DESCRIPTION OF THE MOUNT SKUKUM VOLCANIC COMPLEX, SOUTHERN YUKON

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INTRODUCTION

Tectonic Setting

Tectonically, the Yukon is subdivided into two parts: on the northeast, a suite of rocks representing an ancient North American continent (Interior Platform, and Mackenzie and Rocky Mountain Belts), and on the southwest, an allocthonous block accreted to the ancient North American continent (Intermontane Belt, Fig. 1). After accretion of the Intermontane Belt during the Mesozoic (Monger and Price, 1979; Tempelman-Kluit, 1979), a late Cretaceous northeastward subduction of oceanic lithosphere is thought to have been initiated on the southwest side of the newly accreted block. This produced a southwest facing magmatic arc on the newly accreted fragment. This arc is now represented by the Coast Plutonic Belt (Tempelman-Kluit, 1979), which comprises the Kluane schist, a biotite schist of high temperature, low pressure type, intruded and metamorphosed by the Ruby Range Batholith. It is in this belt that the Early Tertiary Mount Skukum Volcanic Complex (MSVC) occurs, along with many other Upper Cretaceous (Grond et al., 1984) and Early Tertiary volcanic complexes (Sloko volcanic province).

DISTRIBUTION OF THE SLOKO VOLCANIC ROCKS

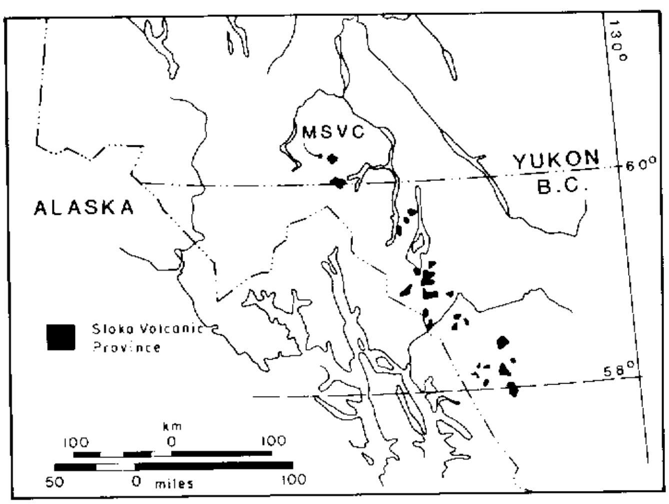


Figure 1. Distribution of Sloko volcanic rocks and location of the Mount Skukum volcanic complex.

The model in which plutonism and volcanism resulted from subduction (Tempelman-Kluit, 1979; Ewing, 1980) has recently been challenged by Gabrielse (1984) who suggests that the emplacement of plutons reflects a regional change in stress. An early stress system producing the characteristic Cordilleran compressional structural trends changed to one producing northwest-striking right lateral strike slip faults and related tensional strain.

Regional Setting

The Mount Skukum Volcanic Complex (MSVC) is about 58 km south-southwest of Whitehorse. It is the northernmost extension of the Sloko volcanic province in western British Columbia, a broad northwest-trending volcanic belt along the northeast margin of the Coast Plutonic Belt (Fig. 1). Rocks of the Sloko volcanic province are preserved as downfaulted blocks and as erosional remnants on higher upland surfaces (Souther, 1967 and 1970). They comprise an assemblage of intermediate to felsic volcanic rocks and derived sedimentary rocks that lie unconformably on Cretaceous granitic rocks, folded Jurassic rocks and Precambrian (?) metasedimentary rocks.

The MSVC is Paleocene-Eocene in age, and elliptical in plan; it covers an area of about 140 km². It is a downfaulted volcanic block, deposited on Cretaceous granitic rocks of the Ruby Range Batholith and older metasedimentary rocks of the Yukon Group (Fig. 2). At least four volcanic outliers occur within a 16 km radius north and west of the complex, and seem to be associated with the Skukum volcanism. The complex is surrounded peripherally by several high-level rhyolite intrusions, which have recently been dated at 53 ± 1.1 Ma using rubidium-strontium geochronology (Pride and Clark, 1985). The Bennett Lake cauldron complex, studied intensively by Lambert (1974), is about 26 km south of the MSVC.

STRATIGRAPHY

The MSVC (Fig. 3), has a maximum vertical thickness of 850 m. It includes: 1) a downfaulted part of an andesitic stratavolcano which forms the western and southern parts of the complex and comprises the distal and medial facies assemblage of Formations 1 and 2, and the more proximal facies assemblage of Formation 3

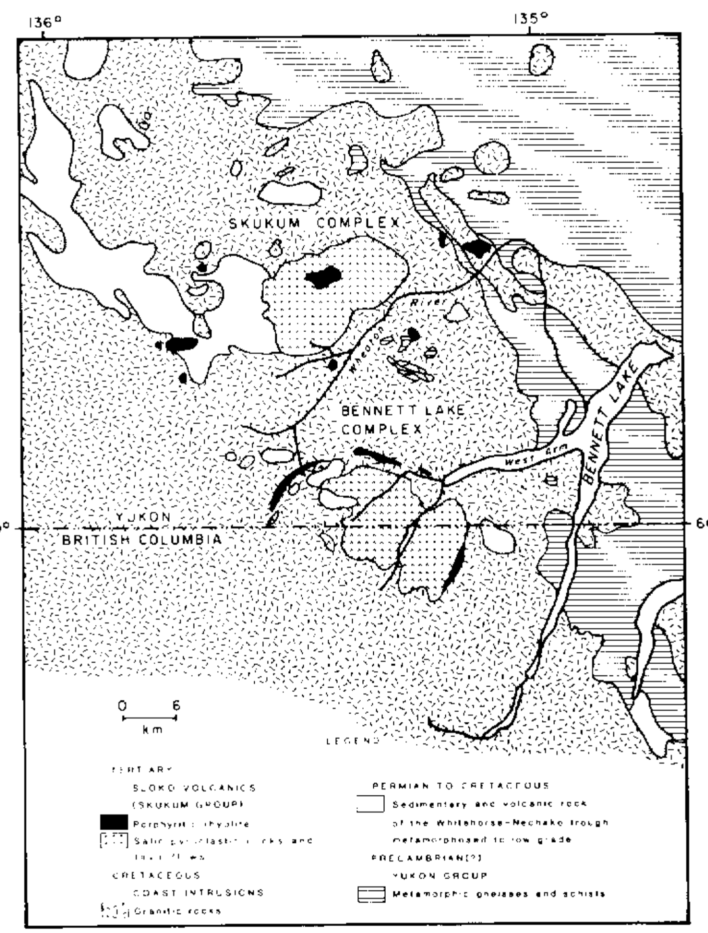
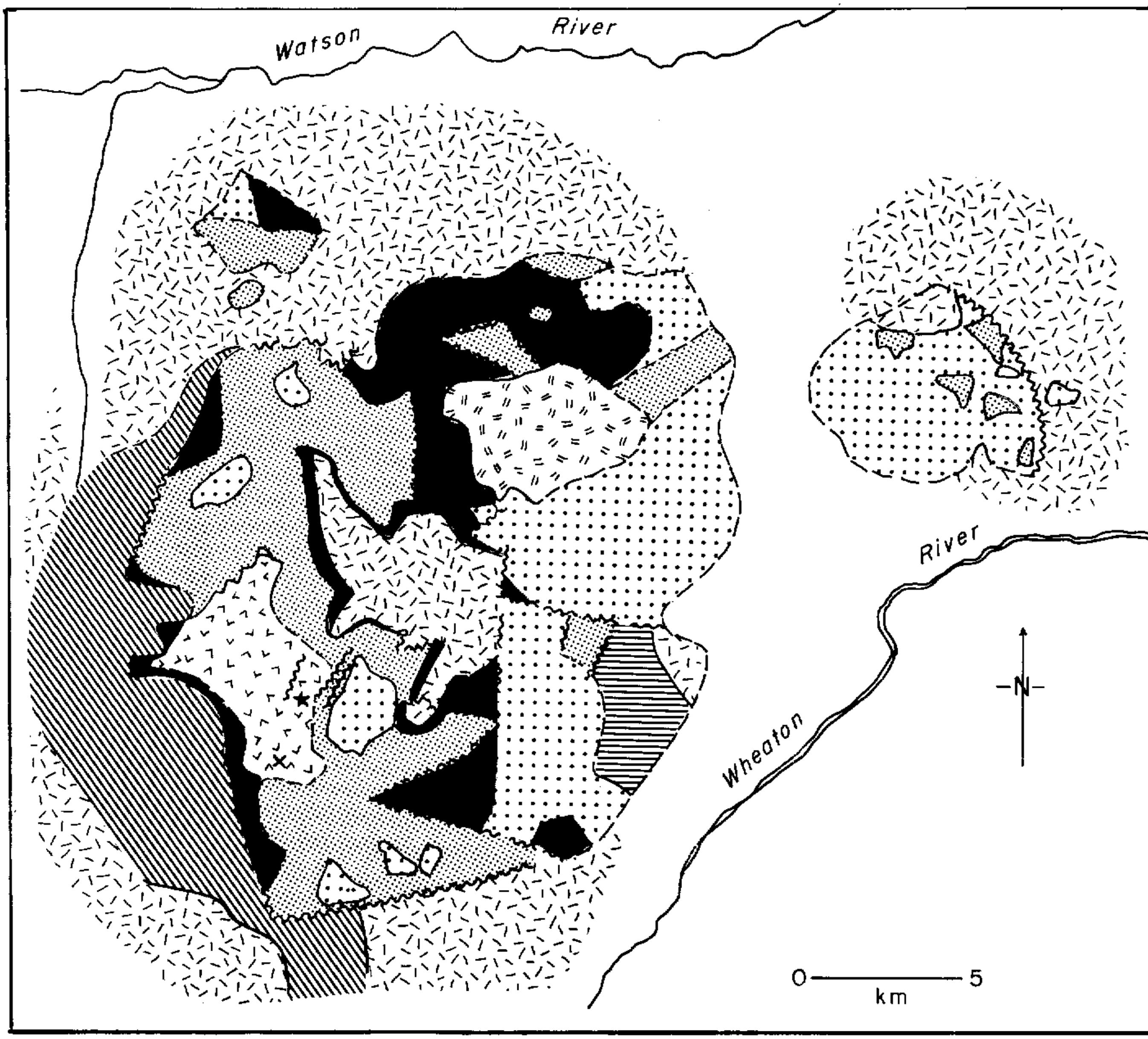


