National Uranium Resource Evaluation

INVESTIGATION OF URANIUM POTENTIAL OF PRECAMBRIAN METASEDIMENTARY ROCKS, CENTRAL LARAMIE RANGE, WYOMING

FINAL REPORT

By: P.J. Graff, J.W. Sears, and G.S. Holden

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Casper, Wyoming 82601

January 1981

PREPARED FOR U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado

This report is a result of work performed by Research Associates of Wyoming, as a part of the National Uranium Resource Evaluation. NURE is a program of the U.S. Department of Energy's Grand Junction, Colorado, Office to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States.

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ABSTRACT

This study is directed toward evaluation of potential uraniferous quartz-pebble conglomerate occurrences or strata-bound uranium occurrences in the Laramie Range. Geologic investigations pursuant to that evaluation provide that metasediments in the central Laramie Range constitute an Archean greenstone belt which overlies remobilized granite-gneiss basement terrane of the Archean Wyoming Province. This greenstone belt is formed of branching arcuate, synformal keels of supracrustal rocks infolded and enveloped by granitic domes. The stratigraphic succession of the belt is a triad formed of lower mafic-ultramafic rocks including komatiites, middle mafic volcanics including pillow basalts, and an upper metasedimentary sequence composed of boulder paraconglomerates, graywackes, marbles, quartzites, pelites, thin quartz-pebble conglomerates and thin, banded iron formation.

Because the metasedimentary sequence does not contain a thick, mature clastic wedge, a thick fluvial section, basal quartz-pebble conglomerates, or significant geochemical or radiometric anomalies and because the sequence is structurally complex and regionally of amphibolite facies metamorphic rank, the potential for uraniferous fossil placers is considered nil.

Occurrences of other types may be indicated by radiometric and geochemical anomalies discovered over sheared zones within the granite-gneiss terrane and small radiometric anomalies over a coarse-grained phase of granite located north of the greenstone belt.

ACKNOWLEDGMENTS

We would like to express our thanks to Dr. Nick Theis, former project director, and to Mr. Jule Anderson, current project director, of Bendix Field Engineering Corporation. Their assistance in logistical and administrative matters and their constructive criticism of geologic considerations were indispensable in the preparation of this report.

Area ranchers and their familes provided us with trespass permission and many helpful discussions of local geology and history. The hospitality and aid which was extended to us on their ranches was greatly enjoyed and appreciated. We wish to thank each of them for their time and consideration.

Special thanks are due Mr. George Snyder of the U.S. Geological Survey, Denver, Colorado. Mr. Snyder shared his insight of the geology and his previous mapping of metasediments in the Laramie Range and greatly enhanced the field work portion of this study.

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INTRODUCTION

SCOPE AND PURPOSE

This study is part of the United States Department of Energy's National Uranium Resource Evaluation (NURE) program to understand the geologic setting, amount and availability of uranium resources within the boundaries of the United States. The systematic study of Precambrian quartz-pebble conglomerates and terranes that may contain those conglomerates is of particular importance to an evaluation program because uranium deposits containing extremely large reserves occur in such terranes in Canada and South Africa. Since large areas of Precambrian rocks in the United States have not been fully assessed for uranium potential and because of the existence of favorable Precambrian terranes within the United States, this project (Figure 1) was undertaken to assess Precambrian metasedimentary rocks in the Laramie Range for the favorability of containing uranium deposits in quartz-pebble conglomerates.

Rocks of interest to this study comprise a thick sequence of Early Precambrian metasedimentary rocks which are exposed in the central part of the Laramie Range, Wyoming. Prior to this investigation these rocks were known to contain thin layers of radioactive quartz-pebble conglomerate and thick layers of metapelitic and amphibolitic rocks; however, detailed geology of the sequence and its fit to the model described for uraniferous conglomerates (Houston and Karlstrom, 1980) was not known. The primary goal of the Laramie

Range Project is to determine how well this Precambrian sequence resembles rocks containing known deposits and to describe its favorability for the occurrence of placer uranium deposits.

JUSTIFICATION

Early Proterozoic-type quartz-pebble conglomerate sequences (Houston and Karlstrom, 1980) contain some of the world's most important mineral deposits. Two such sequences, the Huronian Supergroup in the Blind River-

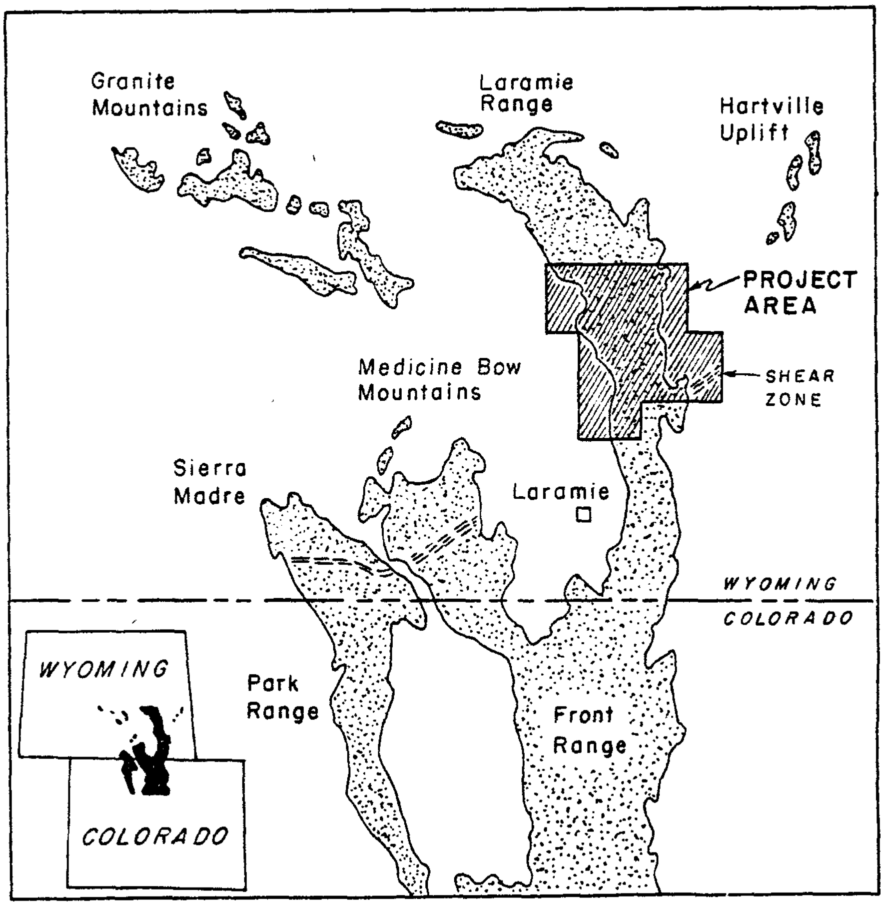

Figure 1. Location of the project area and Precambrian rocks in southeast Wyoming and northeast Colorado.

Elliot Lake area of southern Canada and the Witwatersrand area of South Africa have produced more than 200,000 tons of U_3O_8 (Robertson, 1976; Ninninger, 1974). In addition, the Witwatersrand mines have produced about 55% of all the gold ever mined, currently supply about 65% of the world's annual production and still probably contain the world's largest reserves of gold (Pretorius, 1976).

Recent reports of uraniferous quartz-pebble conglomerates in the Sierra Madre and Medicine Bow Mountains of southern Wyoming (Lanthier, 1978; Graff, 1978 and 1979; Houston and Karlstrom, 1980) describe thick sequences of Archean and Proterozoic clastic rocks which are quite similar to those of Canada and South Africa. Graff (1978) and Houston and Karlstrom (1980) have presented possible correlation schemes for Proterozoic and older metasedimentary sequences that occur in southern Canada and the northern and western United States. In the Wyoming Province (Engel, 1963; Karlstrom, 1979) these mature clastic rocks lie north of a major crustal feature, the Mullen Creek-Nash Fork shear zone, and appear to be a part of an extensive near-shore clastic wedge. If the lower units of this clastic wedge were formed by the same or similar braided streams and if their extent is limited to the continental edge defined by the Mullen Creek-Nash Fork shear zone, then investigation of other supracrustal sequences along that boundary is the next logical step in the search for other uraniferous quartz-pebble conglomerates.

The Laramie Range contains a supracrustal sequence which lies north of the crustal suture that defines the edge of the Archean Wyoming Province.

This sequence occurs some 75 km northeast of, and on structural trend with, the uraniferous quartz-pebble conglomerates of the northern Medicine Bow Mountains. Because of this, and the fact that a radioactively anomalous quartz-pebble layer was known to occur within supracrustal rocks near Slate Creek, this investigation was undertaken to define the metasediments of the central Laramie Range and to describe their favorability for containing significant uranium deposits of fossil placer origin.

URANIFEROUS QUARTZ-PEBBLE CONGLOMERATE MODEL

The model for uraniferous quartz-pebble conglomerates has been developed from geologic investigations performed on Precambrian metasedimentary sequences in Canada, South Africa and Wyoming and from studies of the Precambrian evolution of the lithosphere, hydrosphere, atmosphere and biosphere. This model is first presented by Roscoe (1969) as an outgrowth of his work on the Huronian Supergroup of southern Canada. The model evolved with significant reappraisals by Roscoe (1973) and Robertson (1976). However, its most current and complete form, and in which context it is used here, is presented in Houston and Karlstrom (1980). The review of the quartz-pebble model presented here deals only with those portions of the model that are directly applicable to the supracrustal sequence of the central Laramie Range. A critical element of the model is the depositional age of the conglomeratic host strata. Work done by Roscoe (1969) in southern Canada established that uraniferous quartz-pebble strata and associated clastic rocks of the Huronian Supergroup were deposited during Early Proterozoic time (2.2 to 2.5 b.y. ago). Although this assignment is justified for the Huronian Supergroup and establishes a minimum age of deposition for uraniferous fossil placers, we know that other uranium-bearing clastic sequences transcend the chronologic boundary of 2500 m.y. ago for the end of Archean time. For example, the lowest portion of metasedimentary rocks in the Witwatersrand district, the Pongola Sequence, is older than 3000 m.y. (Van Eeden, 1972) and contains uranium. In the Snowy Range Supergroup (Graff, 1978) of Wyoming some of the uraniferous conglomerates are older than about 2700 m.y. (Carl Hedge, pers. comm.).

Known deposits of fossil placer origin are thus bracketed in age between 2.2 and 3.0 b.y. ago. The younger age appears to be dictated by the evolution of the atmosphere. The facts that the chief detrital uranium mineral in these deposits is uraninite containing uranium in the +4 (reduced) state and that uranium is an extremely oxiphylic element require an oxygen-poor atmosphere during the weathering, transport, and deposition of uranium in fossil placers.

Arguments for the evolution of O_2 in the atmosphere are well conceived and carefully derived. Lines of evidence for such evolution are presented in Ruby (1955), Lepp and Goldich (1964), Cloud (1968 and 1972) and are reviewed by Cloud (1978) and Houston and Karlstrom (1980). A summation of the lines of evidence for a low O_2 Archean atmosphere is provided in Figure 2. This figure, first suggested by S. S. Goldich (pers. comm.), includes biological, mineralogical, and lithological evidence for an oxygen-poor early atmosphere. Although no scale for absolute amounts of oxygen in the atmosphere is intended or implied in Figure 2, Cloud (1978, p. 156) suggests that the atmospheric level of O_2 reached about 1% around 2000 m.y. ago. The oxygen level curve (Figure 2) simply shows low levels of O_2 throughout Precambrian time and an exponential rise in the amount of O_2 since the advent of multicellular life.

Because known deposits and occurrences are in rocks that are older than 2000 m.y., it is the amount of oxygen in the atmosphere at that time that appears to be the limiting factor for deposition of uraniferous conglomerates. After 2000 m.y. ago sufficient oxygen was available to oxidize uranium to the U^{+6} state during weathering and transportation. In this oxidation state uranium is soluble and would not be concentrated as a placer mineral.

Although minimum age of formation is rather clearly defined by evolution of the atmosphere, the maximum age of deposition of uraniferous

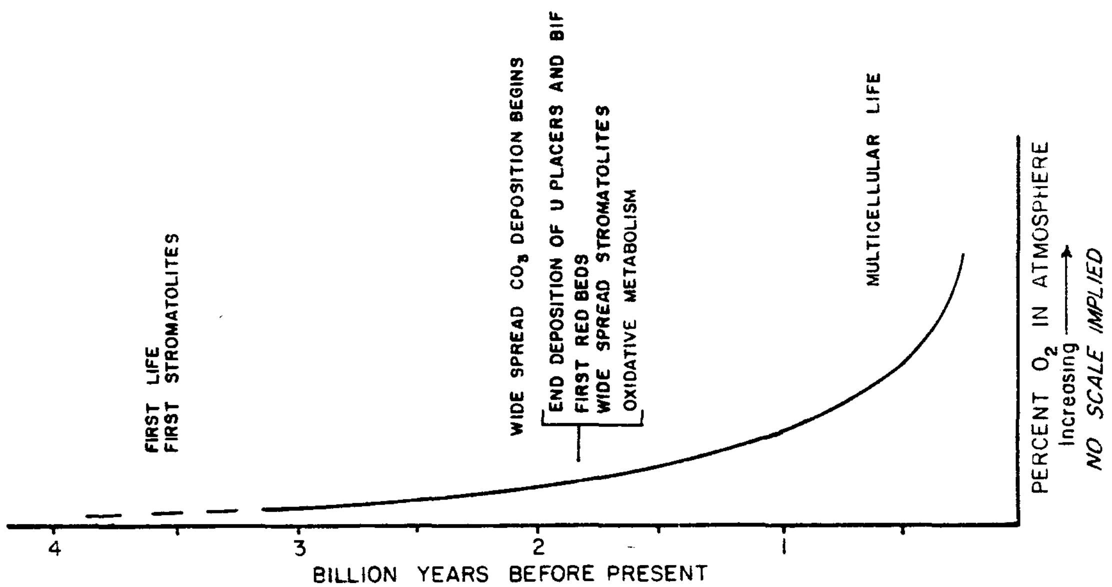

Figure 2. Significant events in the evolution of oxygen-rich atmosphere. Modified from S. S. Goldich (pers. comm.).

fossil placers is not so well understood but may be determined by two factors. First, the achievement of crustal stability for the craton on which the supracrustal sequence lies and secondly, by the evolution of a suitable source rock for the uranium contained in the supracrustal rocks.

The long standing argument over primary mafic or original sialic crust will not be discussed here. For those arguments the reader is referred to Anhaeusser (1973), Anhaeusser and others (1969) and Glikson (1976) who believe that early greenstone belts may preserve original mafic crust, and also to authors such as Hunter (1974), Moorbath (1975) and Windley (1977) who believe high-grade gneisses may be basement for the early greenstone belts.

Whatever the character of primary crust, isotopic evidence supports the concept that stable high-grade gneiss terranes existed as early as 3800 m.y. ago (Goldich and Hedge, 1974; Moorbath, 1975). Although ancient gneisses represent stable areas within the craton since the early Archean, they do not themselves appear to be good source areas for the uranium in fossil placers. Lambert and Holland (1976) report very low Th and U and low Pb and Rb in the Amitsoq Gneiss of Greenland which is about 3800 m.y. old. Analyses of 17 samples reveal a relatively low average K_2O value of 2.98% and K/U ratios that range from 11000 to 100000. Low Th, U, K, and Rb values may be the result of incomplete crustal differentiation at the time of formation of the Amitsoq Gneiss, or the result of metamorphic conditions in the early history of those rocks (Heier, 1973). In very general terms, low uranium content characterizes ancient gneisses which formed before 3000 m.y. ago.

Between 3800 and 3000 m.y. ago extensive ultrabasic and basic volcanism formed the early greenstone belts which are preserved in such rocks as the Malene supracrustals of west Greenland and the lower Onverwacht volcanics of South Africa. These sequences contain clastic sediments in their upper portions but these clastics are immature, flyshoid sediments. Banded iron formations (BIF) in these belts are probably the result of volcanic exhalations rather than fluvially transported iron. These sequences are poor candidates for uraniferous quartz-pebble conglomerates.

About 3000-2800 m.y. ago a world-wide plutonic event occurred that is marked by the intrusion of the first K-rich granites into shield areas. This event may involve the first major reworking of existing continental crust and may have concentrated potassium and ionically similar-sized elements. Although juvenile magmas were still being added to cratons after 3000 m.y. ago, before that time the continental crust was probably not thick enough or dry enough to produce either granulite facies rocks or extensive granitic partial melts (Moorbath, 1975). K-rich granites continued to intrude cratonic areas until about 2500 or 2600 m.y. ago, and diachronous development of the late greenstone belts occurred. Together these rocks form the classic granite-greenstone terranes of the Superior Province of Canada and such K-rich granites contain the necessary "normal" (Roscoe, 1969) crustal amounts of uranium required to be a source rock for fossil placer uranium deposits.

The end of Archean time, about 2500 m.y. ago, was marked by crustal stability of the cratonic masses. While the Archean Eon was characterized by high mobility of crustal material, steep geothermal gradients, and deposition of greenstone belts, the advent of Proterozoic time is marked by three notable occurrences: 1) concentration of high heat flow along linear mobile belts adjacent to and perhaps within cratonic blocks; 2) extensional fracturing of the rigid crust and the emplacement of dike swarms; and 3) deposition of quartz-rich clastic platform sediments in intra- and inter-cratonic basins. The transition from geologic processes dominant during the Archean Eon to those which dominate Proterozoic time can be regarded as a result of a general and gradual increase in the thickness and rigidity of the sialic cratons and as such, cannot be characterized as a sharp time boundary. For that reason, a considerable temporal overlap for the events cited here is not unexpected and does indeed exist. Once it has been achieved, long term crustal stability may have played a significant role in protection of quartz-pebble conglomerate occurrences after their formation. Uranium producing quartz-pebble conglomerates in southern Canada and South Africa are characterized by low metamorphic rank (greenschist facies), and gentle, open folds and faults having small displacements. Thus deposits may have been protected from high temperature intraformational waters and flushing reactions as well as from intense deformation, the creation of fracture porosity, and percolating waters near major faults by the stability of the Archean craton in the areas underlying and surrounding the clastic wedges.

Houston and Karlstrom (1980) describe stratigraphic successions that are most favorable as exploration targets for uranium-bearing quartz-pebble conglomerates. These favorable sequences contain a high percentage of sandstone, conglomerate, shale, and carbonates and minor proportions of volcanic rocks. Houston and Karlstrom (1980) conclude that favorable sequences may also:

1) lie unconformably on Archean granite-gneiss terranes which may contain infolded greenstone belts;
2) overlie earlier sedimentary sequences which contain greater than 50% interbedded volcanic rocks;
3) contain thick banded iron formation and stromatolitic dolomite beds in the upper parts, but these are seldom in contact with uranium-bearing conglomerates; and
4) include conglomerate-based fining-upward cycles of sedimentation which are dominated by fluvial processes of deposition.

PROCEDURES

After preliminary literature studies, field investigations of the Laramie Range metasediments were conducted from May to October, 1980. Field work directed at the determination of fossil-placer uranium potential included:

1) reconnaissance field mapping of the metasedimentary sequence (Plates 1 and 2);
2) radiometric surveys of metasedimentary bodies (Plate 3 and Appendix I);
3) sampling the metasedimentary sequences for geochemical survey (Plate 3 and Appendix II);
4) a description of the stratigraphic column and classification of the metasedimentary sequence; and
5) a comparison of the geology of the Laramie Range metasediments to the geologic requirements of the quartz-pebble model (Table 1).

Mapping was completed by traversing on foot, compilation of previous studies and interpretation of air photographs. Geochemical analyses were performed by

Union Carbide Analytical Laboratories, Oak Ridge, Tennessee, and were done chiefly by neutron activation methods. Radiometric surveys of total gamma, K, U, and Th gamma radiation were conducted using hand-held Eurtec 135 mini-spec differential gamma-ray spectrometers.

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REGIONAL GEOLOGIC SETTING

INTRODUCTION

Precambrian rocks of southeastern Wyoming can be divided into the following groups: Archean granite-gneiss complex, Archean supracrustal rocks, Early Proterozoic-type sequences (Houston and Karlstrom, 1980), Proterozoic amphibolite terranes, and Proterozoic intrusive rocks. These groups are separated into two distinct geologic provinces (Figures 3, 4, and 5) by a major structural feature, the Mullen Creek-Nash Fork shear zone (Houston and McCallum, 1961; Houston and others, 1968). The Wyoming Province consists of the Archean granite-gneiss complex, Archean supracrustal rocks and the unconformably overlying Early Proterozoic-type sequences. These groups lie north of the Mullen Creek-Nash Creek shear zone. South of the shear zone Precambrian rocks consist of Proterozoic-aged amphibolite gneisses and intrusive rocks.

The Mullen Creek-Nash Fork shear zone is a crustal suture that represents the collision of an Early Proterozoic island arc system with the cratonic rocks of the Wyoming Province. Formats for the tectonic systems involved in this collision are presented by Graff (1978) and Hills and Houston (1979). This suture juxtaposes different crustal levels and has a displacement of more than 10 km in a vertical sense (Hills and Houston, 1979) and perhaps hundreds of kilometers in a horizontal sense. The shear zone marks the southern-most exposures of Archean and Early Proterozoic-type rocks.

Age of movement on this suture is determined by the radiometric ages of granites that bracket movement along the shear zone. Hills and Houston (1979) summarize movement on the shear zone as having occurred between 1730 and 1640 m.y. before present. This boundary has been recognized for some time in the Medicine Bow Mountains (Houston and others, 1968) and extends westward through the Sierra Madre. Eastward extension of the zone has been projected to the Laramie Range (Houston and others, 1968; Karlstrom, 1979; Hills and Houston, 1979) where the younger (1435 m.y. old, Subbarayudu, 1975) Laramie Anorthosite-Syenite complex and the 1420 m.y. old (Subbarayudu, 1975) Sherman Granite have intruded the area where the shear zone should be exposed. During field studies for this report cataclastic migmatites were recognized in the Richeau Hills area east of the anorthosite body. The sheared rocks of the Richeau Hills are herein correlated to those of the Mullen Creek-Nash Fork shear zone. This correlation reinforces the earlier projection of

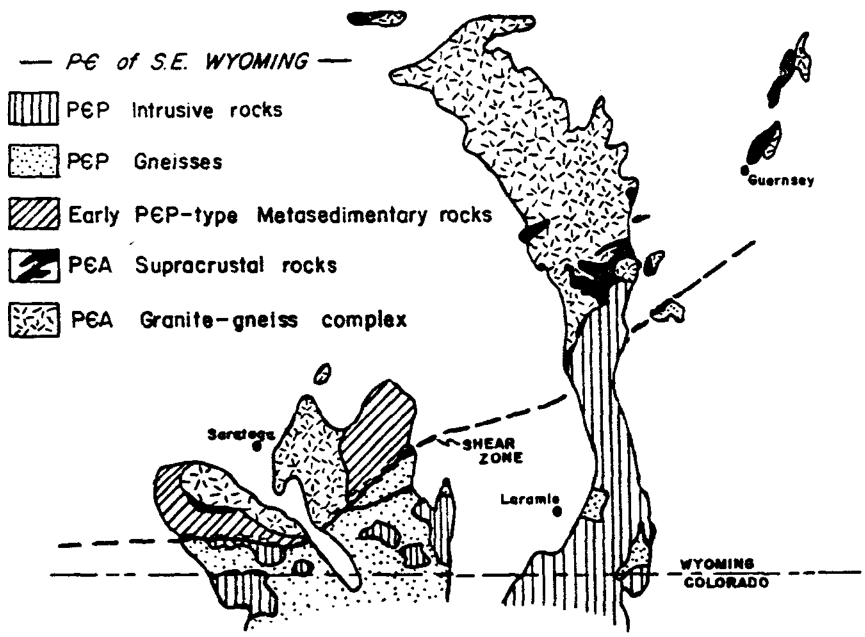


Figure 3. Precambrian terranes of southeast Wyoming.

the shear zone by Karlstrom (1979) and Hills and Houston (1979).

Rocks south of the Mullen Creek-Nash Fork shear zone are composed of 1.7-1.8 m.y. old amphibolite gneisses (Peterman, Hedge and Braddock, 1968), 1.8-1.6 m.y. old mafic intrusive complexes (G. L. Snyder, pers. comm.), 1.7-1.6 m.y. old granites (Hills and Houston, 1979) and 1420 m.y. old Sherman Granite (Subbarayudu, 1975).

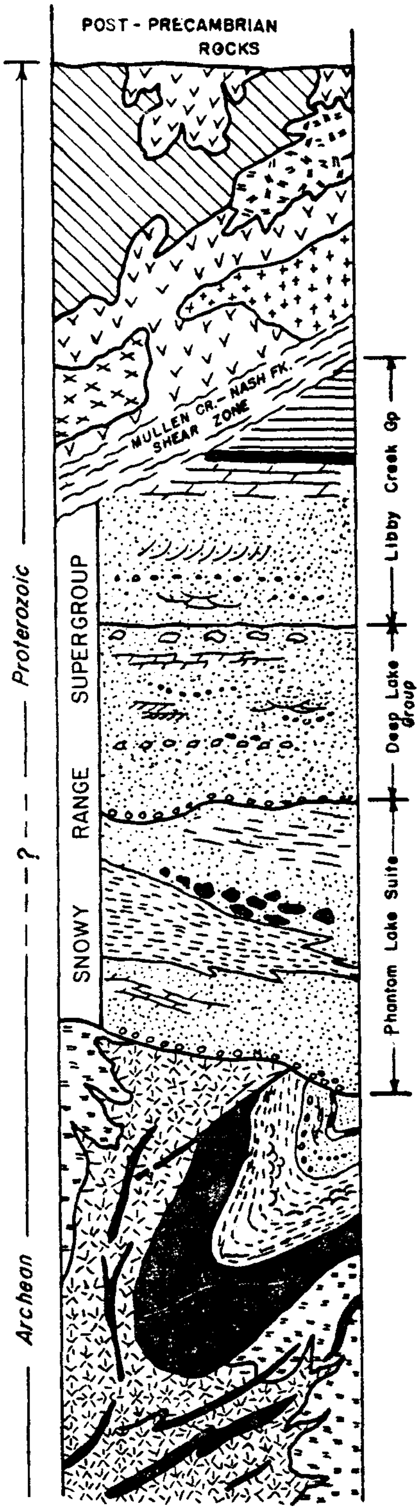
The oldest rocks south of the shear zone are amphibolite gneisses and metasediments that date at about 1.8 b.y. old (Peterman and Hedge, 1968) and are intruded by mafic igneous rocks at 1781 m.y. ago (Snyder, 1980). These gneisses and metasediments are described by Snyder (1980) as amphibolitic gneisses and metapelitic rocks that were most likely deposited in a back-arc basin and which were derived chiefly from the volcanic arc (Graff, 1978; Hills and Houston, 1979). Syn- and post-kinematic granites, 1.7-1.6 b.y. old, intrude the amphibolitic gneisses and range in composition from granodiorites to granites. In the Laramie Range these gneisses and metasediments are preserved as large, mappable inclusions (Darton and others, 1910) in the Sherman Granite. In this report the sheared migmatites of the Richeau Hills are correlated with the 1.8 b.y. old amphibolitic gneisses of the Front Range (Peterman and Hedge, 1968).

The Laramie Anorthosite-Syenite Complex is younger than the Mullen Creek-Nash Fork shear zone and has apparently destroyed the geologic record of such shearing in the area intruded by this complex. The youngest Precambrian rock south of the shear zone is the 1.4 b.y. (Hills and Houston, 1979)

Sherman Granite. The Sherman is unsheared where it is exposed about a kilometer from, and on strike with, sheared migmatites of the Richeau Hills. Because these rocks are younger than about 1.8 b.y. and are of volcanogenic and intrusive origins, they do not in any way fit the prescribed model (Houston and Karlstrom, 1980) and are here dismissed from further consideration as host rocks for uraniferous fossil placers.

Archean age rocks of the Wyoming Province occur only north of the boundary defined by the Mullen Creek-Nash Fork shear zone (Figure 4). These rocks include gneissic terranes, Late Archean granites and supracrustal sequences. Granite-gneiss terranes are complexly intermixed plagioclase-quartz-biotite gneisses which are probably paragneisses that have been invaded by Late Archean granites. The K-poor paragneisses have been radiometrically dated as about 2900 m.y. old (Peterman and Hildreth, 1977; Divis, 1976) but with high Sr^{87}/Sr^{86} initial ratios which suggest that these gneisses represent metamorphosed clastic-sedimentary piles. Peterman and Hildreth (1977) suggest that if the high Sr^{87}/Sr^{86} initial values are projected to an assumed initial ratio that is reasonable for igneous rocks, then an original date of crystallization, or separation from a mantle source, of more than 3200 m.y. ago is indicated. These gneissic complexes are depositional basement for ensialic and Archean supracrustal piles.

The gneissic terrane was invaded by large granite batholiths about 2550-2650 m.y. ago. Emplacement of the K-rich granites was a doming event that folded supracrustal sequences deposited on the early gneisses. These Late Archean granites are in part anatectic and Stuckless (1979) calculates



Proterozoic Gneisses and Intrusive Rocks. Amphibolitic gneisses and metasedimentary rocks of volcanogenic origin which have been invaded by (oldest to youngest) mafic igneous complexes, Syn- and post-kinematic granites, Laramie Anorthosite-Syenite Complex and the Sherman Granite.

Libby Creek Group. Shales, greenstone and carbonate rocks underlain by nearshore marine clastics.

Deep Lake Group. Fluvial quartzite rock with minor amounts of carbonate, shale, and paraconglomerate (tillites?). Basal uraniferous quartz-pebble conglomerate.

Phantom Lake Metamorphic Suite. Dominantly quartzite and volcanic rock. Volcanics include amphibolite schists and garnet amphibolite gneisses. Clastics include quartzite and shales with minor amounts of carbonates, granite-boulder paraconglomerates, and basal (?) uraniferous quartz-pebble conglomerate.

Archean Granite-Gneiss and Supracrustal Rocks. Quartz-plagioclase-biotite and hornblende gneisses intruded by K-rich granites between 2700-2550 m.y. ago. Infolded greenstone belts included mafic and ultramafic rocks, basalts, pillow basalts and andesitic volcanics, and conglomerates, quartzites, calc-silicates and marbles, banded iron formation and metapelites. Mafic dikes are of several ages.

Figure 4. Schematic stratigraphic column for Precambrian rocks, southeast Wyoming.

