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Geology of the Gunung Danum conservation area: geochemistry and soil aspects

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Abstract: The Gunung Danum Conservation area overlies the oldest crystalline basement rocks in Sabah, which is composed of peridotite, amphibolite and basalt. The Middle Miocene Mélange occupies the low lying area and is composed of exotic blocks embedded in a sheared pelitic matrix. The major blocks consist of chert, sandstone, basalt, conglomerate and ultramafic rocks.

The relationship between the crystalline basement and the mélange is interpreted as a sheared zone in which the basement rocks were upthrusted towards the north. Locally, the contact between the mélange and the basalt is believed to be a normal fault dipping to the south.

The high concentration of Ni and Cr in stream sediments reflect the high content of these elements in the ultrabasic bedrock of the Gunung Danum area. The Cr is present as clastic grains of high density chromite, whereas Ni and Zn are partly transported in solution and partly as suspended particles.

The distribution of soil in the Gunung Danum and the neighbouring areas can be classified into three types, namely: the Bidu-Bidu Association, the Mentapok Association and the Bang Association. The Bang Association of mudstone and sandstone origin occupies the low lying areas, while the Gunung Danum area of ultramafic stock is classified as the Bidu-Bidu Association. The soil type in between is the Mentapok Association of which the parent materials are basic and intermediate igneous rocks.

Extensive recent muddy alluvium can be traced along Sungai Danum and Sungai Sabran.

INTRODUCTION

The Gunung Danum area is mountainous and the highest peak has an altitude of 1,093 m. Most of the area is composed of crystalline basement rocks consisting of peridotite, amphibole schist and basalt, which are believed to be the oldest rock association in Sabah (Jurassic or older). Leong (1974) studied the area for its economic mineral exploration potential, e.g. silver, copper, molybdenum, gypsum and alluvial gold.

The younger rock association is a mélange which is composed of a variety of rock assemblages like sandstone, chert, and conglomerate, formed during the Middle Miocene. The rock association is widely distributed in the east coast of Sabah (Muhammad *et al.*, 1988).

The relationship between the crystalline basement and the mélange is interpreted as a sheared zone in which the basement rocks were thrusted towards the north This confirmed the interpretation done by Gibson (1989) and Malavieille and Ritz (1989) in their study areas. The contact between the mélange and the basaltic rocks which contain many gouge structures is believed to be normal faults dipping to the south.

The tectonic activity during the Quaternary is proven from the occurrence of uplifted fluvial cobbles, a few meters above the sea level.

GEOGRAPHY

The area surveyed is about 26 square km, and the entire area is within the Forest Reservation of Sabah which is free from any human activities (Fig. 1). The climate is humid-tropical with an annual average rainfall of about 2,032 mm. The temperature commonly exceeds 30°C at noon; however it is cooler at night and in the early morning.

The Gunung Danum area is a rugged region with an average altitude of 610 m where the highest peak is 1,093 m. The inferred fault in the area has been deduced from the abrupt boundary between the flat area of the valley with a high angle slope seen in most of the area. This is a common phenomenon in the igneous rocks region.

The distribution of the lineaments is different from one place to another, but the ridges mostly trend in the E-W direction, with some trending to the NE-SW direction. It is believed that the trend of the E-W ridges is due to the N-S compression in conjunction with thrust faulting to the north while the NE-SW ridges trend may be an older one.

The drainage pattern of the area is dendritic, with the rivers flowing parallel to the regional structural trend and eventually trending north. The main river is Sungai Danum, and the tributaries are Sungai Sabran, Sungai Siraj and a few other

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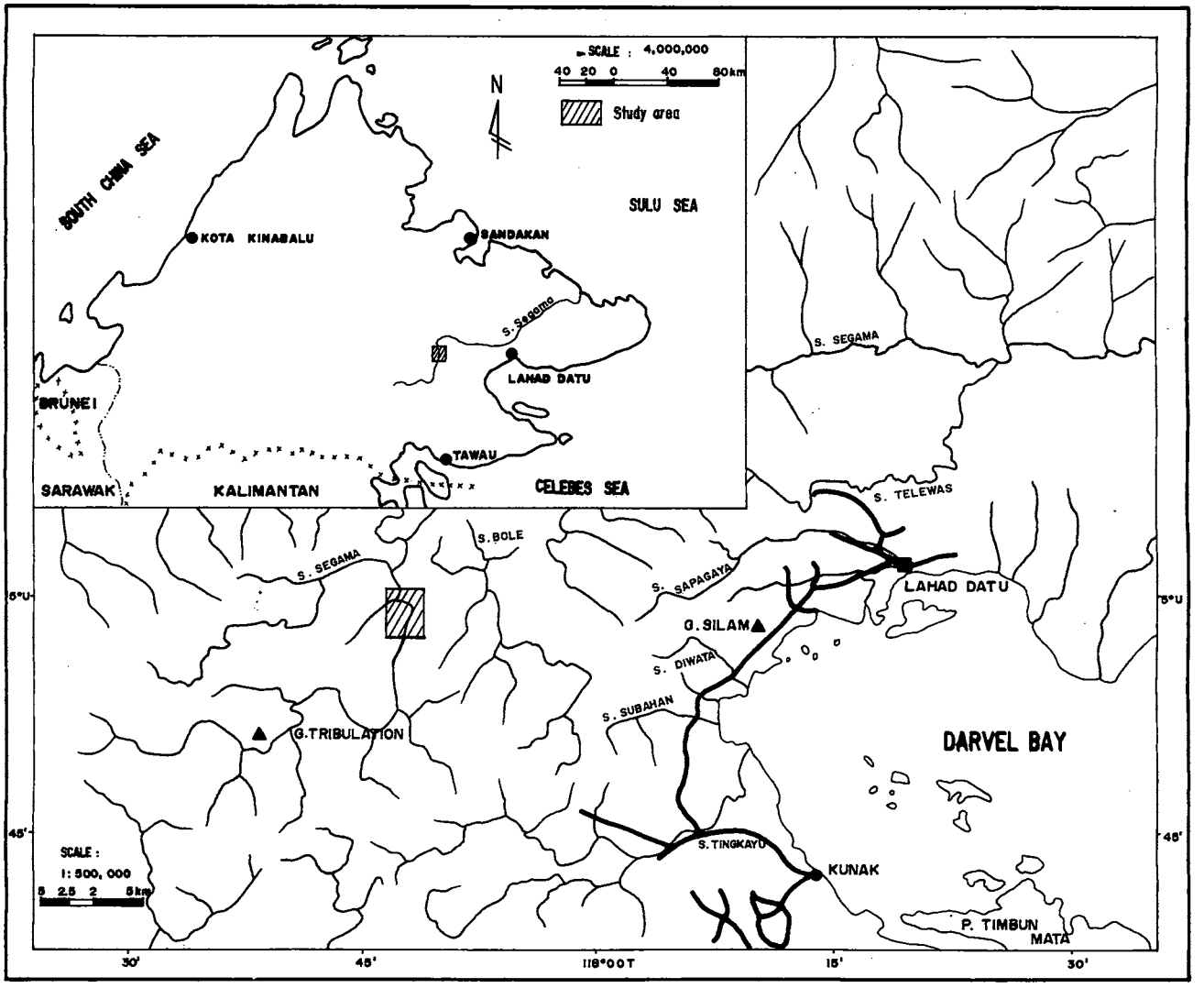


