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A REPORT ON A GEOLOGICAL RECONNAISSANCE OF THE MIDDLE MUSA AREA, NORTHERN DISTRICT, PAPUA

by

J.E. Thompson

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INTRODUCTION

The object of this reconnaissance was to determine the extent of ultrabasic igneous rocks in the area and, within this province, to locate areas of peridotite which, under conditio s of tropical weathering, may produce superficial nickel ores either of the silicate or lateritic-soil type.

This survey, undertaken during February 1958, covered approximately 400 square miles, including most of Special Prospecting Reserve No.17, by broad reconnaissance. Complete vertical aerial photo coverage was available throughout the survey and observations along traverse routes shown on the map, were noted on overlays of this photography. Unfortunately, at this stage, air photo maps have not been compiled and as an interim measure, observations have been transferred to a slightly modified version of the military 1" = 4 miles, "TUFI" Sheet. The location of observations on this small scale is necessarily unsatisfactory and the map must be regarded as no more than a diagrammatic sketch map illustrating primary geological relationships.

The climate of the area is distinctly seasonal, the wet being from December to May, with peak rainfall during January-February. During this wet season movement is considerably hampered by flooded rivers. Open-cut mining operations would also be adversely affected during this season. For the remainder of the year the rainfall does not present a serious problem, except possibly in the shadow of the high, metamorphic mountains east of Wowo Gap.

The most convenient access to the area is by air to the Safia airstrip in the Middle Musa valley. This airstrip, approximately 800 yards long, is well drained and smooth surfaced. It will accommodate Anson aircraft. The grass must be cut every 6 - 8 weeks during the wet season to maintain the airstrip in a serviceable condition; during the dry season, particularly after burning off, grass-cutting may be less frequent. This airstrip is favourably situated for low-cost extension to accommodate large aircraft should the need arise. There is no regular air service to Safia but Anson charters are available from Port Moresby, approximately one hour's flying time away, at a rate of £35 per hour.

The Safia Patrol Post is not continuously manned by Native Affairs personnel but serves as a headquarters when the area is being patrolled.

Labour is not readily obtainable in the immediate vicinity of Safia or in the eastern end of the Middle Musa Valley. The more heavily populated western end and southern flank of the valley could provide ample labour for further exploration in the Middle Musa area.

The area has not previously been examined geologically except for a brief visit by the writer in 1954.

REGIONAL SETTING

As indicated in the accompanying locality plan, the area examined covers the south-eastern extremity of the main Papuan Ultrabasic Belt which extends for approximately 230 miles to the north-west. The south-western margin of this belt is, throughout its length, in fault contact with the metasediments of the Owen Stanley Ranges and their intrusives.

Tertiary and Quaternary sediments and volcanics from the north-eastern outcrop margin of the ultrabasic belt and, in the area covered by this report, occupy a basin wholly enclosed within that belt.

The south-eastern extremity of the ultrabasic belt is abruptly terminated against the high, metamorphic Gorupu Mountains. This may be due to transverse faulting on a regional scale off-setting both the metamorphic and ultrabasic zones to the north-east, so that a continuation of the ultrabasic belt may exist beneath the thick piedmont cover formed along the north-eastern front of the Gorupu Mountains.

PHYSIOGRAPHY

The floor of the Middle Musa Valley, which is approximately 30 miles in length and up to 5 miles in width, is relatively flat, being filled with coarse, ill-sorted alluvia. The sparse vegetation of this valley suggests a low fertility soil capable, however, of supporting grasslands which are burnt annually by natives in search of game. The lower flanks of the valley are composed of a thick succession of gently dipping, poorly consolidated, fresh water sediments, ranging from mudstones to coarse conglomerates which have a characteristic erosion pattern including cuesta and hog-back forms. Where the Adau River intersects this formation on the southern flank of the valley, a canyon, approximately 1,500 feet deep, has been formed by incision of the stream as the formation has been slowly uplifted. South of the valley, beyond the sedimentary formations mentioned above, the Owen Stanley Mountains rise through foothill stages to approximately 8,000 feet.

The Musa River leaves the Middle Musa Valley through a deep, meandering gorge in massive ultrabasic igneous rocks and emerges abruptly into its own flood plain through which it meanders seawards, finally losing identity in a maze of distributaries. East of the Musa Gorge ultrabasic rocks form the Didina Range, ✱ approximately 6,000 feet high, and heavily dissected with a consequent drainage. West of the Musa Gorge, the ultrabasics form a lesser range separating the Middle Musa Valley from the flood and coastal plain. There is a suggestion, in intensity of drainage and drainage pattern, that the eastern end of the Didina Range has been elevated at a greater rate or more recently, geologically, than the western end of the range and its extension beyond the Musa Gorge.

