# SIZE DISTRIBUTION OF GOLD IN DRAINAGE SEDIMENTS: MOUNT WASHINGTON, VANCOUVER ISLAND* (92F/14)

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## INTRODUCTION

Information on the size distribution of gold in stream sediments is useful in deciding where to sample, how large a sample to collect and what size fraction to analyse in stream sediment and heavy mineral surveys for gold (Day and Fletcher, 1986, and *in press;* Fletcher and Day, 1988). Previous publications provided this information for several streams draining gold mineralization in southern British Columbia. Similar data are now presented for streams draining Mount Washington, Vancouver Island.

## DESCRIPTION OF THE STUDY AREA

Mount Washington (elevation 1590 metres) is 22 kilometres northwest of Courtenay on Vancouver Island (Figure 5-4-1). Logging roads provide good access to sampling sites on tributaries of the Tsolum and Oyster rivers (Figure 5-4-2).

Bedrock geology consists largely of basaltic flows of the Karmutsen Formation (Upper Triassic). These flows are locally unconformably overlain by sandstones and basal conglomerates of the Upper Cretaceous Comox Formation and intruded by Tertiary porphyritic quartz diorites (Muller, 1968). Near the summit of Mount Washington, gold-silver-copper mineralization, with pyrite and arsenopyrite, is associated with breccia zones. Extensive gold-arsenic soil geochemical anomalies in the headwaters of McKay and Murex creeks (Better Resources Limited, 1987; J.W. Bristow, personal communication) are related to this mineralization. Gold mineralization is also found in the headwaters of Piggott Creek and in the east of the study area near Constitution Hill (H.P. Wilton, personal communication, 1988).

The entire area has been glaciated by ice moving in an easterly arc around the northern flanks of Mount Washington and over the summit in a northeasterly direction (Fyles, 1959). Bedrock and talus slopes occur at higher elevations but glacial till is widespread and forms an important component of the material eroded by streams. Ground moraine, together with fluvioglacial and marine sediments, mantles the lower slopes of Mount Washington along the Tsolum River valley (Figure 5-4-2).

## METHODS

At each sampling location 10 and 50-kilogram sediment samples were collected from a high-energy site by wet sieving gravels through a 10-mesh (2 millimetre) screen. In the laboratory both samples were wet sieved to give, respectively, a −70-mesh (ASTM) fraction and eight size fractions finer than 2 millimetres. After drying and weighing, heavy mineral concentrates were prepared for the −70+100, −100+140, −140+200 and −200+270-mesh fractions of the 50-kilogram sample using methylene iodide (SG 3.3). All fractions were weighed before pulverizing in a hardened-steel ring mill.

Samples were submitted to a commercial laboratory for determination of gold by fire assay and atomic absorption

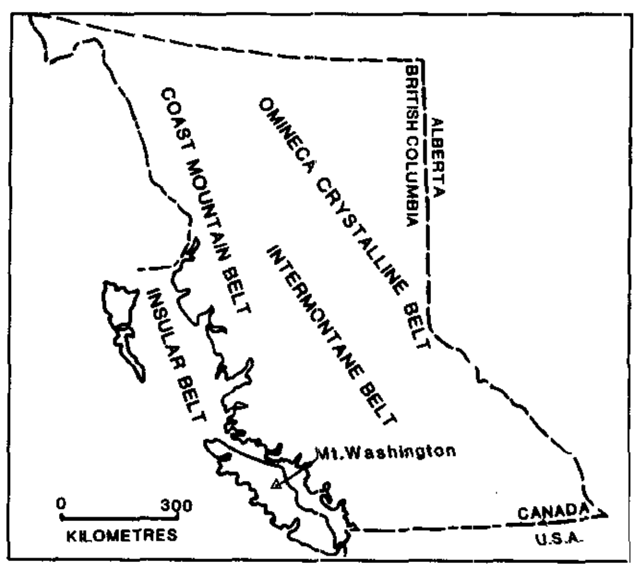


Figure 5-4-1. Location map.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

Table 5-4-1
Results of duplicate gold analyses of pulverized −70 mesh samples

| Sample | Gold (ppb) Set 1 | Set 2 |
|---|---|---|
| 1 | 7465 | 7065 |
| 2 | 20 | 25 |
| 3 | 1135 | 735 |
| 4 | <5 | 10 |
| 5 | 40 | 60 |
| 6 | <5 | 15 |
| 7 | <5 | 10 |