Figure 1. Location of the study area.

Table 1. Stratigraphy of the Gunung Danum area.

AGE	ROCK ASSOCIATION	LITHOLOGY
Quaternary	–	Inland and terrace alluvium, recent alluvium
Middle Miocene	Kuamut Formation	Slump breccia deposit sandstone, chert and conglomerate
lower Cretaceous Jurassic or older	Basalts Crystalline Basement	Basalt, volcanic breccia & Spilite. serpentinite, sepentinized peridotite, amphibolite schist

unnamed rivers.

Superimposed drainage occurs in several places along Sungai Danum. The presence of gorges is a criterion of the superimposed drainage pattern, and can be seen from the close contours in the map. The superimposed drainage may have been caused by periodic and essentially vertical uplift of the ultramafic rocks, possibly due to Quaternary movements (Wilford, 1968).

GEOLOGY

Stratigraphy

One of the main objectives of the Gunung Danum expedition was to determine the stratigraphy of the area. The area mapped consists of the oldest group of rocks in Sabah, Tertiary rocks and the youngest Quaternary rocks (Table 1).

Lithology of the Basement Complex

The crystalline rocks of the Gunung Danum area comprises three main types: serpentinized peridotite, amphibolite schist and basalt. The ultrabasic rock, with subordinate serpentinized peridotite, occurs on Gunung Danum from around 600 m elevation to the summit. The outcrop of the amphibolite schist occurs as a narrow band below the ultrabasic rock with an elevation around 500-600 m and the basalt is in the north eastern and north western portions of the study area.

Serpentinized Peridotites

The ultrabasic rock cropped out along the trail to the summit of Gunung Danum above approximately 600 m elevation and above. Rock samples were collected from certain parts of the study area (Fig. 2).