The Gorupu Mountains, composed of schists and phyllites, attain heights up to 11,000 feet in a short lateral distance. These mountains are obviously bounded on the north-east by a major, currently active, fault. Another fault, striking eastward, probably forms the Wowo Gap, a 2,000 foot saddle between the Didina Range and the Gorupu Mountains, Large landslips head the Wakioki, Anala, Bereruma and Ibinambo streams, indicating current upward movement of the metamorphic mountain block. Remnants of a mature topography have been observed in aerial photographs above about 8,000 feet in the Gorupu Mountains. One such remnant occurs high on the southern side of the Ibinambo River where it emerges from the Gorupu Mountains.

✱. Native name "Didina", not "Didana", as on military map.

Recent volcanoes emerge through the piedmont deposits and coastal plain north-east of the Gorupu Mountains. Mounts Victory and Trafalgar, which together form the Cape Nelson Peninsula, are the two principal volcanoes; lesser volcanoes occur closer to the obvious fault margin of the Gorupu Mountains.

GENERAL GEOLOGY

The youngest formations occurring in the area are Recent, unconsolidated alluvia and andesitic, volcanic products; neither of these have any economic significance or particular bearing on the structure or stratigraphy of the consolidated formations, and will not therefore be discussed further.

Apart from Recent alluvia the Middle Musa Valley basin-fill material is composed of three formations, namely, in order of increasing age:-

1.	Dissected Piedmont	500 feet thick	(estimate only)
2.	Folded Lake Beds	4,000 feet thick	" "
3.	Basal Volcanic Products	2-300 feet thick	" "

These formations are tentatively considered as Plio - Pleistocene, though faunal confirmation is lacking.

That portion of the Middle Musa basin examined is entirely contained within the ultrabasic belt, and probably its origin is structurally related to the transverse faulting in which the metamorphic Gorupu Mountain block and adjoining ultrabasics were off-set to the north-east. The formations mentioned above are now described in greater detail.

1. Dissected Piedmont

This formation was observed near Silimidi Village at the south-eastern end of the Musa Valley. It is poorly exposed and deeply weathered. It presents a rather abrupt escarpment approximately 200 feet high, immediately east of Silimidi Village, caused by frontal erosion of an old piedmont fan by nearby streams. This effect is not so obvious further to the north-east along the front of the formation; the piedmont merging gradually into finer, unconsolidated sediments of the valley floor. The surface of this formation rises towards the foothills to the south-east and east. It is deeply incised by widely separated, consequent streams, with broad, gently sloping interfluves. The primary surface slope of the formation is believed to have been increased by upward movement of the adjoining parent formations. Local deformation of this surface, as indicated by changes in drainage pattern, may be due to incipient folding or faulting expressing movements in the local ultrabasic basement.

The predominant components of this formation in the vicinity of Silimidi Village are peridotites, as large sub-rounded boulders including dunite and harzburgite. Metamorphic components from the main Owen Stanley Range are also present. The true relationship of peridotitic to metamorphic components may be obscured by selective residual concentration induced by differential chemical weathering. However, auger-hole samples through the weathered profile gave significant but sub-economic nickel indications by qualitative testing. Maximum nickel values are estimated at approximately 0.5% Ni. This estimation is based only on comparative qualitative testing of a few samples from near Silimidi. The deposit of the auger test-holes penetrated to 16 feet, the limit of available extension rods, through tight red and mustard-coloured clays without sign of the base of weathering. The extent of this formation as indicated in the sketch map is inferred both from study of vertical aerial photographs and from interrogation of local natives.

At their thickest, that is adjoining the parent formations, this piedmont formation may be of the order of 500 feet.

2. Folded Lake Beds.

This formation is well exposed on both sides of the Middle Musa Valley, rising to approximately 1,500 feet above the present valley floor. Dips up to 20° have been recorded; strikes are generally orientated with the valley. The relationship of these sediments to the younger piedmont deposits described above near Silimidi Village is clearly unconformity. However, at the eastern end of the valley, near the Wowo Gap where evidence is lacking, this relationship may not hold. Locally, particularly on the southern flank of the valley, they appear to rest directly on peridotite. On the northern flank, a volcanic agglomerate formation occurs conformably below the sediments, and is exposed at the head of the Musa Gorge.

The component sediments of this formation range from mudstones through all grades to conglomerates. A tuffaceous element persists throughout but it is predominant in the lower beds which are generally finer. The finer phases, mudstones and siltstones, generally contain an assemblage of small, thin-shelled, probably fresh water, molluscs, and finely comminuted plant remains.

Pebble components of the conglomeratic phases on both flanks of the valley, include all representatives of the ultrabasic suite, together with vesicular lavas, metamorphics of the Owen Stanley type and some well-rounded calcarenite pebbles of suspected Lower Miocene age.