Figure 2. Regional setting of the Mount Skukum volcanic complex.



TERTIARY

Porphyritic rhyolite

SLOKO VOLCANICS
(SKUKUM GROUP)

FORMATION 5

Andesitic breccias and flows

FORMATION 4

Felsic volcanics

FORMATION 3

Interlayered andesitic lava flows and epiclastic rocks with minor pyroclastic rocks

FORMATIONS 1&2

Nonvolcanic coarse alluvial deposits (1), interlayered epiclastic-volcanic sequence (2)

CRETACEOUS

Coast Intrusions
Granitic rocks

LOWER JURASSIC & LATER

Laberge group
Conglomerate and siltstone

PRECAMBRIAN AND LATER

Yukon group
Metamorphic gneisses and schists

X MT SKUKUM

★ Approximate mineralized area

Faults

Figure 3. Simplified geological map of the Mount Skukum volcanic complex.

(Fig. 3); 2) a small felsic cauldron subsidence structure in the northeast corner of the area represented by the felsic cauldron-fill deposits of Formation 4; 3) an andesitic vent facies environment located in a small area in the midwestern part of the complex and comprising the deposits of Formation 5; and 4) a central quartz-feldspar-phyric rhyolite intrusion along the western boundary of the small felsic cauldron.

The MSVC can be subdivided into four formations based on lithology and major unconformities. The following paragraphs briefly summarize the stratigraphy and interpretation of each of the four formations. More detailed stratigraphic and petrographic information are presented in Table 1.

Formation 1

Outcrops of Formation 1 form many discontinuous exposures that lie unconformably on basement rocks in the west and south parts of the complex. Formation 1 comprises 5 to 100 m thick sequences of coarse alluvial deposits composed entirely of basement fragments. Three facies types can be recognized and coincide reasonably well with Miall's (1978) and Rust's (1978) lithofacies types for coarse alluvial deposits (Figs. 4, 5 a,b,c,d): 1) clast supported boulder to cobble conglomerates, that are sometimes normally graded, imbricated and may contain plant fragments at the base of the beds, equivalent to Miall's (1978) GM lithofacies type; and 3) well sorted sandstones that may be planar crossbedded or massive and may contain plant fossils, equivalent to Miall's Sh and Sp lithofacies type. The stratigraphic section is typical of part of an alluvial plain or braided stream. These deposits can only be distinguished on the basis of extent and paleocurrent data (Rust, 1984), both of which are lacking in the MSVC. However, according to Rust (1984), the presence of debris flow deposits indicates that the sequence is more probably an alluvial fan deposit. Most other exposures of this formation are reasonably thin and usually comprise only one lithofacies type, as opposed to the thick stratigraphic section just described.

Two factors control the deposition of coarse alluvial deposits (Rust, 1984): 1) intracratonic faulting that produces sharp terrestrial relief required for accumulation of the coarse alluvial deposits, and 2) climatic extremes that affect the nature of deposition; e.g., the production of large lithic fragments is maximized on steep slopes and in semi-arid or paraglacial/alpine settings. According to Frakes (1979), and Wolfe and Poors (1982), the climate during late Paleocene and Eocene was subtropical, and therefore intracratonic faulting was probably the controlling factor in the deposition of the coarse alluvial deposits.

Formation 2

Formation 2 is restricted to the west and the south parts of the complex and has a maximum thickness of 300 m. This Formation lies unconformably on basement and conformably on Formation 1. The boundary between Formation 1 and 2 is marked by the presence of volcanic material in Formation 2. Formation 2 was described in Pride (1984) and will only be briefly described in this report.

As a result of more extensive mapping, the members of Formation 2 have been revised to provide a more representative description of the rock types within the entire complex (Table 2). Lithologically, Formation 2 is the most diverse formation in the MSVC consisting of a series of interbedded volcanic and epiclastic deposits that, with the exception of members 4 and 5, have limited lateral extent. The diversity is also reflected by clast type variability. The clast types include essential (glass shards and pumice), accessory (andesite and rhyolite), and accidental fragments (granitic and metasedimentary rocks).

Analysis of structures and lithology indicate the presence of several depositional environments: 1) structures such as channels and crossbedding in moderately- to well-sorted sandstones and siltstones indicates a fluvial environment (Fig. 6); 2) carbonaceous, laminated to bedded fine sandstone and siltstone, with limited lateral extent and abundant plant fossils suggests swamp deposits; and 3) welded felsic pyroclastic flow deposits (Fig. 7), minor andesitic lava flows and tuffaceous beds containing accretionary lapilli and reasonably intact glass shards and pumice, represent primary volcanic deposits. There is a clear distinction between sedimentary and primary volcanic deposits, but there is a continuum of rock types between these two end members which are not clearly distinguishable in terms of their environment. A large portion of Formation 2 belongs to this continuum, and the problem of its classification has not yet been resolved. However, the fact that the formation contains a greater proportion of fluvial to primary volcanic deposits, and that the volcanic deposits contain units that are considered more distal suggests that deposition occurred in amedial to distal volcanic facies (Vessel and Davies, 1981). The diversity of lithology may also indicate an interfingering of facies environments from different volcanic centers located at various distances from the MSVC.

Three lines of evidence suggest that faulting occurred prior to and during volcanism: 1) accumulation of coarse alluvial deposits of Formation 1 indicates faulting prior to volcanism; 2) the paleotopographic reconstruction, using a densely-welded flow as a marker horizon, showed that the paleotopography was in part controlled by fault blocks (Pride, 1984); and 3) contemporaneous faults were observed in Formation 2.

The diversity of rock types was probably caused by: 1) concomittant felsic and andesitic volcanism at different volcanic centers, possibly at various distances away from the MSVC, 2) the effect of volcanism on distally deposited epiclastic rocks; the amount of sediment introduced by volcanic activity would have a major effect on fluvial deposition, and 3) the effect on the deposits of the faulted paleotopography which developed prior to and during the volcanism; this faulting would limit lateral continuity of units and would cause changes in grain size that would not be related to the volcanic center.

Formation 3

Formation 3 represents the upper part of a collapsed stratavolcano and is confined to the west and south parts of the complex. Formations 1 and 2 make up the lower part of this stratavolcano. Formation 3 is a gently-dipping sequence of interlayered lava flows and epiclastic rocks that overlies the interlayered epiclastic volcanic sequence of Formation 2. Large isolated fault blocks and slump blocks of Formation 3 also occur in the eastern part of the complex. The boundary between Formation 2 and 3 is marked by the presence of lava flows in Formation 3 and of a welded pyroclastic flow in Formation 2.

The lava flows are mainly andesitic in composition; they range in thickness from 1 to 10 m, are relatively continuous laterally, and can be traced for about 1 km. The flows occur in very broad shallow channels, indicating deposition on a relatively level topography (Fig. 8). The lava flows are morphologically similar to andesitic lava flows elsewhere (Fig. 9, Macdonald, 1972). The base is generally brecciated, although thin hyaloclastic zones form the base of some flows and others are unbrecciated. The flow interior is massive and locally columnar jointed. Vesicularity commonly increases towards the top of the flow, which is usually brecciated; the clasts in the upper breccia are highly vesicular, and void spaces between the vesicular fragments are commonly filled with bedded fine grained pyroclastic and epiclastic material. Distinct changes in phenocryst morphology, type, and abundance occur in the flow sequence indicating a changing magma reservoir.

The epiclastic rocks include laminated to bedded siltstone and sandstone in graded to massive beds that locally contain plant fossils and matrix- to clast-supported conglomerate. These epiclastic rocks mark periods of quiescence. The source area of these epiclastic units was almost exclusively andesite.

Subvertical beds in the lower part of the formation in the west part of the complex that are capped by gently-dipping beds is evidence of an early structural event (Fig. 8). The presence of lava flows suggests a proximal volcanic environment, in which sedimentary rocks derived from an andesitic provenance accumulated during periods of quiescence. The relatively continuous nature of the epiclastic units and lava flows suggest deposition on relatively level topography, after the early collapse event.

Formation 4

The bulk of Formation 4 is a sequence of interlayered, brecciated, flow banded and spherulitic felsic lava flows, pyroclastic rocks that are locally highly altered, and minor felsic epiclastic rocks. These felsic volcanic units form a thick sequence in the northeastern part of the complex which have been downfaulted at least 500 m on the eastern fault contact and about 300 m on the western fault contact. The east and west contacts are well exposed,

TABLE I

Summary of the Stratigraphic and Petrographic Interpretation of the 5 Formations in the MSVC.

FORMATION	THICKNESS MAX (m)	AVERAGE COMPOSITION	DOMINANT ROCK TYPE	MINOR ROCK TYPE	% PYROCLASTICS	% LAVA FLOWS	% EPICLASTICS	LATERAL CONTINUITY	LOWER CONTACT	FACIES AND DEPOSITIONAL ANALYSIS	ENVIRONMENTAL INDICATORS	COMMENTS
5	~400	Intermediate	Heterolithic breccia, monolithic breccia, lava flows and columnar jointed sills.	Tuff and lapilli-tuff, sandstone.	50	15	35(?)	Moderate to poor	Unconformity	Heterolithic pyroclastic and debris flows with laterally equivalent andesitic lava flows. Both are unconformably overlain by ~200 m of coarse monolithic andesitic explosion breccia, debris flows and slump breccias which are, in turn intruded by a series of columnar jointed sills. Sequence represents a vent facies environment.	· Preservation of an ancient crater wall; —extreme propylitic alteration; —poorly bedded monolithic breccia; —ballistic fragments in fine tuffs (possible surge deposit); —coarseness of breccia; numerous intrusions all suggest vent facies environment.	Compared to Fm2, lava flows, intrusions and monolithic breccias are relatively monolithic, and therefore reflect little change in the magma reservoir. Monolithic implies that there is little compositional change throughout the sequence.
4	500	Felsic	Block, and lapilli tuff, flow banded, spherulitic and brecciated lava flows and intrusions.	Coarse conglomerates and breccias and sandstones.	35	60	5	Moderate	Unconformable	A sequence of felsic pyroclastic flows, lava flows and intrusions confined in a small down-faulted area (~300 m) define a cauldron subsidence structure. Intrusions, and flows lying unconformably on Formation 2 also occur outside the cauldron. Provenance area is strictly volcanic (felsic and altered andesite (?)).	Giant slump blocks on the eastern contact suggest slumping of a caldera wall during subsidence. Abundant flow -banded, spherulitic and brecciated lava flows or intrusions may indicate extensive dome and/or flow development.	Because the Skukum rhyolites in the down-faulted area are poorly exposed and partially eroded, their original form and internal variation were not obtainable. However, the fact that generally viscous rhyolites form domes or short stubby flows (Walker, 1973) limits the interpretation of the Skukum rhyolites to the latter two possibilities. Care should be taken in this interpretation as high alkali content and fluorine in the rhyolites would significantly lower the viscosity of the melt, and would change the morphological sections of the associated flows.
3	450	Intermediate	Andesitic lava flows, poorly sorted coarse conglomerates and sandstone.	Lapilli-tuff and tuff.	30-60	65-35	5	Good	Gradational	Interlayered lava flows, debris flows, fluvial sediments and possible cone deposits indicate a proximal volcanic facies environment source area that was largely volcanic (mostly andesite).	Shallow broad channels and relatively continuous flows indicate that deposition took place on a relatively level topography. Subvertical beds in the lower part of the formation indicate an early subsidence event.	The lava flows in this formation show phenocryst size, type, shape and percentage variability throughout the stratigraphic sections. This suggests a changing magma reservoir.
2	~400	Felsic	Felsic lapilli and block tuffs, and clast and matrix supported coarse conglomerates.	Sandstones, siltstones and tuffs.	~60	—	~40	Poor	Gradational with Fm1 and unconformable with basement	Interlayered volcanic (felsic pyroclastic flows - welded to nonwelded, airfall and surge deposits) and sedimentary (fluvial, lacustrine deposits) clast types indicate concomitant felsic and intermediate volcanism as well as exposed basement in the provenance area.	Structures such as channels and ripples in sandstones and siltstones suggest fluvial deposition; dark black, carbonaceous thinly laminated mudstones with limited lateral extent and abundant plant fossils suggest swamp deposits; the combination of these units suggest medial to distal volcanic environment. Welded to non-welded pyroclastic flows, and accretionary lapilli in thin tuff beds suggest a nearby volcanic center. Some sections show contemporaneous faulting.	It is possible that these deposits were associated with more than one volcanic center which may have been located at various distances away from the MSVC. This hypothesis would explain the variability in lithology and clast type.
1	~100	—	Clast and matrix supported pebble-boulder conglomerates and sandstones.	Mudstones and siltstones.	—	—	100	Poor	Unconformity	Interbedded debris flows, coarse clast-supported conglomerates, and sandstones represent an alluvial fan, proximal braided stream, or proximal alluvial plain depositional environment. Coarse alluvial deposits indicate faulting and uplift. Provenance area is strictly non-volcanic (granitic and metasedimentary).	Debris flows (Gms), normally graded to massive beds, imbricated clast supported coarse conglomerates (Gm) and planar crossbedded and massive sandstone (Sp, Sh) suggest alluvial fan deposit. Plant fossils indicate terrestrial origin (Gms, Gm and Sp, Sh are abbreviations of lithofacies types from Miall (1978)).	

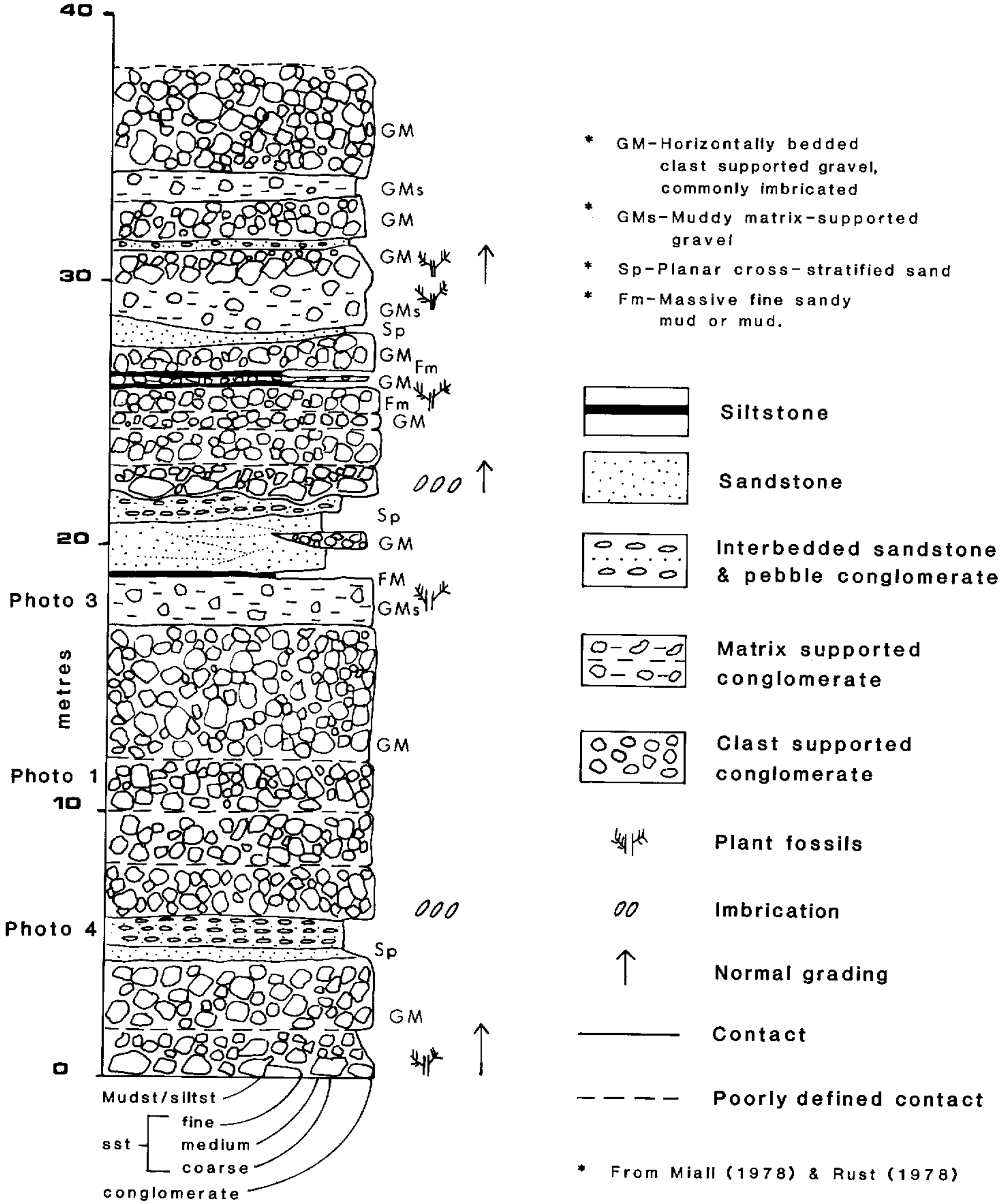


Figure 4. A stratigraphic section of part of Formation 1.

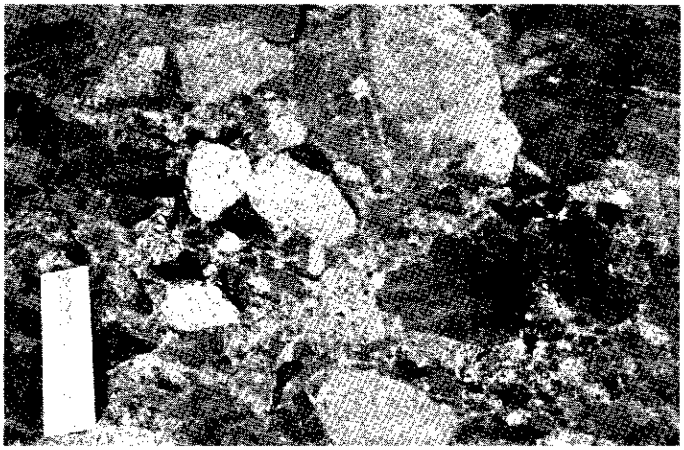


Figure 5. Coarse alluvial clastic rocks:

a) Clast supported conglomerate, from Formation 1, composed entirely of granitic and metasedimentary clasts (scale = 15 cm);

c) Matrix supported conglomerate, the matrix is carbonaceous and is composed of clay to sand size particles. Clast type includes granite and metasedimentary rocks (Formation 1);

b) Carbonized plant imprints in a sandstone bed, Formation 1;

d) Interbedded sandstone and pebble conglomerate (Formation 1).

near vertical faults. Altered felsic volcanic rocks are found along the eastern fault contact and are mixed with giant andesite and conglomerate slump blocks. Steeply east-dipping felsic volcanic units occur in the west half of the downfaulted area (Fig. 10). Other felsic pyroclastic intrusions and flows, and flowbanded, brecciated and spherulitic intrusions and lava flows that occur outside the downfaulted felsic area and lie unconformably on Formation 3 have been correlated with Formation 4.

Most of Formation 4 appears to fill a cauldron subsidence structure. This conclusion is supported by: 1) the occurrence of the bulk of the felsic volcanic rocks in a downfaulted block that has been downdropped at least 300 m; 2) the lithology which is mainly felsic pyroclastic flows, and intrusions that, at one time, may have represented parts of domes, and 3) giant slump blocks that occur along one of the faults suggesting slumping of a caldera wall.

Formation 5

Formation 5 unconformably overlies Formation 1, 2, 3 and 4, within a 4 x 1.5 km area in the west-central part of the complex. It is divisible into three members: a hetrolithic breccia, a sequence of andesitic lava flows and minor pyroclastic flows, and monolithic breccias that are spatially associated with columnar-jointed, andesitic intrusions (Fig. 11). The time relationship between flow and heterolithic breccia member is unclear, as they are not found in contact with each other.

Heterolithic breccia is about 120 m thick and is confined to the western half of the area where it unconformably overlies Formations 1, 2, 3, and 4. The breccia is poorly sorted and contains angular to subangular cobble- to pebble-size clasts that are primarily accessory andesite, although minor essential clasts appear to be present (Fig. 12). The matrix is composed of sand-size particles that are accessory andesite. The breccia forms 5 to 10 m thick beds that probably represent a sequence of debris flows that have accumulated in a reasonably steep-sided valley (Fig. 13).

In the eastern half of the area, the heterolithic breccia is absent, and instead, Formation 3 is overlain by a series of interlayered andesitic lava flows and minor pyroclastic rocks. The lava flows are compositionally distinct from those of Formation 3, and have a high degree of propylitic alteration. Figure 14 shows a sequence of horizontal lava flows in which a crater-like depression developed; the crater was later filled by monolithic breccia.