In hand specimen the rock appears black and

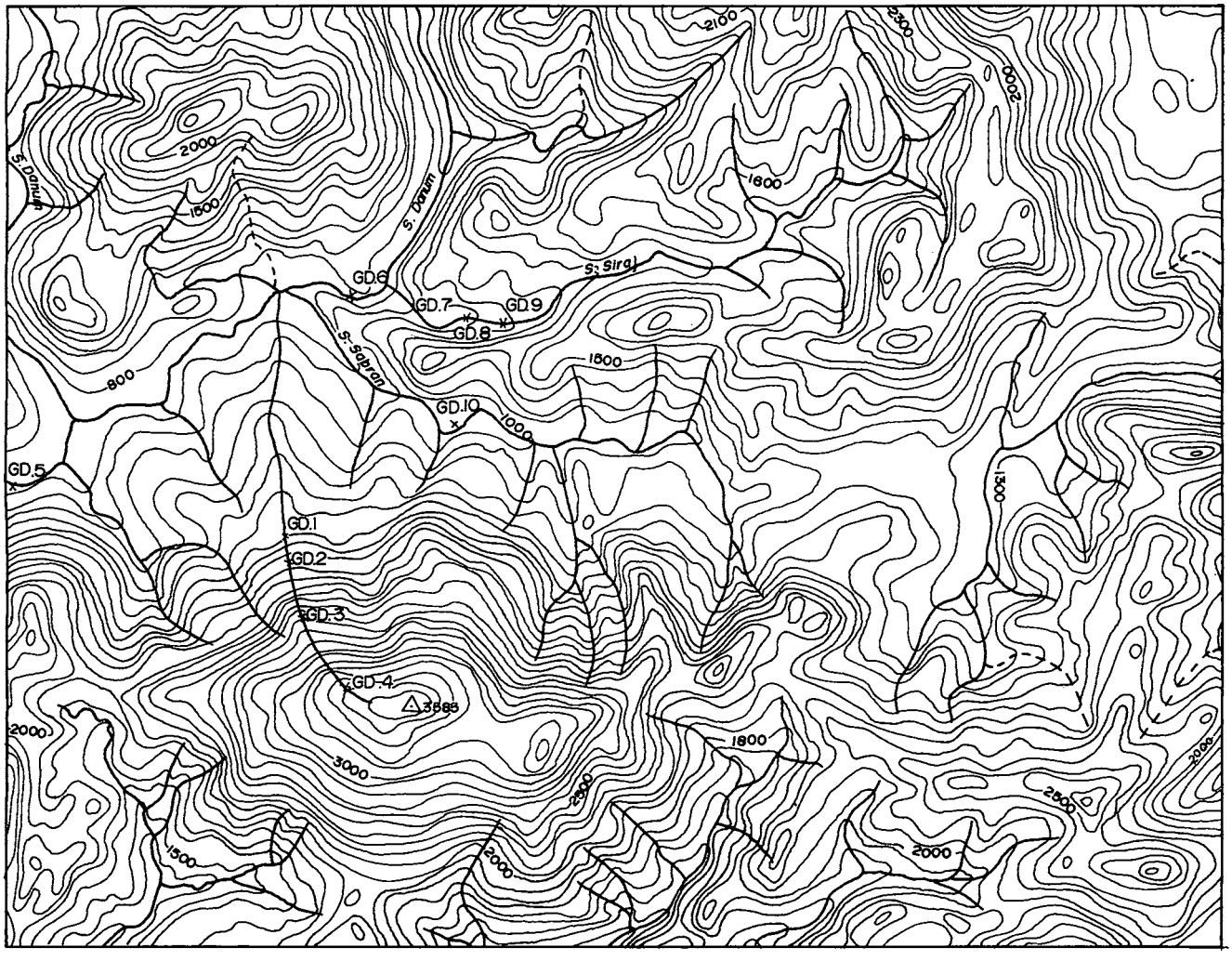


Figure 2. Rock samples distribution of the study area.

massive, without the waxy lustre of serpentinite. It is fine to medium grained, but the individual crystals cannot be easily seen due to the uniform black colour, and it resembles basalt.

The three samples prepared for thin section analysis (GD3 and GD4) are all similar and vary slightly in grain size and degree of alteration. They are medium to coarse grained and consist of olivine (30%) and clinopyroxene, some showing diallage parting (70%) along with minor chromite, opaque oxides of uncertain composition and secondary minerals and can thus be classified as lherzolite, following the IUGS classification (IUGS, 1973). Sample GD3 is somewhat finer grained and fresher than samples GD2 and GD4, showing only minor serpentinization along numerous small fractures. The clinopyroxenes in samples GD2 and GD4 are highly altered, consisting of a fine fibrous core, identified as talk, and rims or columnar colourless tremolite, with fine grained opaque oxides along the cleavage planes.

Amphibolite Schist

Numerous cobbles of amphibole schist and gneiss occur along Sungai Danum and Sungai Sabran and their tributaries, but only one small block, of approximately one square metre in size was observed along the flanks of Gunung Danum, at approximately 500 m elevation. The block showed a schistose texture with black-green fine grained bands of amphiboles and bands of fine to medium grained felsic mineral. In thin section the rock is seen to have a well foliated texture, with bands of fine grained actinolite showing a slight yellow-green pleochroism and extinction angles of 0-10° and bands of medium to fine grained plagioclase and quartz.

Basalt

Brecciated and non-brecciated basalt was observed up and downstream along Sungai Danum and along the northern bank of Sungai Sabran, in areas mapped as Crystalline Basement by Leong (1974) (samples GD5, GD6, GD7, GD8, GD9 and GD10). The basalt breccia (GD6 and GD7) consists of greenish-black clasts of fine grained basalt ranging in size from less than one cm to 10 cm in a fine grained greenish-black matrix. The massive non-brecciated basalt is fine grained and black (GD5, GD8 and GD9) or greenish-black (GD10).

In thin section, only one sample, GD9, does not show a high degree of weathering. It consists of highly saussuritized plagioclase (approximately 70%) and an amphibole (approximately 30%) along with minor opaque oxides. The amphibole is columnar, slightly pleochroic (light to dark brown) and has low extinction angles, and is believed to be basaltic hornblende.

The other basaltic rocks are all highly weathered and consist of highly saussuritized plagioclase, some fine grained clinopyroxene, partly chloritized, minor clinozoisite and primary quartz and abundant calcite and occasional quartz veins. Due to the high degree of weathering, it is not apparent if the basic rocks have undergone metamorphism.

Sedimentary Rocks — Kuamut Formation

Sandstone

The sandstone is grey to dark grey in colour and fine to medium grained. The major constituent of the sandstone is quartz with the amount of 65% or more. Other constituents are feldspar, volcanic fragments and minor zircon and mica grains. Some of the poly crystalline quartz show undulatory extinction and appear to have been derived from quartzite and chert.

The sandstone is moderately well sorted with sub angular to sub rounded grains. The matrix is fine quartz, authigenic clay and minor calcite. The sandstone belongs to the Labang Formation of Oligocene age (Leong, 1974).

Leong (1974) noted that in a tributary valley of Sungai Malubuk, the sandstone bed is in a fault contact with amphibole of the Crystalline Basement, resulting in a zone fault breccia.

Chert

The chert is commonly thin bedded, many of the bedded chert are also intensely jointed and fractured, so that small slabs of the chert break off easily.

The colour of the chert is varied, the most common colour being orange, red, reddish brown or dark brown. The weathered skin is normally of a light orange colour or white. Most of the chert are strongly brecciated with veinlets of calcite, quartz and chalcedony occupying the fractures.