A thickness of approximately 3,000 feet of this formation is exposed on the southern flank of the valley and a probable 1,500 feet on the northern flank. Thus the total thickness in the centre of the basin will be of the probable order of 4,000 feet. The outcrop margin of these beds on both sides of the valley is determined by gravity faults, with downward displacements towards the axis of the valley. At the Adau Gorge, these beds dip at a low angle southwards suggesting that gravity faulting may have also occurred along the contact with the underlying ultrabasics. The coarser, uppermost phases of this formation may not fall strictly within the lake-bed classification which normally implies quiet depositional conditions, but rather they are piedmont products encroaching into a former lake.

3. Basal Volcanic Products.

Four basic volcanic agglomerate beds, the largest being about 15 feet in thickness, separated by fine tuffaceous mudstones, are exposed at the head of the Musa Gorge. They dip south-east at 10° approximately, and are conformable with, and grade into the above-mentioned lake beds. They rest directly on a pyroxenite phase of the ultrabasics. No old erosion surface of the ultrabasics could be located under the volcanics because of poor exposure, but lack of stress structures on both sides of the contact strongly suggests a normal contact. The agglomerate beds stand out in erosional relief for several miles either side of the outcrop area, but were not observed near Busi or in the Sivai Creek area where traverses were made across the lake beds into the ultrabasics.

A coarse well-bedded tuff, 2 - 300 feet thick, which sub-horizontally overlies probable metamorphosed basic rocks east of Kakasa on the coastal side of the ultrabasic range has tentatively been correlated with the similar beds exposed in the Musa Gorge. The western extent of this formation is unknown.

A further group of volcanic rocks forming the northern front of the eastern end of the Didina Range and adjoining definite ultrabasic rocks, is also tentatively correlated with the Basal Volcanic Products of the Middle Musa basin.

An occurrence of volcanic flows and tuffs at the south-western end of the Wowo Gap is also tentatively correlated with the volcanics exposed in the Musa Gorge.

The contact relationships of these latter two occurrences to enclosing formations are completely unknown.

Ultrabasic Igneous Rocks

The ultrabasic igneous rocks are economically important because peridotitic phases within them may, under certain physiographic conditions, weather to form lateritic soils with a nickel content which may be concentrated to economic grade in the lower portion of the soil profile, by leaching and redeposition.

Under certain conditions, not clearly understood, an important end product of the leaching and redepositional process may be garnierite, and other nickel silicate minerals, deposited in open fractures below the soil profile. Thus it is important that peridotite areas be delineated within the ultrabasic igneous complex.

The margins of the ultrabasic mass are usually discernible from the ground, and in aerial photographs, by marked changes in relief and drainage pattern. However, the distribution of various differentiates within that mass is less obvious, particularly in rugged, and thickly wooded, terrain, as is generally the case throughout the Papuan Ultrabasic Belt. Observations near Kokoda, in the Waria Valley, and where the northern end of the ultrabasic belt cuts the coast near Tambu Bay, suggest that the inner, south-western side of the belt contains the more ultrabasic types such as dunite, harzburgite, enstatitite and hypersthenite. On the north-eastern side, basic felspathic rock types predominate. Observations in the area covered by this report, generally support the contention that the more basic rock types occur on the inner side of the belt, adjoining the Owen Stanley Fault.

Serpentinized peridotites within the belt are apparently more susceptible to chemical weathering, under tropical conditions of high rainfall, than their unserpentinized equivalents. Thus, in prospecting for superficial nickeliferous soil or silicate deposits, attention should be particularly directed to areas of serpentinized peridotite. No attempt has been made to map boundaries of differentiates within the ultrabasic complex in this area, but observations along traverses indicate a concentration of peridotites at the eastern end of the Didina Range, and again on the left bank of the Silimidi River. Component boulders of the Dissected Piedmont Deposits at the Eastern end of the Musa Valley, suggest that peridotites may extend from Silimidi River north-east to Wowo Gap.

The largest peridotite area at the eastern end of the Didina Range includes unserpentinized dunite and harzburgite, and serpentinite, presumably after dunite and harzburgite. The fresh dunites occur in the central portion of the Didina Range in the head of the Guara and Baruma Creeks. Eastward, towards Wowo Gap, serpentinization is more apparent.