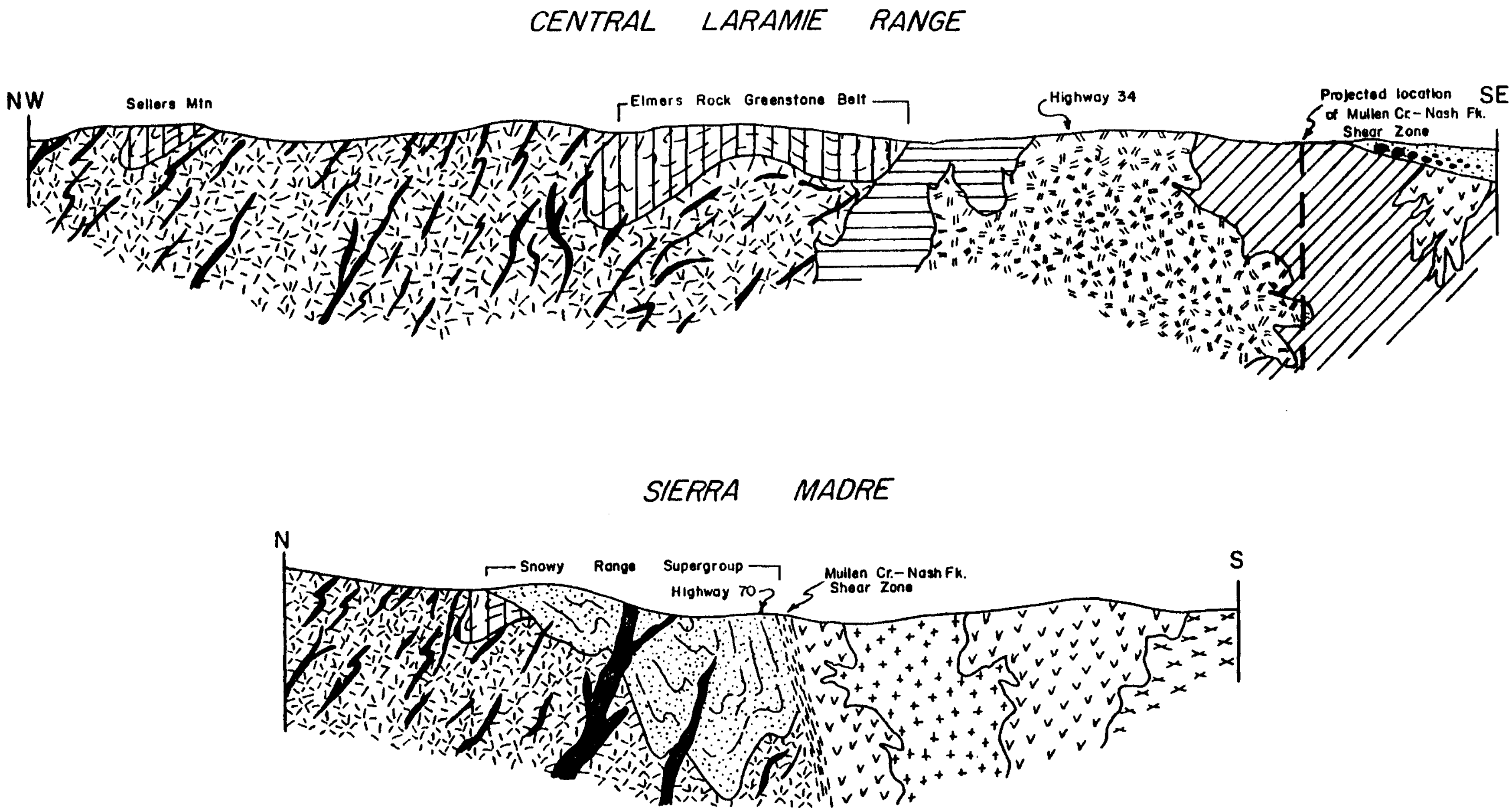
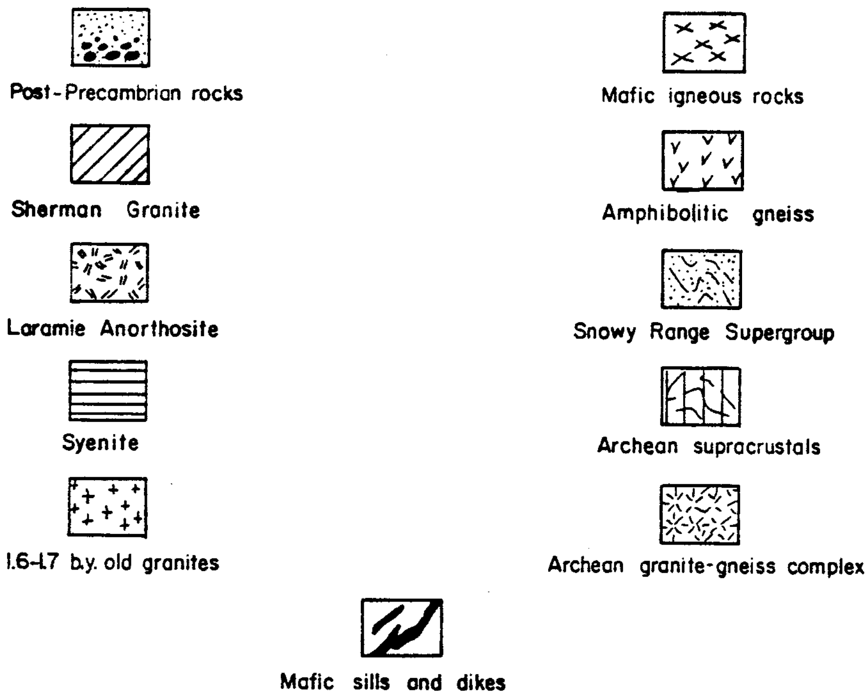


Figure 5. Schematic cross-sections of the Sierra Madre and central Laramie Range.

EXPLANATION FOR FIGURE 5



that, at the time of emplacement, uranium in these granites exceeded that in typical granites. Such concentrations may describe these Late Archean granites as excellent source rocks for the uranium and thorium found in the conglomerates of the ensialic sequences at the southern edge of the Archean craton.

Deposited on and folded into the Archean granite-gneiss complex terrane are supracrustal sequences that form greenstone belts. Such belts are described in the central part of Wyoming by Bayley (1963) and Condie (1976) and also occur in the Sierra Madre and Laramie Range. The greenstone belt in the central Laramie Range contains lower mafic and ultramafic volcanic rock, middle amphibolites and metabasalts, and an upper section of conglomerates, graywackes, marbles, iron formations and metapelites. These belts are folded into arcuate, locally overturned, synclinal keels that are preserved between domes of granitic rock. Sediments exposed in the greenstone belts are immature and indicate deposition in a rapidly subsiding trough. Mature fluvial rocks are absent.

Overlying the granite-gneiss complex and greenstone belts along the southern edge of the Wyoming Province is a clastic wedge more than 16 km thick (Hills and Houston, 1979). This sequence, the Snowy Range Supergroup (Graff, 1979), contains Archean and Early Proterozoic metasedimentary rocks which can be divided into four sedimentation units. Each of these units is a fining-upward sequence which contains a basal conglomerate. The lower two cycles contain basal uraniferous quartz-pebble conglomerates while the upper two cycles are based on paraconglomerates that may be of glacial origin and which are not radioactive. Cycles are formed of thick sequences of clastic sedimentary rocks which are dominated by fluvial quartzites.

STRATIGRAPHY

Introduction

Rock units exposed in the central Laramie Range range from Archean metasediments and gneisses to middle Proterozoic igneous complexes. These units can be divided into three groups and are presented in the column seen in Figure 6. These groups are: 1) granite-gneiss complex, 2) Archean supracrustals, and 3) Proterozoic intrusive and cataclastic rocks. Because the intrusive and cataclastic rocks of Proterozoic age do not fit the model criteria of age, lithology, or depositional environment for quartz-pebble conglomerates as hosts or source rocks for such deposits, they will not be discussed here.

Granite-Gneiss Complex

The oldest rocks in the central Laramie Range are gray, quartz-plagioclase - biotite gneisses which form a migmatite terrane. Inclusions of this gneiss which vary greatly in size and degree of assimilation are present in the granite phases that are involved with the doming event. Prior to that intrusion these gneisses were isoclinally folded and ductily sheared and were probably basement for deposition of the supracrustals of an Archean greenstone belt. Migmatites of the central Laramie Range probably correspond to migmatites in the northern Laramie Range that have been dated as about 3000 m.y. old (Johnson and Hills, 1976). Petrographic analysis suggests that the migmatites are K-poor rocks which contain only minor amounts of microcline and muscovite.

Granites and quartz monzonites that intrude the basement gneisses can be divided into equigranular and porphyritic phases. Both phases occur in massive and foliated habits. Foliation in the granites is concordant with the contact of greenstone belt rocks and contains locally developed mylonites immediately adjoining the contact. This deformation has everywhere destroyed the original relationship of basement and supracrustal rocks. Intrusion of the granites may have been as sheet-like bodies that domed in response to gravitational instability. Solid-state doming of granite bodies is suggested by the lack of migmatites near granite-greenstone contacts. Only small, local inliers of granites and small dikes of felsic gneiss (or metamorphosed felsic sediments) occur within the supracrustals. These granites are K-rich rocks that form one point on a Rb/Sr 2.54 b.y. isochron developed by Hills and Armstrong (1974) for granite rocks of the Laramie Range. Given the relationship to the supracrustal rocks, the 2540 m.y. old date becomes a minimum age for the supracrustals.

Kennedy Dike Swarm

The granite-gneiss complex is intruded by a mafic rock of highly variable composition. These dikes include pristine ultramafic bodies, diabases, ophitic diabases, amphibolites and metamorphosed mafic bodies. Their emplacement in areas near the Kennedy School of the Bull Camp Peak Quadrangle constitutes a dike swarm and is herein named the Kennedy Dike Swarm. Larger bodies within the swarm are less metamorphosed and retain original igneous textures in the center portions and are foliated only along the contacts with granite rocks.

Petrographic analyses of ultramafic dikes yield 5-45% pyroxene, 10-45% plagioclase and 0-85% olivine. Dike compositions range from ultramafic to amphibolites containing as much as 60% hornblende. Metamorphosed dikes contain strongly foliated zones with ophitic textures preserved between sheared areas and pyroxenes are altered to clinozoisite, epidote and hornblende. Unmetamorphosed ultramafic dike material includes olivine cumulates with olivine grains exhibiting corona structures of pyroxene.

Elmers Rock Greenstone Belt

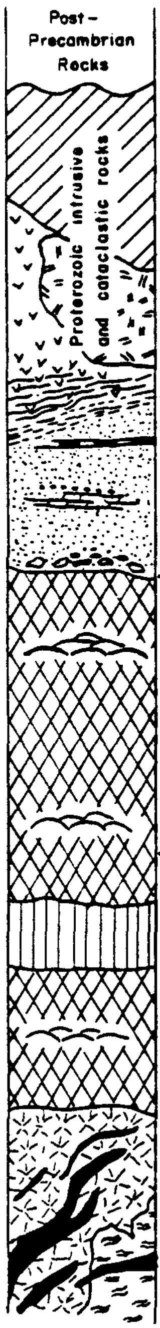
Supracrustal rocks of the central Laramie Range occur as synformal bodies of rock exposed between domes of the Archean granite-gneiss complex. The largest contiguous body of supracrustals occurs in the drainages of Bluegrass and Slate Creeks and spans the width of the Laramie Range. This body, herein named the Elmers Rock Greenstone Belt, is bound to the north by the granite-gneiss complex and is truncated on the south by the Laramie Anorthosite-Syenite Complex. Outliers of this body, or portions of separate similar bodies, occur at Sellers Mountain along the border zone of the Laramie Batholith (Condie, 1976), at Johnson's Mountain, at Marble Quarry Creek, and just north of Wheatland Reservoir Number 2. Stratigraphy and structure of these outlying bodies are compatible with the main body of Elmers Rock Greenstone Belt and the discussion below applies to all occurrences listed above.

The age of the greenstone belt is greater than 2.54 b.y. which is the age determined for granites which dome and fold the supracrustals (Hills and Armstrong, 1974). Cobbles of the gray quartz-biotite-plagioclase gneiss which occur in paraconglomerates within supracrustals are similar to the gray gneiss of the migmatite terrane. Cobbles of gray gneiss and gray gneiss of the migmatite terrane are here correlated to the 3020 m.y. old gneiss (Johnson and Hills, 1976) of the northern Laramie Range. If this correlation is valid then the age of the belt is between about 2540 and 3020 m.y.

The supracrustal sequence can be divided into two groups (Figure 6), lower mafic, ultramafic and amphibolite rocks and an upper group of metasedimentary rocks. The belt is dominated by amphibolites of igneous or volcaniclastic origin comprising about 60-70% of outcrop area. The metasedimentary rocks are chiefly metapelites with lesser amounts of marble, quartzite, conglomerate and other immature sediments.

The lower group is comprised of a monotonous sequence of layered hornblende schists and gneisses that is several kilometers thick. Amphibolites within this sequence are platy to massive, fine- to coarse-grained rocks that range from basaltic to andesitic in composition. In general they are hornblende and plagioclase rocks containing some quartz, sphene and cummingtonite suggesting a rather mafic original composition. Rocks north of Bluegrass Creek which are low in the section appear to be the most mafic in character. Pillow structures are identified by compositional zoning in ovoid forms and evidence

STRATIGRAPHIC SUCCESSION
ELMERS ROCK GREENSTONE
BELT, WYOMING



- Elmers Rock Greenstone Belt. Upper portion contains metapelites, banded iron formation, quartzite, marble, granite-boulder paraconglomerate, graywacke and minor amounts of volcanic rock.

- Middle portion includes felsic volcanics and metatuffs, calc-alkaline volcanics, pillow basalts, volcaniclastic sedimentary rocks, and metabasalts.

- Lower portion is composed of metabasalt, pillow(?) basalts and ultramafic flows or sills which are now metamorphosed to actinolite-chlorite rock.

- Archean Granite-Gneiss Complex. Gray, quartz-biotite-plagioclase gneisses and migmatites intruded by granites. Granites are K-rich and occur in equigranular and porphyritic phases. These are intruded by mafic dikes and ultramafic dikes and sills.

Figure 6. Schematic stratigraphic column of the rocks of the central Laramie Range, Wyoming.

subaqueous deposition for at least some of the flows. Mafic amphibolites contain a pervasive hornblende lineation which is generally down the dip of schistosity.

Within the flow sequence are numerous unlayered irregular amphibolite bodies which may have originally been gabbroic intrusions but contact relationships are not preserved. Intercalated with the amphibolitic flows is a string of actinolite-chlorite pods, 50 to 150 m thick, which extends for nearly 15 km along strike. These rocks also contain some hornblende, cummingtonite, garnet, magnetite, and spinel (hercynite), are locally serpentinized and are here interpreted as metamorphosed ultramafic flows or sills. Analyses of samples from this ultramafic are compatible (Figure 7) with analyses of komatiites of eastern Finland as presented in Blais and others (1978) and are similar to those described as constituents of what Windley and Bridgwater (1977) have called "high-grade supracrustal belts" that are common to nearly all Archean terranes.

In the center of the exposed portion of the belt is a three-cornered dome exposing felsic amphibole rocks. This dome structure upwarps a sequence of flows which are dominated by coarsely recrystallized amphibolite-plagioclase rocks that are interlayered with horizons of volcaniclastic graywackes. These graywackes contain primary sedimentary structures including conglomeratic facies, graded-bedding, channels and cross-beds. Graywacke beds range in thickness from a few meters to a few tens of meters. All facies of sedimentary rocks represent sedimentologically immature clastic debris. Lenticular felsic bodies reaching thicknesses of about 50 m occur just south of

Oxide	Analyses of komatiites Eastern Finland		Analyses of komatiites Elmers Rock Greenstone Belt, Wyoming	
SiO_2	47.84	46.85	45.33	47.69
Al_2O_3	6.86	8.08	3.27	2.50
FeO	10.73	10.75	21.59	18.74
MnO	0.20	0.17	0.33	0.27
MgO	26.67	26.01	29.04	28.73
CaO	7.21	7.45	0.26	2.42
Na_2O	0.01	0.18	0.12	0.30
K_2O	0.10	0.03	0.03	0.06
TiO	0.29	0.40	0.19	0.11
P_2O_5	0.11	0.07	----	----

Figure 7. Table of chemical analyses of komatiites. Total iron is calculated as FeO. Analyses of Finnish komatiites from Blais and others, 1978.

the Boyd Ranch. Petrographic analyses reveal a composition of 35-40% K-spar, 30-35% quartz, 10-15% plagioclase, 10% muscovite, less than 5% biotite and some opaques. These bodies represent fine-grained arkosic sediments or perhaps rhyolitic precursors. Such an interlayering of very immature sediments and intermediate calc-alkaline flows probably represents the upper part of the lower portion of the greenstone belt and signals the transition from deposition of chiefly volcanic to chiefly sedimentary rock.

The amphibolites are overlain by a metasedimentary sequence that is repeated by tight folding. The metasedimentary rocks are thickest in the Cooney Hills area where they may be up to 3 km thick and are thinnest in the western portion of the belt where they are only a few meters thick. Exact stratigraphic order is not implied in the listing below, but the general order of succession is reflected in order of presentation.

Directly overlying the mafic and komatiitic flows and/or sills are paraconglomerates containing gray gneiss boulder clasts. Clasts are matrix supported in a graywacke to amphibolitic graywacke matrix. Clasts have been stretched in the plane of foliation and locally folded about a nearly vertical fold axis. Thickness of the lenses of conglomerate is up to 20 m except at fold hinges where thickening has occurred as a result of folding. Paraconglomerates may change facies along strike to graywacke layers or may pinch out into mafic flows. Shearing in the plane of foliation has occurred along the limbs of folds; intervening layers of amphibolitic rock often completely separate lenses of paraconglomerate. Pink granites are not present as clasts and deposition of the paraconglomerate, therefore, preceeds the unroofing of the pink granite.

Metagraywackes are stratigraphically interspersed with the paraconglomerate, with amphibolites (metaflows) which occur above the paraconglomerate, and with other overlying metasediments. Graywackes are clastic, quartz, amphibole and plagioclase-bearing sediments which locally retain primary sedimentary structures such as graded bedding and possible channelling.

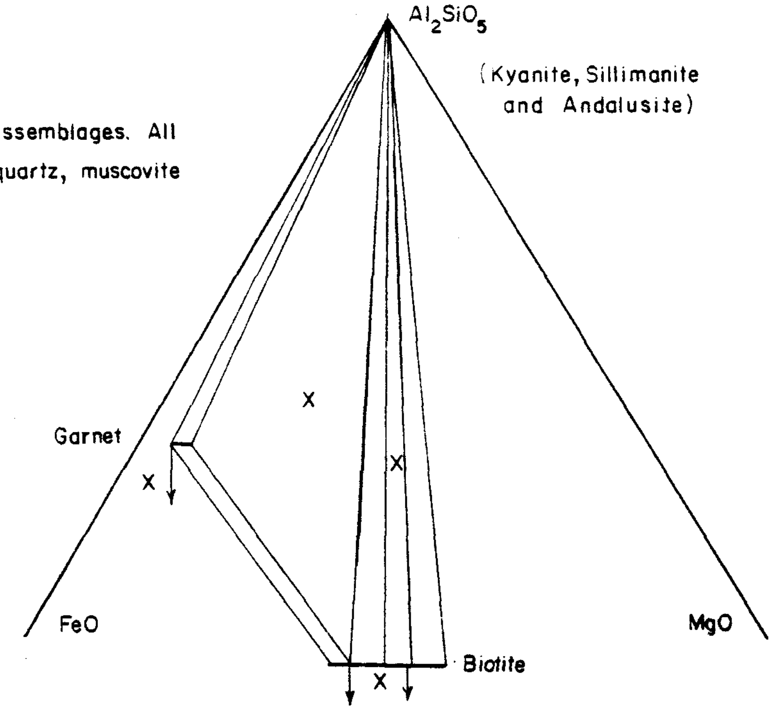
The upper portion of the metasedimentary sequence is dominated by metapelites. Metapelites are dark, schistose high-alumina rocks which contain all three alumino-silicates, biotite, plagioclase, garnet and quartz. Because of their high degree of metamorphism and originally small grain size, sedimentary structures are not preserved. Interlayered with the metapelites are numerous thin layers of dirty quartzite, marble, quartzite and associated marble, banded iron formation and quartz-pebble conglomerates. Dirty quartzite and graywackes are a gradational series of rocks and locally grade into each other or metapelites. The quartzites are highly iron stained and form rusty gossan outcrops. Marbles are generally dolomitic rocks containing tremolite and calc-silicate assemblages. Marbles are locally thickened at fold hinges but are usually only a few meters thick away from highly folded areas. Organoform structures, possibly stromatolites, are preserved in the marbles at several locations. Sinuous bands of quartzite and associated marbles occur in the upper part of the metapelites. These persistent bands are folded and contain fuchsite-rich quartzites that have been locally quarried for facing stone. Banded iron formation occurs in at least two irregular layers within the metapelitic sequence. These layers are up to 30 m thick and are continuous for several kilometers. Both silicate and oxide layers are present. Magnetite and hematite form up to 40% of the oxide layers and quartz forms the remainder of the oxide layers, but iron oxide is a minor constituent of the silicate layers. Silicate layers are composed of cummingtonite-grunerite, garnet, and quartz.

Thin layers, up to 2 m thick, of quartz-pebble conglomerate occur near Squaw Mountain and Halleck Canyon and are quite similar. Both conglomerates contain flattened quartz-pebbles (up to 2 cm) in a matrix of microcline, quartz and muscovite. Conglomerates near Halleck Canyon are more micaceous and contain sillimanite which was formed during the intrusion of the hornblende syenite. The original matrix of these conglomerates was most likely a feldspathic sand with a relatively high clay content. The potassium feldspar content may partially account for relatively higher gross gamma count measured in the field. Felsic gneisses occur as pods, usually concordant with layering throughout the metasedimentary sequence. Precursors for these gneisses are uncertain; they may be metamorphosed felsic volcanic rocks, sedimentary layers, sheared pegmatites, or aplitic dikes.

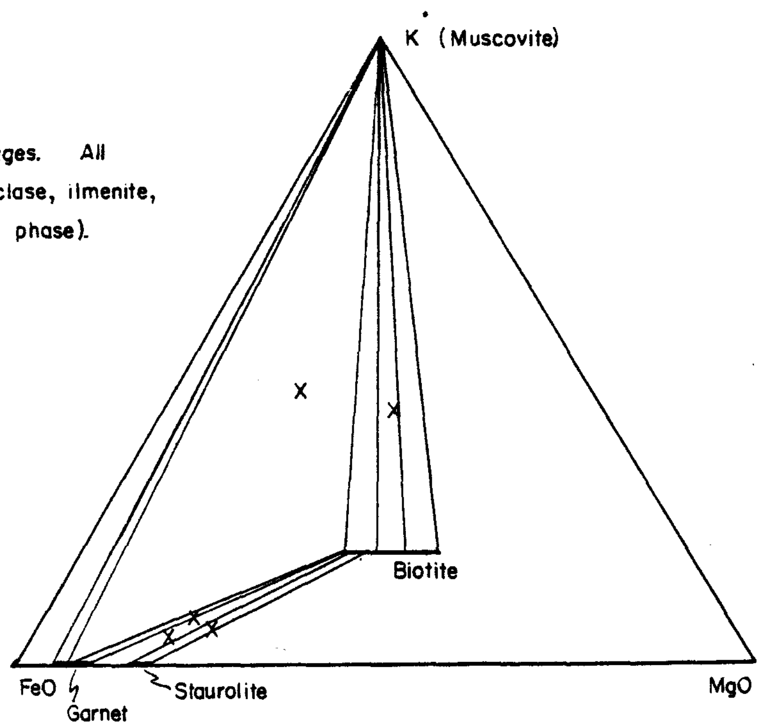
METAMORPHIC GRADE

All rocks of the supracrustal sequence have been metamorphosed at amphibolite facies conditions. Textures are generally granoblastic polygonal and, in all but the most micaceous metapelites, the initial stages of segregation into mafic and felsic layers are evident.

The three Al_2SiO_5 polymorphs, andalusite, sillimanite, and kyanite commonly coexist in the metapelites. At the highest grade, andalusite and sillimanite are stable in the southern part of the belt and sillimanite and kyanite are the assemblage present in the northeastern portions. This suggests that pressure conditions were near those of the Al_2SiO_5 triple point, or between 4.0 and 5.5 kb (12.5 and 17 km; Thompson, 1976). A common assemblage in the metapelites (Figure 8) is sillimanite-garnet-biotite-muscovite-quartz, which indicates that the temperature of the reaction muscovite + staurolite = sillimanite + biotite + garnet + H_2O was exceeded at highest grade. Hence, at 5.5 kb the maximum temperature achieved during metamorphism must have been between 580°C and 650°C (Thompson, 1976; Carmichael, 1978). Use of the garnet-biotite geothermometer suggests a temperature of 600°C (Holden, 1978). Metamorphic grade was similar throughout the entire supracrustal belt except for a slight increase in pressure (but not temperature) toward the northeast.



AFM projection of stable pelitic assemblages. All assemblages contain plagioclase, quartz, muscovite (projection phase) and ilmenite.



KFM projection of stable assemblages. All assemblages contain quartz, plagioclase, ilmenite, and aluminum silicate (projection phase).

Figure 8. Stable metamorphic assemblages, Elmers Rock Greenstone Belt, Laramie Range, Wyoming.

STRUCTURE

The structural setting of the Elmers Rock Greenstone Belt is that of arcuate synformal bodies of supracrustals which wrap around intruding granite domes. Such styles of structure for greenstone belts are described for the Barberton Greenstone Belt of South Africa by Anhaeusser and others (1969) and for greenstone belts of the Rhodesian Archean craton by MacGregor (1951). MacGregor (1951) emphasizes morphological characteristics of arcuate, cuspate synforms which have been enveloped by domal granitic intrusions. Structural descriptions for the African greenstone belts and those of other cratonic areas are highly compatible with structural features observed in the Elmers Rock Greenstone Belt.

Granites which dome and fold the supracrustal sequence are older than about 2600 m.y. and contain xenoliths of earlier gneissic rocks. Domal form is recorded in a circular spread in schistosity within the granites, circular or irregular distribution of dikes within the dome, and by layering in the supracrustal sequence over, or peripheral to, granite domes. Foliation within the granite near contacts with supracrustal rocks has been rotated parallel to the supracrustal contact. Mylonites formed within the granite domes during intrusion are positioned near and parallel to the contact with the dome and the belt.

The belt is formed by branching synformal keels of volcanic, volcaniclastic, and metasedimentary rock whose axial traces are shallowly plunging curvilinear features. Synforms are locally open or overturned but in all cases exhibit well developed down-dip lineations. Schistosity parallels bedding and, regionally, dips are steep and shearing parallel to schistosity is locally evident. Boundaries of the belt with the granites are highly strained features. Penetrative deformation within the greenstone belt is the result of Archean events and is dominated by features which can be related to the intrusion of the enveloping granite bodies.

URANIUM POTENTIAL

Previous Studies

A detailed geochemical sampling program, based on analyses of stream sediment and water samples, was conducted in the Laramie Range in the summer of 1979 (Butz and others, 1980); the area studied includes the project area for this report (Figure 1). Butz reports that anomalous radioactivity forms two bands across the area of his investigations. These anomalies, however, occur in areas that are underlain by Tertiary rocks. Butz and others (1980) report that the geochemical survey detected no significant anomalies over Precambrian rocks.

Smith (1954) investigated the Laramie Range to evaluate the region for the potential for economic uranium deposits. Smith's study revealed eight areas of anomalous radioactivity. Only two of those occurrences, the Cooney Hills area and the Big Chief Mica Mine, occur within the area studied for this report. The Cooney Hills occurs in sediments of the Elmers Rock Greenstone Belt and Smith (1954) reports a value of 0.034% eU_3O_8 for graphitic schists collected at the dump of an abandoned mine. Re-examination of this area (station numbers S30-S45) during this study revealed no radiometric anomalies. Chemical analyses of samples (numbers 105308-105312) yield uranium values ranging from 4.3 to 0.41 ppm. This high value of 4.3 ppm was a sample of schistose graywacke. Smith (1954) reports low radioactivity and no samples taken for chemical analysis. The occurrence at the Big Chief Mica

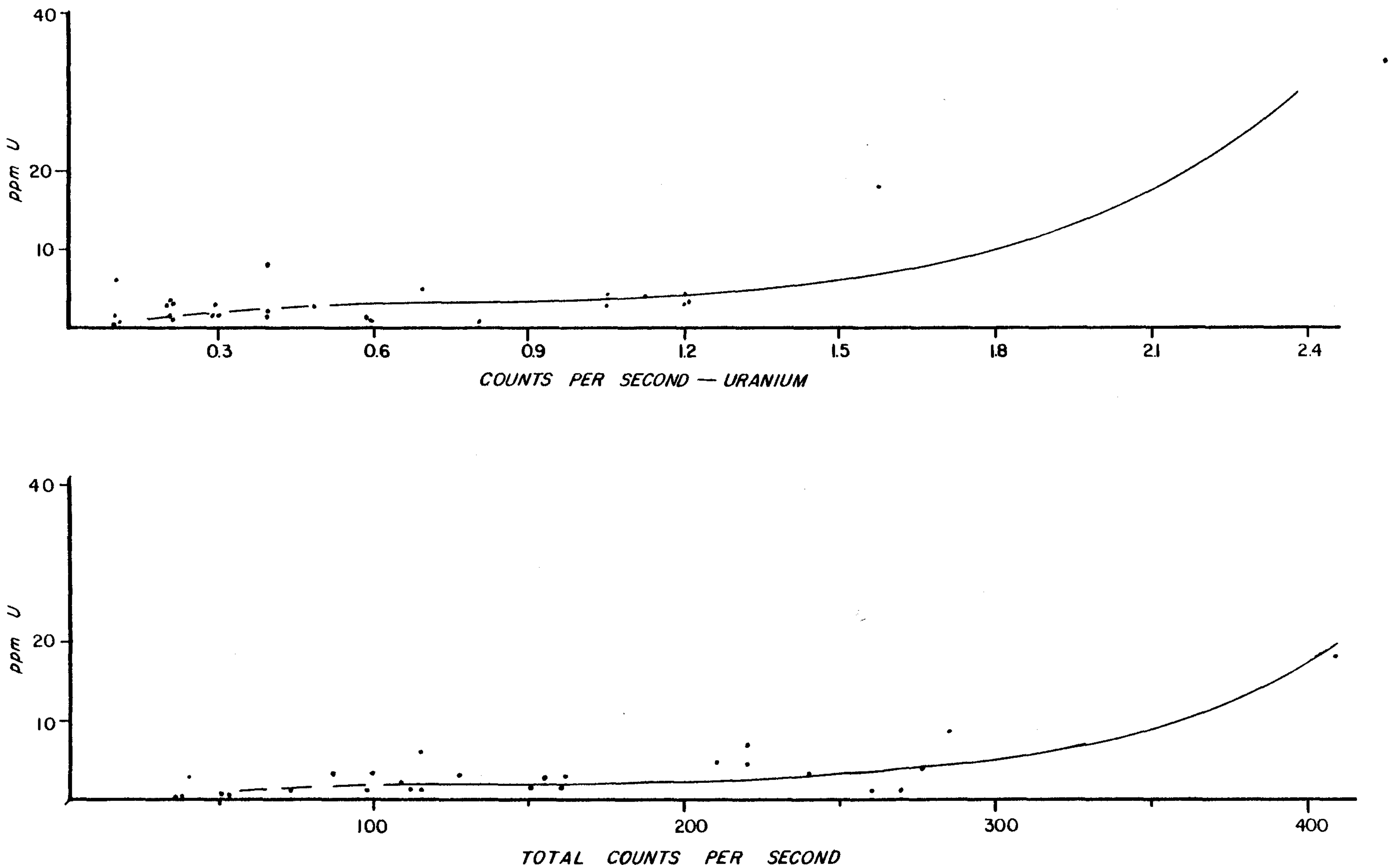


Figure 9. Calibration curves for total gamma ray counts and uranium counts, Eurtec 135 mini-spec spectrometer.

Mine (T.25N., R.71W.) is located in an exploration pit in a pegmatite body containing quartz, K-spar and minor plagioclase and muscovite that intrudes a migmatitic terrane.