Table 5-4-2
Weight percentage of size fractions finer than 10 mesh

| Site | Size fraction (ASTM mesh) −10 +18 | −18 +40 | −40 +70 | −70+ 100 | −100 +140 | −140 +200 | −200 +270 | −270 |
|---|---|---|---|---|---|---|---|---|
| 1 | 48.0 | 35.2 | 12.8 | 1.84 | 0.65 | 0.42 | 0.14 | 1.03 |
| 2 | 58.0 | 30.3 | 9.0 | 1.12 | 0.49 | 0.37 | 0.10 | 0.66 |
| 3 | 58.7 | 30.9 | 7.6 | 1.36 | 0.56 | 0.23 | 0.10 | 0.60 |
| 4 | 46.4 | 30.8 | 13.5 | 3.54 | 2.06 | 0.75 | 0.46 | 2.43 |
| 5 | 46.0 | 43.1 | 9.1 | 0.99 | 0.27 | 0.20 | 0.09 | 0.35 |
| 6 | 60.6 | 26.9 | 8.3 | 1.64 | 0.87 | 0.37 | 0.17 | 1.14 |
| 7 | 54.0 | 29.0 | 11.0 | 2.46 | 1.30 | 0.52 | 0.30 | 1.45 |

Table 5-4-3
Gold contents (ppb) of different size and density fractions of stream sediments

| Site | Size fraction (ASTM mesh) −70 | −70 +100 | −100 +140 | −140 +200 | −200 +270 | −270 |
|---|---|---|---|---|---|---|
| **A. Heavy mineral fractions except −70 and −270 mesh whole sediment** | | | | | | |
| 1 | 7465 | 800 | 3215 | 2745 | 1640 | 330 |
| 2 | 20 | 10 440 | 10 225 | 8730 | 15 000 | 910 |
| 3 | 1135 | 6755 | 15 505 | 19 330 | 14 440 | 1000 |
| 4 | <5 | 6700 | 4455 | 1545 | 2035 | 50 |
| 5 | 40 | 5 | 705 | 25 | <55 | 50 |
| 6 | <5 | 4135 | 6665 | <75 | <145 | 200 |
| 7 | <5 | 155 | 3835 | <45 | 1540 | 60 |
| **B. Light mineral fractions** | | | | | | |
| 1 | | <5 | 20 | 20 | 10 | |
| 2 | | 15 | 35 | 20 | 90 | |
| 3 | | 25 | 15 | 20 | 35 | |
| 4 | | 5 | 5 | <5 | 5 | |
| 5 | | 5 | 5 | <5 | <5 | |
| 6 | | <5 | 15 | 15 | 10 | |
| 7 | | 5 | 5 | 15 | 5 | |

spectroscopy. The entire heavy mineral concentrate was analysed. For all other fractions, a 30-gram subsample of the pulverized material was taken with a riffle splitter. Results of duplicate analyses of −70-mesh samples are summarized in Table 5-4-1.

## RESULTS AND DISCUSSION

The weight percentages of each size fraction finer than 2 millimetres and the gold content of the light and heavy mineral fractions are summarized in Tables 5-4-2 and 5-4-3.

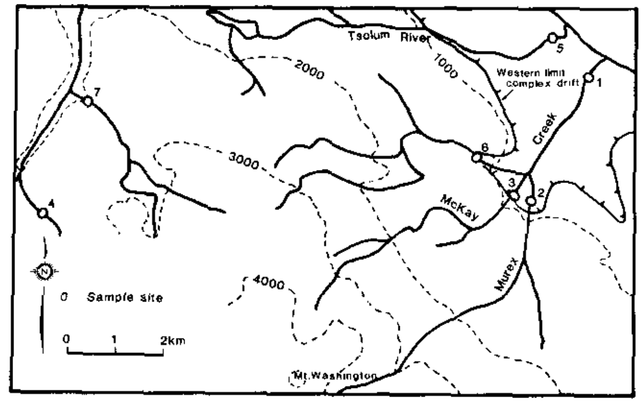


Figure 5-4-2. Drainage basins and sample locations, Mount Washington. Western limit of complex drift from Fyles (1959). Elevations in feet.

The latter shows that although gold occurs almost exclusively in the heavy mineral concentrates there is considerable variability in their gold content between both different sites and size fractions. The latter could result from either differences in size distribution of gold in the source material (that is, the eroding banks and perhaps ultimately the bedrock source of the gold) or differential sorting of different size fractions by the action of the stream.

Insufficient data are available to estimate background concentrations of gold. Nevertheless, the relatively high concentrations in all size fractions of heavy mineral concentrates from McKay, Murex and Piggott creeks suggest that the gold potential of Mount Washington could be clearly recognized by a low-density, heavy mineral survey. Choice of a size fraction does not seem to be too critical. However, as discussed by Day and Fletcher (1986), 20 particles of free gold are required to give a sampling reproducibility (RSD) of 22 per cent. Estimates of the number of gold particles in each fraction (Table 5-4-4) suggest that this could be most conveniently achieved by analysis of the −100-mesh heavy mineral concentrate obtained from approximately 50 kilograms of −10-mesh material. Reducing the sample size to about 2 kilograms of −10-mesh sediment (given one particle of free gold in the heavy mineral concentrate) would theoretically result in an almost 40 per cent chance of missing an anomalous site.