Conglomerate

The conglomerate is a polymictic conglomerate, consisting of subrounded to rounded, cobbles of sandstone, chert, mudstone, with moderately to poorly sorting. The matrix and cement consists of fine to coarse grained tuffaceous sand. The colour of the conglomerate is light to dark brown.

Older Quaternary Sediments

Older Quaternary Sediments consisting mainly of old fluvial alluvium occur inland in the Danum valley area.

These alluvial deposits are of varied origin, however the extensive alluvium deposited during rejuvenation of the valley has not yet reached the head water (Kirk, 1962). Alluvium in the Danum Valley could have been accumulated by the

damming up of the river by the igneous body further down stream (Leong, 1974), who also mentioned the alluvium deposits in many places in the East Coast e.g. Tingkayu-Binuang valley, Kalumpang valley, Upper Umas-Umas valley, Upper Beeston Valley, Lungkasa and Upper Bole valley.

The extension of high level alluvium in the Danum area is thought to have been deposited by the earth movements or Quaternary movement, which also affected the surrounding areas, like the Lungkasa valley (Leong, 1974).

The matrix of this alluvium is sandy clay which contains some boulders of chert, agglomerate, gabbro, sandstone, quartz pebbles and ultramafic rocks. The length of the deposits is about 100 m, trending northeast-southwest and with a thickness of not more than 5 m.

This outcrop is only found on the opposite bank of Sungai Danum and any further extension was not observed. The occurrences of these deposits were not thoroughly studied due to limited time for investigation in the study area.

Recent Alluvium

Recent alluvium along Sungai Danum and Sungai Sabran is much more extensive. Boulders and cobbles of various sizes occur in many rivers around the study area. As the result of the rainy season throughout the year, Sungai Danum always appears muddy.

Geological Structure

The study area is an intensively faulted region (Fig. 3). Major faults trend east-west with tendency towards east-northeast as the Danum fault thrust (Bailey, 1963 referred by Leong, 1974). The faults appear to be high angle thrust or reverse faults. Almost straight line contacts between the rock units are interpreted as high angle reverse faults. Examples of straight line contacts are shown in the Lower Danum with crystalline basement against sandstone of the Labang Formation, which occurs as a block in the Kuamut Formation. Several contacts between the Basement and Chert-Spilite Formation are also straight lines trending east-west (Leong, 1974).

A serpentinite body along Sungai Purut is bounded by straight line contacts which are probably fault contacts also trending east-west (Fig. 4). Thus it appears that east-west trending faults are dominant. Some of these high angle reverse faults can be traced for over 20 miles as the Danum Fault (Leong, 1974). Subsidiary faults trend mainly northeast-southwest, and they are probably minor faults related to the main east-west trending fault.

The many interpreted high angle reverse faults mentioned above probably occupy sites of former faults or fault zones. The nature of the earlier faults is not clear, but the Crystalline Basement was probably broken into several fault blocks bounded by steep scarps in the Mesozoic. These earlier fault scarps were probably sites of renewed faulting in Middle Miocene time. Other Quaternary movements probably include further uplift coupled with submergence in the Darvel Bay area resulting in the steep embayed coastline of the islands in the central Darvel Bay (Teluk Lahad Datu).

GEOCHEMISTRY

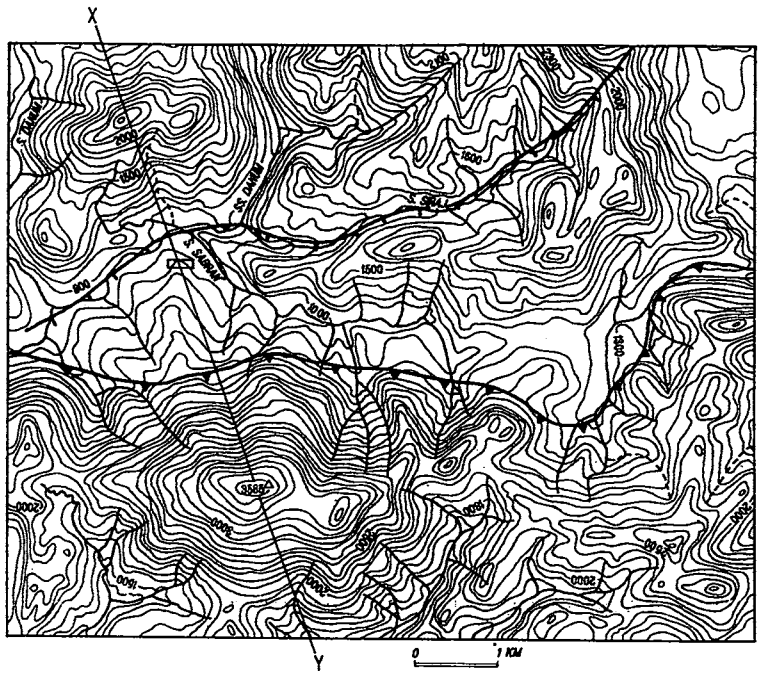
Introduction

Although several studies have been done to determine the relationship between soil chemistry and bedrock geology in tropical rain forest area (Pollack *et al.*, 1982; Dissanayake *et al.*, 1982; Matheis, 1982), few studies have been done on the relationship between stream sediment chemistry and the geology of the drainage basins.