In the immediate vicinity of Wowo Gap a unique peridotite breccia formation occurs. The components of this formation are angular, and extremely variable in size; they are bound together with a bonding material, containing, at least near the surface, nickel silicates and nickeliferous serpentine, chalcedony and magnesite, derived by secondary enrichment from surrounding, decomposing nickeliferous peridotites. This breccia extends at least 4 to 5 miles, with a width of approximately half a mile, and forms the eastern extremity of the Didina Range. This formation has economic significance because of its nickel silicate content which will be discussed later. Residual soil cover in this area is restricted to the tops of spurs and ridges, most of the slopes being too steep. Another small occurrence of this peridotite breccia has been reported by prospector K. Shelley, from the foothills south of Anala and in front of the main Gorupu Mountains. The peridotite breccia, in the coarse phase, has the superficial appearance of a volcanic agglomerate but is probably a rapidly deposited sediment; a scree or landslip deposit formed adjacent to, and owing its formation to, movements along the major fault line separating the ultrabasic Didina Range from the metamorphic Gorupu Mountains. The breccia components are not sheared as would be expected in a compressive fault zone nor are they tightly packed. In some hand specimens there is a suggestion of optical continuity from the component fragments into the matrix. If microscopic examination can verify this, then replacement of the margins of the peridotite components by the matrix material may be responsible for any illusion of loose packing. It may be possible for such a breccia to be the result of fracturing by drag forces on the incompetent peridotite due to upward, or lateral, movement of the adjoining metamorphic block. Fractures so formed could be enlarged by solution weathering and subsequently filled by deposition of supergene minerals derived from weathering processes. Irrespective of its mode of origin, this breccia formation has proved a favourable host for the deposition of supergene derivatives from the decomposing peridotites, which include members of the nickel silicate group of minerals. The depth to which supergene enrichment by nickel silicates has penetrated is unknown, but warrants investigation.

Fine grained gabbros and dolerites form most of the northern flank of the Didina Range and its extension west of the Musa River.

Pyroxenites were observed as boulders in Busi Creek and in outcrop in the Musa Gorge near the contact with volcanic agglomerates underlying the Lake Beds of the Middle Musa Plio-Pleistocene basin.

Boulders of various basic and ultrabasic rocks are prevalent in the Foasi and Domara Rivers which drain to the Musa from the main Owen Stanley Ranges, suggesting that the ultrabasic zone extends around the southern margin of the Middle Musa Basin.

<u>The Owen Stanley Metasediments.</u>

These metasediments are essentially schists and phyllites of probable Palaeozoic age which form the main Owen Stanley and Gorupu Mountains. On the lower north-eastern flank of the Gorupu Mountains green calc-silicate metamorphics occur. These may represent a younger, possibly Mesozoic formation, separated by unconformity from the schists and phyllites, and may be correlated with a wedge of similar metamorphics occurring between the Papuan Ultrabasic Belt and the main Owen Stanley Mountains at Koreppa, in the Waria Valley. However, in this report all the metasediments are considered together because they comprise a structural unit which bounds the ultrabasic belt along major fault contacts. The metasediments are strongly folded and faulted. Details of these structures have not been investigated.

The north-western end of the Gorupu Mountains is a particularly unstable area with large landslips heading all major streams which originate in the 10 - 11,000 foot peaks of these mountains. This instability is undoubtedly due to current activity along the major faults bounding this structural unit.

STRUCTURE

Regionally, the Papuan Ultrabasic Belt is regarded as the core of an early Tertiary thrust block which is now relatively stable. Prior to Pliocene orogeny, transverse buckling and faulting may have formed irregularities in the trace of the early Tertiary thrust line, particularly if the thrust plane is low-angled. The off-setting of the Gorupu Mountains from the main Owen Stanley Range may be an extreme case of such transverse faulting. The Ultrabasic Belt probably continues to the south-east in front of the fault scarp of the Gorupu Mountains and, in large part, forms the floor of the Cape Vogel geosyncline.

Pliocene to Recent orogeny has activated the metamorphic Owen Stanley - Gorupu mountain block with movement along the previously established early Tertiary thrust plane and any lines of subsequent transverse faulting. This orogeny is currently active causing mass erosion of the metamorphic mountains and deposition of the products of this erosion in basins formed by sympathetic warping or other mild structural responses in the regionally competent (rigid) ultrabasic belt.

The Recent orogenic activity is classically and dramatically expressed by major fault scarps and by vulcanism associated with the faulting. Examples of such vulcanism are Mounts Victory and Trafalgar which are thought to be along an extension of the transverse fault which offset the Gorupu Mountains from the Owen Stanley Range. The youngest example of volcanic activity associated with Recent faulting is the Waiowa volcano which erupted in 1944, almost on the trace of the active fault forming the north-east front of the Gorupu Mountains.

Structures within the Plio-Pleistocene basin sediments of the Musa Valley can be attributed to gravitative responses to minor warping of the ultrabasic basin framework or to compaction of the sedimentary column.

The northern front of the ultrabasic ranges north of the Middle Musa Valley may be determined by faulting which has not been unduly activated by the most recent orogeny.

