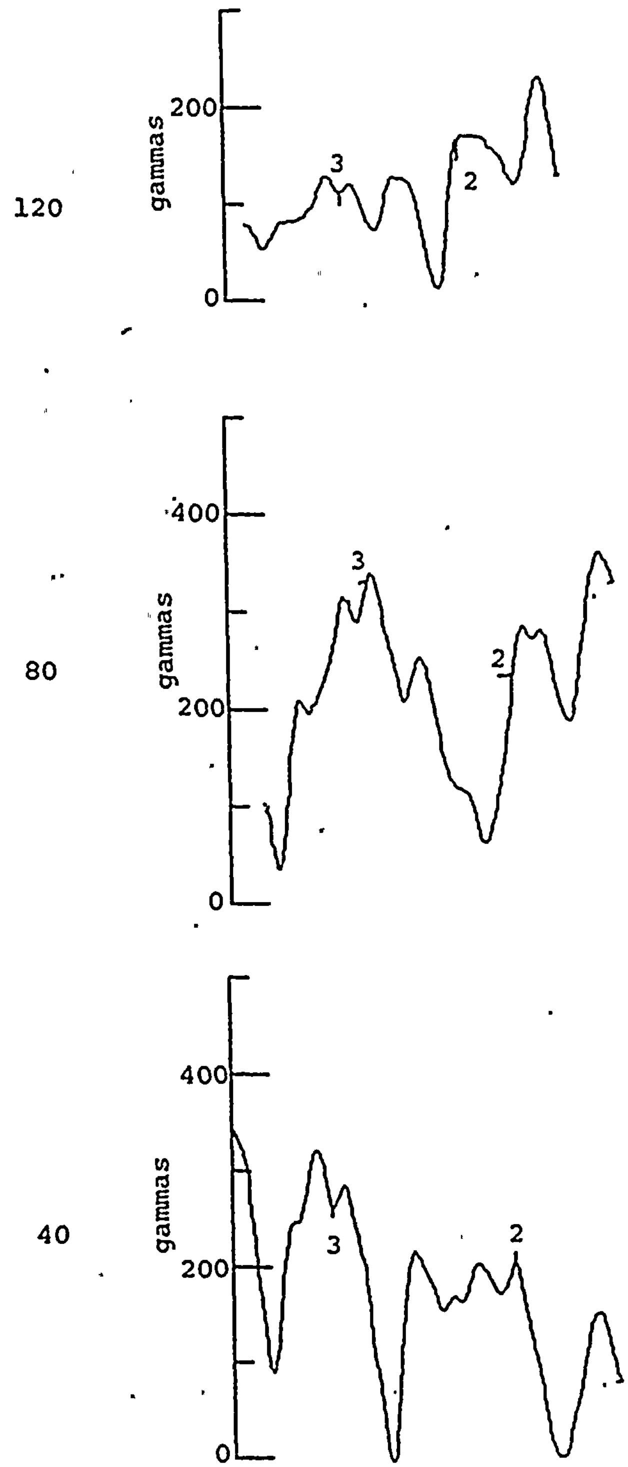
An aeromagnetic anomaly that is coincident with the Zintel Canyon fault, shown on Figure 2R H.5.1, Amendment 23, WNP-1/4 PSAR, can be observed on profiles 370, 450 and 510. This anomaly was successfully modeled as a fault, assuming 200' and 300' offsets and a vertical dipping fault plane.

The Rattlesnake-Wallula trend of aeromagnetic anomalies was successfully modeled as a fault on all four profiles with 200' of offset assumed on profiles 370, 450 and 510, and 100' of offset assumed on profile 570. All profiles were modeled as a vertical fault with the northeast side down. Results of the modeling of profile 570, Figure 360.4-12, are incomplete at this time for the southwest portion where the profile intersects aeromagnetic linear 1, referred to in Question 360.4.

The results of additional aeromagnetic modeling and a revised interpretation of that part of the aeromagnetic data for blocks A and D that includes the Hanford Reservation will be included in a revised version of Chapter 2.5 being prepared for submittal as part of the WNP-1/4 FSAR.



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	LOCATION MAP OF AEROMAGNETIC PROFILES ACROSS SELECTED AEROMAGNETIC LINEARS (WHICH ARE DUE TO TOPOGRAPHY).	FIGURE 1

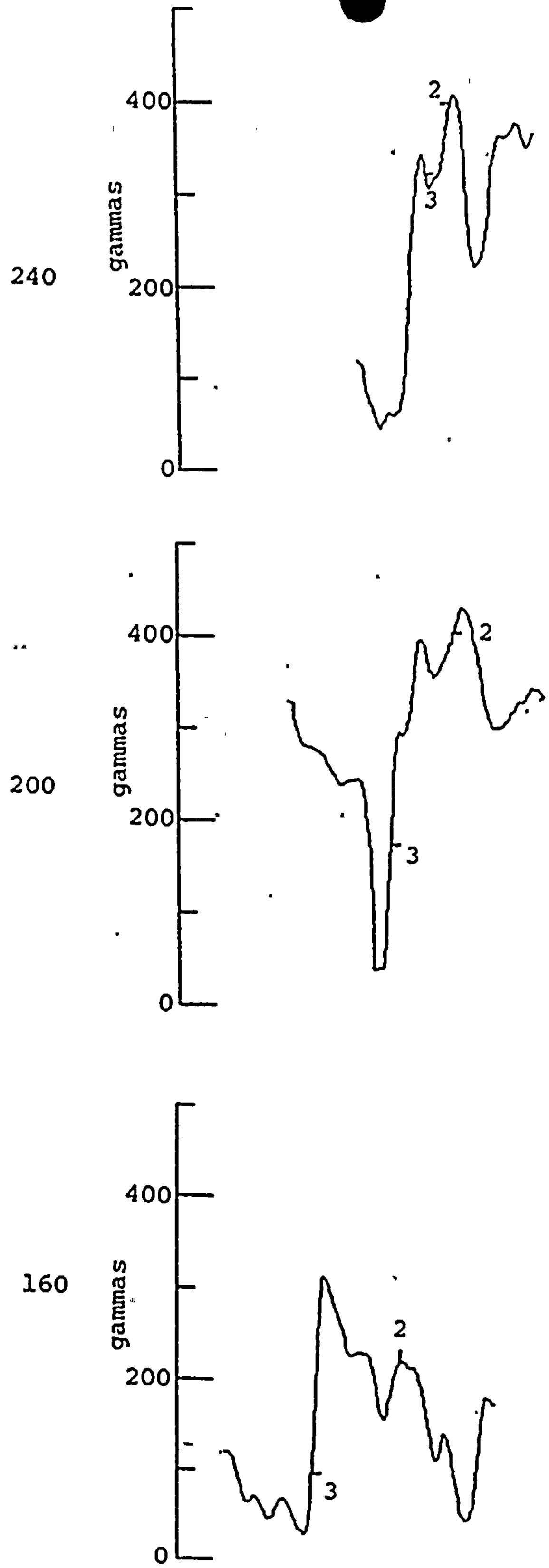


Each profile has
an arbitrary datum.