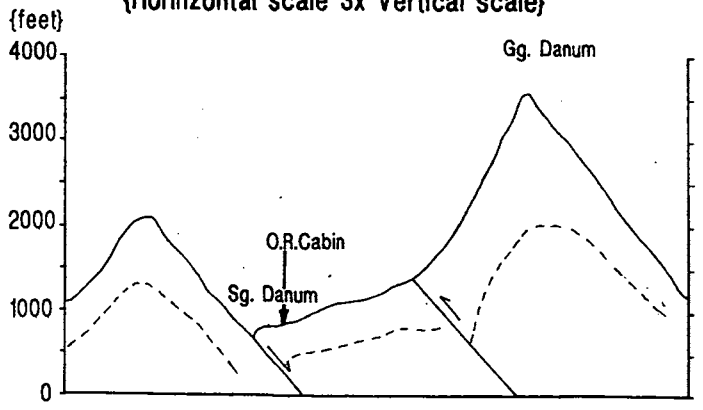
In many tropical underdeveloped countries poor accessibility makes geological surveys of much of the interior area very expensive. Surveys are often limited to areas along the major rivers, which are accessible by boat and are likely to contain outcrops. The less accessible areas are often never surveyed, and their geology is interpreted from aerial photographs. Geochemical stream sediment surveys of major streams and their tributaries could provide information about the geology of their drainage basins, especially regarding the presence of ultrabasic rocks, which have exceptionally high concentrations of metals such as Ni and Cr relative to other rock types. The Gunung Danum area consists of several types of rocks: ultrabasic rock, which forms the summit of Gunung Danum, above the elevation of 600 m, amphibole schist, which occurs along a narrow band between around 500 and 600 m on the flanks of Gunung Danum, a sedimentary mélange, comprising sandstone, breccia and minor chert, on the lower flanks of the mountain, the Chert Spilite Formation, comprising mostly of chert, clastic and pyroclastic rocks and basalt, to the north of the study area and basic volcanic or metavolcanic rocks in the western and eastern portions of the study area (Fig. 4).

The concentration of heavy metals in stream sediments is dependent on several factors: the bedrock type in the drainage basin, the mobility of the metals, environmental factors such as Eh, pH and climate and the presence of mineralization. Cr, Ni and Zn were chosen for analysis because of average differences in concentration in the different bedrock types and differences in mobility.

The concentrations of Cr and Ni are generally



Cross geological section
(Horinzontal scale 3x Vertical scale)



GEOLOGICAL MAP OF GUNUNG DANUM AREA, LAHAD DATU, SABAH

Scale : 0 1 2 3 KM

GEOLOGICAL FORMATION

- QUATERNARY DEPOSIT; inland and terrace alluvium, including some recent alluvium occurring mainly along present river course.
- KUAMUT FORMATION; slumpbreccia deposits, mainly sandstone, chert and conglomerate.
- CRYSTALLINE BASEMENT; mainly serpentinite and serpentinized peridotite, amphibole schist and basalt.

GEOLOGICAL SYMBOL

- Thrust fault.
- Normal fault.

TOPOGRAPHICAL SYMBOL

- 500 - Contour {interval 100 feet}.
- River course.
- 3585 △ - Mountain, hill.
- Operation Raleigh cabin.
- X — Y - Cross section.

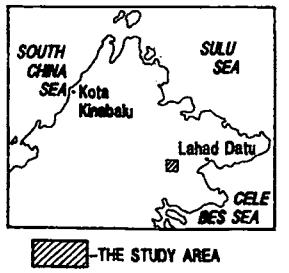


Figure 3. Structural geology of Gunung Danum.