ECONOMIC GEOLOGY

1. Nickel

Residual soils in the main peridotite area at the eastern end of Didina Range, near Wowo Gap, are restricted to the tops of ridges and the rare, gentle to medium slopes. Such areas are usually small, rarely exceeding a few acres, and are separated by deep narrow valleys. Preliminary qualitative testing of auger hole samples taken through soil profiles in these areas indicate that nickel enrichment does occur with concentration towards the base of the soil profile. The thickness of the soil profile ranges up to 20 feet, depending mainly on drainage conditions. Quantitative information on the samples collected during this survey is not yet available but the following assay results on samples collected earlier by prospector K.Shelley indicate the order of nickel values in the area.

Sample	%SiO_2	%Fe	%Ni	%Co
WAKIOKI No.2 at 4 ft.	51.60	9.23	0.81	Nil
" No.2 at 7 ft.	40.00	17.45	1.33	Nil

The high silica and relatively low iron content of these samples indicates that the soils are not of "lateritic" type such as those of the Kokoda area, which they closely resemble in physical characteristics. Nickel silicate minerals were not apparent in either of these samples, though the assay results suggest that the nickel is present in this form.

The following assay results on samples from a typical auger hole in the lateritic type soils over serpentinized dunite in the Kokoda area illustrates the zoning attributed to leaching, migration, and redeposition of soluble minerals in the soil profile and contrasts strongly with the above analyses of samples from the Wowo Gap area.

Sample	%SiO_2	%Fe	%Ni	%Co
KOKODA (B) 3' - 7'	16.54	33.9	0.45	Not detected.
7' - 10'	7.70	45.9	0.65	" "
10' - 14'	12.7	44.5	0.79	Trace
14' - 18'	18.35	42.2	1.42	Not detected.
18' - 22'	22.7	40.3	1.20	Trace
22' - 26'	26.89	38.9	1.15	Trace

The soil samples taken by K.Shelley are probably derived from underlying peridotite breccia containing nickel silicate cementing material which would account for the unusually high silica and low iron content. In residual soils over massive peridotite areas of the Didina Range, zoning relationships similar to that indicated by the assays of the Kokoda sample tabulated above would be expected, but confirming assays are not yet available.

The total nickeliferous soil occurrences in the Wowo Gap area are too small and scattered for consideration as a "lateritic nickel" prospect.

The peridotite breccia formation with interstitial nickel silicates, mentioned earlier, warrants more serious consideration as a nickel ore. A small sample taken by K.Shelley from the surface of this formation assayed 1.2% Ni. Qualitative testing of samples collected by the writer suggests that nickel values consistently over 1% may be expected, at least along the outcrop of this breccia formation. This requires confirmation by systematic sampling and assay. One small sample of this breccia (P146) assayed 0.71% nickel; portion of this sample was roughly separated into its peridotite components and matrix and these portions assayed with the following results:

	Ni%	Specific Gravity	Estimated relative volume.
Peridotite components	0.18%	2.8%	60%
Matrix	1.20%	3.7%	40%

The comparatively low specific gravity of the peridotite components suggest that they are severely leached.

The depth to which nickel silicates occur as a bonding material of the peridotite breccia is unknown but it is possible that the high permeability of the breccia zone has permitted secondary enrichment to more than average depth.

The possiblity of obtaining a nickel silicate concentrate from this breccia by simple physical treatment should be investigated. Large scale hydroelectric power for the arc-smelting of such a concentrate would be readily and cheaply available from the nearby Musa Gorge.

Nickeliferous sulphide mineralisation was not encountered.

2. Cobalt

The association of cobalt with nickel mineralisation is practically universal and may be anticipated in the peridotite areas. Black nodules of manganiferous wad which elsewhere in similar occurrences contains the cobalt oxide, asbolane, were observed in several auger holes drilled through the soil mantles. Quantitative information on the distribution of cobalt in the area is lacking.

3. Chrome

Disseminated chrome spinel has been seen in close association with magnetite in the peridotites of the area, but evidence of lode chromite was not observed.

4. Asbestos

Chrysotile asbestos forms minute cross-fibre veinlets in the serpentinised peridotites of the eastern end of the Didina Range and also in the small peridotite area south of Embessa. No veins of economic thickness were seen but they were not specifically sought.

5. Platinum/Osmiridium

Prospecting for platinum, osmiridium, and associated heavy minerals was not seriously undertaken during this investigation. Elsewhere along the Papuan Ultrabasic Belt the peridotite zones contribute platinum and osmiridium to alluvial deposits from which these minerals have been won as byproducts of alluvial gold mining. Conditions for the concentration of heavy minerals in alluvial deposits near the main peridotite area at the eastern end of the Didina Range are particularly unfavourable due to the rapid spread of alluvia from the adjoining, very actively eroding, Gorupu Mountains.

6. Gold

Alluvial gold has been reported from the western headwater tributaries of the Musa River but no production is recorded.