Horizontal Scale 1:250,000

Vertical Scale 1 inch = 200 gammas

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 40, 80, 120	FIGURE 2

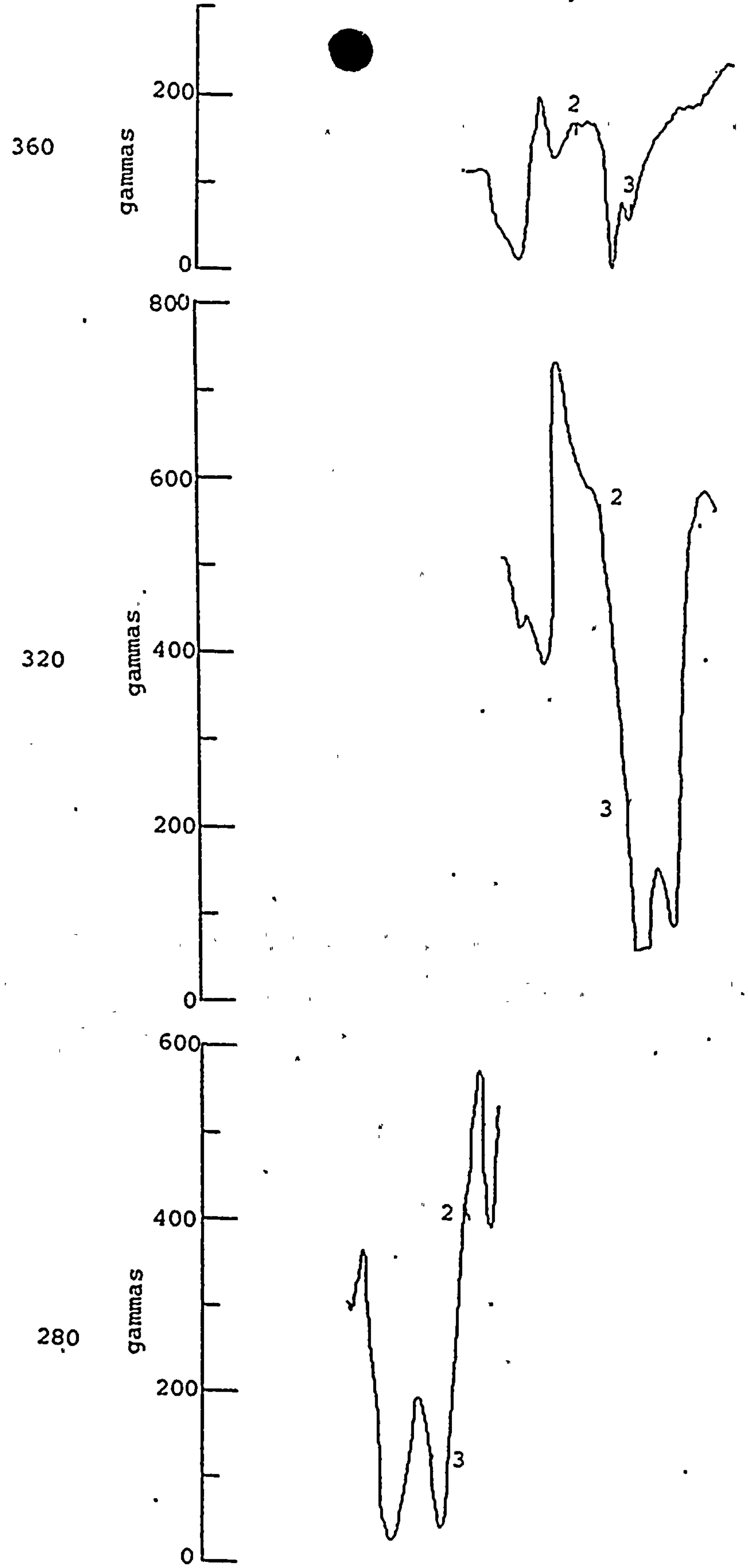


Each profile has
an arbitrary datum.