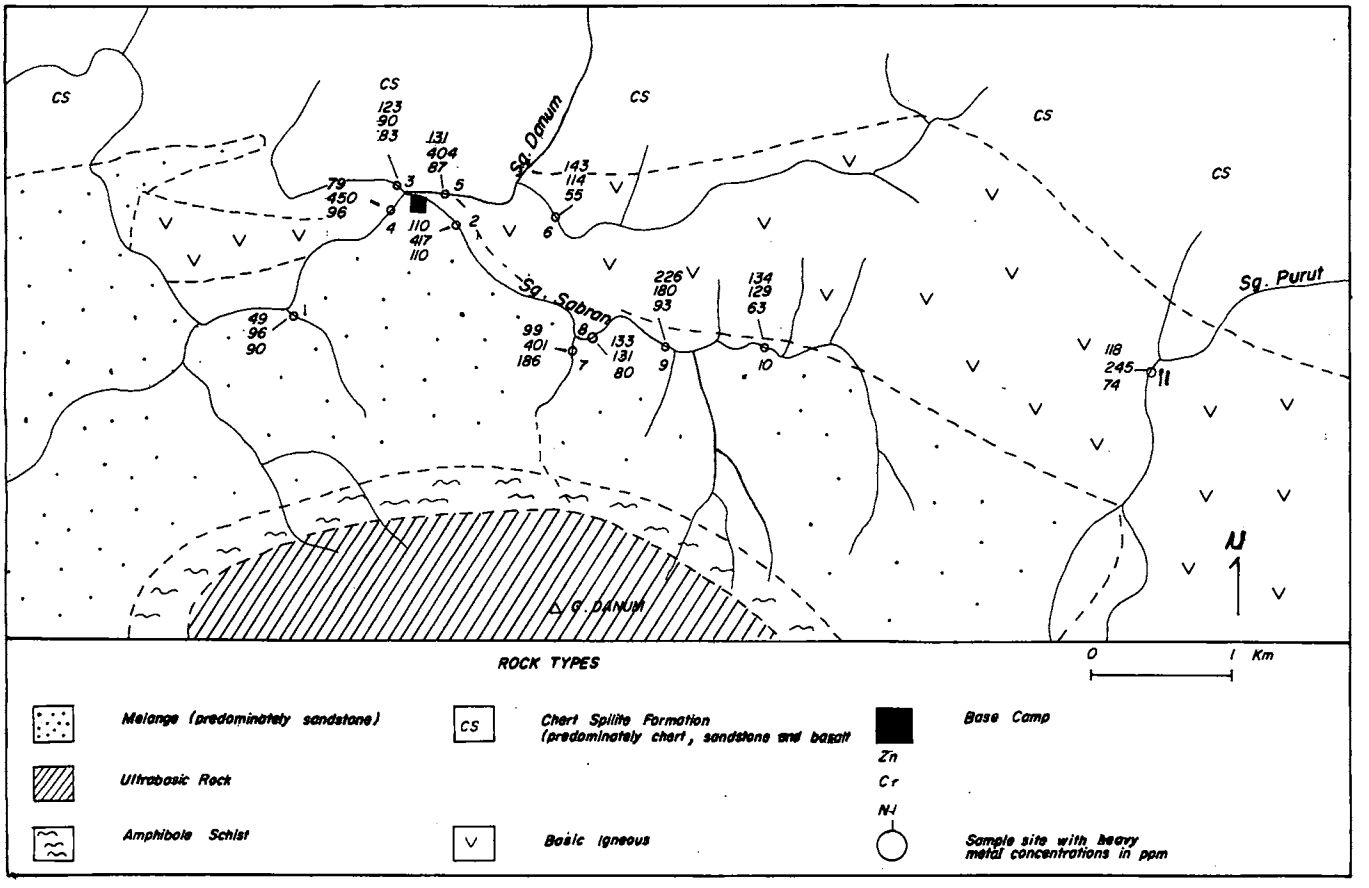


Figure 4. Heavy metal concentrations in stream sediments of the Gunung Danum area.

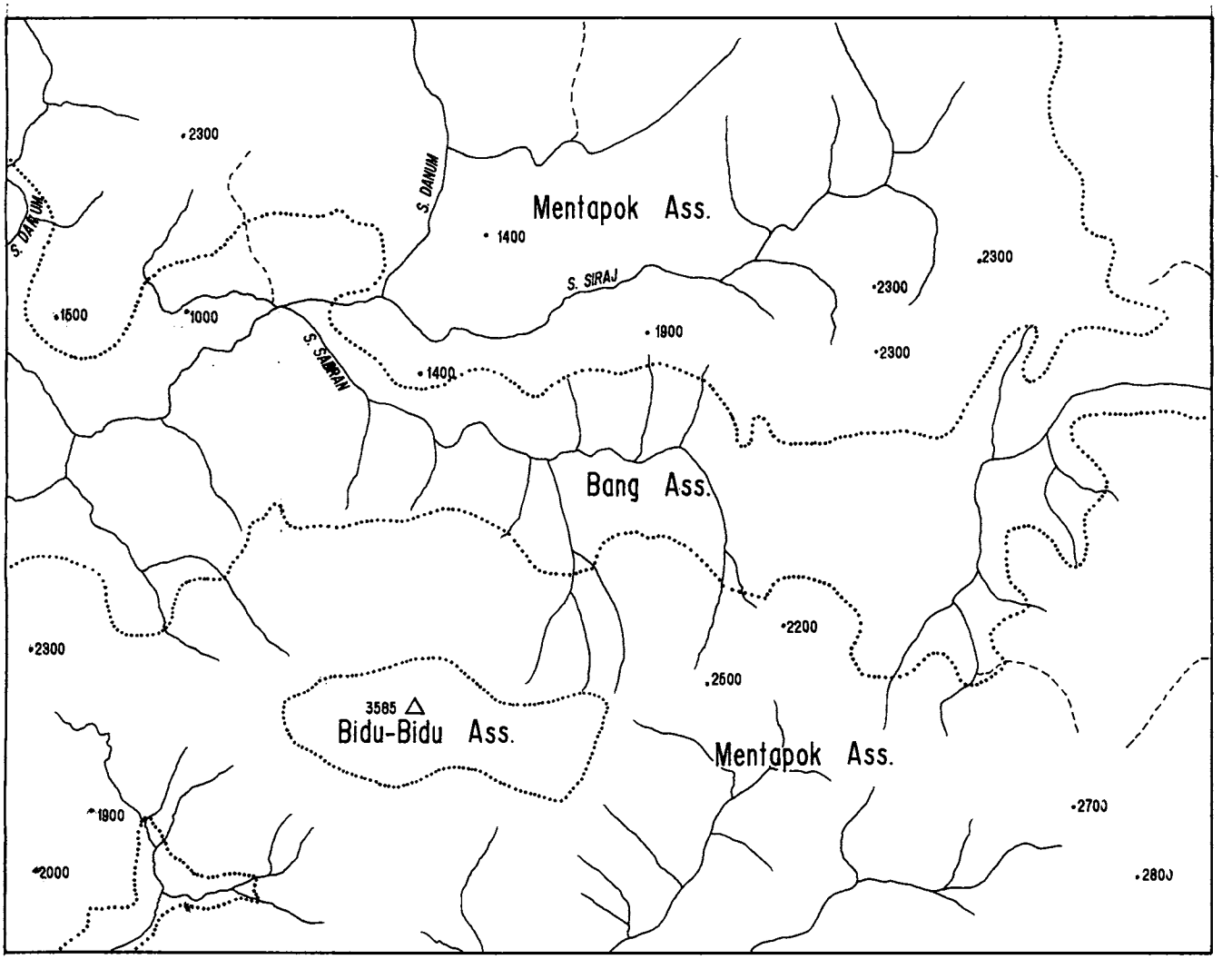


Figure 5. Three types of soil association in the study area.

an order of magnitude or more higher in ultrabasic rocks than in the other rock types in the study area (Tables 2 and 3) and this difference should be apparent in streams draining the various rock types. The Zn concentrations in the various rock types tends to be less consistent, and vary to a lesser degree (Tables 2 and 3).