The Keveri Valley, at the head of the Adau River, a major tributary of the Musa River, was the scene of gold mining activity prior to the 1914-1918 War. After the initial rush the field supported only a few miners who did not remain for long. The area has never been geologically examined and the early failure of the field may have been due to its extreme remoteness. The present-day gravels of the Musa River at both ends of the gorge contain a small unimpressive gold content.

A few gold "colours" were seen in the dish prospects in Busi Creek which was followed for a short distance on the western traverse across the ultrabasic ranges. This gold is apparently derived from mineralisation within the ultrabasic complex.

7. Other Minerals

Occasional boulders of magnesite were observed in the gravels of the Adau and Silimidi Rivers, supporting the inference that ultrabasic rocks occur between the sediments of the Musa basin and the main Owen Stanley Ranges.

A concentrate rich in hydrated iron oxides would be obtained as a byproduct from large scale mining of nickeliferous lateritic soils, but the prospect of such a mining operation in the area under discussion is extremely remote.

Copper sulphide mineralisation occurs in the ultrabasic belt in the Waria Valley, but was not observed in the area covered by this report.

HYDROELECTRIC POWER

The Middle Musa Valley and the Musa Gorge are ideally disposed for the development of large scale hydroelectric power at low cost. Water could be impounded over approximately 100 square miles at an average depth of 50 feet by the construction ☆ of an arch-gravity dam, 400 - 500 feet high, spanning about 600 feet (top measurement) across the Musa gorge just downstream from the ultrabasic - sedimentary contact. This locality is well favoured with good foundations of massive ultrabasic igneous rocks. Good aggregate materials occur nearby. A flow recorder is now being established near the site and recordings should commence later this year.

The power developed from such a scheme would be of industrial magnitude and could possibly be applied to large-scale nickel silicate mining and smelting should further testing of the nickel silicates impregnating the peridotite breccia near Wowo Gap prove encouraging.

Such hydroelectric power may also attract heavy industry to either Oro Bay, approximately 50 miles north, or to Abau, 40 miles south. There are no road links between the Musa Gorge and these harbours.

ECONOMIC SUMMARY

1. The possibility of economic "lateritic" nickel deposits in the area covered by this investigation is remote. Before final dismissal, the area between Silimidi River and Wowo Gap, indicated on the accompanying geological sketch map as uncertain piedmont and ultrabasic formations, should be examined.

2. The nickeliferous peridotite breccia formation adjoining Wowo Gap warrants further attention as a possible low grade nickel ore. Such attention should be directed to:-

(a) determining the extent and grade, both laterally and at depth, of the nickel silicate enrichment;

(b) treatment of the breccia concentrate to obtain a nickel silicate concentrate:

(c) the application of locally generated hydroelectric power to further treatment of the nickel silicate concentrate by hydrometallurgical or arc-smelting processes.

☆ These figures are estimates based on cursory observations and are only intended to indicate the order of magnitude of the hydroelectric potential.

3. Chromite, chrysotile asbestos and gold were observed in small uneconomic quantities. Platinum and osmiridium probably occur but were not noted.