Direct analysis of a sediment sample is an alternative to preparation of a heavy mineral concentrate. Concentrations

Table 5-4-4
Estimated number of particles of free gold in heavy mineral fractions

| Site | Size fraction (ASTM mesh) −70 +100 | −100 +140 | −140 +200 | −200 +270 |
|---|---|---|---|---|
| 1 | 0.9 | 4.2 | 6.7 | 4.0 |
| 2 | 4.2 | 5.8 | 9.8 | 8.9 |
| 3 | 4.7 | 12.5 | 14.8 | 14.0 |
| 4 | 3.6 | 6.8 | 3.0 | 6.9 |
| 5 | — | 0.5 | — | 0.1 |
| 6 | 0.8 | 1.5 | — | 0.1 |
| 7 | 0.1 | 2.2 | — | 1.1 |

**Table 5-4-5**
**Estimated gold content (ppb) of combined size fractions**

| Site | Size fraction (ASTM mesh) | | | | |
|---|---|---|---|---|---|
| | −70 | −100 | −140 | −200 | −270 |
| 1 | 163 | 261 | 277 | 305 | 330 |
| 2 | 507 | 604 | 678 | 847 | 910 |
| 3 | 580 | 815 | 883 | 940 | 1000 |
| 4 | 83 | 74 | 52 | 53 | 50 |
| 5 | 20 | 37 | 30 | 41 | 50 |
| 6 | 115 | 133 | 141 | 176 | 200 |
| 7 | 39 | 60 | 46 | 55 | 60 |

**Table 5-4-6**
**Percentage contribution of −270-mesh fraction to total gold content of −70-mesh fraction**

| Site | Gold content[1] −70 fraction (ppb) | Per cent contributed by −270 fraction |
|---|---|---|
| 1 | 163 | 51 |
| 2 | 507 | 44 |
| 3 | 580 | 36 |
| 4 | 83 | 16 |
| 5 | 20 | 45 |
| 6 | 115 | 48 |
| 7 | 39 | 36 |

[1] Based on the contribution of the weighted gold content of the −270-mesh fraction to the estimated gold content of the −70-mesh fraction (from Table 5-4-5).

of gold in different size fractions of the original sediment have therefore been calculated (Table 5-4-5). Once again, although gold concentrations tend to increase with decreasing grain size, all analysed size fractions of sediments from the McKay-Murex drainage have relatively high gold contents. In Piggott Creek, however, low gold values in the −270-mesh fraction mask the anomalous gold content contributed by the heavy mineral fractions. This is corroborated by a gold content of less than 5 ppm in the −70-mesh fraction of the 10-kilogram sample from the same site (Table 5-4-2).

Regarding the amount of sediment collected and analysed it is important to note that the gold content of the −270-mesh fraction is a major component of the total gold content of a sediment (Table 5-4-6). Thus, where anomalous gold concentrations are present in this fraction, as at Sites 1 and 2 on McKay and Murex creeks, relatively small samples should suffice. This is consistent with the detection of anomalous gold concentrations in −70-mesh sediment at Sites 1 and 2 on McKay Creek using 30-gram fire assay samples. At most sites on Mount Washington this amount of −70-mesh sediment can be obtained from less than 1 kilogram of −10-mesh sediment. However, as noted above, analysis of this fraction does not indicate the presence of anomalous gold values at the site on Piggott Creek.

## CONCLUSIONS

The gold potential of Mount Washington could be recognized in low-density surveys with −100-mesh heavy mineral (SG greater than 3.3) concentrates obtained from about 50 kilograms of gravels at high-energy sites. Use of −70-mesh sediment samples also indicates the presence of anomalous concentrations of gold in McKay and Murex creeks but not in Piggott Creek. The latter has the advantage of requiring a much smaller (1 kilogram) field sample than that needed to prepare a representative heavy mineral concentrate.

## ACKNOWLEDGMENTS

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## REFERENCES

*Better Resources Limited* (1987): Mount Washington Precious Metal Project, Vancouver Island, British Columbia, Company Release, January 1987, 8 pages.

Day, S. and Fletcher, K. (1986): Particle Size and Abundance of Gold in Selected Stream Sediments, Southern British Columbia, Canada, *Journal of Geochemical Exploration*, Volume 26, 203-214 pages.

——— (in press): Effects of Valley and Local Channel Morphology on the Distribution of Gold in Stream Sediments, *Journal of Geochemical Exploration*.

Fletcher, K. and Day, S. (1988): Behaviour of Gold and other Heavy Minerals in Drainage Sediments: some Implications for Geochemical Surveys, *in* Prospecting Areas of Glaciated Terrain, D.R. McDonald and K.A. Mills, Editors, *Canadian Institute of Mining and Metallurgy*, Halifax, 1988, pages 171-183.

Fyles, J.G. (1959): Surficial Geology, Oyster River, Comox, Nanaimo and Sayward Districts, *Geological Survey of Canada*, Map 49-1959.

Muller, J.E. (1968): Geology of Alberni, British Columbia, *Geological Survey of Canada*, Map 17-1968.

# NOTES