Horizontal Scale 1:250,000

Vertical Scale 1 inch = 200 gammas

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 160, 200, 240	FIGURE 3

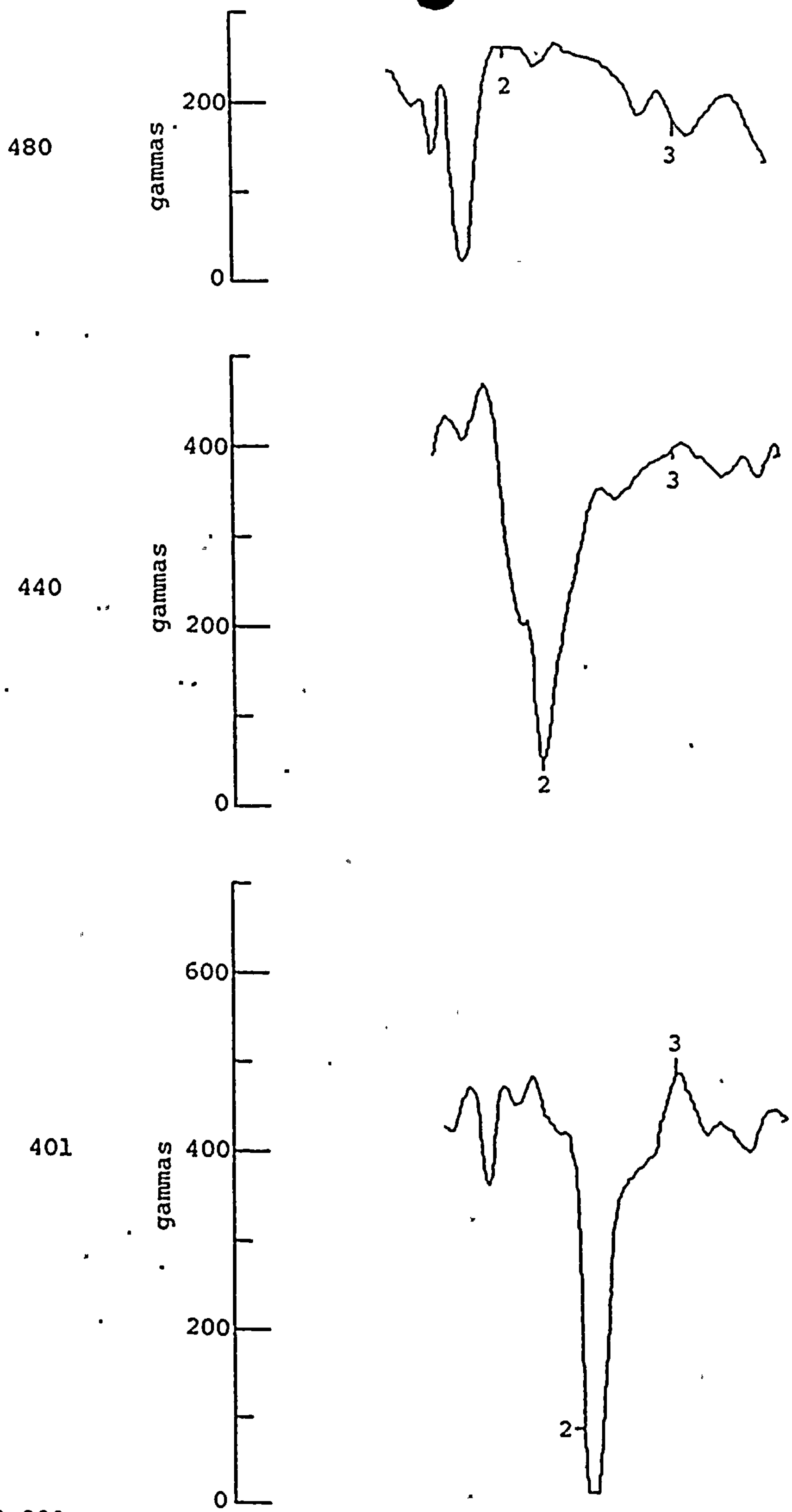


Each profile has
an arbitrary datum.

Horizontal Scale 1:250,000

Vertical Scale 1 inch = 200 gammas

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 280, 320, 360	FIGURE 4

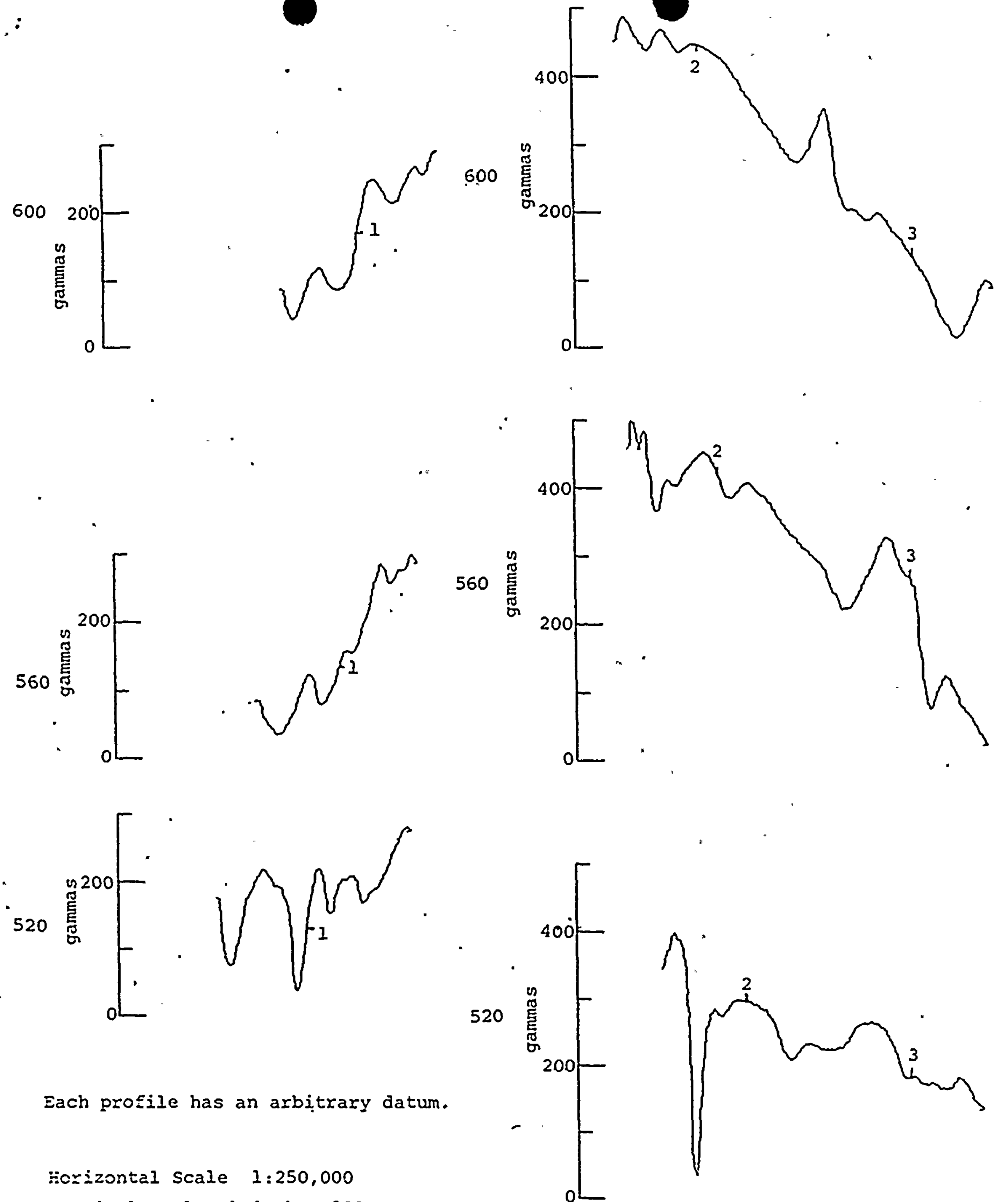


Each profile has
an arbitrary datum.