GEOCHEMICAL AND RADIOMETRIC SURVEYS

Radiometric and geochemical surveys were conducted in conjunction with field mapping performed during the Laramie Range study. These data are recorded and cross-referenced in Appendices I and II. Radiometric readings were taken at each sample and station site and were continuously monitored during traverses with hand-held Eurtec 135 mini-spec gamma-ray spectrometers. Background levels of gamma radiation are estimated at 40-100 counts per second (CPS) for mafic and amphibolite rocks, 100-175 CPS for metasedimentary rocks and 180-320 CPS for granite rocks. Because of the wide variance and overall very low values for gamma radiation, the graphs to relate CPS to parts per million (ppm) uranium have been generated by plotting field data against chemical analysis rather than by comparison to standards. Curves generated by standards are straight-line curves that are heavily weighted to high-grade uranium standards and are not realistic for the low values observed during field studies for this project. The curves used here (Figure 9) are for comparison to field data that are reported in the appendices. Because of the scatter and inconsistent slope at lower count values, these curves are fit by eye rather than by least squares. While we realize that science may be compromised by handling data in this manner, we feel that the curves presented here are the most practical and usable of the options. The lower curve of Figure 9 relates total gamma-ray CPS to ppm uranium and the upper curve

	NO. SAMPLES ANALYZED									COEFFICIENT	LN TRANSFORMATION			
													ROBUST	
ELEMENT	MEASURABLE VALUES	BELOW DETECTION LIMIT	DETECTION LIMIT	MINIMUM VALUE	MAXIMUM VALUE	MEAN	MEDIAN	MODE	STANDARD DEVIATION	OF VARIATION	MEAN	S. D.	MEAN	S. D.
U	135	25	<0.25	<0.25	492.20	7.89	1.70	<0.25	44.143	5.596	0.69	1.11	0.34	1.36
U-NT	159			0.0	531.00	7.57	2.35	0.30	43.606	5.757				
U/TU	157			0.31	1.56	0.80	0.77	1.24	0.263	0.328	-0.28	0.34	-0.27	0.37
AG	9	151	<2	<2	10	3	<2	<2	2.6	0.9	0.92	0.54		
AL	159	1	<0.05	<0.05	12.38	5.24	5.96	6.49	2.230	0.425	1.45	0.88	1.55	0.69
B	10	150	<10	<10	21	13	<10	<10	4.2	0.3	2.53	0.28		
BA	160			7	4972	525	355	29	609.9	1.2	5.50	1.44	5.55	1.37
BE	113	47	<1	<1	46	1	<1	<1	4.4	2.3	0.27	0.58		
CA	153	7	<0.05	<0.05	18.30	2.35	0.88	0.09	2.891	1.229	0.09	1.32	-0.02	1.49
CE	129	31	<10	<10	1186	63	32	<10	108.7	1.7	3.77	0.76	3.46	1.03
CO	108	52	<4	<4	241	29	9	<4	32.8	1.1	2.93	0.95	2.20	1.34
CR	156	4	<1	<1	3299	331	42	5	692.2	2.1	4.05	1.94	3.94	2.02
CU	158	2	<2	<2	26198	203	16	3	2082.3	10.2	2.96	1.28	2.88	1.21
FE	160			0.09	49.91	4.24	2.51	2.14	6.117	1.442	0.89	1.12	0.92	1.09
HF	29	131	<15	<15	82	34	<15	<15	18.8	0.5	3.43	0.49		
K	152	8	<0.02	<0.02	5.03	1.35	1.17	0.06	1.180	0.873	-0.41	1.52	-0.52	1.65
LA	122	38	<2	<2	1560	72	30	2	145.9	2.0	3.71	1.09	3.30	1.73
LI	160			1	54	13	11	1	10.5	0.8	2.27	0.94	2.30	0.94
MG	150	10	<0.05	<0.05	10.58	2.34	1.37	0.08	2.605	1.113	0.08	1.44	-0.07	1.68
MN	159	1	<4	<4	6731	720	402	76	979.6	1.4	5.92	1.24	5.92	1.20
MO	20	140	<4	<4	26	6	<4	<4	5.1	0.8	1.73	0.49		
NA	146	14	<0.05	<0.05	4.47	1.61	1.50	0.06	1.055	0.654	0.12	1.03	-0.01	1.43
NB	50	110	<4	<4	115	16	<4	<4	20.9	1.3	2.36	0.86		
NI	145	15	<2	<2	2043	139	27	2	320.4	2.3	3.60	1.53	3.25	2.05
P	155	5	<5	<5	1518	310	179	159	317.6	1.0	5.24	1.03	5.19	1.27
PB	122	38	<10	<10	192	31	19	15	27.0	0.9	3.24	0.61	2.92	0.84
SC	150	10	<1	<1	43	9	6	<1	9.7	1.0	1.82	1.04	1.75	1.14
TH	129	31	<2	<2	348	21	9	<2	37.1	1.7	2.50	1.01	2.12	1.40
TI	160			10	12639	2025	1296	74	2276.3	1.1	6.96	1.37	7.03	1.39
V	155	5	<2	<2	511	85	56	3	95.0	1.1	3.76	1.36	3.72	1.53
Y	158	2	<1	<1	57	10	6	4	10.6	1.0	1.94	0.90	1.92	0.97
ZN	160			4	378	63	53	52	51.6	0.8	3.82	0.90	3.84	0.93
ZR	145	15	<2	<2	400	74	64	2	65.4	0.9	3.80	1.24	3.70	1.53

Figure 10. Summary statistics, Laramie Range Project. U = uranium soluble in solution of hydrofluoric and nitric acids; U-NT = uranium determined by neutron activation; U/TU = ratio of U to U-NT.

ELEMENT	NO. SAMPLES ANALYZED: MEASURABLE VALUES	NO. SAMPLES ANALYZED: BELOW DETECTION LIMIT	DETECTION LIMIT	MINIMUM VALUE	MAXIMUM VALUE	MEAN	MEDIAN	MODE	STANDARD DEVIATION	COEFFICIENT OF VARIATION	LG TRANSFORMATION: MEAN	LG TRANSFORMATION: S. D.	LG TRANSFORMATION ROBUST: MEAN	LG TRANSFORMATION ROBUST: S. D.
U	130	25	<0.25	<0.25	33.35	2.62	1.62	<0.25	3.687	1.405	0.56	0.86	0.29	1.19
U-NT	154			0.0	31.20	2.86	2.30	0.28	3.957	1.381				
U/TU	152			0.31	1.56	0.80	0.76	1.25	0.266	0.333	-0.28	0.34	-0.28	0.38
AG	9	146	<2	<2	10	3	<2	<2	2.6	0.9	0.92	0.54		
AL	154	1	<0.05	<0.05	12.38	5.25	5.93	5.66	2.213	0.422	1.45	0.88	1.56	0.70
B	8	147	<10	<10	21	12	<10	<10	3.6	0.3	2.48	0.24		
BA	155			7	4972	514	351	29	603.1	1.2	5.48	1.43	5.53	1.38
BE	109	46	<1	<1	46	1	<1	<1	4.5	2.4	0.27	0.58		
CA	148	7	<0.05	<0.05	18.30	2.38	0.88	0.09	2.914	1.227	0.11	1.32	-0.01	1.50
CE	125	30	<10	<10	1186	61	32	<10	108.5	1.8	3.75	0.75	3.45	1.00
CO	104	51	<4	<4	131	27	10	<4	25.8	0.9	2.94	0.91	2.22	1.34
CR	151	4	<1	<1	3299	323	41	5	686.4	2.1	4.03	1.91	3.92	2.01
CU	153	2	<2	<2	26198	209	15	3	2116.0	10.1	2.95	1.29	2.87	1.23
FE	155			0.09	49.91	4.19	2.47	1.09	6.068	1.450	0.87	1.13	0.91	1.09
HF	28	127	<15	<15	82	34	<15	<15	19.1	0.6	3.42	0.49		
K	147	8	<0.02	<0.02	5.03	1.33	1.16	0.06	1.158	0.869	-0.42	1.50	-0.52	1.63
LA	118	37	<2	<2	1560	70	29	2	146.5	2.1	3.68	1.09	3.28	1.70
LI	155			1	54	13	11	1	10.5	0.8	2.26	0.95	2.29	0.94
MG	145	10	<0.05	<0.05	10.58	2.37	1.40	0.08	2.636	1.114	0.08	1.45	-0.08	1.70
MN	154	1	<4	<4	6731	700	418	78	907.5	1.3	5.91	1.24	5.91	1.20
MO	17	138	<4	<4	26	6	<4	<4	5.3	0.9	1.67	0.48		
NA	141	14	<0.05	<0.05	4.47	1.62	1.50	0.06	1.060	0.655	0.12	1.03	-0.01	1.45
NB	49	106	<4	<4	115	16	<4	<4	21.1	1.3	2.36	0.86		
NI	140	15	<2	<2	1968	128	26	2	282.5	2.2	3.58	1.52	3.22	2.03
P	151	4	<5	<5	1518	312	183	161	320.5	1.0	5.23	1.09	5.21	1.21
PB	118	37	<10	<10	192	31	19	15	27.1	0.9	3.24	0.60	2.92	0.82
SC	145	10	<1	<1	43	10	6	<1	9.9	1.0	1.82	1.06	1.75	1.16
TH	125	30	<2	<2	348	20	9	<2	34.9	1.7	2.46	0.98	2.10	1.35
TI	155			10	12639	2059	1309	74	2303.5	1.1	6.96	1.38	7.04	1.41
V	150	5	<2	<2	511	86	57	3	95.8	1.1	3.75	1.37	3.71	1.55
Y	153	2	<1	<1	57	10	6	4	10.3	1.0	1.93	0.89	1.91	0.98
ZN	155			4	378	62	52	51	50.1	0.8	3.80	0.90	3.82	0.93
ZR	141	14	<2	<2	400	74	64	2	66.0	0.9	3.78	1.25	3.68	1.53

Figure 11. Revised summary statistics, Laramie Range, Wyoming. U = uranium soluble in a solution of hydrofluoric and nitric acids; U-NT = uranium determined by neutron activation; U/TU = ratio of U to U-NT.

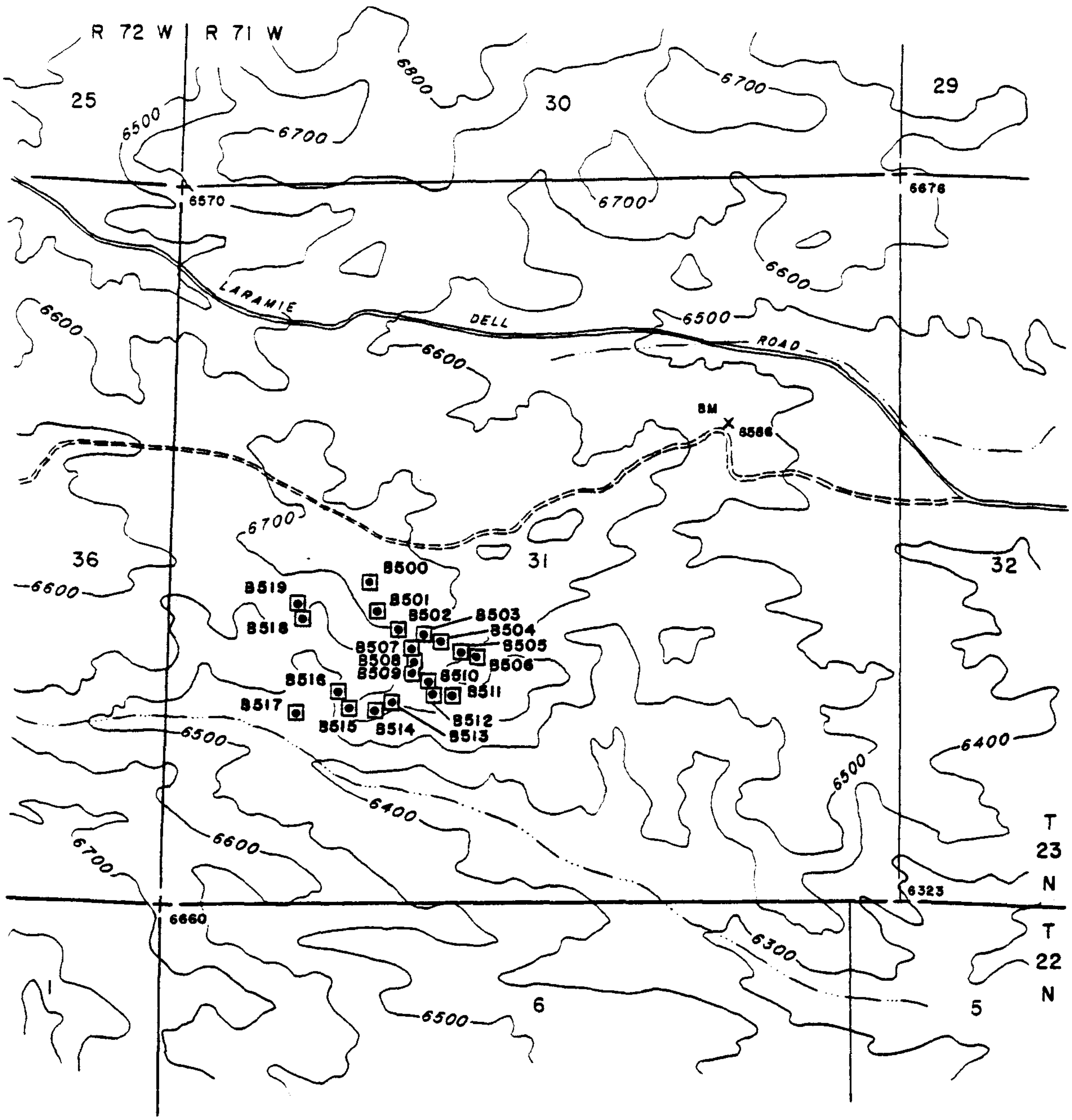


Figure 12. Sampling grid for detailed sampling of metaconglomerate unit. Section 31 T.23N., R.71W., Laramie Range, Wyoming.

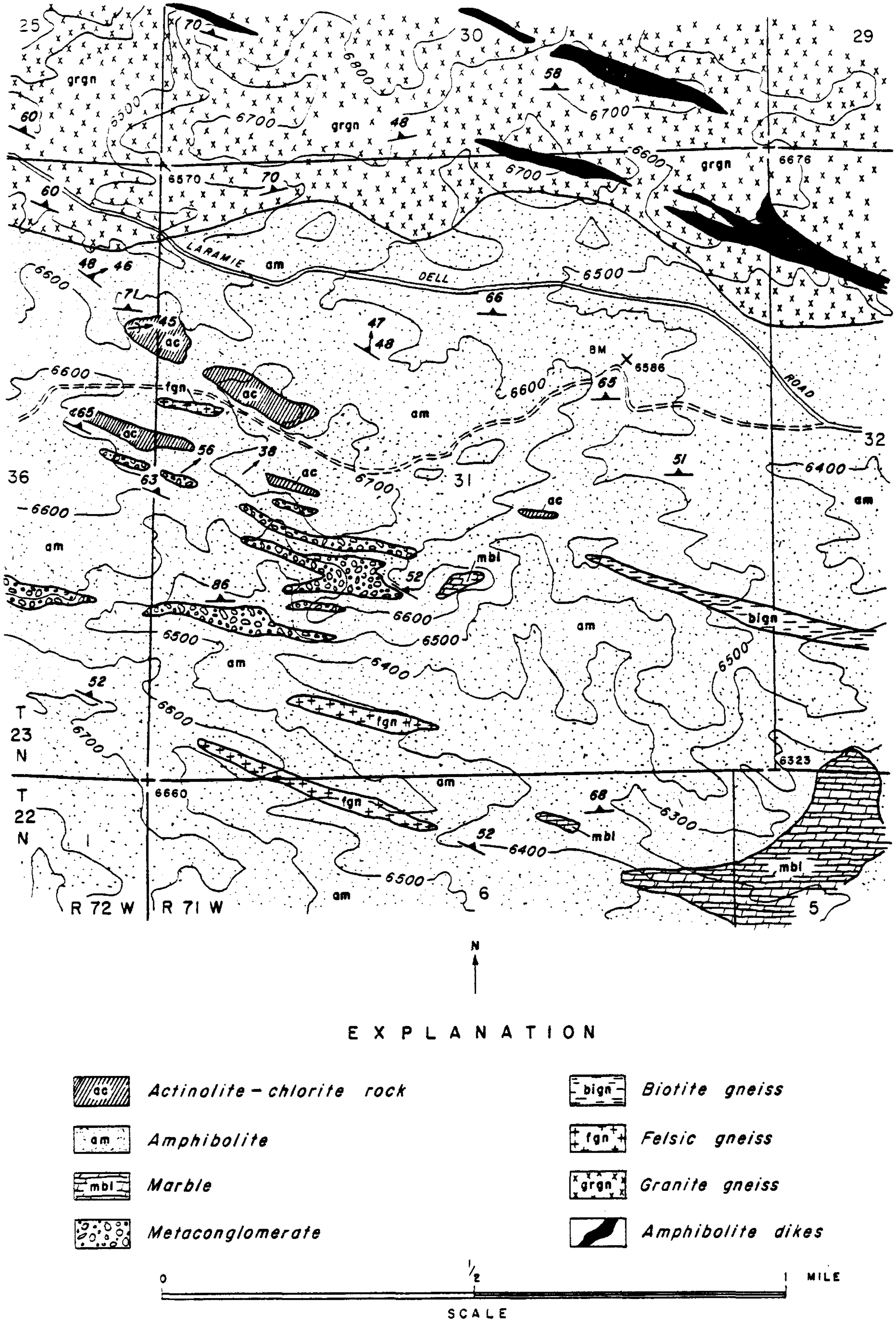


Figure 13. Sketch map of geology of Section 31 T.23N., R.71W. Laramie Range, Wyoming.

relates gamma rays counted on the uranium channel to ppm uranium.

Figure 10 presents the summary statistics for all samples from the Laramie Range Project. These data include values derived from granites and Tertiary rocks as well as from the metasedimentary sequence. If those anomalous values that are not clearly related to the metasedimentary sequence are removed from the data listing, dramatic changes in the basic statistics occur. Figure 11 displays the summary statistics for the Laramie Range which have been adjusted to remove the bias formed by anomalies of Tertiary mineralization and sheared granites. Significant changes occur in the mean value of uranium from 7.89 to 2.86 ppm and the standard deviation changes from 44.1 to 3.96. With respect to the fossil placer model, the second set of statistics (Figure 11) is more realistic.

Sample site and radiometric reading station locations are given in Plate 3 and Figures 12 through 19. Field numbers on those illustrations are cross-referenced to radiometric values at each site and station, latitude-longitude location, rock type, and chemical analysis sample number in Appendix I.

QUARTZ-PEBBLE CONGLOMERATES

The potential in the area studied for deposits or major occurrences of uranium formed as fossil placers is nil. An analysis of criteria for the model developed for such occurrences (Houston and Karlstrom, 1980) compared to the rocks of the central Laramie Range finds almost no compatibility.

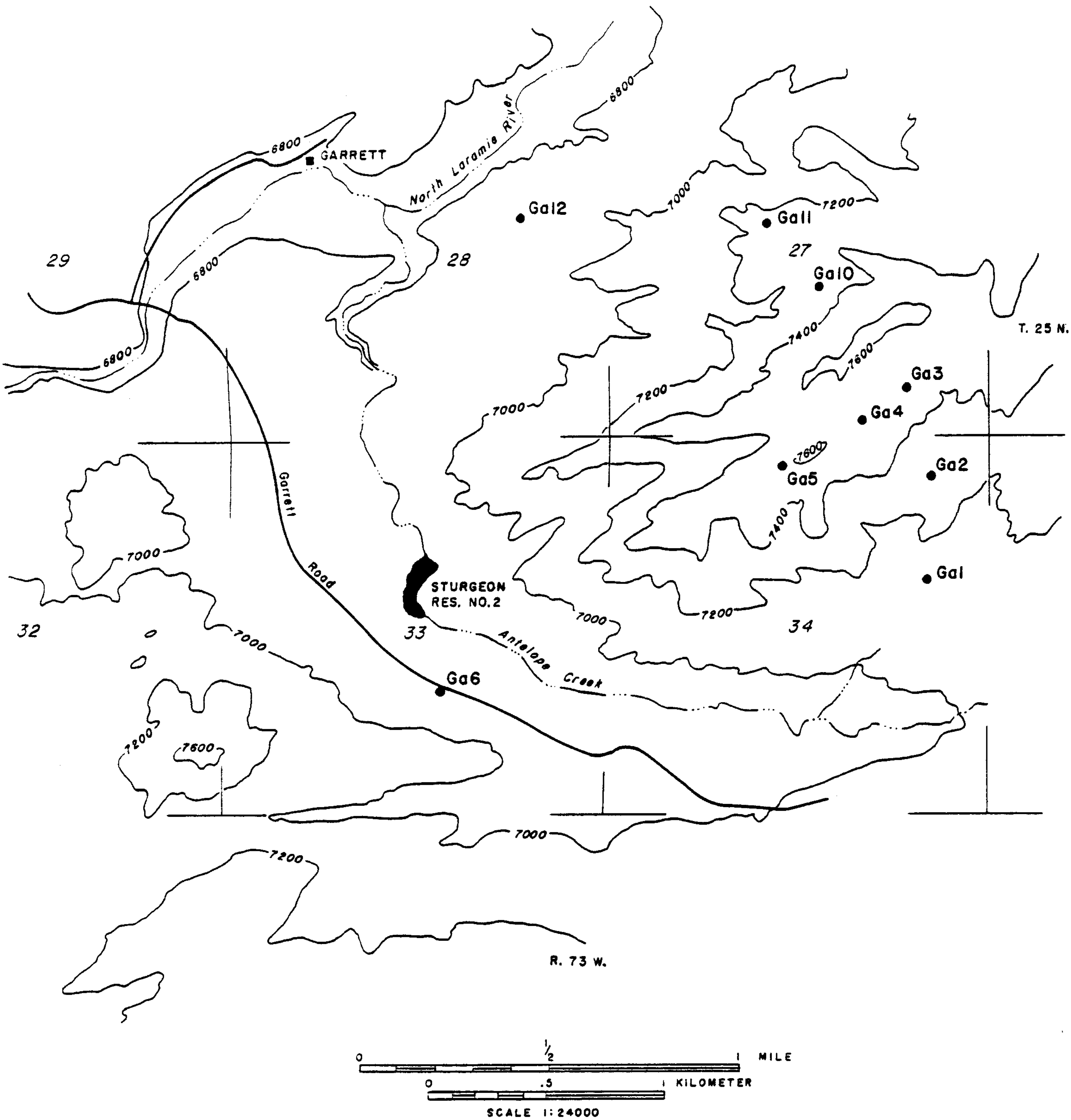


Figure 14. Sample locations at Sellers Mountain area, T.25N., R.73W., Laramie Range, Wyoming.

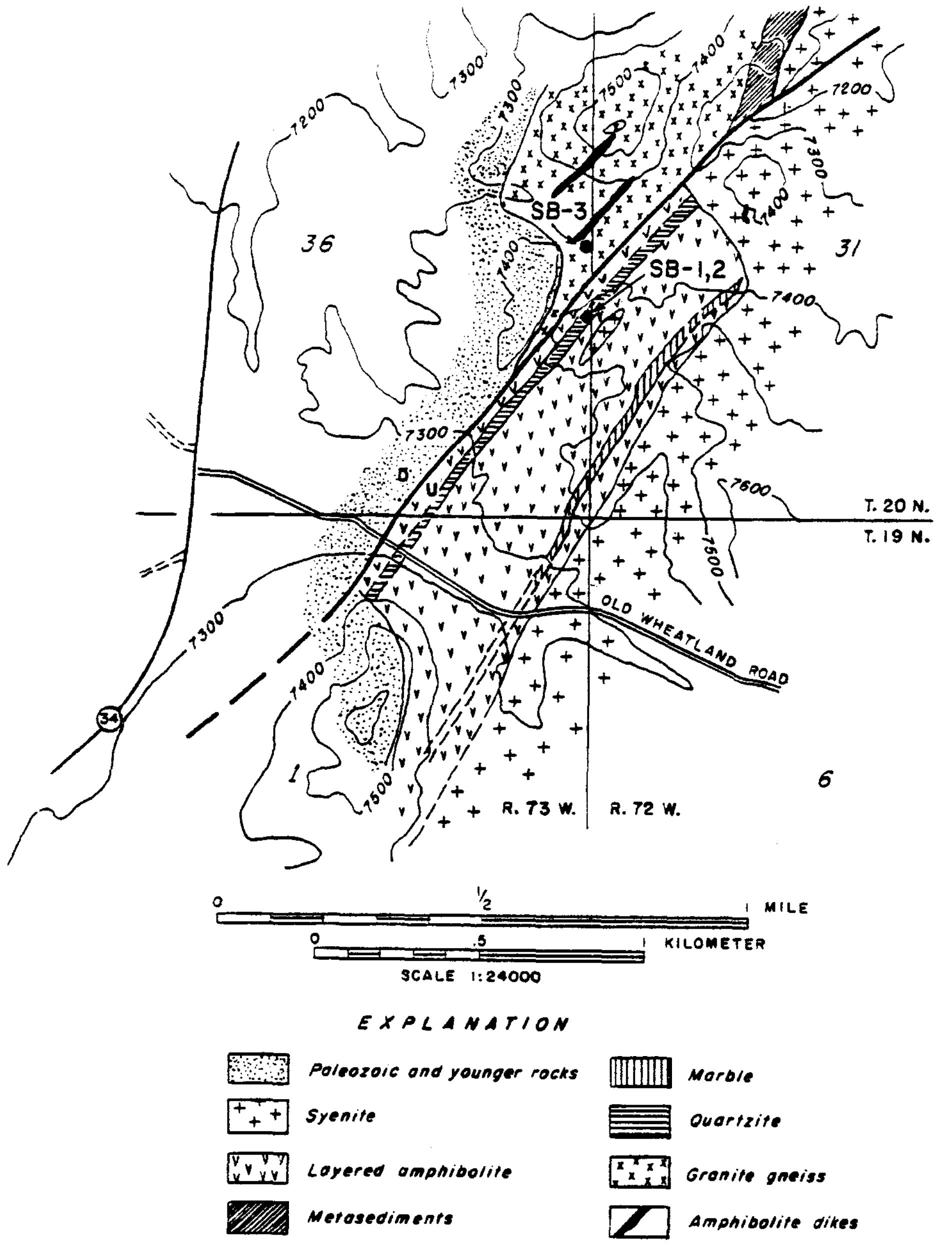


Figure 15. Geology and sample locations south of Morton Pass, Laramie Range, Wyoming.

The stratigraphic sequence of the supracrustals of Elmers Rock Greenstone Belt is dominated by metamorphosed volcanogenic and immature sedimentary rocks. The stratigraphy of Elmers Rock Greenstone Belt is typical of stratigraphies described for other such Archean supracrustal sequences in that it contains a triad formed of lower mafic and ultramafic, middle intermediate and mafic, and upper graywacke and pelitic rocks. This sequence may represent rapid deposition in a trench very near a volcanic source, perhaps a volcanic arc. Subaqueous deposition is evidenced by pillow basalts contained in the lower portion of the belt and by carbonate rocks in the middle and pelites in the upper portions of the pile. Boulder paraconglomerates suggest rapid deposition by mass movement processes. Mature clastics of the belt are limited to very thin quartz-pebble conglomerates and quartzites, which may be cherts, in the upper portion of the pile. In contrast, the model requires thick, mature clastic rocks deposited by braided-river systems on slowly subsiding basement. Uraniferous conglomerates of Canada and Wyoming are quite clean quartz-pebble conglomerates at the base of thick successions of fluvially deposited quartzites. Only minor amounts of volcanic rocks occur in the piles above the quartz-pebble conglomerates.

Metamorphic regimes of the Laramie Range also differ greatly from those of the type-deposit area. Rocks producing uranium from quartz-pebble conglomerates in Canada and South Africa are regionally of the greenschist facies. Delicate primary sedimentary structures such as small clastic dikes and small scale cross-bedding are commonly preserved. However, the minimum conditions reached in the supracrustals of the central Laramie Range are about 600°C and 5-6 kb. All three polymorphs of alumino-silicates occur. A considerable amount of water may have been produced by dehydration reactions during the high-grade metamorphic event. Such high temperature waters may have leached any uranium from the system.

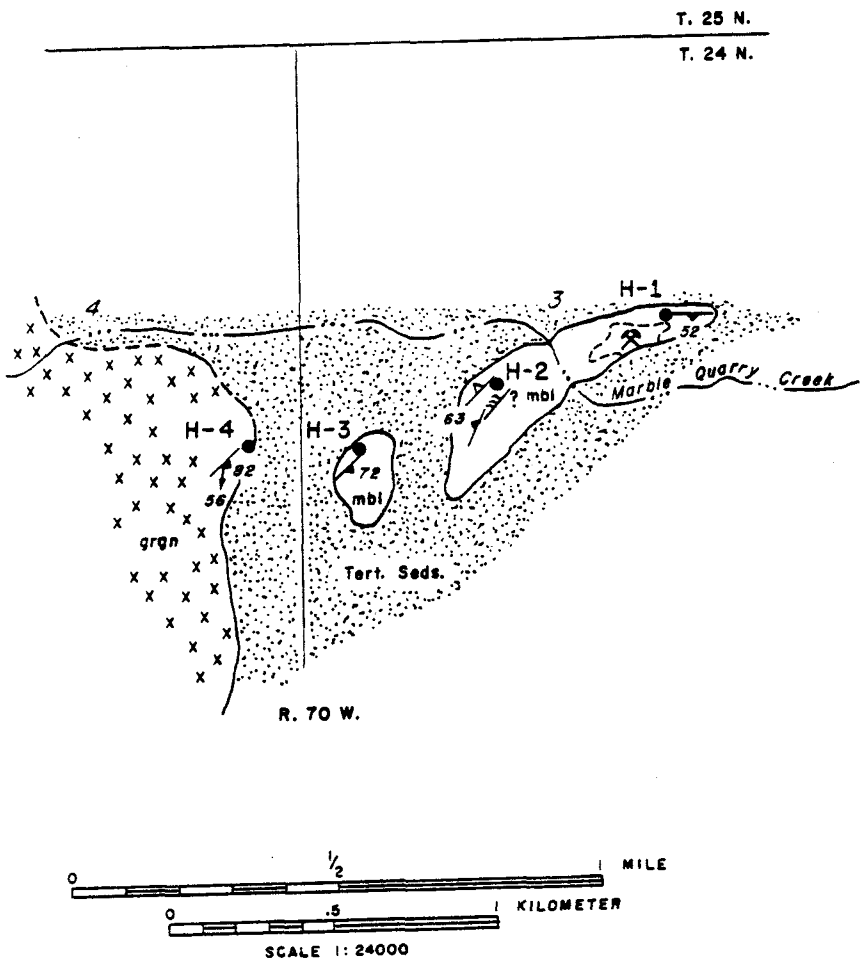


Figure 16. Radiometric station sites in marble and granite gneiss, T. 24N., R.70W., Laramie Range, Wyoming.

Placer concentrations of heavy minerals were not noted in the greenstone sequence. Magnetite and pyrite are disseminated rather than concentrated by fluvial processes. Chemical analyses of conglomeratic rocks for gold showed no significant concentrations.