Most of the Cr in basic and ultrabasic rocks occurs in chromite ($FeCr_2O_4$), a mineral very resistant to weathering. Most of the Ni occurs in the mineral olivine, where it substitutes for Fe, and is highly mobile in an acidic environment and moderately mobile in an oxidizing environment. Zn either occurs in sulphide minerals or substitutes a major element in silicate minerals, and is highly mobile in an acidic or oxidizing environment. In a tropical rain forest environment like Sabah, chemical weathering occurs very rapidly, under acidic and oxidizing conditions, Ni and Zn tend to be leached from the bedrock and adsorbed by clays, Fe and Mg oxides downstream while chromite grains are removed from the bedrock and transported mechanically downstream.

Results of the stream sediment analyses (Tables 4 and 5) show generally high Cr and Ni concentrations in streams draining areas of ultrabasic bedrock and generally lower concentrations in stream draining areas of sedimentary or basic igneous rocks. Samples from Sungai Danum and Sungai Sabran and its tributaries, for example, generally have above average concentrations of both metals while the streams at stations 2, 4 and 7 which drain areas of non-ultrabasic bedrock, have sediments with below average concentrations of Cr and Ni. The relatively high positive correlation between Cr and Ni concentrations (r = +0.552) shows the strong interrelationship of the two metals. Zn has a low negative correlation with Cr (r = -0.198) and Ni (r = -0.221).

Cr, Ni and Zn were only detected in three of the partially extracted samples, samples 9, 10 and 11, where Zn ranged from 10 to 100 ppm, Ni from 1 to 3 ppm and Cr from 1 to 5 ppm. Cold acid extraction only removes some of the weakly adsorbed metals, and it appears that weakly adsorbed metals are not a major constituent of the total metal of the stream sediments in the study area.

The Soil of Gunung Danum

The Operation Raleigh trail heading towards Gunung Danum peak traverses three types of soil associations (Fig. 5). The cabin was built on the Bang Association which developed from mudstones, sandstones and miscellaneous parent material. In between Gunung Danum and the cabin the soil of Mentapok Association occurs. It developed from basic and intermediate igneous rock. Gunung Danum itself is included under the Bidu-Bidu Association where parent material consists of ultrabasic rock of serpentinite and peridotite type (Acres *et al.*, 1975). The Bang and Mentapok soil Associations cover the area between the cabin and the Gunung Danum foothill, 500 meter elevation. The ultrabasic rocks of Gunung Danum are upthrust blocks forming a domelike topography. The soil associations and soil families that occur around the area is given in Table 6 below:-

Bang Association

The Bang soil association occurs on the hills up to 300 m altitude, with slopes averaging between 15° and 25°. The parent material develops from sandstones, mudstones and miscellaneous rocks. The majority of soils are Orthic Acrisols of the Tanjung Lipat and Kumansi Families on sandstones and mudstones; there are some inclusions of fragments of other rocks in the this association. The soils which are developed on miscellaneous rocks include Orthic and Chromic Luvisol.

Mentapok Association

This soil association occurs on the hills with altitudes greater than 330 m and slopes averaging between 15° and 35°. The parent material is basic and intermediate igneous rocks. The dominant soils are Orthic and Chromic Luvisols with Eutric Cambisol and Lithosol occurring on very steep slopes and ridge tops.

Orthic Luvisol: Kubovan Family

The majority of these soils are moderately deep and well drained, and they commonly contain stones, weathered feldspar crystals and small black concretions. They are yellowish brown or dark yellowish brown in colour and consist of clay loam overlying clay. Most argillic horizons have clay contents of between 35 and 65%. The soils are moderately to slightly acidic.

Chromic Luvisols: Beeston Family

These soils have a strong brown to yellowish red argillic horizon. The physical properties are similar to the Kobovan Family.

Eutric Cambisols: Bombalai Family

The soils are well drained, shallow and stony with medium textures and yellowish brown colours. The soils are slightly acidic.

Bidu-Bidu Association

The ultrabasic rocks from which this soil association developed are of serpentinite and peridotite types. Chromium, nickel and cobalt are examples of elements which may be present in such high amounts as to limit the growth of certain plants. This soil also occurs on hills and ridges

Table 2. Average concentrations (in ppm) of Ni, Cr and Zn in various rock types (modified from Krauskopf (1967), Levinson (1980) and Mason and Moore (1988).

	Ultrabasic Rocks	Basic Rocks	Sandstones
Ni	2,000	150	2
Cr	2,000	200	35
Zn	50	100	16

Table 3. Concentrations (in ppm) of Ni, Cr and Zn in the freshest rock samples from the Gunung Danum area.

	Ultrabasic Rocks	Basic Rocks	Sandstones	Amphibole Schist
Ni	3,200	90	undetected	620
Cr	2,300	350	40	40
Zn	150	90	150	80

Table 4. Concentrations (in ppm) of Ni, Cr and Zn in the stream sediment samples from the Gunung Danum area.

Sample number	Ni	Cr	Zn
1	90	96	49
2	110	217	110
3	83	90	123
4	96	450	79
5	87	404	131
6	55	114	143
7	186	401	99
8	80	131	133
9	93	180	226
10	63	129	134
11	74	245	118

Table 5. Statistical data for the heavy metals in the stream sediments from the Gunung Danum area.