Horizontal Scale 1:250,000

Vertical Scale 1 inch = 200 gammas

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 401, 440, 480	FIGURE 5

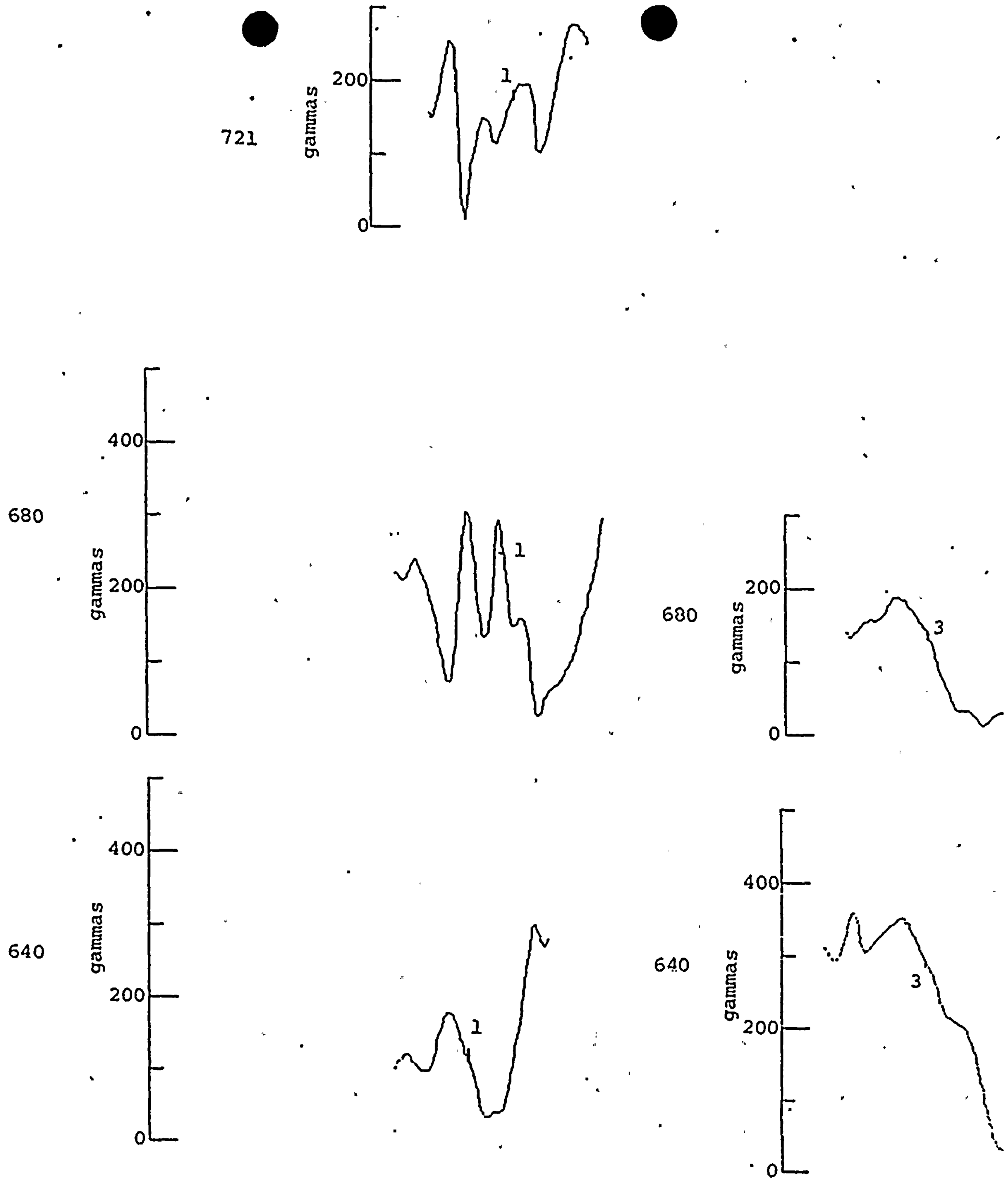


Each profile has an arbitrary datum.

Horizontal Scale 1:250,000

Vertical Scale 1 inch = 200 gammas

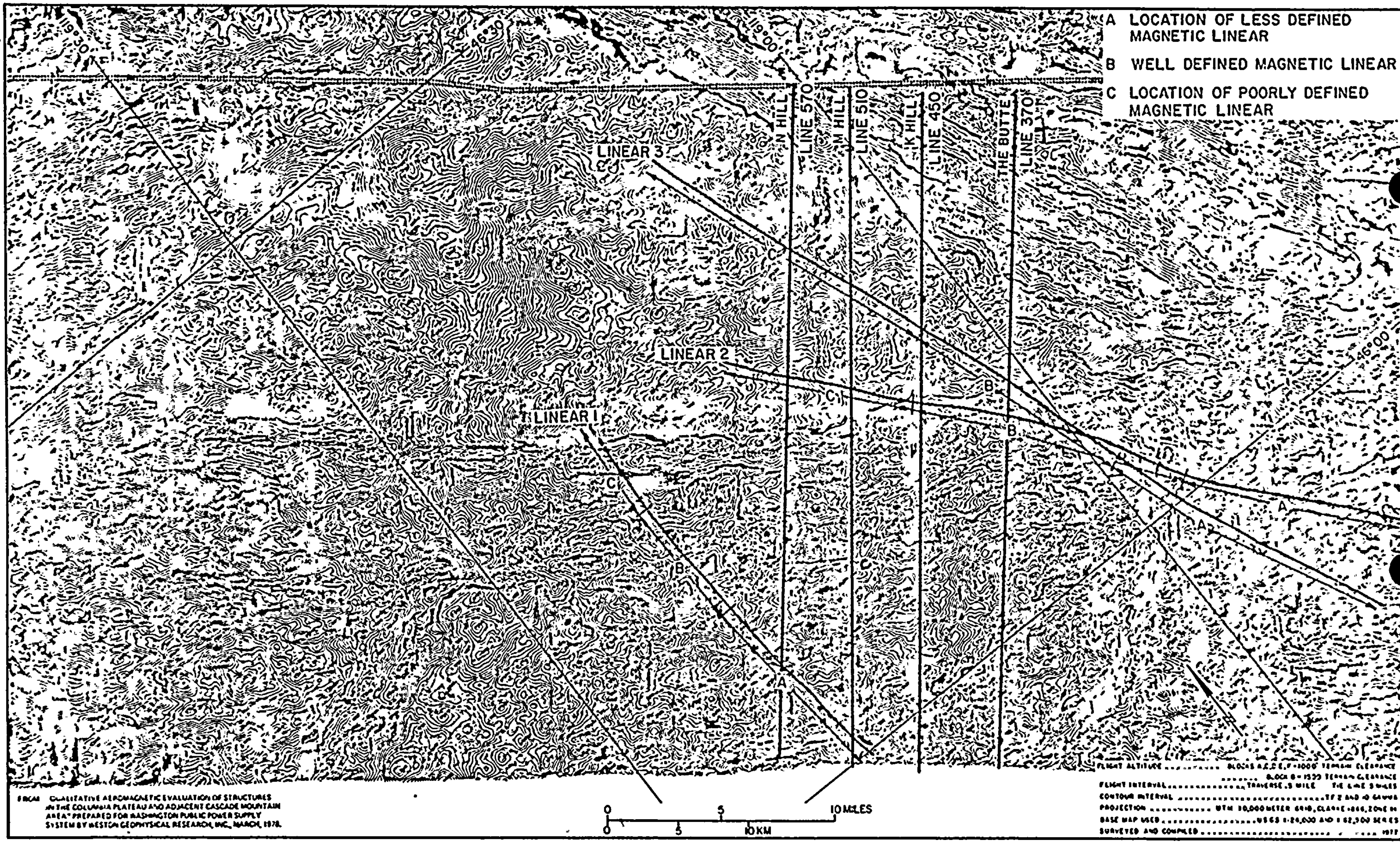
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 520, 560, 600	FIGURE 6



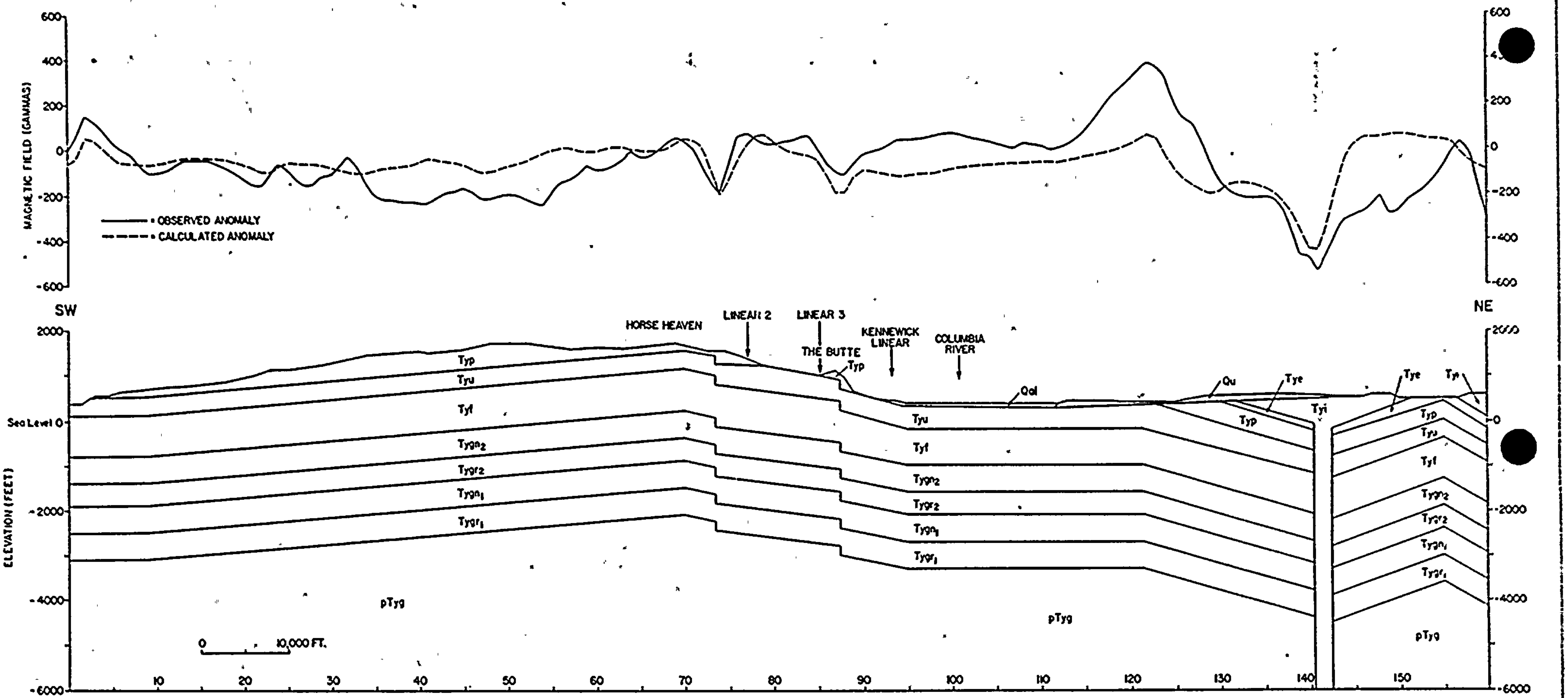
Each profile has an arbitrary datum.

Vertical Scale 1 inch = 200 gammas
Horizontal Scale 1:250,000

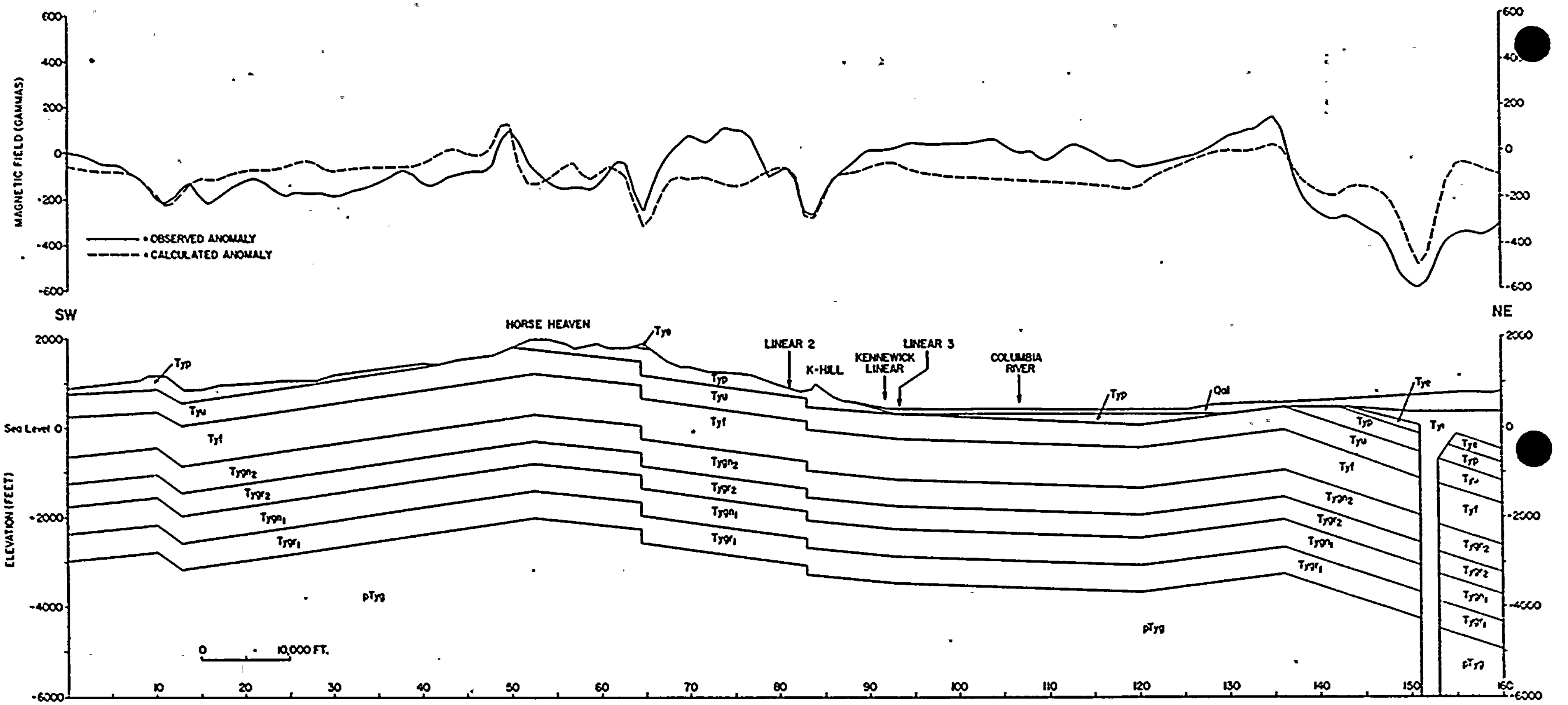
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	MAGNETIC PROFILES 640, 680, 721	FIGURE 7