Structural patterns seen in the greenstone belt differ dramatically from

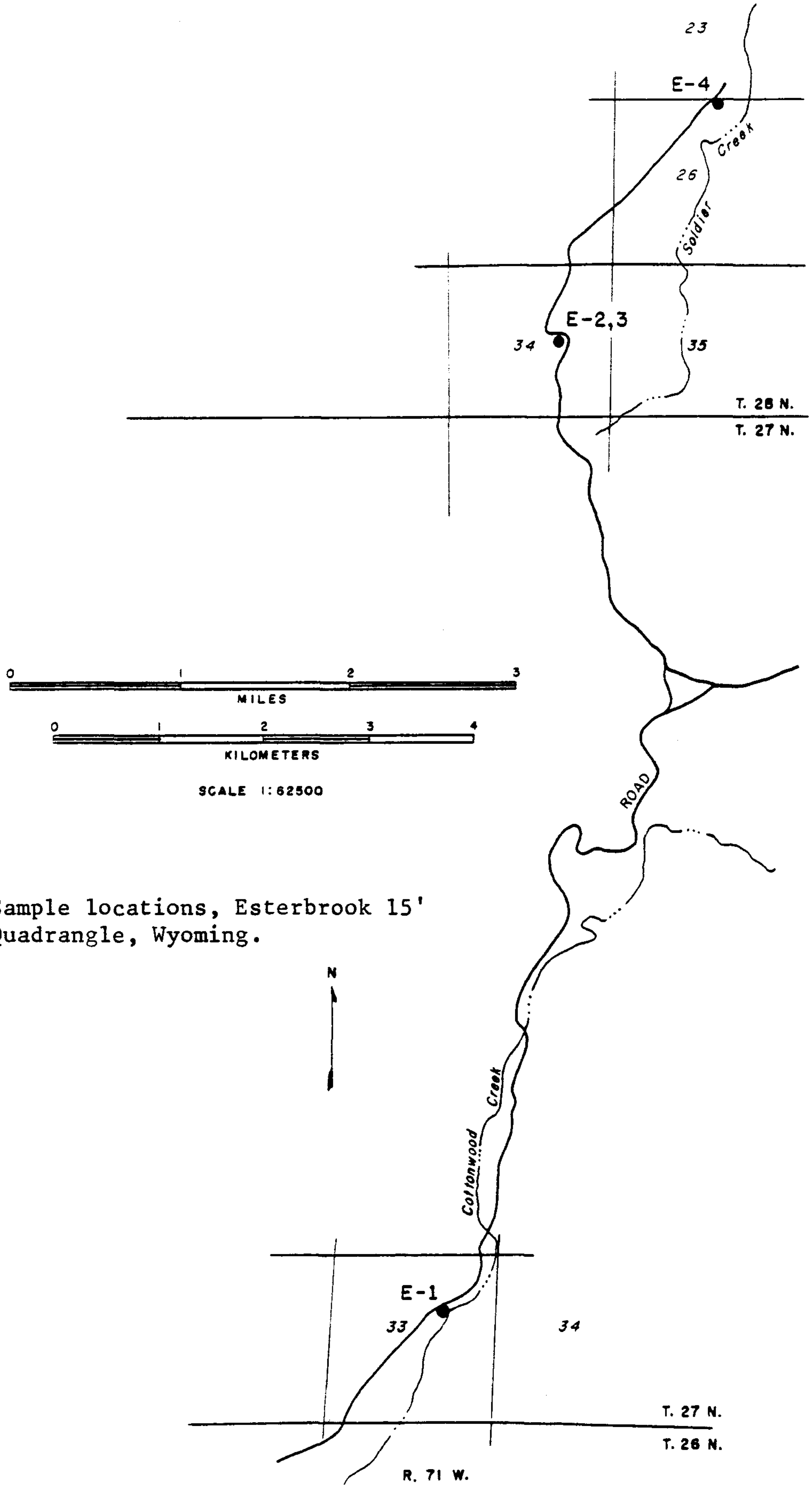


Figure 17. Sample locations, Esterbrook 15' Quadrangle, Wyoming.

regional structural settings of uranium-producing areas in Canada or South Africa. Isoclinal folding and shearing are common in the Laramie Range while only gentle warping occurs in the type-deposit areas. Intense deformation complicates stratigraphic relationships and evidences another event during which uranium could have been transported out of the system.

The age of the Elmers Rock Greenstone Belt is older than 2540 m.y. Granites, which were isotopically re-equilibrated and mobilized at that date, fold the northern edge of the main portion of the belt. Although the metasedimentary sequence is old enough to form uraniferous quartz-pebble conglomerates, the sequence may be as old as 3000 m.y. and may have been deposited before local granites contained sufficient amounts of uranium to be good source terranes.

Detailed studies of quartz-pebble conglomerates in the Squaw Mountain and Halleck Canyon areas were undertaken because conglomerates in these areas are clean quartz-pebble rocks which contain small anomalies of gamma radiation. Radiometric readings are about two times background levels. Chemical analyses of samples from the Squaw Mountain area (numbers 105267-105270) reveal uranium values between 1.2 and 3.7 ppm. However, potassium values for these samples are all greater than 1% and this composition may have been instrumental in producing the small anomaly. Thorium values for these samples range from 40 to 100 ppm and also contributed to the gamma ray anomaly. The thorium-to-uranium ratios for samples 105267-105270 are quite high, the smallest value being at least 10 to 1. Samples from the Halleck Canyon conglomerate included one sample that clearly was more than two times the radiometric values for the rest of that conglomeratic horizon. That sample (number 105315) contained 22 ppm uranium and about 1% potassium; however, other samples (numbers 105313, 105314, 105317 and 105318) contained less than 5 ppm uranium and up to 2.8% potassium. Thorium values are low and do not contribute significantly to the anomaly.

Two samples of gneiss boulder paraconglomerate yielded significant values of uranium of about 530 ppm (sample 105204) and 47 ppm (sample 105324). Thorium values were 23 ppm and 9 ppm respectively which produce very low thorium to uranium ratios. Both samples were from the matrix rock of boulder conglomerate. Matrix composition for the conglomerate varied gradationally between graywacke to amphibolitic graywacke to a gneissic biotite-quartz-plagioclase phase. The matrix material at the sites of the two samples cited above is dominated by the biotite-quartz-plagioclase phase. Clasts within this conglomerate are unsorted, well-rounded, matrix-supported cobbles and boulders of gray biotite-plagioclase-quartz gneiss. Pink equigranular or pink porphyritic granite boulders are not present in the conglomerate. Primary sedimentary structures are absent. Stratigraphic top could not be determined. No concentrations of heavy minerals are visible. Pyrite is absent. No visible uranium minerals have been seen in outcrop or in thin sections of matrix rock. No anomalies of radioactivity, either stratiform or point types of anomalies, are clearly apparent over the unit or at sample sites. However, a small radiometric anomaly of about 2X (315 CPS) was recorded at sample 105204, but this anomaly is much smaller than that which should be produced by a sample containing 500 ppm uranium. Because of high uranium values for samples 105324 and 105204, detailed

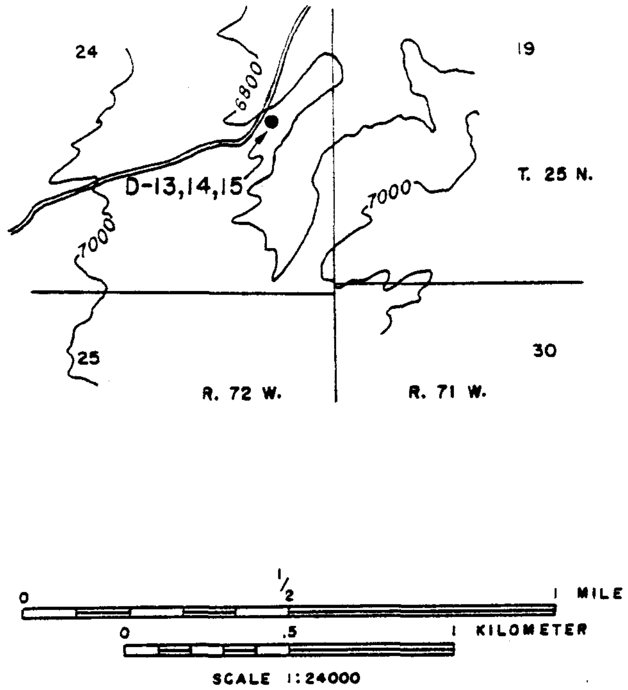


Figure 18. Sample sites of sheared granite, Laramie Range, Wyoming.

sampling of the conglomerate unit was done to test the possibility of a stratiform occurrence. A sketch map of the geology and a sample site map of the detailed sampling are shown in Figures 12 and 13. Sample numbers 105347-105367 have very low thorium and no uranium values greater than 4 ppm. These samples were collected in the area of samples 105324 and 105204, and suggest that the anomalous samples are probably the result of very local conditions within the conglomerate. Because there are very small or no accompanying radioactive anomalies at sample sites, the uranium mineralization may be Tertiary in age. Small patches of Tertiary soils occur throughout the area and may be remnants of Tertiary rock that supplied uranium for such occurrences.

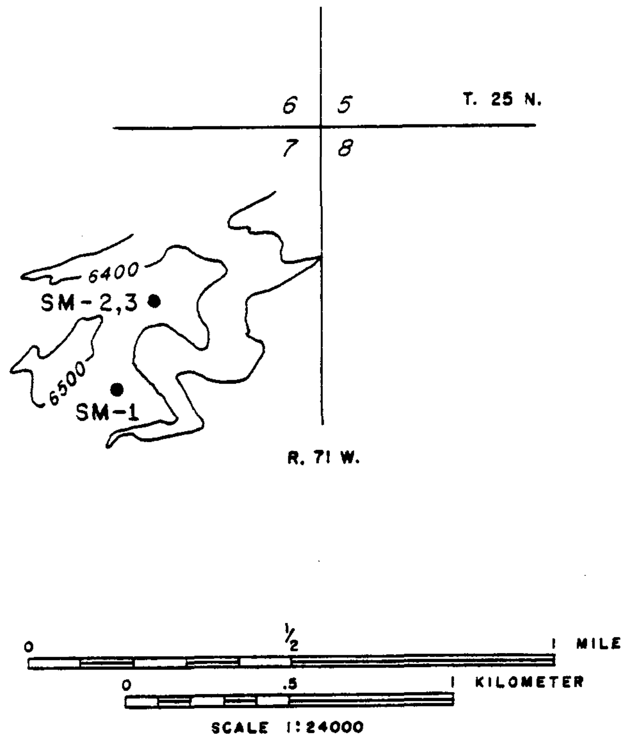


Figure 19. Sample sites of sheared granite, Laramie Range, Wyoming.

Other Uranium Occurrences

Aside from anomalies in the metasediments, occurrences are also recorded in basal Tertiary rocks and in the granite-gneiss complex. The basal Tertiary occurrence (Figure 14, sample Ga6, analysis number 105334) near Sellers Mountain yields values of 150 ppm uranium and thorium values below detection limits. This sample consisted of small fragments of ultramafic rock cemented with a caliche material. The ultramafic character of fragments included in this sample is reflected in high values of chromium, nickel and cobalt contained in the analysis. Tertiary rocks in the area of Ga6 are extremely thin veneers of unconsolidated material with a thin, poorly developed soil horizon and a locally occurring conglomeratic horizon at the base.

Granites exposed in the granite-gneiss complex north of the supracrustal sequence also contain anomalies. Random samples taken north of the study area (Figures 17, 18 and 19) were selected on the basis of yielding higher than background gamma radiation levels. These samples yielded up to about 35 ppm uranium. At most of these sites the granite contained local shear zones with varying degrees of shearing. These shear zones are most often oriented east-west and nearly vertical. Sheared granites near the northern boundary of the study area and immediately north of Garrett, Wyoming are strongly radioactive and commonly yield greater than 50 ppm uranium (Bob Houston, pers. comm.). Further north, in the Deer Creek area, granites contain pods of reduced rock containing sulfides. Analyses of sulfide-bearing rock samples from these pods have yielded up to 32% uranium (Ken Kruger, pers. comm.). These pods are widely scattered bathtub sized and shaped areas of highly iron-stained, sulfide-bearing rock completely enclosed by granite of the Laramie Range Batholith. Because these occurrences are within granite terranes and are, for the most part, outside the area of investigation for this report, they were not studied in detail during field studies conducted for this report. However, such occurrences indicate that granites of the Laramie Range have potential as a source area and/or as a uranium province.

CONCLUSIONS

Uraniferous Quartz-Pebble Conglomerates

The supracrustal sequence in the central Laramie Range has essentially no compatibility with the model (Houston and Karlstrom, 1980) for fossil placer occurrences (Table 1). The critical criterion of age of deposition appears to be satisfied but the Laramie Range supracrustals are a series of immature graywackes and volcanogenic rocks which were deposited in a rapidly subsiding trough behind an Archean volcanic arc. The model, however, requires a mature clastic wedge deposited on a slowly sinking edge of the craton. Because of a general and, in nearly all cases, a specific lack of agreement with the geologic requirements of the model, and the lack of significant regional, stratiform, or significant point radiometric or uranium anomalies related to deposition of the metasediments, the potential for fossil-placer uranium deposits is considered nil. No indications of other types of uranium deposits in the metasedimentary rocks of the supracrustal belt were recognized during this study.

Granites

Although a detailed study of the granite-gneiss terrane is not within the scope and purpose of this project, radioactive anomalous areas within the granite-gneiss terrane were found during routine surveys. These anomalies are centered on shear zones of unknown extent and in places

COMPARISON OF MODEL CRITERIA FOR QUARTZ-PEBBLE CONGLOMERATES
TO ELMERS ROCK GREENSTONE BELT

	Quartz-Pebble Conglomerate Model	Elmers Rock Greenstone Belt
Age:	Must be at least 2000 to about 2800 m.y.	Older than about 2600 m.y.
Source Area:	Granitic terrane containing Late Archean K-rich granites	Apparently K-poor granitic gneisses
Structure:	Gently folded	Intensely deformed; synformal keels of metasediments, overturned isoclinal folds. Mylonite present.
Metamorphic Grade:	Regional greenschist	Regional upper amphibolite (sillimanite)
Mineralogy:	Pyrite chief heavy mineral	Pyrite rare or absent
	Uraninite uranium phase	Uranium absent
	Thucholite present	Thucholite not recognized
	Thorium present	Thorium present
Stratigraphic Constraints:	Unconformably overlie Archean granite-gneiss complexes and greenstone belts	Part of Archean greenstone belt
	Underlie thick Proterozoic stromatolitic and thick Proterozoic BIF sequences	Contains thin Archean stromatolitic and BIF rocks
	Thick fluvial quartzites and conglomerates	Rare quartzites and conglomerates; chiefly pelites
	Minor volcanics in lower units	Ultramafic and mafic volcanics dominate belt
Sedimentological Characteristics:	Fining-upward sequences with clasts-supported conglomerates, cross-beds, channels, ripples - fluvial transport	Matrix-supported paraconglomerates, rare channels - mass movement transport (?); pelites - quiet basin deposition
	Repeated fining-upward sequences	Absent (?)
	Conglomerate-based unconformities	Absent
		Subaqueous deposition - pillow lavas
Lithologic Characteristics:	Thick fluvial quartzites and conglomerates	Thick volcanogenic rocks
	Basal quartz-pebble conglomerates	Ultramafic flows and gneiss-boulder conglomerates
	Texturally mature sediments	Immature sediments
	Rusty outcrop, green-gray fresh rock with pyrite or pyrite casts	Black amphibolite with no pyrite

Table 1. Comparison of model criteria to Elmers Rock Greenstone Belt.

exceed 5X background values. Geochemical analyses of samples selected from these zones contain up to 35 ppm uranium. Other areas within the granite-gneiss terrane are reported to contain strong radioactive anomalies or very high geochemical uranium anomalies from small pods containing sulfide minerals. Because of these anomalously high values of uranium, shear zones and sulfide-rich phases within the granite-gneiss terrane may warrant further study to determine their uranium potential.

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APPENDIX I

Appendix I contains a cross-reference for field sample and radiometric station numbers to sample numbers used for chemical analyses. Latitude-longitude locations are given for each sample/station site. Radiometric readings and geologic codes are also included:

GEOLOGIC CODES

Rock Name	Code
Amphibolite	AM
Amphibolite, coarse-grained	CAM
Amphibolite, fine-grained	FAM
Andesite or meta-andesite	AN
Breccia	BR
Paraconglomerate	PAC
Diabase	DB
Gneiss	GN
Quartzo-feldspathic gneiss	QFGN
Granite gneiss	GGN
Augen gneiss	AUGN
Biotite gneiss	BGN
Granite	GR
White granite	WGR
Red or pink granite	RGR
Graywacke	GW
Iron Formation	IF
Marble	MB
Migmatite	MM
Pegmatite	PG
Vein quartz	VQ
Quartzite	Q
Feldspathic quartzite	FQ
Medium-grained quartzite	MQ
Phyllitic quartzite	PHQ
Pebbly quartzite	PBQ
Sheared quartzite	SQ
Iron-rich quartzite	IQ
Calc-silicate	CS
Micaceous quartzite	MQ
Schist	SC
Chlorite schist	CSC
Mica schist	MSC
Biotite schist	BSC
Syenite	SY
Ultramafic	ULM
No Data	ND

APPENDIX I

RADIOMETRIC DATA

LARAMIE RANGE PROJECT

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
B1		41°55'34"	105°25'08"	ND	ND	ND	ND	ND
B2		- 55'31"	- 25'02"	ND	ND	ND	ND	CAM
B3		- 55'27"	- 24'58"	168	1.8	0.3	0.1	PAC
B4		- 55'24"	- 24'54"	67	0.4	0.1	0.0	FAM
B5		- 55'23"	- 24'48"	48	0.5	0.1	0.0	ULM
B6		- 55'26"	- 24'44"	ND	ND	ND	ND	ND
B7		- 55'30"	- 24'42"	ND	ND	ND	ND	ND
B8		- 55'32"	- 24'34"	ND	ND	ND	ND	ND
B9		- 55'22"	- 24'33"	61	0.4	0.1	0.0	ULM
B10	105200	- 55'20"	- 24'26"	ND	ND	ND	ND	ULM
B11		- 55'19"	- 24'19"	167	1.8	0.2	0.3	PAC
B12		- 55'19"	- 24'16"	ND	ND	ND	ND	ND
B13		- 55'16"	- 24'12"	126	2.0	0.3	0.2	PAC
B14		- 55'14"	- 24'04"	194	1.1	0.4	0.2	PAC
B15		- 55'09"	- 24'01"	164	1.5	0.1	0.3	PAC
B16	105201	- 55'07"	- 23'58"	151	1.1	0.5	0.6	PAC
B17		- 55'07"	- 23'53"	ND	ND	ND	ND	ND
B18		- 55'06"	- 24'10"	ND	ND	ND	ND	ND
B19		- 55'07"	- 24'16"	ND	ND	ND	ND	ND
B20		- 55'24"	- 24'26"	66	0.7	0.3	0.1	AM
B21		- 55'24"	- 24'22"	58	0.5	0.3	0.1	AM
B22		- 55'24"	- 24'16"	52	1.0	0.0	0.1	AM
B23	105202	- 55'24"	- 24'12"	50	0.3	0.0	0.1	ULM
B24		- 55'20"	- 24'08"	50	0.2	0.1	0.2	AM
B25		- 55'17"	- 24'07"	56	0.3	0.1	0.0	AM
B26	105203	- 55'15"	- 24'04"	99	0.8	0.2	0.1	BGN
B27	105204	- 55'12"	- 23'58"	314	1.8	0.5	0.2	BGN
B28		- 55'18"	- 23'58"	47	0.2	0.0	0.0	CAM
B29		- 55'15"	- 23'48"	62	0.6	0.2	0.0	CAM
B30	105205	- 55'18"	- 23'43"	39	0.6	0.1	0.2	BGN
B31		- 55'16"	- 23'40"	63	0.5	0.2	0.1	ULM
B32	105206	- 55'12"	- 23'36"	86	1.1	0.2	0.2	BGN
B33		- 55'10"	- 23'27"	82	0.5	0.1	0.2	BGN
B34		- 55'21"	- 24'52"	64	0.5	0.1	0.2	AM
B35		- 55'21"	- 25'07"	61	0.8	0.1	0.2	AM
B36		- 55'18"	- 25'12"	51	0.4	0.1	0.1	AM
B37		- 55'20"	- 25'23"	50	0.3	0.1	0.1	AM
B38		- 55'23"	- 25'22"	43	0.6	0.1	0.2	AM
B39	105207	- 55'11"	- 25'10"	85	0.5	0.2	0.1	PHQ
B40		- 55'15"	- 25'27"	80	0.6	0.1	0.0	PHQ
B41		- 55'13"	- 25'26"	49	0.4	0.2	0.0	AM
B42		- 55'10"	- 25'38"	61	0.5	0.3	0.0	SQ
B43	105208	- 55'11"	- 25'43"	110	2.2	0.6	0.1	PG
B44		- 55'14"	- 26'06"	48	0.6	0.2	0.1	BGN
B45		- 55'14"	- 26'11"	49	0.2	0.1	0.1	AM
B46	105209	- 55'20"	- 26'32"	53	0.3	0.1	0.0	MQ
B47		- 55'16"	- 26'28"	49	0.8	0.1	0.1	AM
B48		- 55'18"	- 26'38"	34	0.7	0.2	0.0	AM
B49	105210	- 55'24"	- 26'44"	115	1.5	0.2	0.0	BGN
B50		- 55'24"	- 26'36"	53	0.5	0.2	0.1	FAM
B51		- 55'25"	- 26'25"	68	0.4	0.1	0.1	AM
B52		- 55'33"	- 26'18"	54	0.6	0.0	0.1	AM
B53		- 55'40"	- 26'18"	50	0.3	0.0	0.0	AM
B54		- 55'41"	- 26'11"	40	0.3	0.1	0.0	AM
B55		- 55'40"	- 26'05"	47	0.2	0.1	0.1	FAM
B56		- 55'29"	- 26'02"	70	0.4	0.1	0.1	AM
B57		- 55'25"	- 26'02"	86	0.5	0.1	0.1	PG

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
B58		41°55'20"	105°26'02"	45	0.2	0.1	0.0	AM
B59		- 55'12"	- 26'08"	56	0.3	0.0	0.0	FAM
B60	105211	- 55'09"	- 26'22"	45	0.3	0.0	0.1	FAM
B61		- 55'07"	- 26'26"	52	0.4	0.2	0.0	AM
B62	105212	- 55'05"	- 26'26"	43	0.5	0.1	0.0	CS
B63	105213	- 55'05"	- 26'29"	131	1.3	0.2	0.1	AUGN
B64		- 55'02"	- 26'31"	279	1.7	0.7	0.1	AUGN
B65		- 55'08"	- 26'12"	46	0.3	0.1	0.0	AM
B66		- 55'07"	- 26'09"	44	0.1	0.0	0.2	FAM
B67		- 55'06"	- 26'06"	45	0.6	0.0	0.0	FAM
B68		- 55'01"	- 26'03"	44	0.1	0.1	0.1	AM
B69		- 55'00"	- 25'56"	38	0.4	0.2	0.1	AM
B70		- 54'58"	- 25'52"	47	0.3	0.1	0.0	FAM
B71	105214	- 54'58"	- 25'42"	59	0.5	0.1	0.0	FAM
B72		- 54'54"	- 25'40"	57	0.6	0.0	0.0	AM
B73		- 54'46"	- 25'33"	65	0.6	0.1	0.0	FAM
B74		- 54'47"	- 25'22"	58	0.5	0.2	0.0	AM
B75		- 54'53"	- 25'19"	47	0.6	0.0	0.1	FAM
B76		- 54'54"	- 25'10"	52	0.3	0.1	0.1	AM
B77		- 54'57"	- 25'06"	43	0.3	0.1	0.0	AM
B78		- 55'01"	- 25'11"	84	0.6	0.3	0.1	PG
B79		- 55'06"	- 25'18"	50	1.2	0.1	0.0	AM
B80		- 55'10"	- 25'14"	75	0.4	0.0	0.0	PG
B81		- 54'50"	- 25'18"	41	0.6	0.2	0.1	AM
B82	105216	- 54'45"	- 25'18"	150	1.1	0.6	0.2	BGN
B83		- 54'36"	- 25'22"	49	0.4	0.2	0.1	AM
B84	105217	- 54'38"	- 25'18"	95	0.9	0.2	0.2	CAM
B85		- 54'36"	- 25'14"	111	1.9	0.3	0.2	BGN
B86		- 54'34"	- 25'08"	128	1.5	0.2	0.2	BSC
B87		- 54'31"	- 25'03"	123	1.4	0.2	0.2	BSC
B88		- 54'26"	- 24'52"	127	2.3	0.3	0.3	BSC
B89		- 54'26"	- 24'44"	132	1.9	0.3	0.3	BGN
B90	105218	- 54'23"	- 24'44"	131	1.5	0.2	0.0	BGN
B91	105219	- 54'19"	- 24'38"	69	0.8	0.1	0.0	BGN
B92		- 54'15"	- 24'37"	62	0.2	0.0	0.0	AM
B93		- 54'16"	- 24'30"	139	3.2	0.7	0.3	Q
B94		- 54'23"	- 24'28"	128	1.3	0.1	0.4	BGN
B95		- 54'24"	- 24'22"	129	1.1	0.1	0.3	BGN
B96		- 54'23"	- 24'11"	119	1.2	0.3	0.1	BGN
B97		- 54'28"	- 24'05"	ND	ND	ND	ND	BSC
B98		- 54'30"	- 24'19"	58	0.7	0.0	0.1	ULM
B99	105220	- 54'34"	- 24'20"	38	0.7	0.1	0.1	FAM
B100		- 54'38"	- 24'19"	36	1.5	0.1	0.1	AM
B101		- 54'41"	- 24'28"	78	0.7	0.5	0.1	GGN
B102		- 54'47"	- 24'26"	49	0.5	0.1	0.0	AM
B103		- 54'50"	- 24'30"	43	0.4	0.2	0.1	BSC
B104		- 54'54"	- 24'37"	59	0.4	0.2	0.0	AM
B105		- 54'58"	- 24'39"	69	0.6	0.2	0.0	AM
B106	105221	- 55'01"	- 24'41"	51	0.3	0.1	0.1	FAM
B107		- 55'04"	- 24'57"	51	0.5	0.2	0.0	AM
B108		- 54'50"	- 23'03"	55	0.7	0.3	0.2	MB
B109		- 54'46"	- 23'05"	52	0.6	0.2	0.1	MB
B110		- 54'42"	- 23'09"	48	0.5	0.1	0.1	AM
B111	105222	- 54'41"	- 23'10"	138	2.9	0.2	0.4	GW
B112		- 54'43"	- 23'02"	68	0.4	0.3	0.1	AM
B113		- 54'41"	- 23'00"	124	2.7	0.5	0.3	GW
B114		- 54'39"	- 22'59"	91	1.4	0.2	0.1	GW
B115		- 54'33"	- 23'00"	142	1.5	0.7	0.2	GW

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
B116		41°54'32"	105°22'55"	126	2.7	0.4	0.1	BSC
B117	105223	- 54'29"	- 23'07"	108	1.6	0.4	0.1	BSC
B118		- 54'35"	- 23'14"	113	0.8	0.1	0.1	GW
B119		- 54'32"	- 23'26"	94	0.5	0.1	0.1	GW
B120		- 54'36"	- 23'34"	69	0.3	0.2	0.1	GN
B121		- 54'42"	- 23'40"	52	0.1	0.1	0.2	AM
B122		- 54'35"	- 23'42"	43	0.4	0.0	0.1	AM
B123		- 54'49"	- 23'39"	49	0.5	0.1	0.0	AM
B124		- 54'58"	- 23'44"	139	0.9	0.3	0.0	GN
B125		- 54'48"	- 23'44"	ND	0.6	0.0	0.0	AM
B126		- 54'46"	- 23'50"	48	0.4	0.2	0.0	AM
B127	105224	- 54'42"	- 23'54"	116	0.8	0.1	0.0	PG
B128		- 54'38"	- 23'51"	37	0.1	0.0	0.0	AM
B129		- 54'32"	- 23'40"	69	0.5	0.0	0.0	AM
B130	105225	- 54'24"	- 23'40"	125	1.4	0.1	0.1	GW
B131	105226	- 54'14"	- 23'32"	137	0.7	0.8	0.1	GW
B132	105227	- 54'11"	- 23'29"	137	1.4	0.6	0.1	GW
B133		- 54'14"	- 23'14"	56	0.4	0.1	0.1	AM
B134		- 54'44"	- 25'22"	170	1.7	1.0	0.3	Q
B135		- 54'36"	- 25'31"	214	1.6	0.5	0.6	GGN
B136		- 54'32"	- 25'30"	260	3.3	1.3	1.0	GGN
B137		- 54'23"	- 25'24"	75	0.9	0.1	0.1	AM
B138		- 54'17"	- 25'08"	333	3.3	0.7	0.2	GGN
B139	105228	- 54'05"	- 24'53"	138	1.6	0.3	0.0	BGN
B140	105229	- 54'02"	- 24'52"	108	1.5	0.2	0.1	BGN
B141		- 54'00"	- 24'43"	60	0.3	0.1	0.0	AM
B142		- 53'58"	- 24'36"	133	0.9	0.4	0.0	GGN
B143	105230	- 53'56"	- 24'28"	126	1.3	0.1	0.0	BGN
B144	105231	- 53'54"	- 24'18"	130	1.1	0.4	0.0	BGN
B145		- 53'50"	- 24'12"	103	0.4	0.2	0.0	AM
B146		- 53'45"	- 24'10"	117	1.1	0.1	0.1	BGN
B147	105232	- 53'42"	- 24'06"	111	0.9	0.2	0.1	GGN
B148	105233	- 53'36"	- 24'00"	133	1.7	0.6	0.0	BGN
B149		- 53'33"	- 23'48"	192	2.0	0.7	0.2	PAC
B150		- 53'29"	- 23'46"	110	1.6	0.4	ND	PAC
B151		- 53'22"	- 23'48"	121	1.2	0.1	0.2	PAC
B152		- 53'17"	- 23'46"	119	1.0	0.3	0.2	PAC
B153	105234	- 53'14"	- 23'45"	131	0.9	0.5	0.0	BGN
B154		- 53'09"	- 23'45"	101	1.0	0.3	0.1	PAC
B155		- 53'02"	- 23'34"	ND	ND	ND	ND	ND
B156	105235	- 52'57"	- 23'21"	122	0.4	0.3	0.1	GGN
B157		- 53'11"	- 23'20"	96	0.5	0.3	0.1	AM
B158		- 53'28"	- 23'34"	96	0.5	0.1	0.1	PAC
B159		- 54'05"	- 24'06"	124	0.7	0.2	0.0	BSC
B160		- 54'05"	- 24'20"	119	1.1	0.3	0.2	GW
B161		- 54'27"	- 24'27"	101	0.7	0.4	0.0	GW
B162		- 54'35"	- 24'35"	48	0.0	0.1	0.1	AM
B163		- 54'41"	- 24'50"	48	0.5	0.2	0.0	AM
B164		- 54'50"	- 25'05"	50	0.1	0.0	0.1	AM
B165		- 54'45"	- 22'47"	119	1.4	0.3	0.1	GW
B166	105236	- 54'52"	- 22'41"	42	0.2	0.3	0.1	ULM
B167		- 54'53"	- 22'35"	97	0.9	0.4	0.2	GW
B168		- 55'21"	- 24'40"	101	1.5	0.3	0.0	GW
B169		- 55'18"	- 24'30"	122	1.3	0.1	0.2	PAC
B170		- 55'47"	- 24'47"	325	2.3	1.4	1.1	GGN
B171		- 55'50"	- 24'35"	ND	ND	ND	ND	ND
B172		- 55'54"	- 24'28"	340	3.2	1.0	1.0	GGN

