

AGE OF A BASALT DIKE, SUSTUT COPPER DEPOSIT (94D/10E)

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INTRODUCTION

This report sheds further light on the history of mineralization of the Sustut Copper deposit based on new data on the age and composition of a basaltic dike that cuts the deposit.

The Sustut deposit was described in some detail by Church (1974), Harper (1977) and Wilton (1978). Further information regarding the regional geology of the area around the deposit and Takla Group is provided by Monger and Church (1976) and Gale (1996).

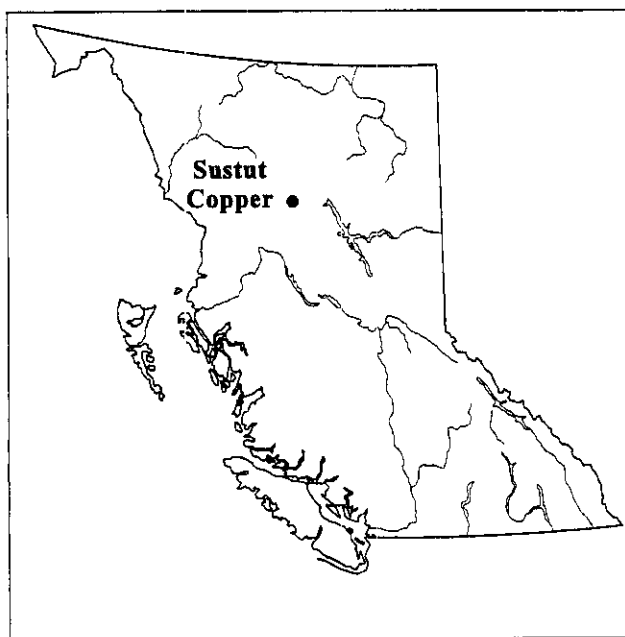


Figure 1. Location map, Sustut copper deposit.

The Sustut Copper deposit is located 130 kilometres north of Smithers B.C. (Fig. 1). It was discovered in 1971 by Falconbridge Ltd. in gently dipping beds of the Takla Group (Upper Triassic). The principal mineral zone is a concordant body of 43.5 million tonnes, grading 0.82 per cent copper, that lies in a transitional middle horizon of the Moosevale Formation between subaqueous and subaerial depositional volcanoclastic facies (Harper 1977). The deposit fits the 'Basaltic Copper' model of Lefebvre and Church (1996). The ore body ranges up to 75 metres thick and underlies a 0.9 x 1.8 km northerly elongated area on the south flank of Mount Savage (Lat.

56°36.4', Long. 126°40.3'). The copper minerals, consisting mainly of chalcocite, bornite, chalcopyrite and native copper, are epigenetic and occur with pyrite, epidote, quartz, prehnite and carbonates in tabular structures suparallel to bedding and related to low grade metamorphic and metasomatic reactions (Church, 1974; Wilton, 1978).

THE BASALT DIKE

The only intrusion in vicinity of the Sustut deposit is a 600 metre long dike that cuts directly across the ore body (Fig. 2). For the most part, the dike is 1.5 meters wide, straight and steeply dipping, at 80° southeast, and remarkably consistent (Photo 1). The largest exposure is a 300 metre long segment that strikes NNE from the East Cirque; the northern extension being lost under felsenmeer blocks towards the North Cliffs. South of the East Cirque, the dike is exposed intermittantly over a distance of about 200 metres. Discontinuities towards the southern extremity of the dike are caused by movement on cross joints and small shears.

The dike is light brown or tan coloured on weathered surfaces and dark grey or blue grey where freshly broken. The rock is characterized by dark augite phenocrysts 2-4 mm in diameter set in a fine grained matrix with numerous feldspar microlites. In thin sect on the rock is crowded with plagioclase microlites interspersed with solitary, subhedral augite phenocrysts and glomerophenocrysts of augite, plagioclase, intergranular magnetite and chlorite. The feldspar is in the andesine-labradorite composition range.

Chemical analysis shows that the dike is a subalkaline basalt, compositionally intermediate between tholeiitic and calc-alkaline magmatic trends, similar to the Takla volcanic rocks (Gale, 1996). The dike is closest in composition to the plagioclase-rich lava clasts in the Moosevale Formation at Sustut Copper, and the feldspathic Takla lava on the Marmot property, located to the northeast. However, unlike this Takla rock, the dike contains lower K₂O values and a significant amount of normative olivine (Table 1).

MINERALIZATION

The main period of mineralization is believed to be shortly after deposition of the Moosevale Formation (Church, 1974). Accordingly, the hydrothermal solutions which carried the copper and other ions were late stage in the development of Takla volcanism. The solutions

flowed through the recently deposited volcanic sandstones and conglomerates between impermeable lahar beds. A minor part of the ore deposit consists of steeply dipping veins that were feeders to the main ore body (Harper, 1977). Some veinlets are younger and hosted by a basaltic dike that cuts the ore body (Wilton, 1978). This late period of mineralization is believed to be related to regional metamorphism that occurred post dike intrusion (early Jurassic or younger).

Table 1
CHEMICAL ANALYSES

	1	2
Oxides Recalculated to 100 percent		
SiO ₂	53.20	49.32
TiO ₂	0.93	1.29
Al ₂ O ₃	16.97	17.53
Fe ₂ O ₃	4.89	2.84
FeO	4.82	7.84
MnO	0.18	0.18
MgO	6.09	7.27
CaO	7.44	9.63
Na ₂ O	3.08	3.43
K ₂ O	2.40	0.67
	100.00	100.00
Oxides as Determined		
LOI	2.00	2.87
P ₂ O ₅	0.37	0.17
SrO	0.08	0.04
BaO	0.03	0.03
Molecular Norms		
Quartz	1.9	-
Orthoclase	14.2	3.9
Albite	27.8	30.7
Anorthite	25.4	30.3
Wollastonite	4.6	6.9
Enstatite + Ferrosilite	19.7	8.5
Forsterite + Fayalite	-	14.9
Illmenite	1.3	1.8
Magnetite	5.1	3.0

1 Takla Lava, (Church, 1994, p. 438)

2 Basaltic Dike, (this study)

Analysis of a whole rock sample from the part of the dike north of the East Cirque yields a late Jurassic K/Ar date of 150 ± 5.0 Ma (see Table 2). Because there are no known late Jurassic volcanic rocks in the area, this date is considered to be the age of regional metamorphism. The true age of the dike is middle Jurassic or earlier - the rock

being a likely feeder to nearby Hazelton Group volcanics or related to a late pulse of Takla volcanism.

Table 2

Whole Rock Date

Latitude	56° 36.4'
Longitude	126° 40.3'
K%	0.505 ± 0.012
Ar ⁴⁰	3.061×10^{-6} cc/gm
% Ar ⁴⁰	83.6
Ma	150 ± 5

DISCUSSION

The principal manifestation of mineralization at the Sustut Copper deposit is the occurrence of the copper ores as open space fillings (and related replacements) in previously permeable sedimentary rocks of the Moosevale Formation (Wilton, 1978). In the impermeable rocks, such as the massive lava flows and dikes, a similar mineralogy is limited to fillings on joints and shears. During diagenesis, porosity in the sedimentary rocks was sealed and the main phase of mineralization completed.

Copper mineralization took place shortly after deposition of the Moosevale Formation and predated regional metamorphism. The hydrothermal solutions which carried the copper, sulphur and other ions, were late fluids from the last stage of Takla volcanism which flowed through the recently deposited volcanics along channelways until impermeable interbeds were reached through which the fluids couldn't flow. Due to stoppage of the flow, cooling and reaction of the metal and sulphur bearing solutions with the red beds, the copper was then precipitated (Wilton, 1978).

The basaltic dike that cuts the ore body is clearly older than the post-Hazelton age for the dike, proposed by Wilton (1978), and the age of regional metamorphism (150 ± 5 Ma, this study). The dike is compositionally similar to the Takla volcanic suite and probably represents a final resurgence of Takla volcanic activity from a sustained magmatic centre under the Sustut Copper deposit - a hot spot source that also contributed to the mineralizing solutions.

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REFERENCES

- Church, B.N. (1974): Sustut Copper; *B.C. Department of Mines and Petroleum Resources, Geology, Exploration and Mining in British Columbia 1973*, pages 417-455.
- Church, B.N. (1975): Geology of the Sustut Area; *B.C. Department of Mines and Petroleum Resources, Geology, Exploration and Mining in British Columbia 1974*, pages 305-310.
- Gale, V. (1996): Paleotectonic Setting of the Takla Group Volcano-Sedimentary Assemblage, Stikine Terrane, McConnell Creek Map Area, North Central British Columbia; Dalhousie University, Unpublished B.Sc. Thesis, 108 pages.
- Harper, G. (1977): Geology of the Sustut Copper Deposit in B.C.; *The Canadian Institute of Mining and Metallurgy, Bulletin Volume 70, Number 777*, pages 97-104.
- Lefebvre, D.V. and Church, B.N. (1996): Volcanic Redbed Cu; in *Selected British Columbia Mineral Deposit Profiles, Volume 2 - Metallic Deposits, B.C. Ministry of Employment and Investment, Open File 1996-13*, pages 5-7.
- Monger, J.W.H. and Church, B.N. (1976): Revised Stratigraphy of the Takla Group, north-central British Columbia; *Canadian Journal of Earth Sciences*, Volume 14, pages 318-326.
- Wilton, D.H.C. (1978): A Genetic Model for the Sustut Copper Deposit, North-Central British Columbia; University of British Columbia, Unpublished M.Sc. Thesis, 215 pages.

LEGEND

Dike.....	
Topographic contour, interval 250 feet.....	
Stream.....	
Lake.....	
Plan view of mineralized area.....	

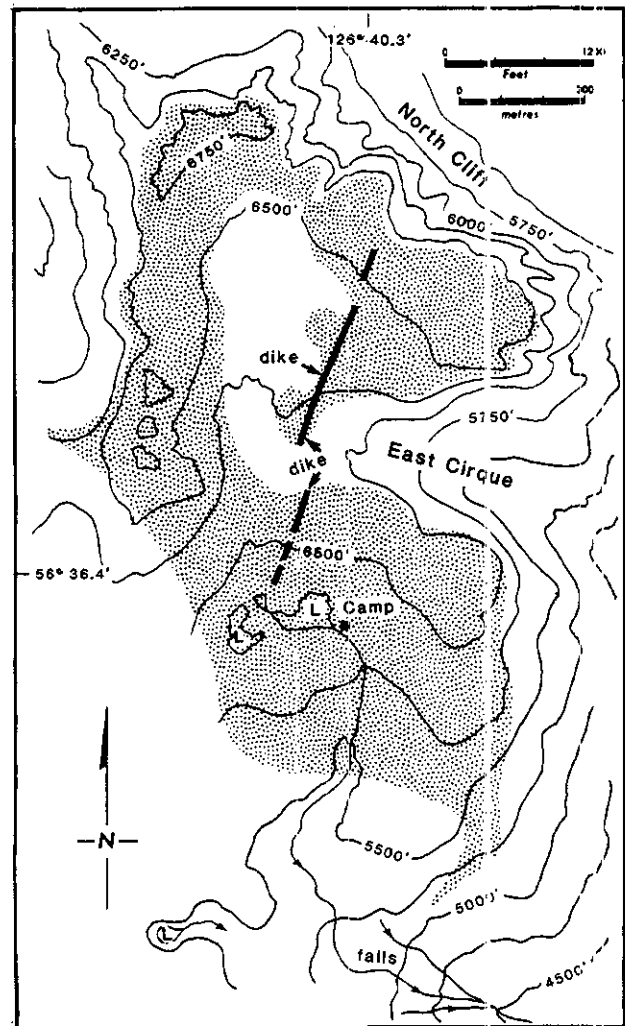


Figure 2. Geological setting of Sustut Copper deposit



Photo 1. Basaltic dike, view south to the Sustut Copper deposit