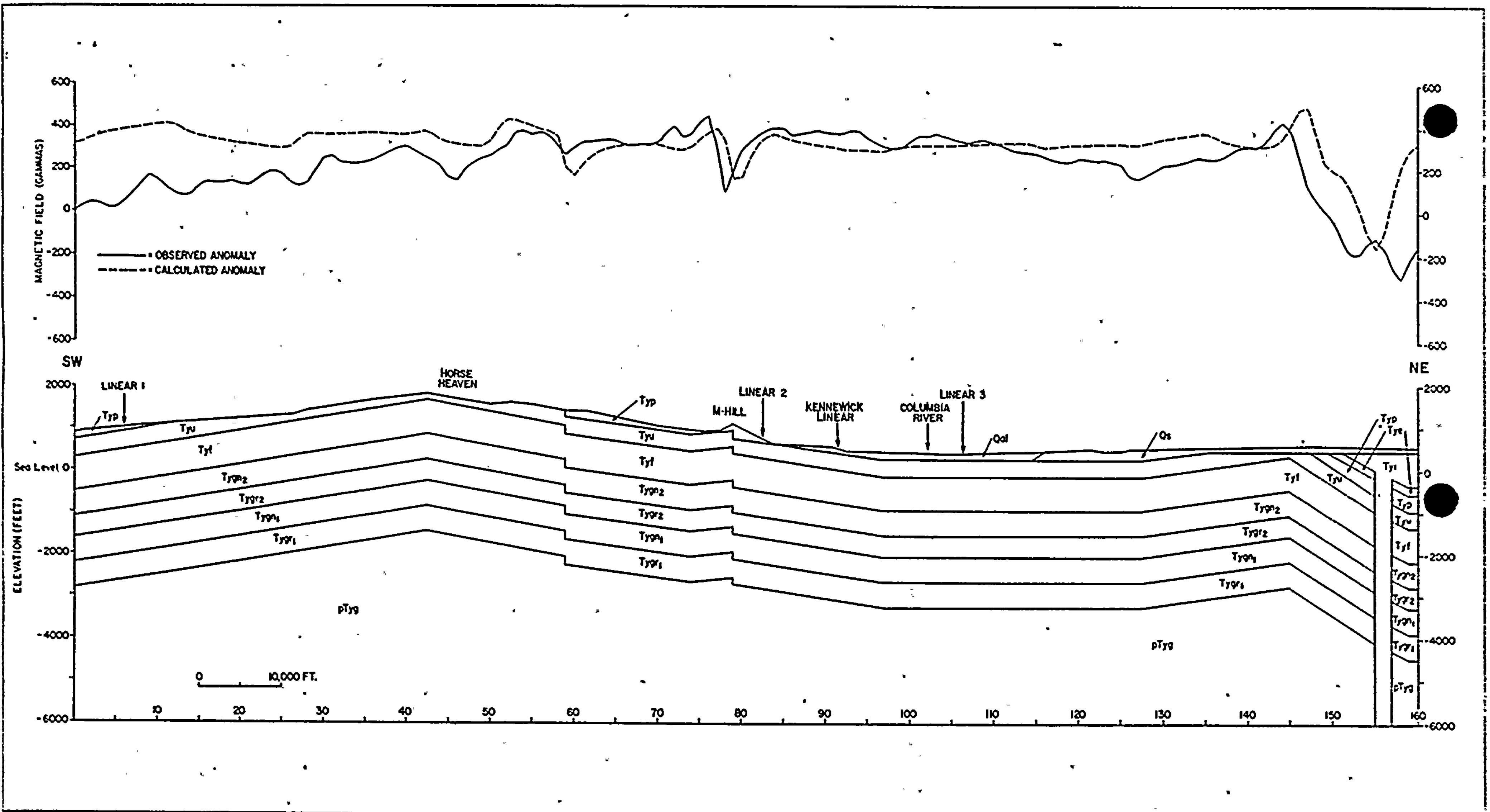
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	LOCATION MAP, MAGNETIC MODELS (WITH RESPECT TO AEROMAGNETIC LINEARS AND ANOMALIES) WALLULA GAP, WASHINGTON	FIGURE 8