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
B173	105237	41°56'02"	105°24'22"	255	1.6	1.2	1.0	FAM
B174		- 56'11"	- 24'17"	511	6.2	2.6	1.6	GGN
B175		- 56'16"	- 23'44"	476	3.3	2.6	1.3	GGN
B176		- 56'20"	- 23'34"	318	1.9	0.8	0.7	QFGN
B177	105238	- 56'23"	- 23'30"	566	6.0	2.6	0.9	RGR
B178		- 56'26"	- 23'34"	411	5.2	1.2	0.8	RGR
B179	105239	- 56'30"	- 23'35"	64	0.2	0.5	0.2	ULM
B180		- 56'40"	- 23'28"	283	3.8	0.8	0.2	GGN
B181		- 56'50"	- 23'32"	212	1.6	0.3	0.2	GGN
B182		- 56'57"	- 23'31"	180	1.4	0.3	0.1	GGN
B183		- 57'02"	- 23'28"	ND	ND	ND	ND	ND
B184	105241	- 57'06"	- 23'28"	622	4.6	2.4	0.8	WGR
B185		- 57'19"	- 23'20"	345	3.0	1.7	0.2	RGR
B186		- 57'21"	- 23'18"	75	0.4	0.1	0.0	DB
B187	105242	- 57'29"	- 23'18"	409	4.5	1.5	0.9	RGR
B188	105243	- 57'48"	- 22'53"	76	0.6	0.1	0.1	ULM
B189	105244	- 57'50"	- 22'42"	240	2.1	1.1	0.1	DB
B190	105245	- 57'33"	- 22'32"	87	0.2	0.1	0.0	DB
B191		- 55'43"	- 24'44"	285	1.7	0.8	0.6	GGN
B192		- 55'36"	- 24'45"	63	1.6	0.1	0.0	ULM
B193		- 55'30"	- 24'30"	75	0.6	0.1	0.0	ULM
B194	105246	- 55'25"	- 24'11"	63	0.4	0.0	0.1	ULM
B195		- 55'27"	- 24'03"	70	1.1	0.1	0.1	AM
B196		- 55'27"	- 23'50"	72	0.4	0.5	0.0	VQ
B197		- 55'25"	- 23'34"	51	0.3	0.1	0.0	AM
B198		- 55'19"	- 23'23"	61	0.5	0.1	0.0	AM
B199	105247	- 55'14"	- 22'56"	54	0.9	0.0	0.0	PHQ
B200		- 55'10"	- 22'41"	117	2.2	1.0	0.2	BSC
B201		- 55'38"	- 22'40"	48	0.6	0.2	0.0	AM
B202		- 55'50"	- 22'52"	151	0.8	0.3	0.0	GN
B203		- 55'46"	- 23'20"	287	2.7	0.6	0.3	GN
B204		- 55'50"	- 23'38"	260	1.7	0.7	0.0	GN
B205		- 55'49"	- 23'40"	334	3.0	0.8	0.0	GN
B206		- 55'44"	- 24'02"	401	4.3	1.5	0.5	GN
B207	105248	- 54'57"	- 26'34"	315	5.5	1.2	0.5	DB
B208		- 54'45"	- 26'28"	344	3.0	0.8	0.1	GN
B209		- 54'38"	- 26'30"	356	3.0	1.2	0.4	GN
B210		- 54'22"	- 26'00"	412	3.7	0.8	0.5	GN
B211		- 54'18"	- 25'45"	269	1.8	0.6	0.2	GN
B212		- 54'07"	- 25'47"	211	1.7	0.9	0.0	GGN
B213		- 53'58"	- 25'26"	204	1.9	0.5	0.4	GGN
B214		- 53'48"	- 25'18"	243	2.6	1.2	0.2	GN
B215		- 53'38"	- 25'02"	209	1.7	0.5	0.I	GGN
B216		- 53'04"	- 25'18"	50	0.2	0.0	0.0	AM
B217		- 52'46"	- 25'11"	42	0.2	0.0	0.0	AM
B218	105249	- 52'38"	- 25'00"	53	0.4	0.2	0.0	FAM
B219		- 52'38"	- 24'44"	53	0.5	0.0	0.0	AM
B220		- 52'51"	- 24'34"	88	0.4	0.1	0.0	AM
B221		- 53'01"	- 24'38"	52	0.4	0.0	0.0	AM
B222		- 53'08"	- 24'24"	60	0.3	0.1	0.0	AM
B223		- 53'12"	- 24'10"	50	0.4	0.3	0.0	AM
B224		- 53'28"	- 24'12"	60	0.3	0.1	0.0	AM
B225		- 53'34"	- 24'16"	150	1.1	0.1	0.0	GGN
B226		- 53'57"	- 22'40"	62	0.4	0.1	0.1	AM
B227		- 53'53"	- 22'41"	93	1.2	0.5	0.1	PAC
B228		- 53'49"	- 22'56"	40	0.2	0.1	0.1	ULM
B229		- 53'28"	- 22'53"	41	0.7	0.1	0.0	ULM
B230		- 53'25"	- 22'47"	37	0.3	0.2	0.1	ULM

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
B231	105250	41°53'01"	105°22'42"	35	0.6	0.1	0.0	ULM
B232		- 52'59"	- 23'01"	95	0.4	0.3	0.1	BGN
B233		- 52'36"	- 22'52"	65	0.6	0.3	0.1	AM
B234		- 52'30"	- 22'57"	52	0.6	0.1	0.1	AM
B235		- 52'36"	- 23'15"	63	0.9	0.3	0.1	BR
B236		- 52'24"	- 23'24"	45	0.5	0.0	0.1	AM
B237		- 53'06"	- 23'49"	38	0.4	0.1	0.0	AM
B238		- 53'02"	- 24'00"	59	0.4	0.2	0.1	AM
B239	105251	- 53'02"	- 24'08"	93	1.3	0.3	0.1	BGN
B240		- 52'55"	- 24'17"	81	1.0	0.8	0.0	BGN
B241		- 52'40"	- 24'17"	48	0.3	0.1	0.0	AM
B242		- 52'30"	- 24'21"	45	0.5	0.0	0.0	AM
B243	105324	- 55'12"	- 24'01"	ND	ND	ND	ND	PAC
B244		- 52'56"	- 22'58"	124	2.0	0.5	0.1	GGN
B245		- 53'06"	- 23'12"	92	0.5	0.2	0.1	GW
B246		- 53'25"	- 23'16"	88	1.3	0.3	0.1	GW
B247		- 53'40"	- 23'30"	97	2.0	0.2	0.3	GW
B248		- 53'39"	- 23'24"	127	1.7	0.9	0.4	PHQ
B249		- 53'38"	- 23'04"	54	0.1	0.1	0.1	AM
B250		- 53'21"	- 23'02"	84	0.9	0.1	0.1	AM
B251		- 53'13"	- 23'02"	58	0.4	0.2	0.0	AM
B252		- 53'05"	- 22'58"	50	0.5	0.2	0.0	GW
B253		- 57'20"	- 28'46"	226	2.2	0.7	0.7	GGN
B254		- 57'26"	- 29'00"	181	2.6	0.1	0.3	GGN
B255		- 57'30"	- 29'18"	162	2.0	0.4	0.1	GGN
B256		- 57'34"	- 29'39"	199	1.7	0.5	0.3	GGN
B257		- 57'43"	- 29'41"	104	0.8	0.5	0.2	DB
B258	105252	- 57'54"	- 29'50"	161	1.9	1.0	0.6	GGN
B259		- 58'10"	- 29'48"	179	2.1	0.6	0.4	GGN
B260		- 58'19"	- 29'52"	184	2.4	0.6	0.3	GGN
B261		- 58'28"	- 29'52"	140	1.5	0.6	0.3	GGN
B262		- 58'46"	- 29'50"	136	1.3	0.7	0.3	RGR
B263		- 58'58"	- 29'44"	212	3.2	0.7	0.5	RGR
B264		- 59'11"	- 29'44"	69	0.6	0.2	0.1	DB
B265		- 59'25"	- 29'44"	240	2.6	0.7	0.5	GGN
B266		- 59'36"	- 29'42"	206	2.0	0.6	0.3	GGN
B267		- 59'31"	- 29'32"	285	2.8	0.7	0.7	RGR
B268		- 59'31"	- 29'22"	253	2.6	0.7	0.5	RGR
B269	105269	- 59'20"	- 29'08"	245	2.9	1.2	0.5	RGR
B270		- 59'18"	- 28'53"	148	1.3	0.7	0.3	BSC
B271		- 59'08"	- 28'38"	112	1.6	0.6	0.2	GGN
B272		- 59'05"	- 28'24"	173	1.4	0.6	0.4	GGN
B273		- 59'05"	- 28'09"	87	0.7	0.3	0.0	DB
B274		- 59'02"	- 27'55"	127	1.6	0.2	0.1	RGR
B275		- 58'56"	- 27'45"	118	0.6	0.4	0.1	GGN
B276		- 58'36"	- 27'56"	240	2.6	0.7	0.4	GGN
B277		- 58'36"	- 28'19"	124	1.9	0.4	0.5	RGR
B278		- 58'27"	- 28'35"	129	1.0	0.2	0.4	GGN
B279		- 58'17"	- 29'04"	163	1.7	0.4	0.7	RGR
B280		- 58'11"	- 29'11"	150	1.7	0.6	0.2	RGR
B281		- 57'59"	- 29'09"	151	2.0	0.5	0.1	RGR
B282		- 58'01"	- 28'41"	209	2.9	0.5	0.4	RGR
B283		- 57'54"	- 28'31"	158	1.5	0.6	0.2	RGR
B284		- 57'48"	- 28'26"	149	2.2	0.1	0.2	RGR
B285		- 57'38"	- 28'18"	142	2.4	0.0	0.6	RGR
B286		- 57'30"	- 28'30"	132	1.4	0.2	0.4	RGR
B287		- 59'04"	- 26'12"	94	0.4	0.5	0.1	DB

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
B288		41°59'18"	105°25'52"	243	2.0	0.5	0.5	RGR
B289		- 59'09"	- 25'43"	134	0.8	0.8	0.2	GGN
B290		- 59'04"	- 25'28"	248	2.1	1.3	0.5	GGN
B291		- 59'02"	- 25'08"	157	1.4	0.6	0.3	GGN
B292		- 58'48"	- 24'54"	263	2.8	0.8	0.5	MM
B293		- 58'42"	- 24'36"	85	1.1	0.5	0.2	DB
B294		- 58'38"	- 24'24"	219	2.8	0.8	0.4	MM
B295		- 58'38"	- 24'10"	168	2.6	0.3	0.3	MM
B296		- 58'36"	- 23'58"	140	2.4	0.4	0.1	RGR
B297		- 58'36"	- 23'42"	121	1.3	0.1	0.2	MM
B298		- 58'40"	- 23'27"	171	2.5	0.5	0.4	MM
B299		- 58'43"	- 23'06"	160	2.5	0.7	0.1	MM
B301	105254	- 57'26"	- 29'58"	146	1.3	0.4	0.0	DB
B302		- 57'07"	- 29'50"	205	3.2	0.6	0.2	RGR
B303		- 56'56"	- 29'39"	159	2.4	0.3	0.0	RGR
B304		- 56'55"	- 29'22"	275	3.2	0.9	0.6	RGR
B305		- 57'02"	- 28'46"	260	3.8	1.0	0.1	RGR
B306		- 57'12"	- 28'14"	360	4.2	1.6	0.7	PG
B307		- 57'16"	- 27'46"	269	3.3	0.5	0.3	RGR
B308	105255	- 57'19"	- 27'25"	303	3.5	1.0	0.1	DB
B309		- 57'11"	- 27'02"	320	2.8	0.8	0.3	RGR
B310		- 57'02"	- 26'59"	310	2.9	0.6	0.1	RGR
B311		- 56'43"	- 26'48"	340	4.2	0.7	0.2	RGR
B312		- 56'30"	- 26'21"	271	2.4	1.0	0.4	RGR
B313		- 56'28"	- 26'12"	346	3.8	0.7	0.3	RGR
B314		- 56'15"	- 26'18"	370	4.5	1.4	0.3	RGR
B315		- 56'03"	- 26'22"	400	4.8	1.4	0.2	RGR
B316		- 55'52"	- 26'49"	65	0.3	0.1	0.1	AM
B317	105256	- 55'43"	- 26'41"	128	1.3	0.2	0.1	BGN
B318		- 55'28"	- 26'27"	45	0.3	0.1	0.0	AM
B319		- 55'46"	- 26'21"	72	0.6	0.1	0.0	AM
B320		- 55'42"	- 25'53"	257	3.3	0.3	0.0	GGN
B321		- 55'42"	- 25'33"	61	0.6	0.1	0.0	AM
B322		- 55'57"	- 25'35"	395	3.7	0.8	0.1	GGN
B323		- 56'11"	- 25'35"	375	4.5	1.3	0.2	GGN
B324		- 56'14"	- 25'10"	410	4.3	1.6	0.7	GGN
B325		- 56'24"	- 24'57"	297	2.6	0.8	0.5	GGN
B326		- 59'04"	- 26'24"	78	0.7	0.1	0.1	DB
B327		- 59'07"	- 26'41"	115	2.5	0.4	0.0	RGR
B328		- 59'21"	- 27'04"	110	1.5	0.2	0.1	DB
B329		- 59'36"	- 26'56"	300	3.7	0.9	0.7	RGR
B330		- 59'48"	- 26'26"	380	3.5	0.6	0.5	RGR
B331		- 59'58"	- 25'51"	78	0.7	0.2	0.0	AM
B332		- 59'59"	- 25'37"	183	2.0	0.3	0.0	GR
B333	105257	- 59'46"	- 23'26"	116	0.3	0.3	0.0	AUGN
B334		- 59'47"	- 23'51"	300	2.8	0.8	0.0	RGR
B335		- 59'38"	- 24'23"	228	1.2	0.8	0.2	RGR
B336		- 59'29"	- 25'00"	220	2.1	0.5	0.0	RGR
B400		- 58'45"	- 22'52"	114	2.8	0.0	0.1	MM
B401		- 58'52"	- 22'11"	167	2.6	0.2	0.5	GN
B402		- 58'52"	- 22'31"	177	1.3	0.3	0.7	GN
B403		- 59'18"	- 22'38"	148	2.8	0.7	0.3	RGR
B404		- 59'08"	- 22'53"	141	1.7	0.3	0.2	MM
B405		- 59'02"	- 23'10"	126	1.4	0.3	0.2	MM
B406		- 59'14"	- 23'21"	140	1.3	0.5	0.2	RGR
B407		- 59'08"	- 23'37"	416	4.4	1.3	0.7	RGR
B408		- 58'54"	- 23'53"	171	1.7	0.9	0.4	MM
B409		- 58'53"	- 24'10"	232	3.1	0.2	0.6	RGR

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
B410		41°58'58"	105°24'20"	232	2.3	0.5	0.3	RGR
B411		- 59'00"	- 22'32"	153	1.9	0.2	0.2	RGR
B412		- 59'05"	- 22'43"	131	1.8	0.3	0.2	RGR
B413	105258	- 59'09"	- 22'56"	123	1.3	0.4	0.2	WGR
BW1		- 50'20"	- 30'18"	292	2.6	0.8	0.4	RGR
BW2		- 50'24"	- 30'48"	337	3.7	1.1	0.5	RGR
BW3		- 50'26"	- 31'15"	335	3.3	0.7	0.3	RGR
BW4		- 50'32"	- 31'33"	354	3.6	0.7	0.3	RGR
BW5		- 50'59"	- 31'25"	227	2.3	1.0	0.3	RGR
BW6		- 51'14"	- 31'02"	313	3.6	0.7	0.3	RGR
D1		42°00'18"	- 25'29"	250	3.3	1.0	0.0	GR
D2		- 00'39"	- 25'22"	400	4.3	2.2	3.0	GR
D3		- 00'55"	- 25'28"	255	3.1	0.5	0.3	GR
D4		- 01'17"	- 25'05"	290	3.0	1.1	0.2	GR
D5		- 01'36"	- 24'45"	70	0.5	0.5	0.1	AM
D6		- 01'38"	- 24'08"	195	1.9	0.6	0.0	GR
D7		- 01'26"	- 23'46"	275	3.4	0.6	0.0	GR
D8		- 00'59"	- 23'43"	206	1.4	0.8	0.2	GR
D9		- 00'42"	- 23'48"	268	2.6	0.3	0.0	GR
D10		- 00'31"	- 23'53"	231	1.9	0.5	0.1	GN
D11		- 00'15"	- 23'39"	107	0.8	0.1	0.1	AM
D12		- 00'01"	- 23'11"	306	1.9	1.1	0.1	GR
D13	105336	- 07'40"	- 25'08"	690	5.1	3.3	1.5	GN
D14	105337	- 07'40"	- 25'08"	690	5.1	3.3	1.5	GN
D15	105338	- 07'40"	- 25'08"	690	5.1	3.3	1.5	GN
E1	105343	- 16' -	- 22' -	427	5.7	1.2	1.0	GR
E2	105344	- 21' -	- 21' -	591	7.1	2.3	1.5	GR
E3	105345	- 21' -	- 21' -	591	7.1	2.3	1.5	GR
E4	105346	- 23' -	- 20' -	568	5.5	2.5	1.3	GR
G1		41°52'28"	- 22'57"	36	0.4	0.0	0.0	AM
G2		- 52'24"	- 22'44"	49	0.9	0.1	0.0	AM
G3		- 51'16"	- 24'32"	125	1.7	0.7	0.3	AM
G4		- 51'32"	- 24'28"	130	2.3	0.5	0.4	GGN
G5		- 51'48"	- 24'10"	51	0.4	0.0	0.0	AM
G6		- 52'01"	- 23'50"	67	0.4	0.1	0.0	AM
G7		- 51'47"	- 23'30"	46	0.7	0.0	0.1	AM
G8		- 51'29"	- 23'14"	50	0.3	0.1	0.0	AM
G9		- 51'44"	- 23'04"	61	0.5	0.2	0.2	AM
G10	105320	- 51'53"	- 22'54"	62	0.7	0.0	0.0	DB
G11		- 52'02"	- 22'54"	48	0.8	0.1	0.1	AM
G12		- 52'16"	- 23'14"	42	0.5	0.1	0.0	AM
G13		- 52'29"	- 23'26"	54	0.6	0.2	0.0	AM
G14		- 52'28"	- 24'26"	36	0.1	0.1	0.0	ULM
G15		- 51'54"	- 24'32"	170	1.5	0.5	0.2	GGN
G16		- 51'30"	- 28'24"	204	2.0	1.4	0.6	RGR
G17		- 51'46"	- 27'56"	217	2.2	0.8	0.3	RGR
G18		- 51'46"	- 27'50"	73	0.6	0.3	0.1	AM
G19	105316	- 51'47"	- 27'52"	55	0.5	0.1	0.1	ULM
G20		- 51'33"	- 27'02"	100	0.6	0.0	0.0	AM
G21		- 51'26"	- 27'42"	66	0.2	0.2	0.1	AM
G22		- 51'17"	- 28'01"	162	2.4	0.9	0.5	RGR
G23		- 51'02"	- 28'46"	376	3.0	1.2	1.4	RGR
G24		- 50'52"	- 29'14"	259	2.6	1.1	0.7	RGR
G25		- 50'44"	- 29'34"	320	2.7	1.2	0.9	RGR
G26		- 51'00"	- 29'38"	375	2.8	1.5	1.1	RGR
G27		- 51'21"	- 29'20"	281	2.9	0.5	0.4	RGR
G30		- 51'14"	- 22'32"	54	0.3	0.1	0.0	AM

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
G31		41°51'14"	105°22'56"	41	0.5	0.1	0.0	AM
G32		- 51'14"	- 23'12"	237	1.2	0.6	0.0	RGR
G33		- 51'18"	- 23'24"	62	0.3	0.0	0.1	AM
G34		- 51'21"	- 23'40"	140	0.9	0.2	0.0	RGR
G35		- 51'17"	- 24'07"	237	1.7	0.7	0.2	GGN
G36		- 51'15"	- 24'22"	165	2.2	0.3	0.0	RGR
G37		- 51'02"	- 24'40"	230	2.5	0.7	0.0	GGN
G38		- 50'48"	- 25'10"	206	1.7	0.7	0.1	GGN
G39		- 50'37"	- 25'13"	84	0.2	0.2	0.0	AM
G40		- 50'15"	- 25'32"	178	1.3	0.4	0.0	GGN
G41		- 50'04"	- 26'02"	220	0.8	0.2	0.1	GGN
G42		- 50'05"	- 26'24"	230	0.7	0.1	0.1	GGN
G43		- 50'22"	- 26'28"	230	1.0	0.3	0.1	GGN
G44		- 50'56"	- 26'29"	316	1.8	1.1	0.0	GGN
G45	105321	- 51'24"	- 26'18"	418	3.7	2.3	0.0	AUGN
G46		- 51'32"	- 25'59"	130	0.7	0.2	0.1	GGN
G47		- 51'45"	- 25'46"	281	2.2	1.3	0.1	GR
G48		- 51'50"	- 25'21"	138	1.5	0.4	0.1	BGN
G49		- 51'54"	- 25'04"	71	0.3	0.1	0.0	ULM
G50	105322	- 51'53"	- 24'58"	160	1.3	0.3	0.2	UQ
G51		- 51'50"	- 24'40"	54	0.4	0.3	0.0	AM
G52		- 50'28"	- 24'44"	265	3.0	0.9	0.3	GGN
G53		- 50'56"	- 28'02"	424	5.4	1.9	0.4	RGR
G54		- 50'40"	- 28'11"	170	3.1	0.4	0.6	RGR
G55		- 50'23"	- 28'21"	160	2.6	0.2	0.2	RGR
G56		- 50'02"	- 28'40"	146	2.7	0.2	0.0	RGR
G57		- 50'14"	- 29'22"	325	2.8	0.9	0.9	RGR
G58		- 50'20"	- 29'48"	460	5.5	1.5	0.7	RGR
GA1		42°05'48"	- 34'38"	131	1.4	0.1	0.2	WGR
GA2		- 06'02"	- 34'37"	145	2.3	0.5	0.2	RGR
GA3	105331	- 06'15"	- 34'40"	95	0.8	0.3	0.3	MSC
GA4	105332	- 06'11"	- 34'52"	107	0.2	0.7	0.1	PAC
GA5	105333	- 06'04"	- 35'04"	115	1.3	0.1	0.2	PAC
GA6	105334	- 05'33"	- 36'08"	435	4.3	2.2	0.1	Basal Tertiary?
GA10		- 06'29"	- 34'57"	116	0.9	0.5	0.2	CS
GA11		- 06'37"	- 35'07"	100	0.5	0.5	0.0	GW
GA12	105335	- 06'37"	- 35'52"	186	1.4	0.9	0.1	GN
H1		- 04'53"	- 13'15"	59	0.5	0.1	0.0	MB
H2		- 04'46"	- 13'37"	49	0.3	0.0	0.0	MB
H3		- 04'40"	- 13'55"	55	0.2	0.1	0.0	MB
H4		- 04'41"	- 14'09"	188	1.1	0.5	0.0	MM
M1		41°54'46"	- 22'24"	120	1.8	0.4	0.0	BSC
M2		- 54'45"	- 22'19"	103	1.1	0.3	0.1	GW
M3		- 54'43"	- 22'10"	106	1.3	0.0	0.1	GW
M4	105254	- 54'42"	- 22'02"	76	0.7	0.1	0.4	ULM
M5		- 54'43"	- 21'56"	102	0.7	0.3	0.0	BSC
M6		- 54'38"	- 21'55"	117	1.3	0.3	0.1	GW
M7		- 54'37"	- 22'01"	118	1.4	0.3	0.1	GW
M8		- 55'01"	- 22'30"	70	0.5	0.2	0.0	AM
M9		- 55'01"	- 22'22"	46	0.5	0.2	0.0	AM
M10		- 54'51"	- 22'13"	92	1.1	0.4	0.1	GW
M11		- 54'51"	- 22'01"	57	0.4	0.0	0.0	ULM
M12		- 54'49"	- 21'40"	56	0.4	0.0	0.0	ULM
M13		- 54'58"	- 21'40"	42	0.4	0.0	0.1	AM
M14		- 55'11"	- 21'36"	42	0.5	0.1	0.0	AM
M15		- 55'23"	- 21'43"	56	0.7	0.2	0.1	AM
M16		- 55'34"	- 21'47"	51	0.3	0.0	0.2	AM
M17		- 55'41"	- 22'03"	212	1.3	0.5	0.2	RGR

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
M18		41°55'39"	105°22'25"	176	0.8	0.4	0.1	RGR
M19		- 57'32"	- 22'08"	215	2.6	0.8	0.2	RGR
M20		- 57'48"	- 22'58"	306	2.6	0.9	0.5	MM
M21	105260	- 57'56"	- 21'50"	85	0.9	0.0	0.1	ULM
M22	105261	- 58'07"	- 21'41"	417	0.5	0.1	0.0	ULM
M23	105262	- 58'07"	- 21'33"	40	0.2	0.0	0.0	ULM
M24		- 58'19"	- 21'26"	193	1.0	0.3	0.0	GGN
M25		- 58'26"	- 21'08"	44	0.1	0.2	0.0	ULM
M26	105263	- 58'35"	- 21'01"	41	0.0	0.1	0.0	ULM
M27	105264	- 58'45"	- 20'58"	45	0.4	0.0	0.1	ULM
M28		- 58'45"	- 20'36"	115	0.5	0.6	0.1	GN
M29		- 58'47"	- 20'17"	50	0.3	0.2	0.0	GB
M30		- 58'53"	- 19'56"	36	0.1	0.0	0.0	ULM
M31		- 58'47"	- 19'47"	130	0.1	0.2	0.0	GGN
M32		- 58'37"	- 20'00"	164	1.2	0.4	0.1	GGN
M33		- 58'30"	- 20'18"	164	1.2	0.2	0.0	MM
M34		- 58'17"	- 20'29"	300	1.5	0.6	0.0	GGN
M35		- 58'18"	- 20'38"	64	0.4	0.1	0.0	AM
M36		- 58'18"	- 20'44"	44	0.4	0.1	0.0	ULM
M37		- 58'10"	- 20'56"	52	0.2	0.1	0.1	ULM
M38		- 59'57"	- 21'08"	135	0.7	0.1	0.0	GN
M39		- 57'41"	- 21'28"	209	1.3	0.3	0.2	GGN
M40		- 57'00"	- 21'36"	180	1.2	0.4	0.1	RGR
M41		- 57'12"	- 21'49"	200	0.9	0.7	0.2	MM
M42		- 54'14"	- 17'38"	173	1.3	1.1	0.7	SY
M43	105265	- 54'12"	- 17'31"	126	1.0	0.3	0.1	SQ
M44		- 54'12"	- 17'24"	270	1.6	1.1	1.1	BSC
M45	105266	- 54'17"	- 17'16"	360	3.0	1.9	0.2	CS
M46		- 54'20"	- 17'02"	84	0.6	0.2	0.0	AM
M47		- 54'26"	- 17'05"	90	0.5	0.1	0.1	AM
M48	105267-105270	- 54'34"	- 17'04"	275	2.1	1.2	0.0	PBQ
M49		- 54'39"	- 16'48"	180	2.2	1.0	0.2	PG
M50		- 54'34"	- 16'44"	67	0.5	0.0	0.3	AM
M51	105271	- 54'31"	- 16'50"	210	1.6	1.1	0.2	PBQ
M52		- 54'28"	- 16'32"	235	1.7	0.6	0.1	SY
M53		- 54'26"	- 16'18"	ND	ND	ND	ND	ND
M54		- 54'23"	- 16'00"	223	1.5	0.9	0.2	WGR
M55		- 54'20"	- 15'55"	281	2.3	1.0	0.0	RGR
M56		- 54'12"	- 16'06"	290	1.0	0.3	0.1	SY
M57		- 54'08"	- 16'13"	108	0.6	0.3	0.1	Q
M58		- 53'59"	- 15'58"	260	1.3	0.5	0.0	SY
M59		- 53'51"	- 15'42"	203	1.9	0.5	0.0	CS
M60	105272	- 54'09"	- 17'46"	181	1.7	0.1	0.1	CAM
M61		- 54'02"	- 17'56"	245	1.5	0.7	0.0	GN
M62		- 54'05"	- 18'12"	140	0.6	0.2	0.0	BGN
M63	105273	- 54'10"	- 18'20"	126	0.6	0.0	0.0	BSC
M64	105274	- 54'17"	- 18'28"	128	1.1	0.3	0.0	BGN
M65		- 53'58"	- 18'40"	111	0.7	0.2	0.1	BSC
M66		- 53'55"	- 18'48"	196	1.9	0.6	0.0	BSC
M67		- 53'52"	- 18'49"	60	0.7	0.2	0.0	Q
M68		- 53'44"	- 18'52"	220	2.8	0.9	0.2	GN
M69		- 53'39"	- 18'58"	98	0.8	0.1	0.0	MB
M70	105275	- 53'38"	- 19'02"	240	3.1	1.0	0.2	PBQ
M71	105276	- 53'35"	- 19'06"	240	2.6	0.2	0.1	BGN
M72		- 53'34"	- 19'20"	67	0.6	0.0	0.1	Q
M73		- 53'48"	- 19'08"	105	1.1	0.2	0.1	MB
M74		- 54'00"	- 19'09"	126	1.1	0.6	0.0	BSC

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
M75		41°54'06"	105°19'06"	130	1.5	0.5	0.2	BSC
M76		- 54'08"	- 19'00"	120	1.0	0.7	0.1	BSC
M77		- 54'12"	- 18'50"	92	0.7	0.2	0.1	AM
M78		- 54'20"	- 18'41"	211	1.4	0.6	0.0	BSC
M79		- 54'23"	- 18'16"	170	2.5	0.3	0.0	PG
M80		- 54'22"	- 18'02"	124	0.7	0.3	0.0	BSC
M81		- 54'40"	- 19'34"	122	0.6	0.3	0.1	BSC
M82		- 54'32"	- 20'02"	150	1.6	0.1	0.3	BSC
M83		- 54'39"	- 20'04"	109	1.6	0.5	0.0	PHQ
M84		- 54'48"	- 20'00"	46	0.4	0.1	0.0	ULM
M85	105277	- 54'49"	- 20'08"	71	0.6	0.4	0.1	ULM
M86		- 54'50"	- 20'14"	47	0.6	0.4	0.1	CSC
M87		- 54'50"	- 20'29"	72	0.9	0.2	0.0	GW
M88		- 54'53"	- 20'39"	97	0.9	0.2	0.0	ULM
M89		- 54'51"	- 20'56"	190	1.4	0.3	0.4	BSC
M90		- 54'53"	- 21'06"	131	1.1	0.2	0.2	BSC
M91		- 54'48"	- 21'12"	55	0.4	0.3	0.0	AM
M92		- 54'44"	- 21'30"	86	1.1	0.3	0.0	GW
M93		- 54'38"	- 21'34"	129	1.4	0.4	0.1	Q
M94	105278	- 54'35"	- 21'28"	77	0.5	0.1	0.1	FAM
M95		- 54'24"	- 21'20"	45	0.2	0.1	0.2	ULM
M96		- 54'21"	- 21'06"	93	0.6	0.3	0.2	GW
M97		- 54'23"	- 20'56"	63	0.7	0.2	0.0	Q
M98		- 54'30"	- 20'56"	95	1.3	0.3	0.1	GW
M99		- 54'42"	- 20'54"	45	0.4	0.2	0.2	ULM
M100		- 54'57"	- 20'47"	54	0.4	0.1	0.0	AM
M101		- 55'10"	- 20'46"	55	0.2	0.1	0.1	AM
M102		- 55'19"	- 20'56"	45	0.6	0.1	0.0	AM
M103		- 55'28"	- 21'06"	56	0.5	0.0	0.1	AM
M104		- 55'34"	- 21'10"	183	1.2	0.7	0.2	GGN
M105		- 55'46"	- 20'57"	260	2.6	0.7	0.0	GGN
M106		- 55'54"	- 20'47"	282	1.7	0.9	0.1	GGN
M107		- 55'54"	- 20'29"	256	3.0	0.7	0.2	GGN
M108		- 56'00"	- 20'12"	74	0.5	0.2	0.2	AM
M109		- 55'37"	- 19'56"	130	0.4	0.2	0.0	AM
M110		- 55'27"	- 19'57"	232	2.4	0.5	0.2	GGN
M111		- 55'18"	- 20'02"	54	0.1	0.1	0.0	AM
M112		- 55'10"	- 20'02"	58	0.1	0.0	0.0	ULM
M113		- 54'57"	- 19'47"	63	0.5	0.1	0.0	ULM
M114		- 54'46"	- 19'51"	56	0.4	0.1	0.0	AM
M115		- 54'32"	- 19'46"	118	0.6	0.5	0.1	GW
M116		- 54'24"	- 19'40"	161	1.3	0.5	0.1	AM
M117		- 54'10"	- 19'36"	68	0.2	0.1	0.0	AM
M118		- 54'16"	- 19'50"	56	0.6	0.2	0.1	AM
M119		- 54'11"	- 20'05"	56	0.2	0.2	0.0	AM
M120		- 54'20"	- 20'03"	160	1.0	0.3	0.0	BSC
M121		- 54'30"	- 19'52"	146	1.4	0.4	0.0	BSC
M122	105279	- 55'59"	- 19'49"	176	1.6	0.0	0.3	GGN
M123		- 56'01"	- 19'30"	201	2.6	0.6	0.1	GGN
M124		- 56'13"	- 19'25"	270	3.4	0.9	0.3	PG
M125		- 56'21"	- 19'14"	288	3.0	0.9	0.7	GGN
M126		- 56'30"	- 19'06"	258	3.0	0.5	0.0	BGN
M127		- 56'35"	- 19'05"	201	1.9	0.6	0.2	GGN
M128	105280	- 56'46"	- 19'00"	240	2.0	0.7	0.2	WGR
M129		- 56'55"	- 19'08"	135	0.8	0.1	0.4	PG
M130		- 57'10"	- 19'06"	310	2.1	0.5	0.1	GGN
M131	105282	- 57'15"	- 19'07"	270	2.1	0.6	0.0	CAM
M132		- 57'58"	- 19'21"	220	1.1	0.6	0.3	BGN