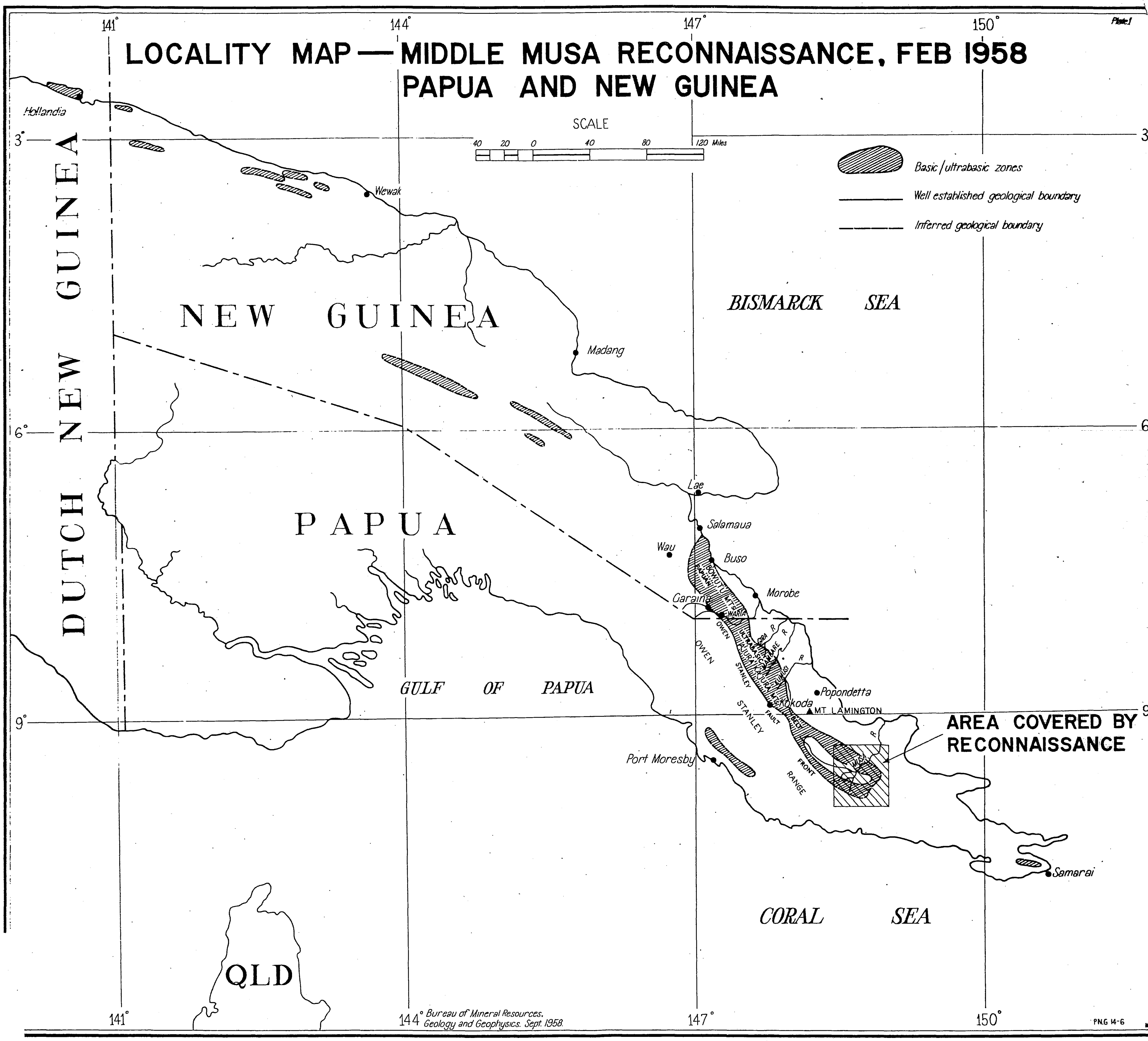
4. No other economic minerals were seen in the area.

5. The Musa River is a potential source of large scale, cheap hydroelectric power which, if not used locally for treatment of nickel silicate ore, could serve to attract heavy industry to the natural harbours of Oro Bay or Abau.

ACKNOWLEDGMENT

The practical assistance and the good company of prospector K.Shelley during part of the survey were greatly appreciated.