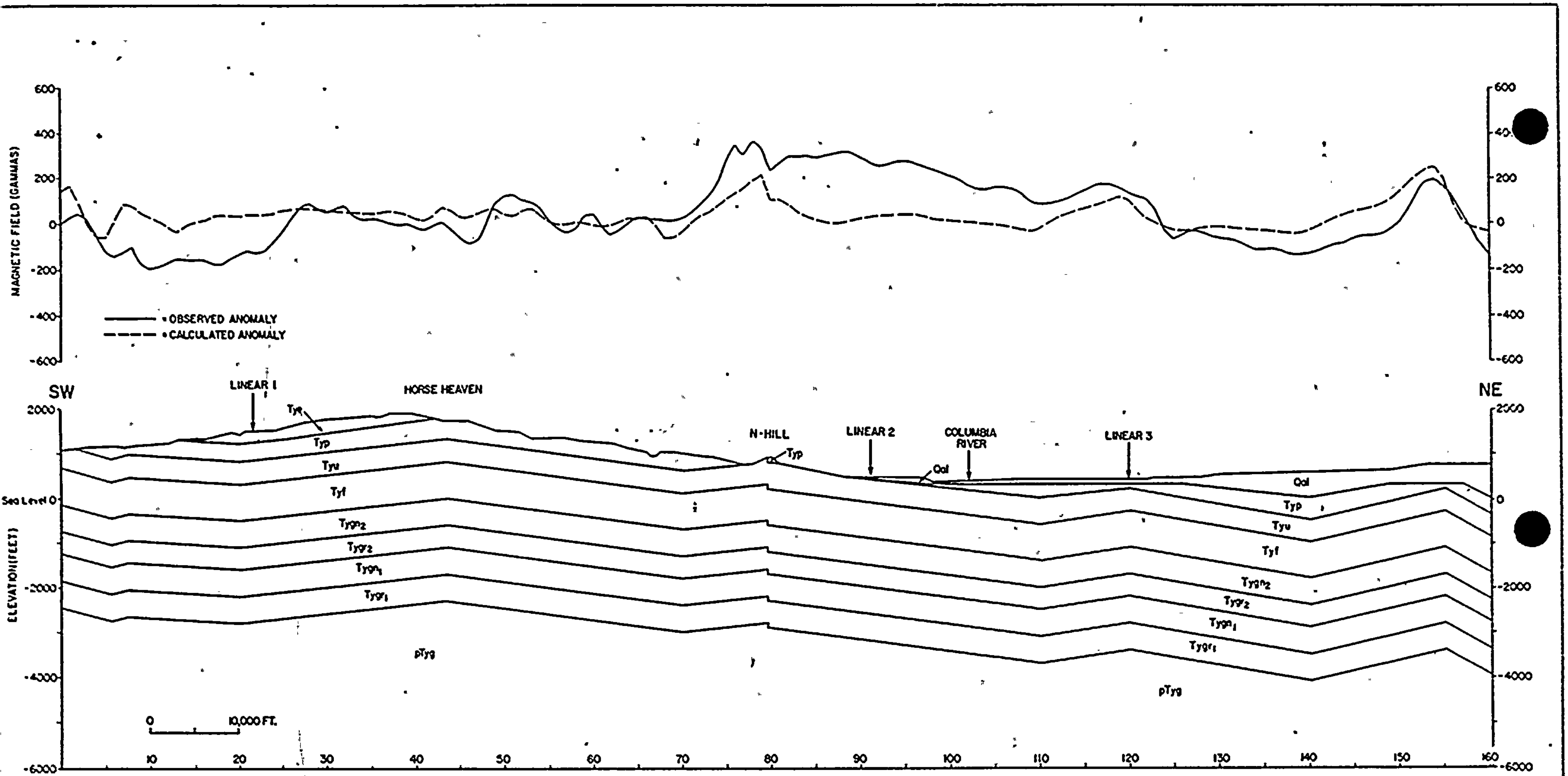
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GEOLOGIC PROFILE AND MAGNETIC PROFILES, LINE 370, HORSE HEAVEN HILLS, BUTTE, ICE HARBOR DAM, WASHINGTON	FIGURE 9



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GEOLOGIC PROFILE AND MAGNETIC PROFILES, LINE 450, HORSE HEAVEN HILLS, K. HILL, STRAWBERRY ISLAND, WASHINGTON	FIGURE 10



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GEOLOGIC PROFILE AND MAGNETIC PROFILES, LINE 510, HORSE HEAVEN HILLS, M. HILL, PASCO, WASHINGTON	FIGURE 11



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	GEOLOGIC PROFILE AND MAGNETIC PROFILES, LINE 570, HORSE HEAVEN HILLS, N. HILL, COLUMBIA RIVER, WASHINGTON	FIGURE 12

Q. 360.005

Some of the data and discussions in the FSAR of those Columbia Plateau structures relevant to the WNP-2 site are slightly different from the information provided in Amendment 23 to the WNP-1/4 PSAR (Docket Nos. 50-460 and 50-513). For example, with regard to the Wallula Gap Fault, your FSAR states that the "...probable fault movement occurred after the deposition of the Touchet beds, and thus less than 12,000 years ago." However, in Appendix 2R H.4 of the WNP-1/4 PSAR (Amendment 23), you indicate that the fault is older than the Quaternary Kennewick fanglomerate based on trenching. Additionally, in this same amendment to the WNP-1/4 PSAR, you indicate that the faulting along the Horse Heaven Hill Anticline occurred about 3.5 million years before the present (mybp). The WNP-2 FSAR does not discuss this particular point but, rather, questions the existence of faulting along the Horse Heaven Hill Anticline and indicates that it could be the sole result of folding. Clarify these apparent discrepancies and provide cross-references in the WNP-2 FSAR to the appropriate sections of the WNP-1/4 PSAR.

Response:

The low-level seismicity of the Columbia Plateau attests to ongoing deformation of the region, although in most areas seismicity is not associated with surface manifestations of faulting (Woodward-Clyde Consultants, 1980a, b). Surface faulting of Quaternary age, essentially unknown in 1977 at the time Amendment 23, WNP-1/4 PSAR and the WNP-2 FSAR were submitted, has since been recognized in two general areas of the Plateau: (1) Toppenish Ridge, approximately 80 km west of the WNP-1-2-4 sites (Campbell and Bentley, 1980) and (2) about 25 km southeast of the WNP-1-2-4 sites, from the vicinity of Wallula Gap on the Columbia River southeastward to the Walla Walla/Milton-Freewater area (Shannon and Wilson, 1979a, b, 1980). The two areas of deformation can both be related to Plateau structural elements, but they appear to have little in common and are geographically distinct.

In the Columbia Plateau of Washington, it is believed that most plateau folding and thrust faulting occurred after Elephant Mountain time (10.5 mybp) and before about 4 to 5 million years ago. The younger limit of this deformational interval is not as well defined as the older. In the Yakima

area, the entire Columbia River basalt sequence, including the Ice Harbor member of the Saddle Mountain Basalt, is generally folded conformably according to Bentley (1977). The Pliocene Thorp Formation, from which one tephra unit has been dated as 3.7 mybp (Bentley, 1977), may be represented by conglomerates on Manastash Ridge that were folded with underlying units. The most important folding on the Yakima Ridge appears to have occurred after deposition of the Elephant Mountain member. Deformation in the western part of the ridge appears to have ceased prior to the emplacement of a one-million-year old andesite flow (Tieton Andesite) in an erosional embayment across the north flank of the Yakima anticline. The flow exhibits neither faulting nor tilting.