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
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SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
M133		41°57'30"	105°19'29"	164	0.6	0.3	0.1	AM
M134		- 57'39"	- 19'34"	186	0.7	0.5	0.3	GGN
M135		- 57'47"	- 19'36"	231	1.5	0.5	0.1	GGN
M136		- 57'51"	- 19'34"	105	0.5	0.3	0.1	Q
M137	105283	- 58'00"	- 19'29"	56	0.2	0.2	0.1	IF
M138	105285	- 58'17"	- 19'14"	135	0.9	0.4	0.1	ULM
M139		- 58'08"	- 19'00"	223	1.9	0.8	0.0	GGN
M140		- 58'00"	- 18'47"	75	0.4	0.2	0.0	IF
M141		- 57'53"	- 18'43"	280	1.9	0.5	0.0	GGN
M142		- 57'43"	- 18'32"	262	0.2	0.6	0.0	WGR
M143		- 57'30"	- 18'30"	156	1.1	0.2	0.0	RGR
M144		- 57'11"	- 18'20"	216	1.4	0.7	0.0	GGN
M145		- 57'05"	- 18'14"	219	1.1	0.1	0.1	GR
M146		- 56'48"	- 18'04"	244	1.9	0.4	0.2	GR
M147		- 56'38"	- 18'19"	290	1.7	0.4	0.1	GGN
M148		- 56'31"	- 18'28"	350	2.4	0.9	0.4	GGN
M149		- 56'16"	- 18'56"	290	2.0	0.8	0.2	GGN
M150		- 56'01"	- 18'56"	192	1.0	0.3	0.0	GGN
M151	105286	- 55'49"	- 18'55"	201	1.3	0.4	0.4	Q
M152		- 55'42"	- 19'00"	250	1.9	0.7	0.2	GGN
M153		- 55'32"	- 19'14"	65	0.4	0.1	0.0	AM
M154		- 55'23"	- 19'07"	54	0.1	0.1	0.1	ULM
M155		- 55'15"	- 19'21"	99	0.6	0.1	0.0	GW
M156		- 55'08"	- 19'31"	93	0.7	0.2	0.1	GW
M157		- 53'08"	- 22'22"	139	2.0	0.2	0.5	GW
M158		- 53'24"	- 22'16"	62	0.5	0.2	0.2	AM
M159		- 53'28"	- 22'08"	ND	ND	ND	ND	ND
M160		- 53'34"	- 22'07"	90	2.1	0.4	0.1	AM
M161		- 53'40"	- 21'50"	95	0.9	0.9	0.1	AM
M162		- 53'55"	- 21'42"	110	1.8	0.4	0.2	PAC
M163		- 54'03"	- 21'59"	110	0.5	0.1	0.3	AM
M164	105289	- 54'10"	- 21'56"	225	2.9	1.1	0.5	FQ
M165	105287	- 54'12"	- 21'54"	230	2.2	0.1	0.5	FQ
M166	105288	- 54'12"	- 21'58"	260	2.7	0.8	0.6	IQ
M167	105290	- 54'11"	- 22'06"	218	2.0	0.7	0.5	FQ
M168	105291	- 54'14"	- 22'12"	350	3.6	1.2	0.4	FQ
M169	105292	- 54'07"	- 22'24"	215	2.7	0.6	0.5	FQ
M170		- 52'37"	- 22'14"	70	0.8	0.1	0.1	AM
M171		- 52'49"	- 22'13"	67	0.6	0.0	0.0	AM
M172	105293	- 52'46"	- 22'03"	140	2.0	0.2	0.0	BSC
M173		- 52'35"	- 21'36"	92	0.8	0.1	0.2	GW
M174		- 52'33"	- 21'23"	120	1.3	0.4	0.0	AM
M175		- 52'33"	- 21'16"	55	0.2	0.1	0.0	ULM
M176	105294	- 52'37"	- 20'38"	131	0.9	0.3	0.0	BSC
M177		- 52'36"	- 20'21"	53	0.1	0.0	0.0	ULM
M178		- 52'56"	- 20'22"	116	1.1	0.4	0.0	GW
M179		- 53'04"	- 20'25"	100	0.9	0.4	0.2	GW
M180		- 53'07"	- 20'40"	40	0.5	0.0	0.0	ULM
M181		- 53'13"	- 21'14"	95	1.4	0.1	0.1	GW
M182		- 53'14"	- 21'24"	80	0.5	0.4	0.1	AM
M183		- 53'05"	- 21'35"	95	0.6	0.1	0.0	AM
M184		- 52'54"	- 21'47"	95	1.1	0.4	0.1	AM
M185		- 52'51"	- 22'02"	148	1.8	0.5	0.0	BSC
M186		- 54'26"	- 20'40"	56	0.7	0.1	0.1	ULM
M187		- 54'08"	- 21'01"	76	0.6	0.1	0.0	AM
M188		- 54'10"	- 21'14"	106	1.1	0.1	0.0	GW
M189	105295	- 54'04"	- 21'21"	151	0.9	0.3	0.1	BGN

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
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SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
M190		41°53'59"	105°21'22"	173	1.8	0.5	0.0	PAC
M191		- 53'55"	- 21'19"	120	1.0	0.4	0.1	BSC
M192		- 53'57"	- 21'02"	120	0.7	0.5	0.0	PAC
M193		- 53'53"	- 20'57"	120	1.3	0.2	0.1	PAC
M194		- 53'58"	- 20'42"	128	1.0	0.2	0.0	BSC
M195	105296	- 54'04"	- 20'28"	131	1.3	0.4	0.1	BSC
M196	105297	- 54'10"	- 20'37"	180	1.7	0.4	0.1	GW
M200	105298	- 55'06"	- 18'18"	75	0.7	0.1	0.1	MQ
M201	105299	- 55'10"	- 18'25"	285	2.9	0.4	0.2	BR
M202	105301	- 55'15"	- 18'19"	224	2.7	0.5	0.4	GW
M203	105300	- 55'35"	- 18'40"	ND	ND	ND	ND	BGN
M204	105302	- 55'35"	- 18'40"	ND	ND	ND	ND	ULM
M205	105303	- 54'54"	- 18'08"	ND	ND	ND	ND	PHQ
M206		- 55'01"	- 18'06"	205	1.8	0.6	0.3	PHQ
M207		- 55'30"	- 18'14"	71	1.0	0.3	0.2	AM
M208		- 55'34"	- 18'05"	108	1.2	0.0	0.1	GW
M209		- 55'43"	- 17'59"	112	1.0	0.2	0.0	AM
M210		- 55'34"	- 17'27"	114	0.4	0.1	0.1	BSC
M211		- 55'27"	- 17'26"	65	0.1	0.1	0.0	AM
M212		- 55'21"	- 17'28"	110	0.3	0.1	0.0	Q
M213		- 55'17"	- 17'31"	219	0.1	0.0	0.0	Q
M214		- 54'58"	- 17'43"	189	0.4	0.0	0.0	Q
M215		- 54'48"	- 17'56"	145	0.2	0.3	0.1	Q
M216		- 54'40"	- 18'00"	138	1.3	0.4	0.3	PHQ
M217		- 54'34"	- 18'18"	135	1.6	0.5	0.2	BSC
M218		- 54'37"	- 18'30"	117	1.1	0.3	0.1	AM
M219		- 54'41"	- 18'45"	90	1.0	0.3	0.0	BSC
M220	105304	- 54'48"	- 18'48"	87	0.8	0.3	0.0	PBQ
M221		- 54'50"	- 18'28"	71	0.2	0.4	0.0	PHQ
M231	105305	- 52'47"	- 19'32"	152	0.9	0.2	0.0	BGN
M232		- 52'59"	- 19'28"	70	0.4	0.2	0.2	AM
M233	105306	- 53'05"	- 19'33"	55	0.1	0.0	0.1	PBQ
M234		- 53'16"	- 19'33"	141	0.4	0.0	0.1	BGN
M235		- 53'11"	- 19'44"	60	0.2	0.1	0.0	Q
M236		- 53'22"	- 19'48"	60	0.4	0.2	0.0	AM
M237		- 53'36"	- 19'50"	143	1.8	0.4	0.0	BSC
M238		- 53'45"	- 20'01"	70	0.3	0.3	0.1	AM
M239		- 53'54"	- 20'20"	40	0.3	0.0	0.0	ULM
M240		- 53'41"	- 20'34"	38	0.3	0.0	0.0	ULM
M241		- 53'27"	- 20'47"	37	0.1	0.1	0.0	ULM
M242		- 53'19"	- 20'59"	76	0.4	0.4	0.0	AM
M243		- 53'07"	- 21'00"	90	0.3	0.2	0.0	AM
M244		- 52'50"	- 20'56"	52	0.2	0.1	0.0	AM
M245		- 52'33"	- 20'50"	37	0.2	0.0	0.0	ULM
M261		- 58'55"	- 22'18"	148	1.5	0.3	0.2	GGN
M262		- 58'50"	- 22'11"	140	2.5	0.7	0.2	MM
M263		- 59'05"	- 22'08"	186	1.4	0.4	0.5	MM
M264		- 59'08"	- 22'00"	240	4.2	0.4	0.4	MM
M265		- 59'11"	- 21'45"	248	1.9	0.7	0.5	GR
M266		- 59'17"	- 21'28"	206	2.6	0.3	0.6	GN
M267	105307	- 59'24"	- 21'26"	308	3.7	0.5	0.5	GGN
M268		- 59'30"	- 21'39"	187	2.3	0.4	0.4	GGN
M269		- 59'38"	- 21'26"	148	1.2	0.2	0.3	GR
M270		- 59'42"	- 21'22"	159	1.5	0.4	0.1	GN
M271		- 59'42"	- 21'08"	132	1.0	0.4	0.4	GR
M272		- 59'40"	- 20'56"	69	1.1	0.4	0.2	AM
M273		- 59'44"	- 21'35"	168	2.9	0.3	0.4	GGN
M274		- 59'40"	- 21'46"	201	3.1	0.4	0.4	GGN

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
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SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant: TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
M275		41°59'37"	105°21'58"	187	2.3	0.1	0.5	GGN
M276		- 59'36"	- 22'16"	129	1.1	0.2	0.1	GR
M277		- 59'31"	- 22'22"	263	2.3	0.7	0.3	GN
M278		- 59'20"	- 22'26"	153	1.1	0.6	0.3	GN
M279		- 57'53"	- 15'10"	109	1.1	0.5	0.1	MQ
M280		- 57'45"	- 15'06"	54	0.6	0.3	0.1	FAM
M281	105325	- 57'34"	- 15'16"	44	0.3	0.1	0.0	Q
M282		- 57'00"	- 15'39"	276	2.0	0.9	0.8	PBQ
M283	105326	- 56'49"	- 15'40"	334	2.6	1.1	0.8	PBQ
M284		- 56'40"	- 15'49"	180	2.1	0.2	0.1	QFGN
M285		- 56'25"	- 16'05"	154	0.9	0.3	0.3	QFGN
M286		- 56'17"	- 16'19"	60	0.4	0.1	0.0	MB
M287		- 56'29"	- 16'29"	72	0.4	0.1	0.0	IF
M288		- 56'37"	- 16'11"	58	0.7	0.3	0.0	IF
M289		- 56'47"	- 16'04"	87	1.0	0.0	0.1	MB
M290		- 56'57"	- 15'58"	163	1.5	0.8	0.4	SC
M291		- 57'06"	- 15'51"	79	0.6	0.1	0.1	AM
M292		- 56'43"	- 16'35"	85	0.8	0.3	0.2	AM
M293		- 56'34"	- 16'42"	133	1.7	0.2	0.1	SC
M294		- 56'22"	- 16'45"	90	0.2	0.2	0.2	MB
M295		- 56'11"	- 16'42"	172	2.4	0.5	0.7	QFGN
M296		- 56'03"	- 16'44"	71	0.4	0.0	0.2	FAM
M297	105327	- 55'55"	- 16'54"	117	1.0	0.4	0.2	Q
M298		- 55'45"	- 17'10"	84	1.1	0.2	0.1	Q
M299		- 55'48"	- 17'26"	305	3.3	0.6	0.8	MSC
M300		- 57'22"	- 15'34"	88	0.2	0.0	0.1	BSC
M301		- 57'16"	- 16'02"	80	0.3	0.0	0.0	AM
M302		- 57'09"	- 16'11"	229	1.3	0.8	0.0	BSC
M303		- 56'55"	- 16'23"	220	1.1	0.4	0.0	BSC
M304		- 57'00"	- 16'31"	149	0.6	0.5	0.1	BSC
M305		- 57'01	- 16'47"	163	0.7	0.7	0.0	BSC
M306		- 57'13"	- 16'40"	246	1.2	1.0	0.2	RGR
M307		- 57'16"	- 16'38"	162	1.0	0.4	0.2	BGN
M308		- 57'26"	- 16'29"	57	0.4	0.0	0.1	AM
M309		- 57'33"	- 16'06"	162	1.4	0.7	0.3	BGN
M310		- 57'37"	- 15'42"	144	1.2	0.4	0.2	GW
M311		- 56'50"	- 16'46"	129	0.5	0.2	0.1	GW
M312		- 56'43"	- 16'55"	132	1.4	0.1	0.1	GW
M313		- 56'40"	- 17'08"	52	0.2	0.0	0.1	AM
M314		- 56'38"	- 17'14"	202	1.5	0.6	0.0	GR
M315		- 56'23"	- 17'35"	76	0.2	0.3	0.4	AM
M316		- 56'08"	- 18'01"	276	2.0	1.3	0.3	GR
M317		- 56'07"	- 17'46"	46	0.1	0.1	0.0	BSC
M318		- 56'03"	- 17'38"	75	0.7	0.0	0.2	MB
M319	105328	- 56'00"	- 17'31"	124	0.7	0.1	0.1	BGN
M320		- 55'59"	- 17'21"	145	0.3	0.4	0.0	BGN
M321		- 56'04"	- 17'15"	197	1.2	0.4	0.1	BGN
M322		- 56'40"	- 16'34"	129	1.0	0.5	0.2	GW
M323		- 59'45"	- 15'10"	256	1.5	0.6	0.4	GGN
M324		42°00'00"	- 15'42"	184	0.9	0.3	0.0	GGN
M325		41°59'42"	- 15'32"	80	0.4	0.0	0.0	AM
M326		- 59'45"	- 16'39"	249	1.5	0.7	0.2	GGN
M327		- 59'36"	- 16'34"	219	1.2	0.9	0.4	GGN
M328		- 59'26"	- 16'37"	210	1.3	0.5	0.1	GGN
M329		- 59'13"	- 16'14"	134	0.6	0.2	0.0	GGN
M330		- 59'11"	- 15'31"	139	1.5	0.5	0.2	GGN
M350		- 56'01"	- 17'10"	87	0.8	0.1	0.1	Q

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant				GEOLOGIC CODE
				TOTAL COUNTS	K	U	Th	
M351	105329	41°56'12"	105°17'01"	100	0.3	0.2	0.1	IF
M352		- 56'16"	- 16'50"	54	0.2	0.1	0.1	IF
M353		- 59'08"	- 15'16"	144	1.1	0.6	0.3	FAM
M354		- 59'02"	- 15'21"	157	0.6	0.6	0.6	PHQ
M355		- 59'00"	- 15'40"	151	2.2	0.7	0.5	PHQ
M356		- 58'56"	- 15'50"	231	2.4	0.2	0.1	GN
M357		- 58'54"	- 16'12"	87	0.9	0.2	0.1	AM
M358	105330	- 58'53"	- 16'24"	63	0.5	0.1	0.1	ULM
M359		- 58'46"	- 16'23"	205	2.4	0.7	0.4	GN
M360		- 58'53"	- 16'45"	114	1.4	0.2	0.3	MSC
M361		- 58'48"	- 16'56"	132	1.5	0.2	0.1	MSC
M362		- 58'44"	- 17'10"	156	2.8	0.6	0.3	MSC
M363		- 58'38"	- 17'15"	84	0.7	0.4	0.1	AM
M364		- 58'44"	- 17'34"	165	1.3	0.5	0.4	MSC
M365		- 58'38"	- 17'56"	61	0.5	0.0	0.2	ULM
M366		- 58'32"	- 18'24"	113	0.8	0.6	0.4	MSC
M367		- 58'41"	- 18'20"	187	2.5	0.6	0.3	GGN
M368		- 58'21"	- 18'20"	48	0.6	0.2	0.1	IF
M369		- 58'11"	- 18'08"	216	2.9	0.7	0.6	MM
M370		- 58'05"	- 17'51"	154	1.6	0.4	0.2	WGR
M371		- 58'03"	- 17'40"	62	0.2	0.4	0.0	IF
M372		- 58'05"	- 17'24"	51	0.3	0.5	0.1	ULM
M373		- 58'04"	- 17'10"	59	0.3	0.2	0.1	AM
M374		- 58'14"	- 17'03"	60	0.1	0.1	0.0	ULM
M375		- 58'16"	- 16'52"	208	1.9	0.8	0.3	BGN
M376		- 58'24"	- 16'40"	ND	ND	ND	ND	ND
M377		- 58'30"	- 16'26"	179	1.9	0.4	0.1	BGN
M378.		- 58'35"	- 16'02"	164	0.8	0.4	0.4	AM
M379		- 58'41"	- 15'46"	248	1.0	1.3	0.9	WGR
M380		- 58'44"	- 15'10"	231	1.6	1.1	0.7	BSC
P1	105318	- 51'23"	- 19'38"	110	1.0	0.3	0.1	FQ
P2		- 51'32"	- 19'32"	182	1.3	0.5	0.3	FQ
P3		- 51'44"	- 19'33"	110	0.8	0.5	0.1	Q
P4	105319	- 51'52"	- 19'29"	114	1.1	0.4	0.0	GGN
P5		- 52'04"	- 19'25"	130	0.2	0.3	0.0	Q
P6	105315	- 52'07"	- 19'22"	240	1.7	0.4	0.0	MQ
P7	105314	- 52'17"	- 19'35"	111	0.9	0.5	0.0	RGR
P8		- 52'22"	- 19'47"	84	0.6	0.3	0.2	AM
P9		- 52'32"	- 19'05"	142	0.6	0.4	0.0	BGR
P10		- 52'15"	- 20'54"	42	0.6	0.0	0.0	ULM
P11		- 52'03"	- 20'56"	90	0.5	0.4	0.0	AM
P12	105313	- 51'52"	- 20'48"	90	0.5	0.2	0.1	FQ
P13		- 51'29"	- 20'43"	104	0.2	0.5	0.2	BGN
P14		- 51'18"	- 20'46"	123	1.6	0.3	0.0	BGN
P15		- 51'25"	- 21'45"	50	0.4	0.0	0.1	AM
P16		- 51'20"	- 22'02"	47	0.3	0.1	0.0	AM
P17		- 51'18"	- 22'14"	54	0.5	0.1	0.1	AM
P18		- 52'20"	- 22'29"	95	1.5	0.3	0.0	GN
R1		42°00'02"	- 15'44"	65	0.0	0.6	0.1	AM
R2		- 00'13"	- 15'45"	55	0.4	0.0	0.0	AM
R3		- 00'27"	- 15'29"	173	1.1	0.5	0.1	MM
R4		- 00'29"	- 15'37"	177	1.2	0.5	0.0	MM
R5		- 00'31"	- 15'52"	53	0.3	0.1	0.0	ULM
R6		- 00'56"	- 16'15"	122	0.3	0.2	0.0	MM
R7		- 00'41"	- 17'03"	115	0.5	0.4	0.0	MM
R8		- 00'22"	- 17'21"	118	0.8	0.3	0.1	MM
R9		- 00'04"	- 17'40"	138	0.3	0.4	0.1	MM
S1		41°53'24"	- 14'24"	310	5.0	0.5	0.6	SY

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	Counts per second using 10 second time constant				GEOLOGIC CODE
				TOTAL COUNTS	K	U	Th	
S2		41°53'42"	105°14'31"	330	4.6	0.7	0.3	BGN
S3	105323	- 53'36"	- 14'09"	238	1.2	0.7	0.0	FQ
S4		- 53'34"	- 13'48"	168	1.5	0.4	0.0	RGR
S5		- 53'36"	- 13'29"	116	0.6	0.2	0.1	GN
S6		- 53'48"	- 13'12"	165	1.0	0.4	0.1	GN
S7		- 53'53"	- 12'39"	262	1.7	1.0	0.1	RGR
S8		- 54'10"	- 12'00"	208	1.3	0.3	0.1	RGR
S9		- 54'09"	- 12'04"	126	0.4	0.3	0.1	GN
S10		- 54'30"	- 11'51"	181	1.4	0.2	0.2	RGR
S11		- 54'52"	- 11'48"	130	0.4	0.4	0.0	RGR
S12		- 55'06"	- 11'52"	290	1.2	0.6	0.0	RGR
S13		- 55'34"	- 11'44"	146	0.8	0.6	0.1	GN
S14		- 55'49"	- 12'02"	115	0.4	0.2	0.1	MM
S15		- 55'54"	- 12'10"	125	0.7	0.4	0.1	GR
S16		- 56'01"	- 12'07"	135	0.6	0.2	0.1	RGR
S17		- 56'26"	- 12'10"	171	0.5	0.2	0.1	RGR
S18		- 56'44"	- 12'32"	203	1.1	0.8	0.0	MM
S19		- 57'04"	- 12'29"	245	1.0	0.9	0.1	MM
S20		- 57'12"	- 12'09"	243	1.9	0.4	0.0	RGR
S21		- 57'14"	- 11'49"	266	1.4	0.5	0.0	RGR
S30		- 56'41"	- 08'38"	94	0.8	0.0	0.2	RGR
S31		- 56'48"	- 08'44"	83	0.9	0.5	0.1	Q
S32		- 56'50"	- 08'48"	177	2.3	0.4	0.2	SC
S33	105308	- 56'54"	- 08'58"	123	1.6	0.4	0.1	PHQ
S34		- 57'00"	- 08'59"	147	1.6	0.4	0.1	ND
S35	105309	- 57'09"	- 09'06"	182	2.5	0.6	0.1	BGN
S36		- 57'32"	- 09'14"	86	0.5	0.0	0.0	Q
S37		- 57'37"	- 09'22"	137	0.8	0.1	0.2	SC
S38		- 57'44"	- 09'22"	168	0.9	0.4	0.3	BGN
S39		- 57'41"	- 09'40"	101	1.0	0.1	0.2	BSC
S40		- 57'34"	- 09'50"	118	1.5	0.3	0.1	BSC
S41	105310	- 57'10"	- 10'08"	156	2.4	0.1	0.1	FQ
S42		- 57'06"	- 10'10"	129	1.1	0.1	0.2	Q
S43	105311	- 57'04"	- 09'34"	105	1.1	0.1	0.0	FAM
S44	105312	- 56'53"	- 09'33"	118	1.6	0.3	0.0	SC
S45		- 57'32"	- 11'02"	69	0.5	0.2	0.0	MB
S46		- 57'24"	- 11'16"	54	0.3	0.2	0.0	AM
S47		- 57'20"	- 11'24"	59	0.7	0.1	0.1	AM
S48		- 57'14"	- 11'30"	69	0.2	0.2	0.0	AM
S49		- 57'14"	- 11'39"	176	1.6	0.1	0.2	RGR
S50		- 58'08"	- 14'16"	150	0.9	0.2	0.0	Q
S51		- 58'07"	- 14'00"	210	1.2	0.3	0.0	PHQ
S52		- 57'58"	- 14'10"	112	0.5	0.4	0.0	PHQ
S53		- 57'53"	- 14'16"	129	0.5	0.5	0.0	PHQ
S54		- 57'16"	- 14'08"	161	0.6	0.3	0.0	BSC
S55		- 58'22"	- 14'27"	179	0.9	0.4	0.2	GGN
S56		- 58'30"	- 14'54"	194	1.0	0.4	0.2	GGN
S60		- 59'16"	- 14'35"	98	0.7	0.3	0.3	FAM
S61		- 59'14"	- 14'48"	101	0.6	0.4	0.0	FAM
S62		- 58'36"	- 14'33"	85	0.5	0.3	0.3	AM
S63		- 58'37"	- 14'19"	247	2.6	0.8	0.9	PHQ
S64		- 58'43"	- 14'06"	149	1.5	0.2	0.2	WGR
S65		- 58'54"	- 14'03"	215	2.9	1.2	0.4	BGN
S66		- 59'12"	- 14'08"	79	1.0	0.4	0.3	AM
SM1	105339	42°09'12"	- 24'18"	530	4.0	2.3	0.5	GN
SM2	105341	- 09'21"	- 24'14"	511	6.4	2.6	1.4	GN
SM3	105342	- 09'21"	- 24'14"	511	6.4	2.6	1.4	GN

RADIOMETRIC DATA

LARAMIE RANGE PROJECT
(continued)

SAMPLE/ STATION NUMBER		LATITUDE	LONGITUDE	TOTAL COUNTS	K	U	Th	GEOLOGIC CODE
				Counts per second using 10 second time constant				
B500	105347	41°55'16"	105°24'04"	182	2.3	0.6	0.3	PAC
B501	105348	55'14"	24'03"	131	1.9	0.3	0.1	PAC
B502	105349	55'13"	24'02"	156	2.9	0.5	0.0	PAC
B503	105350	55'12"	24'00"	183	1.5	0.3	0.2	PAC
B504	105351	55'12"	23'59"	144	1.8	0.6	0.4	PAC
B505	105352	55'11"	23'57"	175	2.0	0.4	0.1	PAC
B506	105353	55'11"	23'57"	167	1.3	0.4	0.6	PAC
B507	105354	55'11"	24'00"	246	3.2	0.7	0.0	PAC
B508	105355	55'10"	24'00"	178	2.1	0.3	0.1	PAC
B509	105356	55'09"	24'00"	220	1.3	0.7	0.2	PAC
B510	105357	55'08"	23'59"	190	2.4	0.7	0.3	PAC
B511	105358	55'08"	23'58"	171	1.2	0.6	0.2	PAC
B512	105359	55'08"	24'00"	110	1.1	0.7	0.2	PAC
B513	105360	55'07"	24'02"	188	1.9	0.5	0.3	PAC
B514	105361	55'07"	24'04"	141	2.8	0.9	0.3	PAC
B515	105362	55'07"	24'06"	165	1.5	0.3	0.2	PAC
B516	105363	55'09"	24'07"	118	1.2	0.2	0.2	PAC
B517	105364	55'07"	24'13"	208	2.2	0.8	0.4	PAC
B518	105366	55'14"	24'12"	137	1.5	0.2	0.2	PAC
B519	105367	55'15"	24'12"	131	1.8	0.8	0.6	PAC

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APPENDIX II

CHEMICAL ANALYSES
LARAMIE RANGE PROJECT
WYOMING

Uranium values reported here were determined by two methods:

U = Soluble uranium in a solution of hydrofluoric and nitric acid

U-NT = Uranium determined by neutron activation

U/TU = Soluble uranium/uranium determined by neutron activation

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	U/TU	AG (PPM)	AL (%)	B (PPM)	BA (PPM)	BE (PPM)	CA (%)	CE (PPM)	CO (PPM)
105200	40-41.922	-105.407	-3-92-	0.36	0.30	1.2	<2	1.7	<10	150	<1	5.9	<10	54
105201	40-41.919	-105.399	-3-92-	3.0	3.2	0.95	<2	4.8	<10	350	1	0.60	55	13
105202	40-41.923	-105.403	-3-92-	0.27	0.20	1.3	<2	2.0	<10	67	<1	3.1	<10	62
105203	40-41.921	-105.399	-3-92-	3.2	3.5	0.92	<2	5.4	<10	300	1	1.5	36	16
105204	40-41.920	-105.399	-3-92-	490.	530.	0.93	<2	6.0	<10	700	1	0.29	47	6
105205	40-41.922	-105.395	-3-92-	<0.25	0.0		<2	6.9	<10	55	<1	6.6	24	42
105206	40-41.920	-105.393	-3-92-	3.2	3.0	1.1	<2	6.9	<10	400	1	0.28	32	6
105207	40-41.920	-105.419	-3-92-	9.4	11.	0.89	<2	12.	<10	160	3	8.0	20	5
105208	40-41.920	-105.429	-3-92-	<0.25	0.20	0.63	<2	3.1	<10	71	<1	4.0	13	59
105209	40-41.922	-105.442	-3-92-	1.0	1.8	0.58	<2	7.8	<10	51	13	1.6	12	<4
105210	40-41.923	-105.446	-3-92-	1.1	1.6	0.71	<2	7.4	<10	720	1	1.9	58	9
105211	40-41.919	-105.439	-3-92-	<0.25	0.30	0.42	<2	5.0	<10	41	1	3.9	49	59
105212	40-41.918	-105.441	-3-92-	<0.25	0.10	1.3	<2	0.83	<10	10	1	18.	<10	7
105213	40-41.918	-105.441	-3-92-	1.7	3.0	0.57	<2	5.6	<10	52	4	0.43	36	<4
105214	40-41.916	-105.428	-3-92-	<0.25	0.10	1.3	<2	6.9	<10	42	<1	9.0	19	39
105216	40-41.912	-105.422	-3-92-	0.83	1.6	0.52	<2	6.1	<10	340	1	2.1	43	12
105217	40-41.911	-105.422	-3-92-	0.57	1.2	0.48	<2	6.0	<10	220	1	8.6	59	13
105218	40-******	-*******	-3- -	0.57	1.7	0.34	2	7	<10	750	1	0.8	23	28
105219	40-41.905	-105.411	-3-92-	1.7	2.7	0.64	<2	3.8	<10	330	<1	0.21	26	14
105220	40-41.909	-105.406	-3-92-	<0.25	0.10	1.3	<2	6.1	<10	34	<1	7.5	10	44
105221	40-41.917	-105.411	-3-92-	<0.25	0.30	0.42	<2	6.2	<10	42	<1	5.0	29	40
105222	40-41.911	-105.386	-3-92-	0.98	1.7	0.58	<2	7.6	10	760	1	0.45	58	16
105223	40-41.908	-105.385	-3-92-	0.89	2.1	0.42	<2	7.2	<10	720	1	1.1	38	16
105224	40-41.912	-105.398	-3-92-	5.8	5.8	1.00	2	6.0	<10	26	1	0.53	78	<4
105225	40-41.907	-105.394	-3-92-	1.8	2.5	0.70	<2	6.2	<10	280	1	0.98	40	10
105226	40-41.904	-105.392	-3-92-	2.1	2.8	0.76	<2	7.2	<10	610	1	2.3	64	13
105227	40-41.903	-105.391	-3-92-	1.1	2.2	0.49	<2	8.0	<10	420	1	1.4	66	11
105228	40-41.901	-105.415	-3-92-	1.6	2.6	0.61	<2	7.0	<10	350	1	0.44	23	21
105229	40-41.901	-105.414	-3-92-	2.2	2.5	0.86	<2	6.6	<10	750	1	3.3	53	11
105230	40-41.899	-105.408	-3-92-	1.1	2.2	0.50	<2	7.0	<10	1600	1	0.59	60	4
105231	40-41.898	-105.405	-3-92-	2.6	2.9	0.89	<2	5.9	<10	480	2	0.68	35	9
105232	40-41.895	-105.402	-3-92-	3.9	4.0	0.96	2	5.0	<10	44	1	0.24	19	<4
105233	40-41.893	-105.400	-3-92-	3.0	2.8	1.1	<2	6.0	<10	550	1	1.7	42	14
105234	40-41.887	-105.396	-3-92-	1.8	3.4	0.54	<2	6.4	<10	540	1	1.9	61	17
105235	40-41.882	-105.389	-3-92-	1.0	2.0	0.51	<2	5.4	<10	39	2	0.35	<10	<4
105236	40-41.914	-105.378	-3-92-	1.6	2.7	0.58	<2	1.0	<10	48	<1	0.11	<10	130
105237	40-41.934	-105.406	-3-92-	0.54	0.70	0.77	<2	6.7	<10	140	<1	6.9	32	42
105238	40-41.940	-105.392	-3-92-	33.	31.	1.1	<2	6.2	<10	390	1	0.91	1200	<4
105239	40-41.942	-105.393	-3-92-	<0.25	0.10	1.3	<2	3.2	<10	53	<1	4.3	<10	60
105241	40-41.952	-105.391	-3-92-	1.6	2.9	0.56	<2	9.7	<10	76	2	3.3	<10	<4
105242	40-41.958	-105.388	-3-92-	10.	18.	0.57	<2	6.6	<10	27	1	6.9	150	<4
105243	40-41.963	-105.381	-3-92-	0.72	1.0	0.72	<2	2.4	<10	110	2	7.3	37	55
105245	40-41.959	-105.376	-3-92-	<0.25	0.20	0.63	<2	5.1	<10	21	<1	6.2	<10	47
105246	40-41.924	-105.403	-3-92-	<0.25	0.10	1.3	<2	1.9	<10	9	<1	<0.05	<10	87
105247	40-41.921	-105.382	-3-92-	1.8	2.6	0.71	3	7.6	<10	720	1	0.65	46	<4
105248	40-41.916	-105.443	-3-92-	<0.25	0.20	0.63	<2	5.9	<10	64	<1	8.3	20	40
105249	40-41.877	-105.417	-3-92-	0.78	0.50	1.6	<2	5.8	<10	180	1	6.0	<10	37
105250	40-41.883	-105.384	-3-92-	1.3	1.4	0.94	<2	7.5	<10	560	1	2.4	40	13
105251	40-41.884	-105.422	-3-92-	2.6	3.6	0.73	<2	6.4	<10	180	1	2.5	46	22
105252	40-41.965	-105.497	-3-92-	2.4	2.9	0.81	<2	7.1	<10	710	1	1.1	32	<4
105253	40-41.989	-105.486	-3-92-	2.0	2.3	0.86	<2	5.6	<10	60	4	0.37	<10	<4
105254	40-41.957	-105.499	-3-92-	<0.25	0.10	1.3	2	6.2	<10	50	<1	7.2	33	44
105255	40-41.955	-105.457	-3-92-	<0.25	0.20	0.63	<2	4.5	<10	54	<1	4.9	14	52
105256	40-41.929	-105.445	-3-92-	1.4	1.8	0.76	<2	7.7	<10	230	1	3.8	51	7
105257	40-41.996	-105.391	-3-92-	1.5	2.1	0.74	<2	5.7	<10	950	2	0.19	77	4