The heterolithic breccia and flow members are, in turn, overlain by a thick (approximately 200 m) sequence of monolithic breccia composed largely of nonvesicular clasts. The breccia is generally poorly bedded, but differs in clast size, shape, and percentage, from place to place, reflecting different types of deposits - explosion breccia (Fig. 15a), and debris flow breccia (Fig. 15b). The explosion breccia sometimes occurs in single unstratified nongraded beds that do not exceed a few meters in thickness, may be interbedded with debris flow breccias, or a fine-bedded sequence of primary volcanic deposits (surge, airfall, or pyroclastic flow). The explosion breccia is clast supported with subangular to angular clasts. These breccias seem to correspond to those explosion breccias described by Self (1982). The debris flow breccias are typically matrix supported with subrounded to rounded clasts. A complete description of the groundmass characteristics of the breccias is presently underway and therefore a complete interpretation of the breccias is not possible at this time. It seems likely that

TABLE II

Comparison of subdivision of Fm2 used in Pride (1984) to a revised subdivision based on rock types of the entire complex.

Members	SUBDIVISIONS OF Fm2 USED IN PRIDE (1984)	REVISED SUBDIVISION OF FORMATION 2
7	Planar bedded tuff and conglomerate, reversely graded in part.	These two members are only found locally in the central part of the complex.
6	Interbedded siltstone and sandstone.	
5	Densely to moderately welded felsic pyroclastic flow.	These two members almost always occur together. Member 5 appears to be much more extensive than initially thought.
4	Clast supported conglomerate.	
3	Heterolithic debris and/or pyroclastic flows.	These members are much thicker in the south and have been grouped into one member that is dominantly composed of felsic volcanic and associated epiclastic rocks; heterolithic debris flows, felsic pyroclastic flows, tuffs, sandstone, siltstone and conglomerates and minor lava flows.
2	Interbedded siltstone and sandstone.	
1	Monolithic debris flows.	Equivalent to Formation 1.

Figure 6. Well developed channels in the lower part of Formation 2. These deposits indicate fluvial deposition.

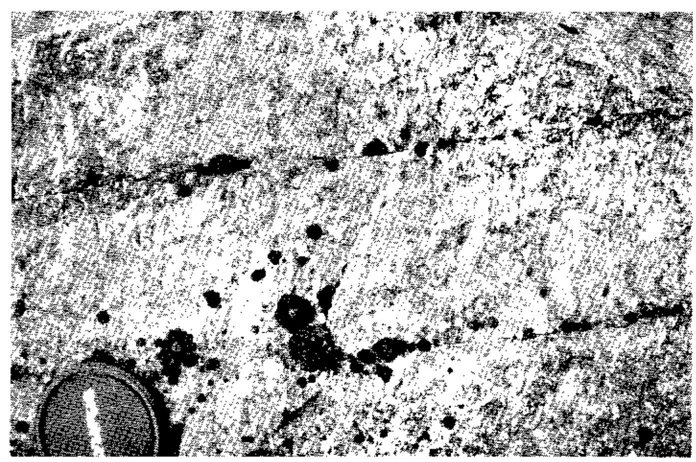


Figure 7. A densely welded flow in Formation 2 indicating a primary volcanic deposit.

the variation in breccias is much larger than the two just mentioned. The breccias have intense propylitic alteration, and in places the matrix is composed of hematite, jasper or a siliceous material. The lower and upper parts of the member contain well-bedded sequences of tuff and lapilli tuff, one of which represents a surge deposit (Fig. 16a,b). This member is intruded by a series of pod-like, columnar-jointed andesitic sills and dykes which vary greatly in size and shape (Figs. 11 and 17).

The great thickness of poorly-bedded coarse-grained breccias, the presence of ballistic fragments in surge deposits, evidence of a crater, and the presence of numerous intrusions support the idea that this formation represents a vent facies environment.

STRUCTURE

The MSVC is a fault bounded, elliptical area of volcanic rock which contains a smaller subsidence structure in its eastern half. The area is downfaulted into Cretaceous and Precambrian basement rocks. There is no clear evidence for cause of the major subsidence of the MSVC, it may have resulted from regional stresses, volcanic activity, volcanic loading, or a combination of all three. It probably was related at least in part to the volcanism. The small felsic cauldron subsidence structure is a volcanic feature and the coincidence of vent facies and subsidence suggest a volcanic origin. However, regional stresses may have contributed also to subsidence. For example, the accumulation of the non-volcanic, coarse alluvial deposits of Formation 1 suggest that intracratonic faults occurred prior to volcanism. Also, the style of faults is not consistent around the complex: 1) the northern fault is a series of small discontinuous faults that have no consistent trends and are vertical to steeply dipping. The volcanic rocks at the faults are steeply to moderately dipping. 2) The western contact appears to be a moderately-dipping reverse fault. The volcanic rocks are tilted to subvertical at the fault. 3) The southern contact is a straight, continuous vertical fault, that is partly intruded by rhyolite dykes. 4) The eastern contact is sharp and near vertical and marks the wall of the small caldera of Formation 4. It therefore seems likely that downfaulting was not related to single caldera collapse, but rather to a series of different volcanic events, perhaps controlled in part by regional stress.

A NNE-trending fracture system is the dominant, and perhaps the latest structural feature in the MSVC (Fig. 18). It is variably developed throughout the MSVC, controls the trends of some dykes and is the host fracture system for the quartz-calcite precious metal veins near Mt. Skukum.

MINERALIZATION

The star in Figure 2 marks the approximate location of the mineralized area. Economic epigenetic gold veins (V-2) are found

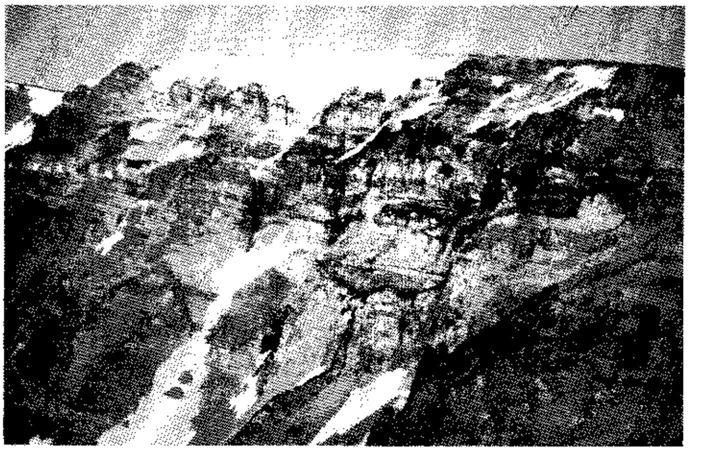


Figure 8. A cliff exposure of Formation 3, located in the mid-western part of the complex. Note the subvertical beds and vertical clastic dykes in the lower part of the section, this suggests an early subsidence event. The upper part of the section comprises a reasonably continuous sequence of interlayered lava flows and epiclastic rocks deposited in broad shallow channels.

in three major subparallel NNE-trending fault zones. The veins consist of quartz and calcite and are unusual in that they contain no sulphides and have poorly developed wall rock alteration. As of February 1984, the average grade was 27 g/t (0.8 oz/ton) gold and 22.63 g/t (0.66 oz/ton) silver, with proven reserves of 149,114 tonnes (164,222 tons). Major features in, and associated with the mineralized area are listed below:

1). Two very different vein types are present: 1) early V-1 veins that are restricted to Formation 4, are less than 4 cm wide, are composed of a blue green siliceous material, commonly fill void spaces in breccias, and are not gold bearing, and; 2) late V-2 veins that are restricted almost entirely to the flow member of Formation 5 near Mt. Skukum, are centimetres to metres wide, consist of a medium to coarse grained quartz and calcite assemblage, textures range from massive to brecciated, occur along the NNE-trending fracture system, cross-cut the V-1 veins and are gold bearing. NNE-trending V-2-like veins occur away from Mt. Skukum, but are not gold bearing, are thinner, and may contain gypsum.
2). Hematite and jasper veins are concentrated near Mt. Skukum (Fig. 19).
3). A pyrite halo occurs around the main mineralized area.
4). Andesites in the mineralized zone have a higher degree of propylitic alteration than andesites farther from the mineralized zone.
5). Many felsic flows and domes occur near the mineralized area (Fig. 20).
6). Faults and brecciated to nonbrecciated dykes are more abundant near the mineralized area (Fig. 20).
7). A leached solfataric cap suggests the presence of a hydrothermal vent (Fig. 20).
8). The mineralized veins occur in Formation 4, the vent facies environment (Fig. 20).

All these factors suggest that the mineralization was spatially associated with a volcanic vent. The presence of V-1 veins, jasper and hematite, the pyrite halo, the extensive propylitic alteration and the hydrothermal vent, suggests that there may have been several phases of hydrothermal activity, the last of which produced the gold mineralization near Mt. Skukum. Both felsic and andesitic volcanism or even an unknown agent at depth may have been the heat source for the hydrothermal systems.

MODEL FOR THE EVOLUTION OF THE MOUNT SKUKUM VOLCANIC COMPLEX

1). Early faulting produced intracratonic uplift, and resulted in deposition of the coarse alluvial deposits of Formation 1.
2). Felsic and andesitic volcanism was initiated in the Skukum area and felsic vents may be represented by the peripheral rhyolite plugs. Interfingering of the different facies of individual volcanic centers may have resulted in the distal to medial volcanic deposits of Formation 2. Variability in the clast type indicates that basement was exposed during felsic and andesitic volcanism.

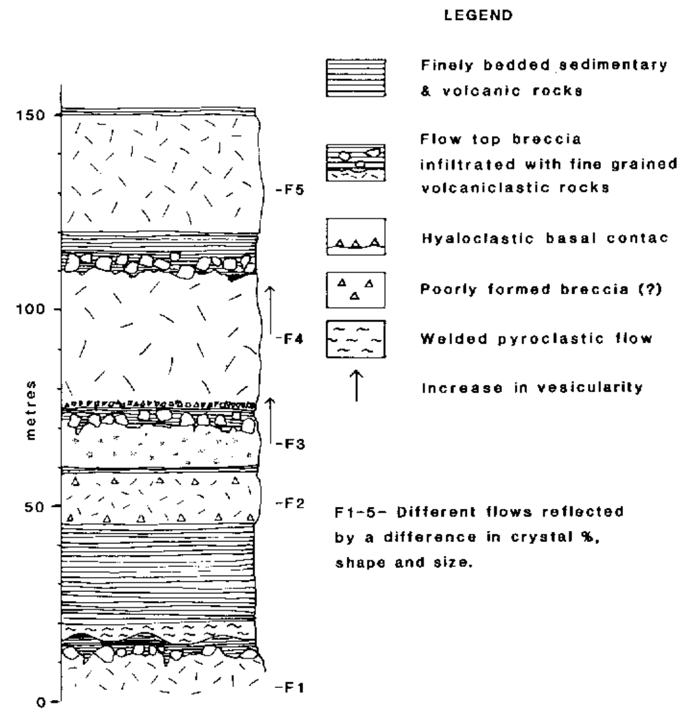


Figure 9. Stratigraphic section of part of Formation 3.

Figure 10. A photograph, looking north at the small felsic cauldron subsidence structure located in the northeast corner of the complex. The felsic beds on the western side of the cauldron dip steeply to the northeast.

3). Faulting continued throughout this time.
4). The topography was gradually infilled by deposition of volcanic units and the densely welded pyroclastic flow of Formation 2 filled most of the remaining depressions.
5). Andesitic lava flows of Formation 3 were erupted intermittently from a nearby vent or vents; periods of quiescence are marked by interbedded epiclastic rocks. Early subsidence in the western part of the complex is defined by the vertical beds in the lower part of the sequence, but the upper sequence which comprises a series of relatively continuous lava flows interbedded with epiclastic rocks was deposited on relatively level topography. The volcanic sequence may have subsided along the southern and western fault contact at any time after the deposition of Formation 3.
6). The deposition of Formation 3 was followed by a period of nondeposition and erosion.

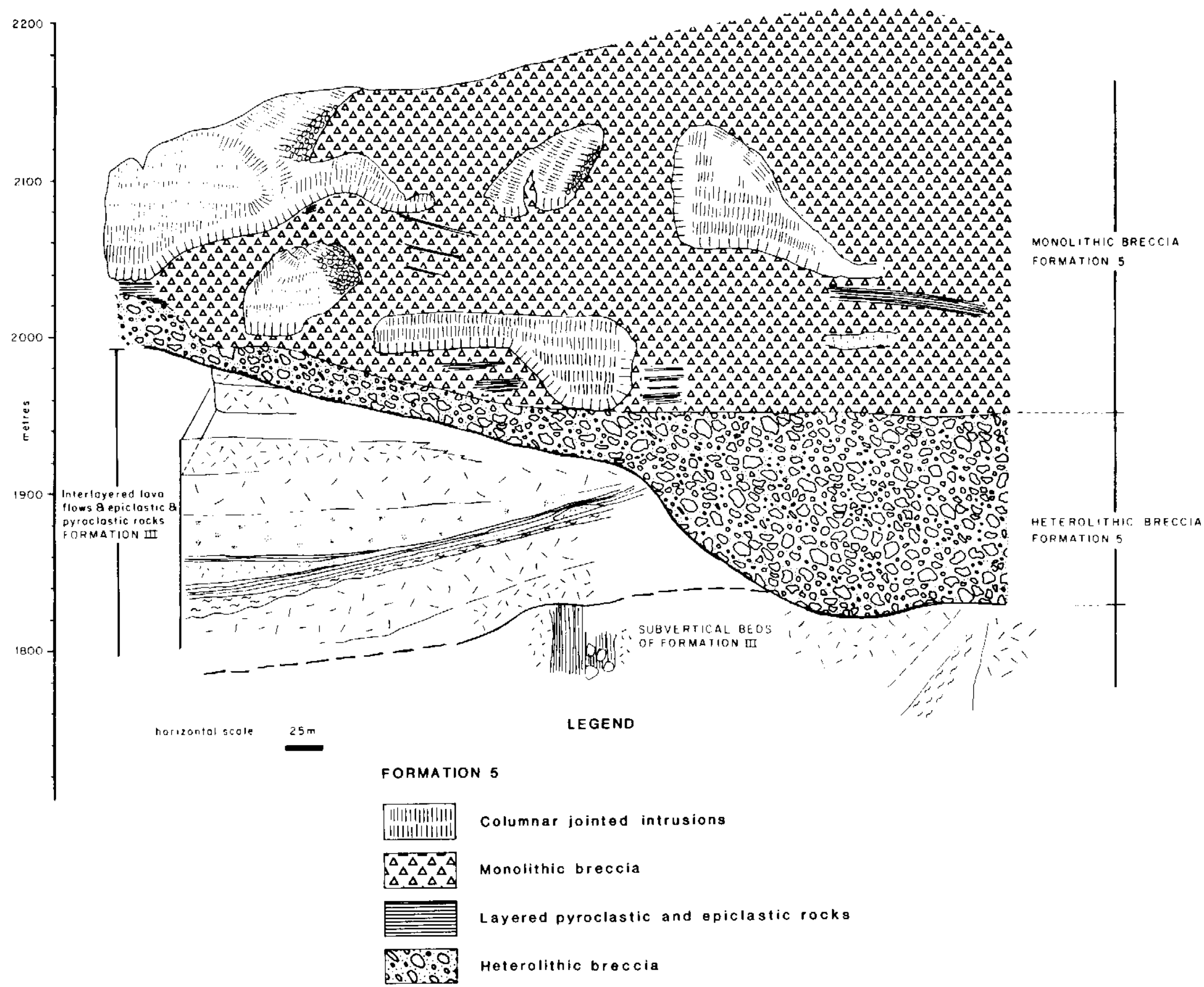


Figure 11. Sketch of a section of two members of Formation 5 northwest of Mt. Skukum.

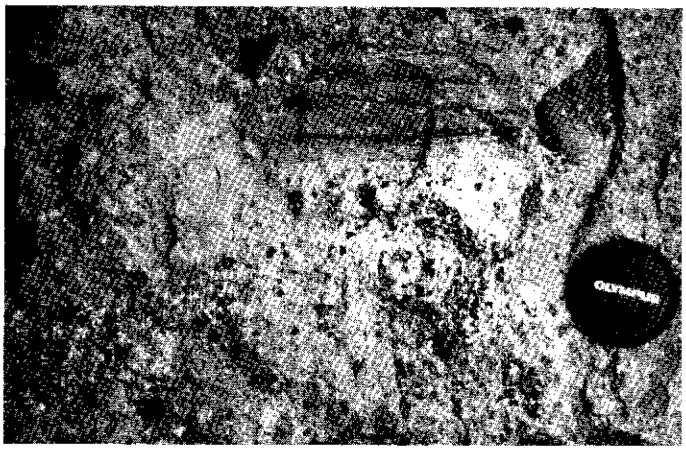


Figure 12. Photograph of a typical heterolithic breccia. The breccia is poorly sorted and contains angular to subangular andesitic clasts which are less than 25 cm in size.

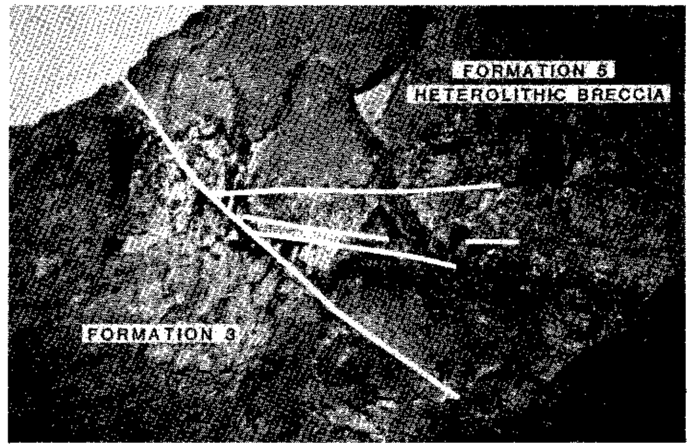


Figure 13. An exposure showing the heterolithic breccia of Formation 5, unconformably overlying Formation 3. The contact marks the outline of a valley which has been filled with a series of beds of heterolithic breccia.

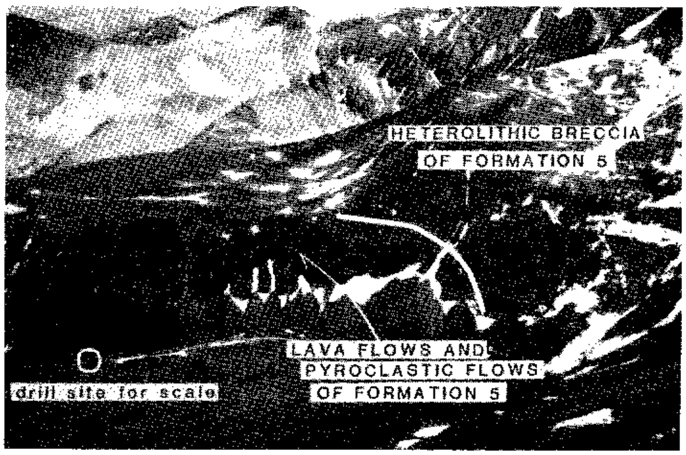


Figure 14. This photograph shows the massive dark bands of near horizontal andesitic lava flows of Formation 5. On the right hand side of the photograph, the lava flows have slumped into a crater-like depression, the crater is now filled with a 200 m thick sequence of poorly bedded monolithic breccia.

(a)

(b)

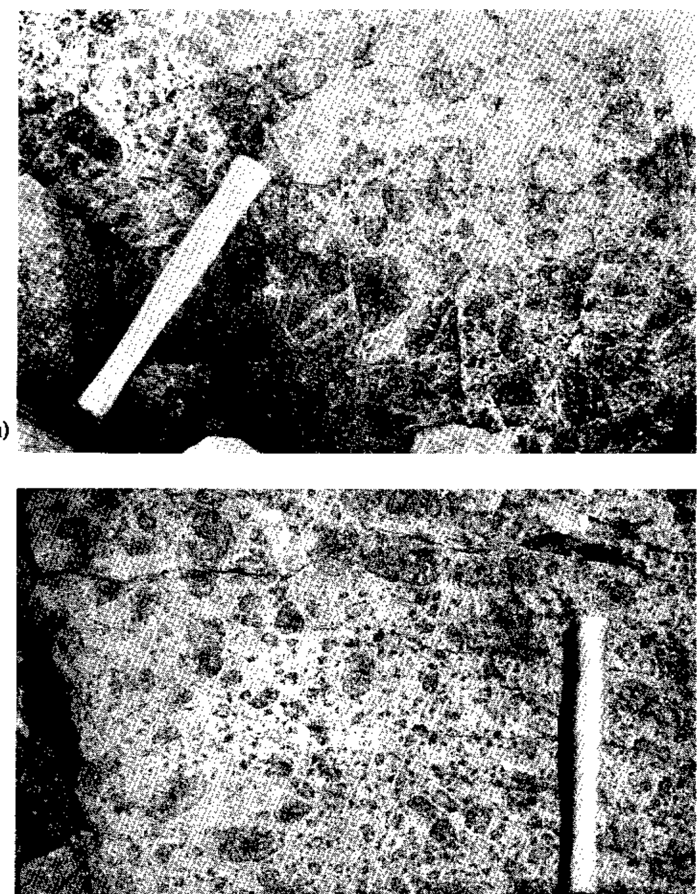


Figure 15. Propylitically altered andesite monolithic breccia from Formation 5. a) This particular exposure has been interpreted as an explosion breccia. b) This exposure may represent a debris flow deposit.

7). Catastrophic plinian eruptions occurred from a vent that may have been near the central rhyolite plug and resulted in major caldera subsidence in the northeast corner of the complex, and the accumulation of the thick sequence of pyroclastic flows. Other smaller rhyolite intrusions which may represent former vents occur outside the complex.
8). After the deposition of Formation 4, there was a period of quiescence, and erosion.
9). Faulting or pyroclastic eruptions resulted in the deposition of the heterolithic breccias of Formation 5.
10). Compositionally distinct andesites were erupted just north of Mt. Skukum. The eruption began with extrusion of andesitic lavas and minor pyroclastic flows and was followed by catastrophic explosions which produced at least one crater, a thick sequence of poorly bedded monolithic breccias, minor surge, airfall (?), and pyroclastic flow deposits, and andesitic intrusions.
11). Intrusion of the central rhyolite plug, and the development of the NNE-trending fracture pattern.
12). Hydrothermal systems probably existed at various times throughout volcanism, however, the epigenetic gold veins appear to have been the latest hydrothermal system which was localized in the vent facies environment of Formation 5. Some late felsic dykes crosscut the gold veins.

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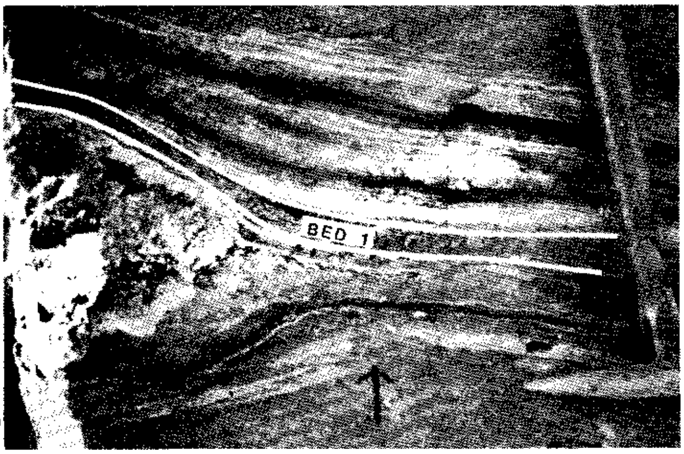

(a)

(b)

Figure 16. Tuff of Formation 5. a) Photograph of a ballistic fragment of porphyritic andesite which has impacted and truncated the underlying tuff deposits. The sample has subsequently been mantled by a series of tuff beds which, along strike, show small ripple bedforms, suggesting deposition was from a surge. b) The laterally equivalent bedded tuffs of Figure 16a located approximately 5 m along strike.

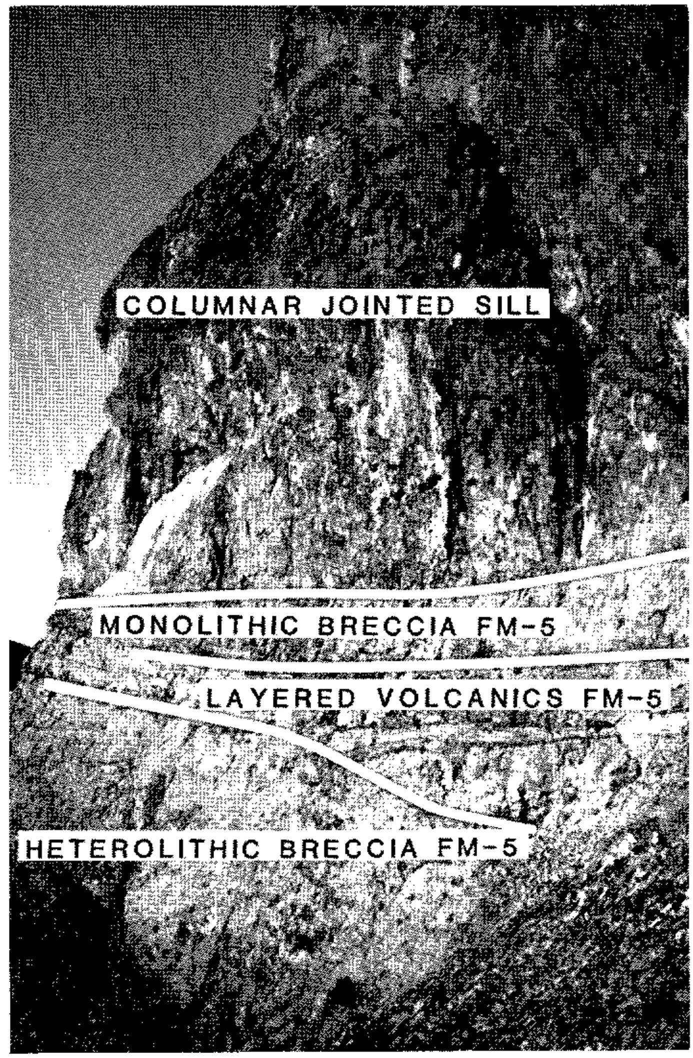

Figure 17. A photograph showing the columnar jointed sill-like intrusions. The basal contact is chilled and irregular and overlies the monolithic breccias. These breccias are in turn underlain by a bedded volcanic sequence and by the heterolithic breccias. (Formation 5).

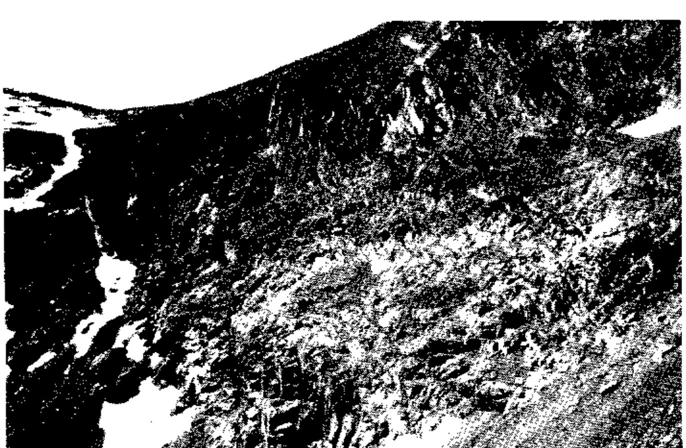

Figure 18. A photograph taken just northwest of Mt. Skukum showing the pervasive NNE-trending fracture pattern.

Figure 19. A photograph of jasper hematite veins in Formation 4.

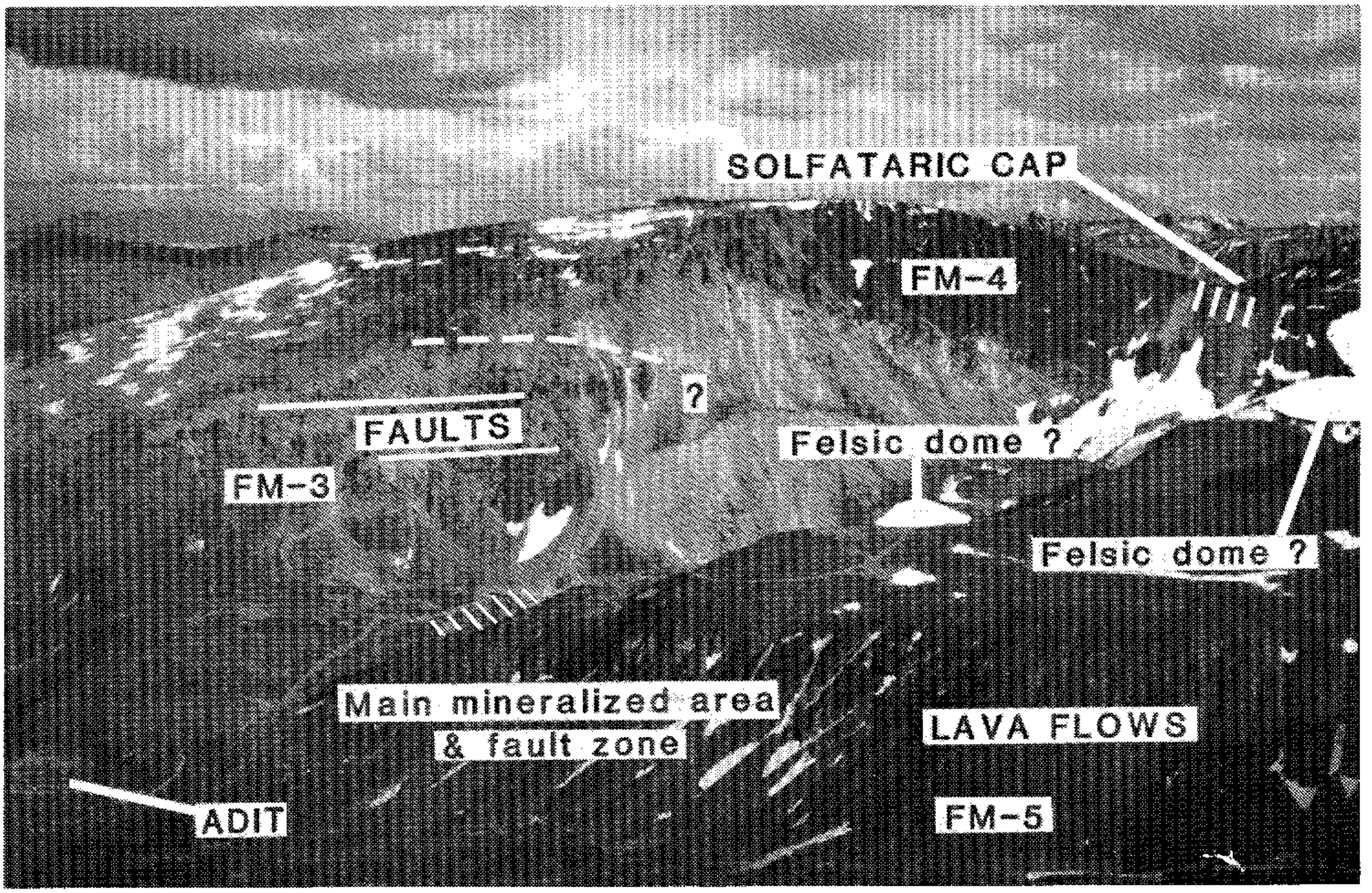

Figure 20. Photograph showing the location of the main mineralized zone, as well as the geology of the area. The photograph shows some features that are associated with the mineralized area: 1) faults and dykes, 2) felsic domes and intrusions, 3) leached solfataric cap, 4) the precious metal veins cut Formation 5. Figure 14 joins Figure 20 on its eastern side.

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