LOCALITY MAP — MIDDLE MUSA RECONNAISSANCE, FEB 1958
PAPUA AND NEW GUINEA



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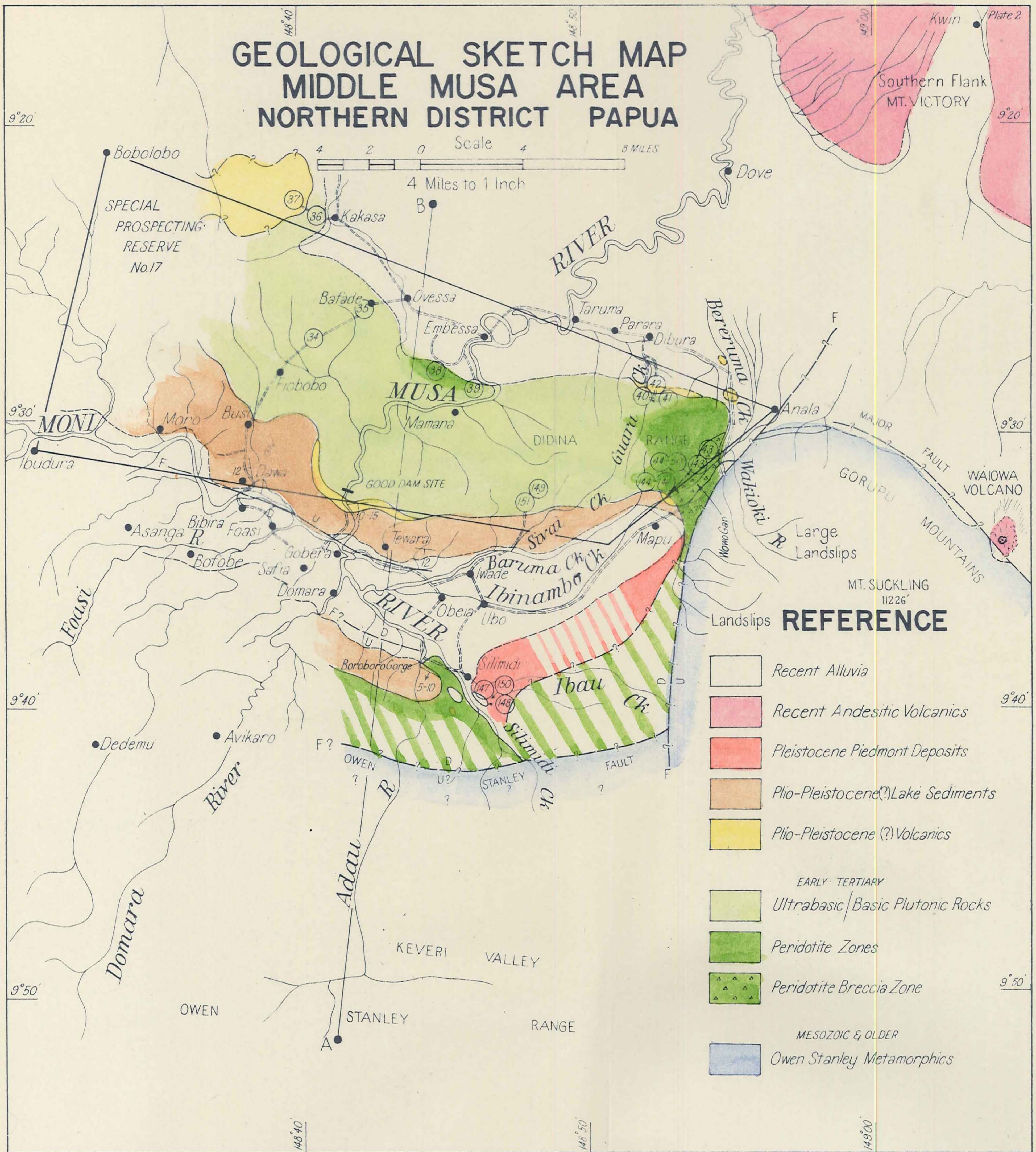
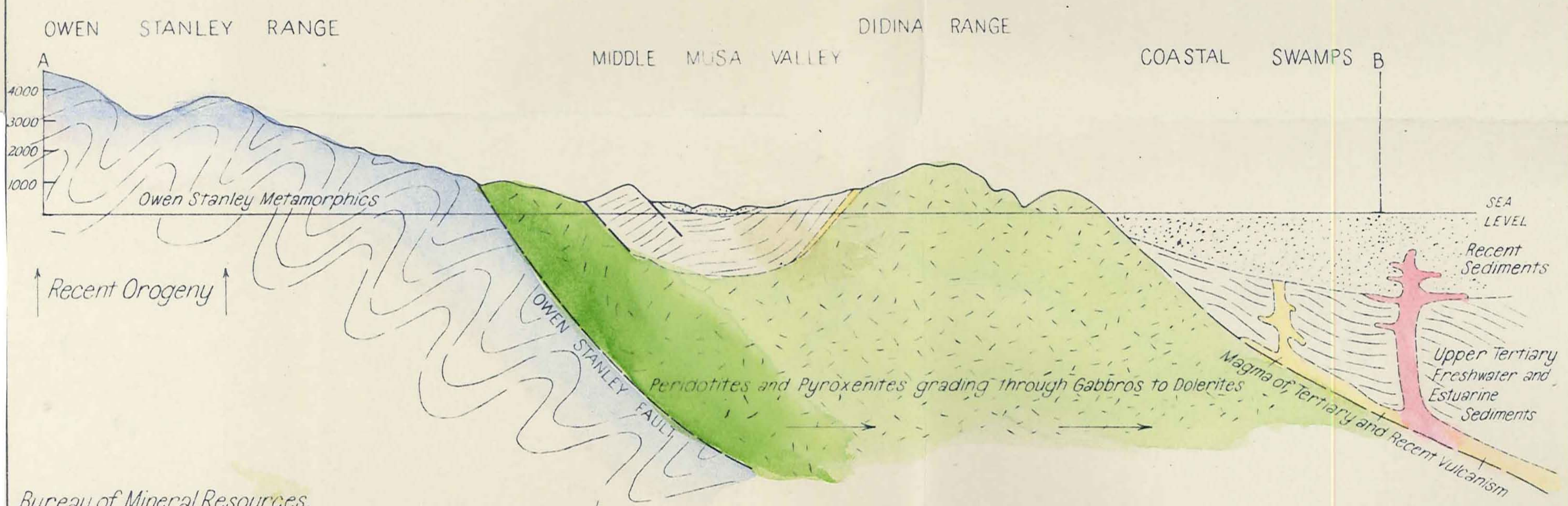
REDUCE AB 18" TO AC 12"



DIAGRAMMATIC SECTION

Vertical Scale: 1 Inch to 5000 Feet



Bureau of Mineral Resources, Geology and Geophysics. Sept. 1958.

P.N.G. 14-7

V.C.