DR SAMPLE NUMBER	CR (PPM)	CU (PPM)	FE (%)	HF (PPM)	K (%)	LA (PPM)	LI (PPM)	MG (%)	MN (PPM)	MO (PPM)	NA (%)	NB (PPM)	NI (PPM)	P (PPM)	PB (PPM)
105200	2500	31	5.0	<15	0.04	<2	2	8.5	1000	<4	0.15	<4	490	5	<10
105201	150	15	2.3	<15	0.96	73	17	1.5	570	7	1.7	5	56	110	26
105202	2500	37	6.4	<15	0.04	<2	23	8.4	1200	<4	0.25	<4	320	55	15
105203	470	13	2.4	<15	0.66	33	14	2.3	760	<4	2.6	<4	100	190	13
105204	470	42	2.3	<15	1.2	60	14	1.6	290	10	2.8	<4	34	500	<10
105205	320	100	7.2	18	0.15	<2	14	4.3	1300	<4	2.1	<4	150	250	10
105206	24	21	1.5	36	1.1	43	29	0.72	140	<4	4.1	<4	20	330	<10
105207	22	240	0.54	<15	0.18	13	11	0.29	280	<4	2.2	36	14	630	190
105208	2600	18	6.2	<15	0.08	<2	9	8.3	1300	<4	0.54	<4	600	33	<10
105209	1	11	0.14	<15	0.22	10	28	<0.05	37	<4	4.3	44	3	38	51
105210	43	62	3.4	<15	1.3	66	27	1.2	620	6	2.7	7	22	730	27
105211	<1	130	17.	<15	0.08	<2	12	2.0	1800	<4	0.88	<4	14	910	29
105212	75	18	6.9	<15	0.04	<2	4	6.0	2800	<4	0.22	<4	19	26	15
105213	6	10	0.23	18	1.5	29	3	0.05	25	<4	3.5	8	2	38	26
105214	300	240	8.6	<15	0.17	<2	21	3.3	1800	5	1.5	<4	130	270	18
105216	73	92	3.0	<15	1.1	47	21	1.9	480	5	1.5	<4	29	440	59
105217	100	150	10.	<15	0.22	46	10	3.3	4000	<4	0.36	<4	27	1200	<10
105218	22	690	6	69	1.9	26	23	1.6	840	<4	1.3	<4	14	310	46
105219	28	35	3.9	<15	0.71	21	15	1.4	360	<4	1.3	<4	31	220	16
105220	400	76	7.9	<15	0.15	<2	28	4.3	1400	<4	0.99	<4	130	210	<10
105221	28	87	8.5	<15	0.13	<2	17	3.0	1300	<4	1.4	<4	39	440	<10
105222	85	7	3.8	17	3.1	62	54	2.1	250	4	1.6	<4	40	750	29
105223	40	12	6.6	<15	1.9	31	45	3.0	870	<4	2.1	<4	21	1500	21
105224	7	53	0.11	23	0.10	90	5	<0.05	55	<4	3.9	76	4	120	100
105225	34	16	1.9	<15	1.2	48	14	0.95	400	<4	1.7	4	18	400	110
105226	44	27	4.1	38	1.2	66	23	1.5	950	<4	2.3	5	23	910	30
105227	25	7	3.1	<15	1.4	68	30	1.5	510	<4	3.5	<4	17	1200	17
105228	44	42	3.2	<15	1.5	19	25	1.4	120	<4	2.0	<4	34	290	53
105229	74	7	3.4	33	0.90	64	16	1.7	960	<4	1.7	6	27	460	15
105230	16	5	2.1	<15	3.8	71	20	0.95	450	5	1.4	6	12	410	30
105231	92	9	2.1	16	0.97	50	17	1.1	370	<4	2.5	4	29	160	22
105232	6	23	0.37	17	0.71	20	4	0.07	26	<4	2.4	18	<2	43	32
105233	180	27	2.4	<15	1.6	36	18	1.6	500	<4	1.7	8	59	160	31
105234	110	170	3.8	34	1.7	67	30	1.5	470	4	2.6	<4	47	160	110
105235	6	7	0.37	24	2.3	10	4	0.07	42	<4	2.9	<4	3	49	41
105236	2100	45	9.7	<15	<0.02	<2	2	10.	1500	<4	<0.05	<4	1600	<5	17
105237	280	160	8.8	<15	0.13	<2	7	3.8	1400	<4	1.5	<4	130	380	16
105238	<1	4	1.5	<15	2.1	1600	5	0.10	260	<4	2.0	<4	<2	890	120
105239	1600	43	6.5	<15	0.08	<2	4	7.5	1200	<4	0.50	<4	660	80	17
105241	<1	<2	0.14	<15	0.31	<2	6	<0.05	33	<4	4.2	<4	<2	50	<10
105242	10	2	2.1	<15	0.11	170	2	<0.05	140	<4	0.76	7	<2	780	14
105243	1000	13	7.2	<15	0.05	20	2	7.9	930	<4	0.49	<4	780	430	<10
105245	1300	6	6.0	20	0.08	<2	12	6.6	1100	<4	0.88	<4	350	88	<10
105246	2700	20	6.1	<15	<0.02	<2	3	9.1	300	<4	<0.05	<4	950	<5	<10
105247	14	14	0.44	<15	1.6	54	22	0.25	70	<4	2.5	<4	8	230	34
105248	620	89	6.8	<15	0.12	<2	6	4.7	1200	<4	0.99	<4	140	220	20
105249	70	120	11.	<15	0.34	<2	18	3.0	1600	<4	1.5	<4	41	530	<10
105250	92	23	3.3	<15	1.2	45	22	1.8	400	<4	1.9	<4	33	680	19
105251	86	89	4.5	<15	0.27	41	53	2.4	520	5	2.4	<4	35	520	25
105252	12	5	1.0	<15	2.0	44	11	0.22	190	<4	3.1	5	<2	250	53
105253	19	5	0.58	<15	2.4	4	14	0.08	89	4	2.8	67	6	19	47
105254	200	180	9.3	<15	0.10	<2	5	3.7	1500	<4	1.2	<4	88	370	24
105255	1300	65	5.7	<15	0.12	<2	5	6.8	1000	<4	0.69	<4	560	120	<10
105256	32	34	3.1	<15	1.1	50	15	0.70	770	<4	0.86	<4	31	810	17
105257	6	6	2.0	<15	2.8	85	33	0.47	290	4	2.1	<4	9	270	18

LARAMIE RANGE

DR SAMPLE NUMBER	SC (PPM)	TH (PPM)	TI (PPM)	V (PPM)	Y (PPM)	ZN (PPM)	ZR (PPM)
105200	6	2	570	78	5	41	2
105201	6	26	1100	46	4	98	62
105202	22	3	1100	120	5	71	3
105203	8	13	1300	62	8	67	67
105204	7	23	1300	58	5	82	110
105205	35	<2	4300	280	13	87	4
105206	2	6	1500	29	2	29	90
105207	4	16	510	16	39	24	19
105208	24	<2	1100	100	3	32	3
105209	<1	<2	27	3	10	9	11
105210	6	9	2700	59	9	74	120
105211	43	3	13000	510	37	120	32
105212	2	6	300	24	2	27	<2
105213	3	36	220	7	7	6	81
105214	30	5	4500	300	13	73	3
105216	7	8	2400	74	7	81	93
105217	11	<2	5200	120	11	160	5
105218	7	<2	2300	60	6	110	73
105219	9	7	1800	64	4	12	91
105220	33	<2	4100	260	12	89	2
105221	36	3	5800	320	19	110	16
105222	15	12	3600	100	5	57	100
105223	12	6	5500	100	15	68	170
105224	18	17	95	4	36	10	5
105225	7	12	2000	56	3	100	92
105226	8	12	3300	73	12	71	130
105227	9	7	4600	75	8	57	190
105228	14	7	3100	130	2	98	88
105229	8	14	2600	75	13	74	45
105230	5	12	2100	35	6	35	100
105231	6	21	1300	50	5	45	67
105232	1	17	110	3	6	43	69
105233	8	18	1300	60	12	49	35
105234	9	24	1700	79	5	260	72
105235	1	9	190	5	1	8	68
105236	6	2	790	45	2	40	<2
105237	31	<2	6200	300	15	110	11
105238	5	350	960	7	16	34	280
105239	26	3	1600	140	5	49	4
105241	<1	<2	170	<2	<1	6	170
105242	4	33	2800	44	6	7	89
105243	19	<2	5000	160	13	43	42
105245	28	<2	1800	150	6	51	9
105246	13	2	990	66	1	52	4
105247	8	7	2300	72	3	12	92
105248	31	<2	4200	230	9	70	16
105249	31	<2	6600	310	19	140	6
105250	10	8	3500	96	9	78	68
105251	9	10	2700	82	8	63	83
105252	1	15	890	14	5	49	91
105253	<1	29	89	2	39	39	65
105254	32	6	7000	300	14	100	8
105255	21	<2	2200	150	7	52	15
105256	6	10	2800	60	14	60	99
105257	1	25	950	13	20	67	140

LARAMIE RANGE

OR SAMPLE NUMBER	D. O. E. SAMPLE ST LAT	LONG	NUMBER L TY REP	U (PPM)	U-NT (PPM)	U/TU	AG (PPM)	AL (%)	B (PPM)	BA (PPM)	BE (PPM)	CA (%)	CE (PPM)	CO (PPM)
105258	40-41.986	-105.382	-3-92-	1.1	1.5	0.72	<2	7.2	<10	790	1	3.7	93	15
105259	40-41.912	-105.367	-3-92-	<0.25	0.40	0.31	<2	2.5	<10	9	1	5.1	<10	71
105260	40-41.966	-105.364	-3-92-	0.60	1.2	0.50	<2	7.0	<10	110	1	0.21	19	<4
105261	40-41.967	-105.361	-3-92-	<0.25	0.10	1.3	<2	1.1	<10	19	<1	2.6	<10	54
105262	40-41.969	-105.359	-3-92-	<0.25	0.10	1.3	<2	0.84	<10	16	<1	1.1	<10	120
105263	40-41.976	-105.350	-3-92-	<0.25	0.10	1.3	<2	6.7	<10	46	<1	8.7	<10	34
105264	40-41.979	-105.349	-3-92-	0.28	0.30	0.93	<2	6.6	<10	100	<1	8.1	11	34
105265	40-41.903	-105.292	-3-92-	2.8	2.8	0.99	<2	0.06	<10	120	1	0.17	14	7
105266	40-41.905	-105.288	-3-92-	0.65	0.80	0.81	<2	0.28	<10	19	<1	3.0	<10	<4
105267	40-41.909	-105.284	-3-92-A	2.5	3.7	0.67	<2	1.7	<10	2200	1	5.8	200	<4
105268	40-41.909	-105.284	-3-92-B	1.2	2.3	0.51	<2	2.3	<10	1900	<1	3.7	76	<4
105269	40-41.909	-105.284	-3-92-C	2.3	3.4	0.68	2	1.6	<10	1800	1	5.2	180	4
105270	40-41.909	-105.284	-3-92-D	1.7	2.2	0.78	<2	2.2	<10	1300	<1	2.7	76	<4
105271	40-41.909	-105.281	-3-92-	1.5	2.3	0.65	<2	2.3	<10	1300	<1	2.3	110	<4
105272	40-41.902	-105.296	-3-92-	0.53	1.5	0.35	<2	7.5	<10	72	1	0.69	44	97
105274	40-41.905	-105.308	-3-92-	3.5	4.6	0.76	2	6.0	<10	520	1	0.88	50	15
105275	40-41.894	-105.317	-3-92-	3.0	4.1	0.74	<2	6.5	<10	1100	<1	0.24	98	4
105276	40-41.893	-105.318	-3-92-	<0.25	0.10	1.3	<2	7.6	11	590	1	0.86	16	62
105277	40-41.914	-105.337	-3-92-	<0.25	0.20	0.63	<2	7.7	<10	53	<1	2.8	27	65
105278	40-41.910	-105.358	-3-92-	0.39	0.80	0.49	<2	5.8	<10	130	1	5.7	56	39
105279	40-******	-*******	-3- -	3.0	3.0	0.99	<2	6	<10	280	1	0.6	<10	<4
105280	40-41.946	-105.317	-3-92-	2.6	5.4	0.48	2	5.4	<10	320	3	1.1	100	<4
105281	40-41.953	-105.318	-3-92-	2.7	5.4	0.49	<2	5.3	<10	1200	3	0.96	200	<4
105282	40-41.954	-105.319	-3-92-	0.35	0.70	0.50	<2	5.5	<10	73	1	5.0	77	32
105283	40-41.967	-105.325	-3-92-	0.40	0.40	1.0	<2	0.16	<10	12	<1	0.15	<10	5
105285	40-41.971	-105.321	-3-92-	<0.25	0.0		<2	1.3	<10	17	<1	5.6	<10	53
105286	40-41.930	-105.315	-3-92-	1.8	1.7	1.1	<2	6.1	<10	450	1	5.5	92	15
105287	40-41.903	-105.365	-3-92-	3.7	5.1	0.73	<2	5.4	<10	1400	1	0.26	96	<4
105288	40-41.903	-105.366	-3-92-	3.4	3.7	0.92	<2	5.9	10	1500	1	0.07	22	<4
105289	40-41.903	-105.366	-3-92-	3.3	4.5	0.74	<2	5.6	<10	1500	2	0.14	66	<4
105290	40-41.903	-105.368	-3-92-	2.4	4.4	0.56	<2	6.1	<10	1400	1	0.11	78	<4
105291	40-******	-*******	-3- -	0.69	1.2	0.58	<2	2	<10	370	<1	0.1	18	<4
105292	40-41.902	-105.373	-3-92-	4.9	6.1	0.81	<2	6.0	<10	1300	2	0.56	43	<4
105293	40-41.879	-105.367	-3-92-	1.5	3.3	0.46	<2	7.4	11	500	1	0.33	42	43
105294	40-41.877	-105.344	-3-92-	0.96	2.0	0.48	<2	6.4	<10	730	1	1.7	75	24
105295	40-41.901	-105.356	-3-92-	2.8	2.0	1.4	<2	6.0	<10	640	1	2.0	37	10
105296	40-41.901	-105.474	-3-92-	1.0	2.6	0.40	<2	5.2	<10	870	1	0.38	62	28
105297	40-41.903	-105.344	-3-92-	1.8	3.7	0.47	<2	5.6	12	710	3	0.39	<10	<4
105298	40-41.918	-105.305	-3-92-	0.31	0.70	0.44	<2	0.79	<10	61	<1	0.23	13	5
105299	40-41.919	-105.307	-3-92-	5.6	8.1	0.69	<2	0.37	<10	56	<1	0.16	20	19
105300	40-41.926	-105.311	-3-92-	<0.25	0.10	1.3	<2	3.6	<10	89	<1	0.16	23	23
105301	40-41.921	-105.305	-3-92-	2.2	3.6	0.60	<2	6.1	<10	740	1	0.64	78	6
105302	40-41.926	-105.311	-3-92-	<0.25	0.10	1.3	<2	1.9	<10	46	<1	1.1	<10	63
105303	40-41.915	-105.302	-3-92-	3.5	5.0	0.71	<2	6.4	11	720	1	0.16	66	<4
105304	40-41.913	-105.313	-3-92-	0.32	0.30	1.1	<2	0.19	<10	27	<1	0.13	<10	<4
105305	40-41.880	-105.326	-3-92-	0.76	1.1	0.69	<2	6.4	<10	91	4	0.48	<10	<4
105306	40-41.885	-105.326	-3-92-	<0.25	0.10	1.3	<2	<0.05	<10	28	<1	<0.05	<10	<4
105307	40-41.990	-105.357	-3-92-	0.96	2.6	0.37	<2	6.9	<10	640	1	1.5	77	5
105308	40-41.948	-105.149	-3-92-	1.6	3.1	0.53	<2	4.6	<10	680	1	0.17	51	8
105309	40-41.952	-105.152	-3-92-	2.1	4.1	0.52	<2	5.1	<10	430	2	0.16	80	<4
105310	40-41.953	-105.169	-3-92-	0.86	1.5	0.57	<2	5.1	<10	1100	<1	0.50	26	<4
105311	40-41.951	-105.159	-3-92-	0.41	0.70	0.59	<2	6.9	<10	1000	1	5.1	62	46
105312	40-41.948	-105.159	-3-92-	2.1	4.3	0.50	<2	4.1	<10	360	<1	10.	79	<4
105313	40-41.864	-105.347	-3-92-	0.81	1.1	0.74	<2	6.7	<10	130	<1	1.1	<10	5
105314	40-41.871	-105.327	-3-92-	3.8	5.7	0.66	<2	6.4	<10	100	4	0.22	190	<4

LARAMIE RANGE

OR SAMPLE NUMBER	CR (PPM)	CU (PPM)	FE (%)	HF (PPM)	K (%)	LA (PPM)	LI (PPM)	MG (%)	MN (PPM)	MO (PPM)	NA (%)	NB (PPM)	NI (PPM)	P (PPM)	PB (PPM)
105258	50	35	4.5	<15	1.1	110	13	1.6	720	<4	2.4	<4	22	1000	26
105259	3300	21	8.4	21	0.03	<2	12	7.5	1800	<4	0.34	<4	770	160	<10
105260	26	2	0.09	<15	3.6	15	3	0.09	44	<4	2.8	18	<2	170	61
105261	2200	21	5.4	66	0.02	<2	6	8.3	1100	<4	0.24	<4	550	28	12
105262	870	25	9.3	<15	0.03	<2	2	11.	1300	5	0.14	<4	2000	<5	12
105263	740	34	4.4	<15	0.05	<2	4	5.3	880	<4	0.67	<4	260	58	10
105264	630	46	4.8	<15	0.12	<2	4	4.8	900	<4	0.81	<4	220	91	<10
105265	10	110	3.0	<15	0.03	<2	8	<0.05	260	<4	<0.05	<4	22	110	20
105266	7	40	7.4	<15	0.02	<2	1	8.5	6700	<4	0.05	<4	2	70	<10
105267	29	19	1.7	20	1.5	260	10	3.4	190	<4	0.12	9	24	250	31
105268	17	6	1.7	<15	2.0	94	7	1.7	240	<4	0.14	<4	<2	160	22
105269	33	13	1.7	33	1.3	220	9	3.2	190	<4	0.11	8	15	150	27
105270	18	14	1.2	82	1.9	100	5	1.3	200	<4	0.18	4	3	400	21
105271	28	6	1.3	31	1.3	140	7	1.1	140	<4	0.13	<4	15	150	<10
105272	460	11	11.	<15	0.38	26	42	6.1	210	4	0.33	<4	170	1100	12
105274	130	17	6.2	<15	1.1	47	17	1.6	1100	<4	1.3	<4	48	1200	21
105275	17	30	0.50	78	5.0	120	10	0.12	96	<4	0.48	<4	12	82	27
105276	280	210	2.8	<15	4.6	<2	17	0.74	900	<4	0.58	<4	160	430	24
105277	270	140	13.	<15	0.14	<2	13	6.1	2200	<4	0.14	<4	220	420	25
105278	140	16	9.4	<15	0.28	16	11	2.7	1400	<4	1.4	<4	83	1200	12
105279	5	11	0	<15	3.8	<2	10	<0.0	83	<4	1.7	9	6	77	26
105280	9	3	4.0	<15	0.10	130	4	0.07	180	4	2.3	27	8	210	25
105281	5	23	3.1	<15	1.3	110	23	0.24	330	<4	2.1	27	34	110	<10
105282	4	5	9.8	<15	0.12	43	10	1.9	820	<4	0.44	<4	11	1400	17
105283	5	35	50.	<15	<0.02	<2	1	0.13	59	<4	<0.05	<4	13	540	36
105285	1400	4	5.8	<15	0.05	<2	12	7.3	1300	<4	0.41	<4	190	<5	<10
105286	96	15	4.9	18	0.67	90	15	1.8	1200	<4	2.4	<4	31	960	19
105287	5	8	0.96	<15	2.7	130	6	0.33	240	<4	1.9	8	7	92	13
105288	11	10	1.1	49	4.0	60	11	0.49	82	<4	0.61	15	5	49	<10
105289	7	10	1.0	38	3.3	62	9	0.43	80	<4	1.4	10	10	71	<10
105290	6	6	1.1	<15	3.1	85	15	0.29	64	<4	1.3	13	3	84	25
105291	7	27	0	<15	1.2	14	6	0.1	71	<4	0.3	<4	8	39	<10
105292	4	8	0.71	<15	2.9	73	7	0.33	77	<4	1.6	10	7	150	25
105293	630	100	8.3	<15	2.9	29	22	1.8	770	<4	0.27	<4	290	540	25
105294	120	40	5.2	<15	1.6	75	20	1.5	540	<4	0.85	<4	62	1200	<10
105295	81	10	2.1	<15	1.5	46	14	0.84	630	<4	1.8	<4	33	190	55
105296	130	35	6.7	<15	1.8	51	32	2.1	490	<4	0.70	<4	71	850	12
105297	4	11	0.95	<15	2.3	<2	30	0.94	200	<4	0.47	32	<2	79	<10
105298	24	43	2.0	<15	0.07	10	1	0.14	4000	<4	<0.05	<4	<2	83	14
105299	13	110	50.	<15	0.04	<2	2	0.06	150	26	<0.05	<4	27	290	79
105300	52	4	4.1	<15	0.42	13	24	5.5	590	<4	0.07	<4	84	78	<10
105301	8	5	2.2	<15	2.1	99	18	0.38	240	<4	1.9	5	10	580	16
105302	2700	28	6.0	<15	<0.02	<2	2	9.2	390	<4	<0.05	<4	970	140	15
105303	5	15	1.2	<15	2.9	80	12	0.50	59	<4	1.1	9	10	250	24
105304	10	97	0.88	<15	0.03	2	1	0.05	200	<4	<0.05	<4	6	49	<10
105305	5	10	0.94	<15	2.3	4	39	<0.05	200	<4	2.5	39	<2	450	53
105306	10	22	1.1	<15	<0.02	2	1	0.13	700	<4	<0.05	<4	7	17	<10
105307	15	4	2.0	24	1.9	78	20	0.45	240	<4	2.6	<4	2	420	27
105308	90	10	2.7	<15	0.77	55	29	1.9	140	<4	0.73	<4	37	560	130
105309	14	3	2.1	<15	1.8	64	25	1.8	250	<4	0.80	15	4	33	11
105310	42	8	0.81	<15	3.2	27	3	0.15	150	<4	1.2	<4	14	320	31
105311	53	130	10.	<15	0.26	27	20	3.4	1300	<4	1.1	<4	81	870	31
105312	38	16	2.1	<15	3.7	94	3	0.28	45	10	<0.05	11	11	170	<10
105313	36	23	0.76	31	0.13	3	16	0.43	130	<4	4.5	<4	19	420	<10
105314	7	8	1.6	<15	2.8	210	8	0.11	130	<4	2.4	120	<2	180	22

LARAMIE RANGE

OR SAMPLE NUMBER	SC (PPM)	TH (PPM)	TI (PPM)	V (PPM)	Y (PPM)	ZN (PPM)	ZR (PPM)
105258	13	2	4300	110	17	77	81
105259	10	3	990	94	7	140	4
105260	8	2	70	<2	5	10	5
105261	8	<2	840	90	3	37	<2
105262	10	<2	510	32	2	53	<2
105263	26	7	1300	120	4	40	2
105264	26	<2	1700	140	6	53	8
105265	<1	2	10	240	3	18	5
105266	<1	2	97	7	4	200	<2
105267	1	100	3200	120	37	33	63
105268	1	40	2400	65	21	32	78
105269	2	87	2900	110	33	34	130
105270	1	46	1900	31	19	23	91
105271	1	43	2000	64	23	24	91
105272	36	<2	7000	260	14	35	94
105274	16	4	5800	140	13	31	130
105275	3	15	420	11	9	15	200
105276	41	<2	4900	360	5	32	5
105277	34	<2	7400	370	13	95	<2
105278	25	<2	11000	340	35	130	23
105279	1	9	160	<2	5	6	40
105280	4	12	2700	5	56	14	400
105281	7	20	1800	2	22	44	370
105282	26	4	12000	380	26	52	41
105283	<1	3	76	14	3	57	<2
105285	12	4	870	120	3	71	<2
105286	13	2	4500	120	22	77	110
105287	3	20	420	<2	6	17	130
105288	3	17	470	9	6	37	120
105289	3	24	420	15	6	86	120
105290	4	20	510	3	5	14	110
105291	1	7	180	3	2	7	38
105292	4	25	500	5	7	55	130
105293	27	3	6800	260	15	60	130
105294	13	8	5500	150	9	84	110
105295	6	16	1400	61	7	380	76
105296	11	<2	6600	220	7	30	80
105297	1	14	72	4	14	15	51
105298	4	5	390	36	5	21	15
105299	<1	13	170	230	2	64	<2
105300	21	<2	140	120	5	49	9
105301	5	15	2200	28	8	31	150
105302	13	4	1400	120	5	53	<2
105303	4	23	1300	21	5	18	99
105304	<1	<2	63	2	1	10	2
105305	1	6	280	6	23	110	21
105306	<1	<2	12	<2	<1	41	<2
105307	2	28	1900	29	3	60	110
105308	11	7	1000	80	4	27	44
105309	2	15	1300	5	6	27	280
105310	3	9	410	25	5	11	39
105311	21	3	9500	300	21	130	16
105312	7	23	1200	150	7	14	22
105313	2	4	1000	22	1	13	60
105314	1	22	520	5	44	38	230

LARAMIE RANGE

OR SAMPLE	D. O. E. SAMPLE	NUMBER		U	U-NT	U/TU	AG	AL	B	BA	BE	CA	CE	CU
NUMBER	ST LAT	LONG	L TY REP	(PPM)	(PPM)		(PPM)	(%)	(PPM)	(PPM)	(PPM)	(%)	(PPM)	(PPM)
105315	40-41.869	-105.323	-3-92-	22.	30.	0.75	10	1.5	<10	960	1	12.	21	22
105316	40-41.863	-105.464	-3-92-	0.38	0.40	0.95	<2	2.0	<10	64	<1	3.0	<10	66
105318	40-41.856	-105.327	-3-92-	0.61	0.70	0.87	<2	1.8	<10	260	<1	<0.05	21	<4
105319	40-41.864	-105.325	-3-92-	0.39	0.30	1.3	<2	1.9	<10	90	<1	<0.05	<10	<4
105320	40-41.865	-105.382	-3-92-	<0.25	0.20	0.63	<2	1.7	<10	7	<1	0.89	<10	95
105321	40-41.857	-105.438	-3-92-	3.2	3.7	0.86	<2	6.8	<10	1100	1	0.78	140	<4
105322	40-41.865	-105.416	-3-92-	1.0	1.3	0.79	<2	6.7	<10	140	46	2.9	11	<4
105323	40-41.893	-105.236	-3-92-	2.6	4.1	0.63	<2	5.3	<10	1500	3	0.32	100	<4
105324	40-41.920	-105.400	-3-92-	46.	47.	0.97	<2	3.3	<10	590	<1	0.15	29	7
105325	40-41.959	-105.254	-3-92-	3.5	4.3	0.81	<2	4.1	12	1200	1	<0.05	48	<4
105326	40-41.947	-105.261	-3-92-	1.4	2.1	0.65	<2	2.5	<10	5000	<1	0.23	69	<4
105327	40-41.932	-105.282	-3-92-	0.54	0.60	0.90	<2	1.0	<10	860	<1	<0.05	16	<4
105328	40-41.933	-105.292	-3-92-	0.97	2.2	0.44	<2	7.0	<10	790	1	0.65	30	22
105329	40-41.937	-105.284	-3-92-	0.46	0.50	0.92	<2	0.05	<10	61	<1	<0.05	<10	<4
105330	40-41.981	-105.273	-3-92-	<0.25	0.20	0.63	<2	4.1	<10	30	<1	3.7	<10	63
105331	40-42.104	-105.578	-3-92-	1.3	1.5	0.84	<2	5.7	<10	140	1	1.8	39	6
105332	40-42.103	-105.581	-3-92-	2.6	2.6	0.97	<2	6.9	<10	110	1	5.5	23	7
105333	40-42.101	-105.584	-3-92-	3.2	3.2	0.98	<2	6.9	21	510	1	7.2	48	12
105334	40-42.092	-105.602	-3-92-	150.	140.	1.0	<2	1.1	21	28	1	5.4	<10	240
105335	40-42.110	-105.598	-3-92-	4.3	4.5	0.96	<2	6.0	<10	960	2	0.79	73	<4
105336	40-42.128	-105.419	-3-92-	3.7	4.3	0.86	<2	6.4	<10	1400	1	0.35	73	<4
105337	40-42.128	-105.419	-3-92-	3.8	4.2	0.91	<2	6.4	<10	1500	1	0.67	77	<4
105338	40-42.128	-105.419	-3-92-	6.5	7.1	0.91	<2	6.3	<10	2200	1	0.42	110	4
105339	40-42.153	-105.405	-3-92-	7.3	7.6	0.96	<2	6.6	<10	360	2	0.67	44	4
105341	40-42.156	-105.404	-3-92-	9.1	11.	0.82	<2	6.5	<10	76	1	0.17	87	<4
105342	40-42.156	-105.404	-3-92-	33.	35.	0.95	<2	9.0	12	870	3	2.1	290	<4
105343	40-******	-*******	-3-92-	2.8	4.4	0.65	<2	6.8	<10	1500	1	0.46	41	<4
105344	40-******	-*******	-3- -	1.9	2.9	0.64	<2	7	<10	980	3	0.9	120	<4
105345	40-******	-*******	-3-92-	4.0	4.3	0.92	<2	6.8	<10	1100	3	0.86	110	<4
105346	40-******	-*******	-3-92-	6.7	7.3	0.92	<2	5.9	<10	670	1	0.40	130	4
105347	40-41.921	-105.401	-3-92-	2.0	2.4	0.82	<2	6.1	<10	1300	1	0.59	47	11
105348	40-41.921	-105.401	-3-92-	2.8			<2	6.5	<10	1100	1	0.62	32	14
105349	40-41.920	-105.401	-3-92-	2.1	2.4	0.86	<2	5.6	<10	530	1	2.2	26	21
105350	40-41.920	-105.400	-3-92-	2.3	2.4	0.94	<2	5.7	<10	730	1	1.7	25	20
105351	40-41.920	-105.400	-3-92-	2.6	2.9	0.91	<2	5.4	<10	490	1	0.53	32	20
105352	40-41.920	-105.399	-3-92-	2.8	3.9	0.71	<2	5.7	<10	550	1	0.55	44	16
105353	40-41.920	-105.399	-3-92-	2.4	1.8	1.3	<2	4.5	<10	370	1	0.12	25	9
105354	40-41.920	-105.400	-3-92-	2.1	1.5	1.4	<2	6.5	<10	320	2	1.4	12	12
105355	40-41.919	-105.400	-3-92-	1.7	2.0	0.85	<2	6.3	<10	360	2	0.72	26	22
105356	40-41.919	-105.400	-3-92-	3.3	3.7	0.90	<2	6.5	<10	860	1	0.20	50	6
105357	40-41.919	-105.400	-3-92-	1.6	1.9	0.86	<2	6.1	<10	480	2	0.74	25	21
105358	40-41.919	-105.399	-3-92-	2.6	3.7	0.71	<2	5.8	<10	560	1	0.12	21	17
105359	40-41.919	-105.400	-3-92-	3.1	3.5	0.89	<2	5.7	<10	530	1	0.35	28	12
105360	40-41.919	-105.401	-3-92-	3.3	3.2	1.0	<2	6.5	<10	490	1	0.47	28	12
105361	40-41.919	-105.401	-3-92-	3.5	3.3	1.1	<2	5.7	<10	330	1	0.64	16	9
105362	40-41.919	-105.402	-3-92-	3.6	3.1	1.1	<2	7.1	<10	200	2	0.50	21	11
105363	40-41.919	-105.402	-3-92-	2.1	2.7	0.77	<2	7.3	<10	120	1	1.4	20	19
105364	40-41.919	-105.404	-3-92-	1.8	3.2	0.55	<2	5.7	<10	300	1	0.66	18	6
105366	40-41.921	-105.403	-3-92-	2.3	2.9	0.79	<2	5.4	<10	84	1	2.0	22	14
105367	40-41.921	-105.403	-3-92-	1.4	2.3	0.62	<2	6.2	<10	810	1	1.8	35	17