Plio-Pleistocene Simcoe Lavas of unknown age (formational range 4.5 to 0.9 m.y., Shannon and Wilson, 1973) lie unconformably across fold and thrust structures of the Simcoe-Horse Heaven Anticline in south-central Washington. The lavas are cut by a northwest-striking fault with dextral slip. In the same general area of the plateau, a similar fault appears to cut a 4.5 m.y. old Simcoe flow, but is overlapped by a flow dated at 3.5 m.y. (Shannon and Wilson, 1973). Shannon and Wilson interpret the 4.5 to 3.5 m.y. old fault as being synkinematic with formation of the Columbia Hills and Horse Heaven Anticlines, but the most recent work by the U.S.G.S. suggests otherwise.

Campbell and Bentley (1980) report that the summit, north flank, and alluvial fans at the base of the north flank of Toppenish Ridge are broken by nearly 95 surface ruptures up to 9 km in length. Most of the ruptures are less than 1 km long. Six of the ruptures have lengths in excess of 3 km. The faulted zone varies in width from 0.5 to 2.2 km and has a length, more or less parallel to the ridge, of 32 km. Most flank and summit ruptures are sub-vertical faults for which no strike-slip displacement is evident. Faults at the base of the north-flank are lobate in plan-view and are interpreted as comprising a thrust zone coincident with the older south-dipping Toppenish fault. Some cut glaciofluvial slackwater deposits of Touchet type and others displace post-"Touchet" alluvial fans. Mt. St. Helens ash (12,800 y.b.p.) is present in some of the slackwater deposits, but has not yet been shown to be faulted. Campbell and Bentley (1980) attribute the Toppenish faults to north-south compression, with thrusting at the northern base of the anticlinal hinge zone. Bentley (personal communication, 1980) believes that the 30 km-long faulted segment of Toppenish Ridge may be terminated at its western and eastern ends by northwest-striking strike-slip faults. These bounding faults may be responsible in some way for localizing Quaternary rupture along the anticline.

To the east, faulting in the vicinities of Wallula Gap and the southern Walla Walla Valley near Milton-Freewater is apparently related to a zone of dextral transcurrent faulting (Shannon and Wilson, 1979a, b), that includes the topographically prominent Wallula fault. Bingham and others (1970) first noted features within the zone that suggested to them the possibility of Quaternary displacement. Recent studies (Shannon and Wilson, 1979a, b, 1980) indicate the involvement in faulting of late Pleistocene and/or Holocene units (including undated colluvium, Palouse Formation, Touchet Formation, and younger loess) at eight separate localities. The four westernmost localities lie within a 20 km-long segment of the Wallula fault zone. The most western of these localities is at Finley Quarry west of Wallula Gap on the northern end of The Butte. Two of the four eastern localities lie along faults in the Milton-Freewater area (Barrett and Milton-Freewater faults, Shannon and Wilson, 1979b) that are in general alignment with the Wallula zone farther west. These six localities could be considered as defining a linear zone of 55 km in length within which youthful, (late Quaternary) faulting has occurred. There is no evidence however, that this hypothetical zone is characterized by a single throughgoing faults, and some evidence exists to the contrary. No physical continuity between any two of the six on-trend fault localities can be demonstrated by field relationships.

The eight fault localities need to be kept in perspective, particularly the easternmost localities which might be considered to extend the length of the Wallula Fault zone of youthful faulting from 20 to 55 km. For example, at two of the eastern localities are small faults that dip northward at low angles (26° and 30°) and thus have geometric differences with faults in the Wallula zone. Apparent displacements on the two are both quite small. On one, the Buroker fault east of Walla Walla, the base of the late Pleistocene Palouse Formation is offset with a throw of approximately 0.5 meter (Shannon and Wilson, 1979b). South of Umapine near Milton-Freewater, small faults believed to relate to the larger, but inferred Barrett fault, cut Touchet beds and clastic dikes across them with a maximum offset of 0.5 meters (Shannon and Wilson, 1979b). However, clastic dikes also appear to cut the fault at the same locality. Youthful faulting 10 km farther to the southeast of the Umapine locality is suspected, but not documented. Shannon and Wilson (1979b) found angular basaltic debris in loess along the trace of an inferred bedrock fault. They suggest that the basalt fragments may have been derived from a fault scarp and were subsequently mixed with surficial loess deposits. At the fourth locality (Little Dry Creek fault south of Milton-Freewater), basalt and Palouse beds are down dropped along a steep (75°) northeast dipping fault of about 0.5 meters displacement. This fault lies south of an east-projected trace of the Wallula fault zone, and is not in alignment with it.

Some fault displacements within the Wallula zone are clearly pre-Holocene. Along one southerly strand of the zone near Yellepit, west of the Columbia River and southeast of The Butte, late Pleistocene Kennewick gravels (age ca. 55,000 y.b.p. Woodward-Clyde Consultants, 1978) overlie sheared and displaced basalts but are not themselves deformed (WNP-1/4 PSAR Amendment 23, Appendix 2R H.4). Collectively the eight documented or inferred cases of late Pleistocene or Holocene faulting at Finley Quarry and in areas to the east, support the contention that a zone of diffuse and discontinuous dextral strain extends southeastward across the Columbia Plateau into southeastern Washington and northeastern Oregon. The Wallula fault is a segment of that zone, but appears to lose surficial expression at both ends. The folded and faulted (The) Butte, west of Wallula Gap, is both the southeasternmost expression of the doubly plunging brachyanticlines associated with the Rattlesnake structure and apparently, the northwesternmost expression of the surficially continuous Wallula fault. Some recent workers studying the area (e.g. Shannon and Wilson, 1979a) have suggested that the isolated anticlines, which extend like beads in a string southeastward from Rattlesnake Mountain, lie above a deep-seated zone of limited displacement. No throughgoing surficial fault connects the anticlines and no Quaternary displacements have been reported northwest of Finley Quarry.

Although all the geologic and geophysical field work that was planned by WPPSS for 1979 has been completed, the process of synthesizing the data has not been completed. It is planned that all of the data collected since Amendment 23, and the WNP-2 FSAR, which were filed October, 1977, will be included and discussed more completely in a revised FSAR for WNP-1-2-4, scheduled for completion by late spring or early summer, 1980.

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