	Mean (ppm)	Standard Deviation	Correlation	Coefficients
Ni	92.3	34.6	Ni-Cr	+0.552
Cr	223.2	134.9	Ni-Zn	-0.221
Zn	122.2	44.3	Cr-Zn	-0.199

Table 6. The Soil Associations ofthe Gunung Danum area (Acres and Folland, 1975).

Association	Landforms	Parent Material	Main Soil Unit	Soil Families
Bang	steep hills: altitudes < 300 m slopes 15-25°	mudstones/ sandstones	Orthic Acrisol Dystric Cambisol	Tanjung Lipat Kumansi Laab
Mentapok	Mountains with slopes > 25°	Basic and intermediate igneous rock Lithosol	Orthic Luvisol Chromic Luvisol Eutric Cambisol	Kobovan Beeston Bombalai
Bidu-Bidu	Hills and mountains slopes generally > 25°	Ultrabasic igneous rock	Chromic Luvisol Orthic Luvisol Eutric Cambisol	Malawali Tingkayu Binuang

with in mountain masses composed of the Chert-Spilite and Kuamut Formations. The soils are predominantly Orthic and Chromic Luvisols with Eutric Cambisols, and more rarely, Lithosols on ridges and very steep slopes.

Chromic Luvisols: Malawali Family

Chromic Luvisols of the Malawali Family are generally moderately deep, well drained and stony. They have ochric A horizons, eluvial horizon with clay loam texture and reddish brown argillic horizons with clay textures. Subangular blocky structures are strongly developed throughout. The soils are slightly acid to near neutral in reaction.

Orthic Luvisol: Tingkayu Family

These soils are physically and chemically similar to Chromic Luvisols of the Malawali Family differing only in their colours, which are commonly yellowish brown to dark yellowish brown.

Eutric Cambisols: Binuang Family

Eutric Cambisols of the Binuang Family have Ochric A and Cambi B horizons. They are shallow, stony and fine textured with strong subangular blocky structures throughout. The soils are slightly acidic.

Physical Properties of Soils

Some physical properties of the top 15 cm of the soils mentioned above were determined and listed as Table 7 below.

All the samples show very high contents of clay, very low contents of silt and low contents of sand. Thus the soils are classified as clay. Only soil sample number 3 shows a higher content of sand. This soil probably developed from sandstone blocks of the Kuamut Formation which also occur in the Bidu-Bidu Association. The soil pH is acidic to neutral.

The properties of soils are generally governed by clay therefore, high Cation Exchange Capacity and base saturation percentages are expected. Most of the soils have a high to very high organic matter content which ranges from 2.4% to 17.5%. This value will give a low bulk density of soil. All these properties indicate that the soil is very mature which is a normal situation for natural forest soil.

CONCLUSION

The Gunung Danum Conservation area is made up of Crystalline Basement and slump breccia deposits. Stratigraphically, the Crystalline Basement of Lower Cretaceous or older, is made up of basalt, volcanic breccia, spilite, serpentinite, peridotite and amphibolite, while the slump breccia is made up of blocks and fragments of clastic sedimentary rocks which was formed during the Middle Miocene tectonism. The deposition of the slump breccia coincided with the fault movements.

In general, the occurrence of ultrabasic bedrock at the summit of Gunung Danum seems to be reflected in the high Ni and Cr concentrations in the sediments of the streams draining the mountain. The high mean concentration of Cr relative to Ni is probably the result of the topography: the Cr is probably present as clastic grains of high-density chromite, which would be easily transported from the ultrabasic bedrock on the summit of Gunung Danum by the swift flowing, high gradient streams, and deposited at the base of the mountain. The more mobile Ni and Zn are partly transported in solution and partly transported as less dense minerals. The Ni and Zn in solution would be gradually adsorbed by clays, Fe and Mg oxides downstream while the Ni and Zn in the lower density minerals would be transported further down stream and spread out over a larger area than the dense chromite. The absence of the metals in most of the partially extracted samples indicates that they occur mostly in clastic grains at the base of the mountain, and the relatively unweathered ultrabasic rocks, as described in the petrography section, tends to confirm this.

Table 7. Some Physical Properties of Soil in the Gunung DanumArea.

Soil Sample	Elevation (meter)	% Mineral Content			Particle Size Classifiction	pH	Soil Association
		Sand	Silt	Clay			
1	360	31.13	5.34	63.53	Clay	4.6	Bang
2	500	18.23	6.46	75.31	Clay	5.6	Mentapok
3	580	48.20	4.89	46.91	Sandy Clay	4.9	Bidu-Bidu
4	600	19.05	1.57	79.38	Clay	5.8	Bidu-Bidu
5	700	13.52	2.20	84.28	Clay	5.7	Bidu-Bidu
6	800	27.67	2.20	84.28	Clay	7.0	Bidu-Bidu
7	900	31.47	3.34	65.19	Clay	7.0	Bidu-Bidu
8	1000	43.24	1.15	55.61	Clay	6.1	Bidu-Bidu

The occurrence of several bedrock types in the drainage basins of most streams in the Gunung Danum area makes the interpretation of stream geochemical data complex, but in general, the presence of ultrabasic bedrock in the drainage basin of a stream is reflected in the high "total extractable" Ni and Cr concentrations in the sediments.

The soil type of the area can be divided into three associations based on their parent material, namely: the Bidu-Bidu Association, the Bang Association and the Mentapok Association. Their properties are usually governed by high contents of clay and organic matter resulting in giving low bulk density of soil type.

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