LARAMIE RANGE

DR SAMPLE NUMBER	CR (PPM)	CU (PPM)	FE (%)	HF (PPM)	K (%)	LA (PPM)	LI (PPM)	MG (%)	MN (PPM)	MO (PPM)	NA (%)	NB (PPM)	NI (PPM)	P (PPM)	PB (PPM)
105315	34	26000	2.2	54	1.0	2	9	6.2	5600	<4	0.18	4	29	64	<10
105316	2000	24	6.1	<15	0.02	<2	2	9.0	1500	<4	0.13	<4	510	220	12
105318	100	<2	0.10	<15	0.77	25	2	<0.05	<4	4	<0.05	<4	3	6	<10
105319	12	14	0.52	<15	1.3	5	9	<0.05	18	<4	0.23	<4	3	52	<10
105320	3100	30	7.8	<15	<0.02	<2	2	6.5	1200	<4	<0.05	<4	990	27	<10
105321	1	4	0.78	<15	3.2	180	11	0.10	150	<4	2.3	<4	<2	150	39
105322	10	4	0.18	<15	0.19	13	3	0.11	58	<4	2.5	9	<2	140	15
105323	8	8	0.62	35	2.5	130	8	0.24	42	<4	2.3	28	10	51	26
105324	310	43	2.7	40	0.99	36	11	1.3	280	4	1.5	<4	31	130	13
105325	20	13	2.0	<15	1.7	61	8	0.15	37	<4	0.06	4	3	95	<10
105326	17	6	1.1	<15	2.1	72	4	0.14	100	<4	0.16	<4	17	63	13
105327	5	18	0.28	<15	0.46	12	2	<0.05	11	<4	<0.05	<4	<2	37	<10
105328	170	36	5.2	<15	1.7	31	28	2.4	790	4	1.9	<4	80	750	93
105329	10	14	2.4	23	<0.02	2	1	0.12	980	<4	<0.05	<4	<2	180	<10
105330	2300	47	7.2	<15	<0.02	<2	2	6.6	1100	<4	0.15	<4	460	100	<10
105331	27	10	0.86	<15	0.46	37	22	0.76	180	<4	1.6	<4	43	140	13
105332	110	19	2.3	<15	0.07	30	6	1.1	1100	<4	1.4	<4	44	280	20
105333	38	15	1.5	<15	0.96	59	5	1.6	2000	<4	1.9	<4	23	380	19
105334	2200	48	20.	<15	0.02	<2	10	4.0	5700	11	0.17	<4	2000	<5	17
105335	<1	11	2.0	<15	1.4	110	10	0.20	280	<4	2.2	10	21	290	25
105336	6	11	1.8	<15	3.3	110	7	0.30	160	<4	1.4	4	23	170	44
105337	12	12	1.2	<15	3.4	100	6	0.22	120	<4	1.5	<4	26	150	47
105338	7	10	2.0	<15	2.7	150	9	0.52	220	<4	1.8	<4	27	230	70
105339	13	43	1.7	<15	1.6	44	14	0.49	340	<4	2.5	5	35	150	43
105341	4	12	0.95	<15	1.3	87	5	0.13	570	<4	3.5	5	26	69	27
105342	3	10	2.6	<15	4.6	310	38	0.51	280	<4	0.88	9	22	94	48
105343	6	8	0.45	<15	2.9	79	2	0.05	42	<4	2.1	<4	14	250	11
105344	8	16	1	<15	2.7	140	10	0.3	290	<4	2.1	12	20	360	44
105345	8	13	1.7	<15	2.8	87	13	0.28	230	<4	2.0	15	27	300	43
105346	8	9	0.65	<15	2.1	170	2	0.16	68	<4	2.5	<4	27	470	12
105347	58	66	2.7	<15	2.3	53	22	0.95	390	<4	1.5	4	19	190	42
105348	430	6	3.0	<15	2.3	39	27	2.2	870	<4	1.9	<4	73	290	33
105349	280	30	3.5	<15	1.4	15	18	2.5	830	<4	1.8	<4	88	140	21
105350	280	27	3.5	<15	1.4	25	23	2.6	800	<4	1.8	<4	92	310	33
105351	460	58	4.9	<15	1.4	37	33	2.6	560	<4	1.5	<4	78	150	35
105352	160	6	2.9	<15	1.2	66	20	1.6	400	<4	2.3	<4	47	130	23
105353	58	36	2.7	<15	1.4	26	19	1.3	410	<4	1.8	<4	23	110	10
105354	93	3	2.4	<15	1.2	9	16	1.4	400	<4	2.3	<4	26	90	25
105355	190	3	4.2	<15	2.0	28	27	2.3	730	<4	1.7	<4	47	210	13
105356	18	10	1.3	<15	3.6	73	10	0.85	230	<4	1.5	6	14	270	29
105357	270	3	4.0	<15	1.9	24	24	2.6	670	<4	1.7	<4	73	240	24
105358	180	4	3.9	<15	2.4	20	25	1.8	560	<4	1.3	<4	44	130	14
105359	110	8	2.4	<15	1.1	31	21	1.4	500	<4	2.6	<4	31	290	17
105360	120	4	2.5	<15	1.3	32	17	2.0	430	<4	3.1	<4	31	200	38
105361	99	7	1.8	<15	0.98	14	12	1.1	460	<4	2.6	<4	25	140	15
105362	97	19	2.4	<15	1.2	22	18	1.5	550	<4	3.5	13	28	100	13
105363	190	4	4.8	<15	0.07	22	7	2.6	1100	<4	3.9	<4	54	36	46
105364	83	2	1.5	<15	0.92	16	14	1.0	340	<4	2.7	4	21	210	<10
105366	450	10	2.1	<15	0.08	22	3	2.3	780	<4	3.1	<4	85	150	17
105367	440	27	2.7	<15	1.2	59	18	2.1	630	<4	2.7	<4	88	340	22

LARAMIE RANGE

DR SAMPLE NUMBER	SC (PPM)	TH (PPM)	TI (PPM)	V (PPM)	Y (PPM)	ZN (PPM)	ZR (PPM)
105315	3	<2	760	24	6	130	28
105316	18	<2	570	69	4	71	<2
105318	1	7	100	13	2	4	44
105319	<1	<2	150	12	1	7	25
105320	10	<2	610	56	2	78	<2
105321	2	64	620	9	3	25	86
105322	2	11	52	2	9	6	2
105323	1	21	520	5	29	20	210
105324	6	9	910	42	3	97	46
105325	3	85	1900	75	8	12	110
105326	1	42	1600	31	8	8	90
105327	2	<2	390	14	1	6	33
105328	17	7	3700	130	11	140	55
105329	1	<2	14	7	1	20	<2
105330	17	3	1700	130	5	76	3
105331	2	10	640	20	3	35	75
105332	9	5	2300	89	7	110	37
105333	6	25	1800	43	15	75	67
105334	8	<2	480	200	13	250	<2
105335	5	7	1400	3	18	72	210
105336	3	79	1700	15	4	48	62
105337	2	67	1100	12	3	48	67
105338	3	140	1800	21	4	53	120
105339	3	53	700	19	10	61	76
105341	4	68	100	2	57	35	93
105342	5	130	510	43	51	37	120
105343	1	48	410	9	14	19	64
105344	4	19	1200	14	16	47	79
105345	4	30	1300	18	15	61	110
105346	1	36	600	13	14	28	110
105347	6	26	1300	55	7	110	88
105348	8	15	1300	59	5	160	68
105349	12	8	1800	97	9	110	51
105350	12	11	2000	98	12	110	56
105351	8	14	1300	65	4	110	64
105352	6	13	1100	52	4	93	63
105353	5	7	1400	36	2	53	30
105354	6	9	1100	55	3	81	25
105355	11	9	2000	95	4	150	62
105356	2	25	740	19	6	53	90
105357	11	11	2000	97	4	120	53
105358	6	15	1300	53	3	79	68
105359	6	12	1300	54	3	110	65
105360	7	17	1400	64	4	150	74
105361	6	14	1300	47	3	95	68
105362	6	16	1300	51	3	120	67
105363	10	9	2300	61	5	110	76
105364	4	10	1000	36	3	77	63
105366	9	10	760	69	10	100	66
105367	8	11	1400	69	8	89	67

-------CORRECTIONS-------

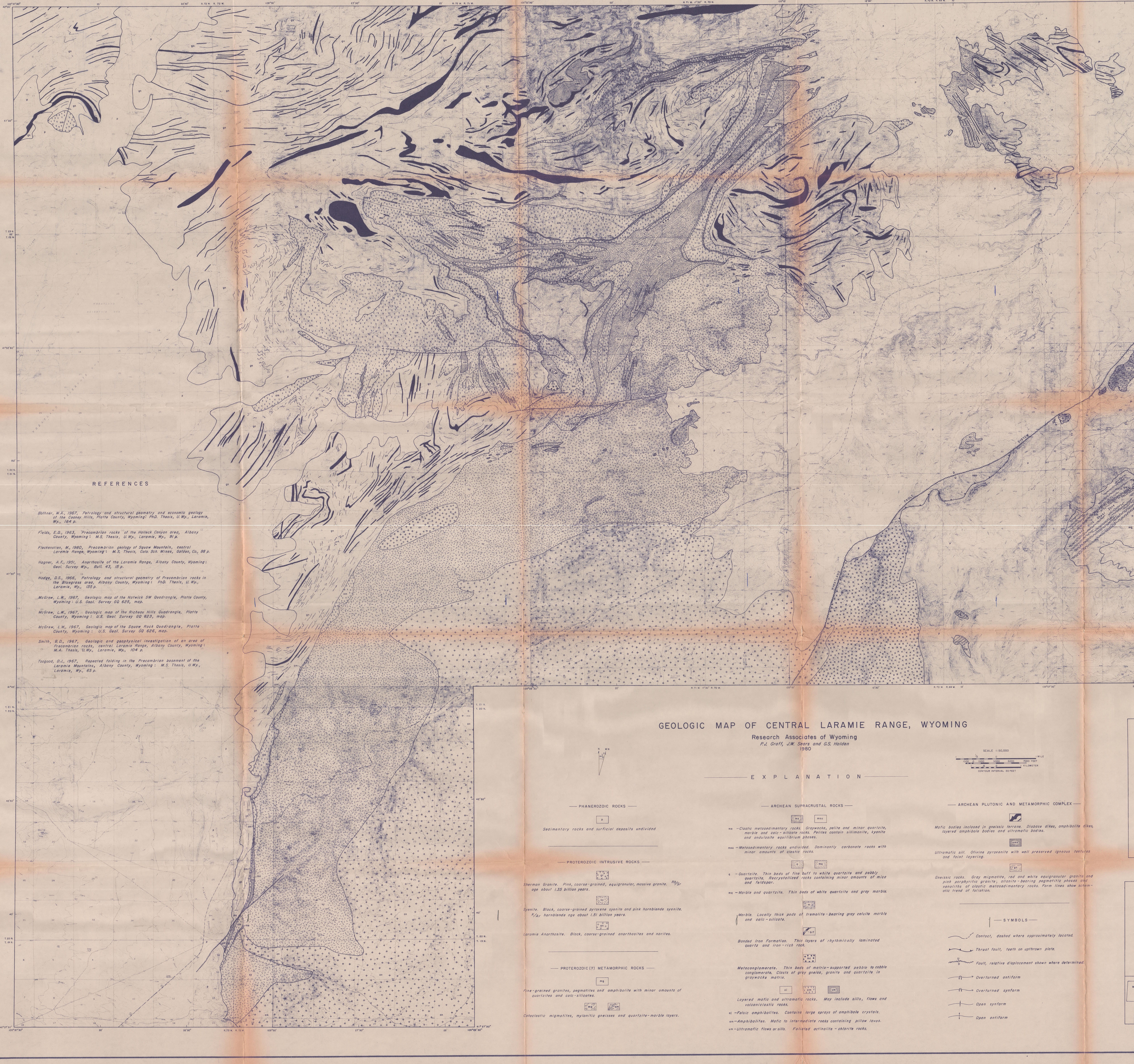
SAMPLE NUMBER	LAT.	LONG.
105218	41.906	105.412
105279	41.933	105.330
105291	41.903	105.370
105343	42.27	105.37
105344	42.35	105.35
105345	42.35	105.35
105346	42.38	105.33

GOLD VALUES - LARAMIE RANGE

Sample		Au (ppm)	Sample		Au (ppm)
105203	=	<0.1	105276	=	<0.04
105204	=	<0.15	105287	=	<0.1
105218	=	0.07 ± 25%	105288	=	<0.03
105223	=	<0.14	105289	=	<0.1
105225	=	<0.13	105290	=	<0.1
105228	=	<0.12	105291	=	<0.02
105229	=	<0.12	105292	=	<0.1
105232	=	<0.15	105293	=	<0.03
105233	=	<0.1	105294	=	<0.06
105250	=	<0.12	105298	=	<0.009
105265	=	0.01 ± 25%	105299	=	0.013 ± 25%
105266	=	<0.008	105301	=	<0.06
105267	=	<0.1	105303	=	<0.04
105268	=	<0.02	105306	=	<0.004
105269	=	<0.03	105308	=	<0.04
105270	=	<0.1	105309	=	<0.02
105271	=	<0.1	105311	=	<0.04
105275	=	<0.03	105328	=	<0.04

SiO_2 VALUES - LARAMIE RANGE

SAMPLE	SiO_2 (%)
105200	60.62
105220	57.58
105236	45.33
105239	56.74
105254	57.72
105259	60.21
105262	47.69



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GEOLOGIC MAP OF CENTRAL LARAMIE RANGE, WYOMING

Research Associates of Wyoming

P.J. Graff, J.W. Sears and G.S. Holden

1980

SCALE 1:50,000

CONTOUR INTERVAL 20 FEET

EXPLANATION

PHANEROZOIC ROCKS

p

Sedimentary rocks and surficial deposits undivided

PROTEROZOIC INTRUSIVE ROCKS

gr

Sherman Granite. Pink, coarse-grained, equigranular, massive granite. Rb/Sr age about 1.35 billion years.

sy

Syenite. Black, coarse-grained pyroxene syenite and pink hornblende syenite. K/Ar hornblende age about 1.51 billion years.

an

Laramie Anorthosite. Black, coarse-grained anorthosites and norites.

PROTEROZOIC (?) METAMORPHIC ROCKS

mg

Fine-grained granites, pegmatites and amphibolite with minor amounts of quartzites and calc-silicates.

mg qm

Cataclastic migmatites, mylonitic gneisses and quartzite-marble layers.

ARCHEAN SUPRACRUSTAL ROCKS

ms msu

ms – *Clastic metasedimentary rocks. Graywacke, pelite and minor quartzite, marble and calc-silicate rocks. Pelites contain sillimanite, kyanite and andulasite equilibrium phases.*

msu – *Metasedimentary rocks undivided. Dominantly carbonate rocks with minor amounts of clastic rocks.*

q mq

q – *Quartzite. Thin beds of fine buff to white quartzite and pebbly quartzite. Recrystallized rocks containing minor amounts of mica and feldspar.*

mq – *Marble and quartzite. Thin beds of white quartzite and gray marble.*

m

Marble. Locally thick pods of tremolite-bearing gray calcite marble and calc-silicate.

bif

Banded Iron Formation. Thin layers of rhythmically laminated quartz and iron-rich rock.

mc

Metaconglomerate. Thin beds of matrix-supported pebble to cobble conglomerate. Clasts of gray gneiss, granite and quartzite in graywacke matrix.

ai am um

Layered mafic and ultramafic rocks. May include sills, flows and volcaniclastic rocks.

ai – *Felsic amphibolites. Contains large sprays of amphibole crystals.*

am – *Amphibolites. Mafic to intermediate rocks containing pillow lavas.*

um – *Ultramafic flows or sills. Foliated actinolite – chlorite rocks.*

ARCHEAN PLUTONIC AND METAMORPHIC COMPLEX

Mafic bodies inclosed in gneissic terrane. Diabase dikes, amphibolite dikes, layered amphibole bodies and ultramafic bodies.

ums

Ultramafic sill. Olivine pyroxenite with well preserved igneous textures and faint layering.

gn

Gneissic rocks. Gray migmatite, red and white equigranular granite and pink porphyritic granite; allanite-bearing pegmatitic phases and xenoliths of clastic metasedimentary rocks. Form lines show schematic trend of foliation.

SYMBOLS

Contact, dashed where approximately located.

Thrust fault, teeth on upthrown plate.

Fault, relative displacement shown where determined.

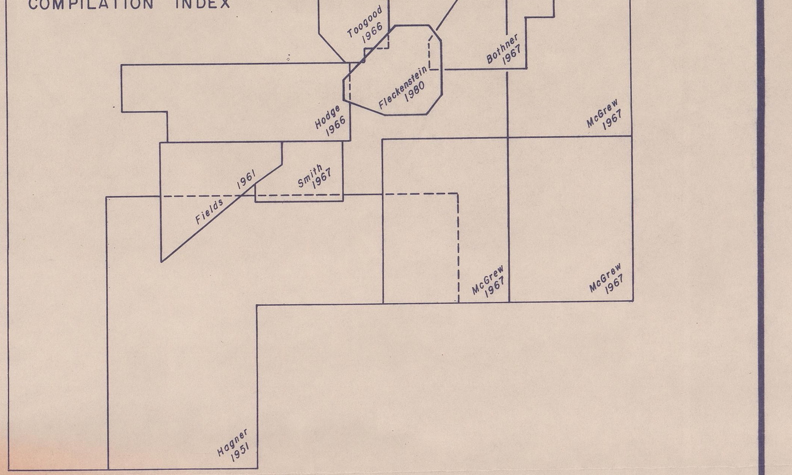
Overturned antiform

Overturned synform

Open synform

Open antiform

COMPILATION INDEX



LOCATION INDEX

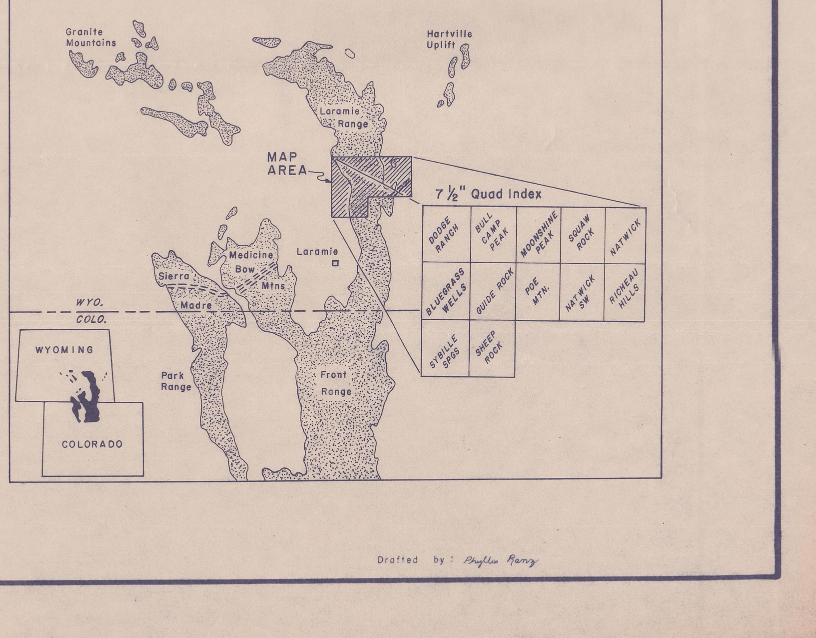
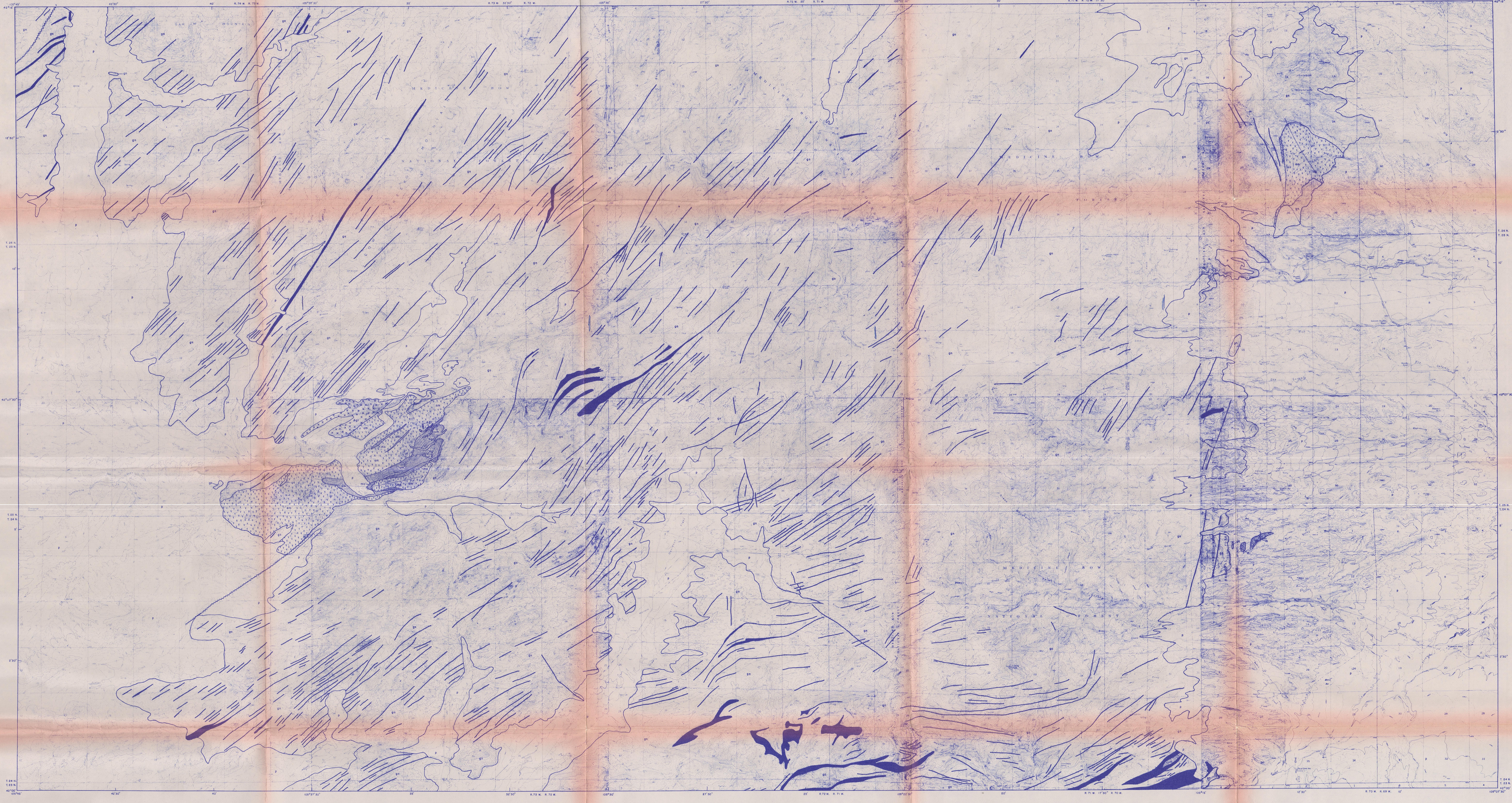


PLATE 2



EXPLANATION

PHANEROZOIC ROCKS

p

Sedimentary rocks and surficial deposits undivided

ARCHEAN ROCKS

Agr

Archean granitic rocks

gn

Archean granitic gneiss complex

m ms q

Metasedimentary rocks

ms – *Chiefly graywacke and pelitic sequences with lesser amounts of conglomerate, quartzite, marble and calc-silicate rocks.*
q – *Quartzite.*
m – *Marble and calc-silicate rocks.*

am um

Layered mafic and ultramafic rocks. May include sills, flows and volcaniclastic rocks.
am – *Amphibolite, mafic and layered mafic rocks.*
um – *Ultramafic flows or sills.*

Mafic bodies inclosed in the gneissic terrane.

SYMBOLS

Contact, dashed where approximately located.

Fault

Open synform

NOTE:
This map compiled chiefly from air photographs

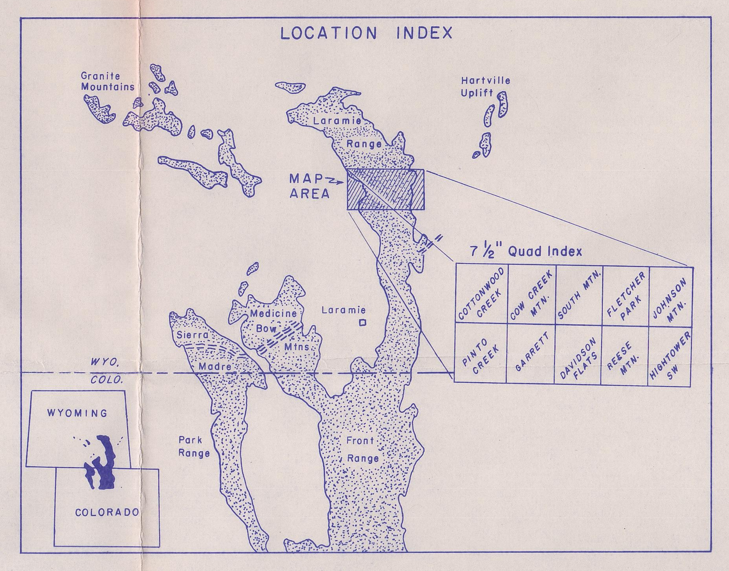
SCALE 1:50,000

1 ½ 0 1 MILE
1000 0 1000 3000 5000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET

N MN 14½° 1°

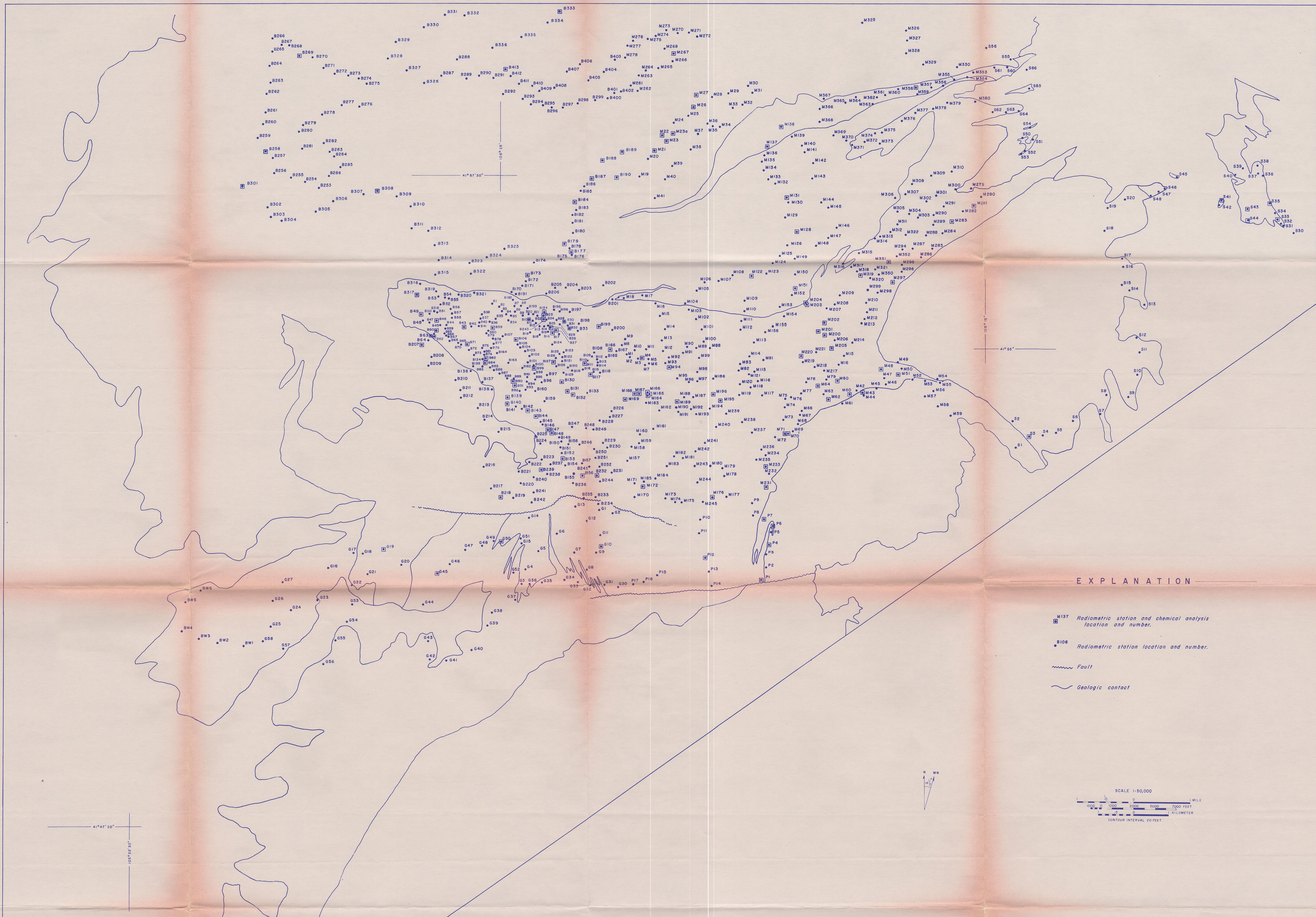
RECONNAISSANCE GEOLOGIC MAP OF NORTHERN CENTRAL LARAMIE RANGE, WYOMING

Research Associates of Wyoming
P.J. Graff, J.W. Sears and G.S. Holden
1980



Drafted by: *Phyllis Ranz*

PLATE 3



SAMPLE SITE AND RADIOMETRIC STATION LOCATION MAP

Research Associates of Wyoming
P.J. Graff, J.W. Sears and G.S. Holden
1980

Drafted by: