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DISTRIBUTION AND MORPHOLOGICAL CHARACTERISTICS OF VISIBLE GOLD IN HARRIS CREEK (82L/2)

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INTRODUCTION

The distribution and morphology of gold particles from stream sediments, glacial tills and soils have been used to assess their distance from source (Antweiler and Campbell, 1977; Averill, 1988; Petts *et al.*, 1991; Nikkarinen, 1991; Averill and Huneault, 1991; Grant *et al.*, 1991). Here we present preliminary data on the distribution and morphology of gold in Harris Creek, southern British Columbia.

LOCATION AND GEOLOGY

Harris Creek is a gravel-bed river 25 kilometres east of Vernon in southern British Columbia (Figure 3-3-1). The catchment basin has an area of 225 square kilometres, of which about 60 per cent is between 1300 and 2000 metres above sea level on the dissected plateau of the Okanagan Highland. A simplified geological map, after Jones (1959), is shown in Figure 3-3-2. The area had a complex history during the Fraser glaciation when an ice sheet advancing from the north first impounded a lake in the Harris Creek catchment basin and then over-rode the glaciolacustrine sediments deposited in the lake (Ryder, 1991; Ryder and Fletcher, 1991). The lake was subsequently re-established as the ice sheet melted and retreated.

Our previous studies of gold in Harris Creek have shown that: preferential accumulation of gold in bar-head cobble-gravels counteracts the effects of downstream anomaly decay (Day and Fletcher, 1989, 1991; Fletcher, 1990), and transport of particulate gold only occurs during late spring when brief periods of high discharge caused by nival floods disrupt the cobble framework and release trapped gold (Fletcher and Wolcott, 1991).

STUDY METHODS

After removal of boulders a preliminary field concentrate was prepared by panning 40 kilograms of sediment, collected from bar-head sites (Figure 3-3-2) to obtain a near-black magnetite-rich sand. The field concentrate was then further upgraded in the laboratory with a gold pan. The magnetic fraction, which makes up about 90 per cent of the

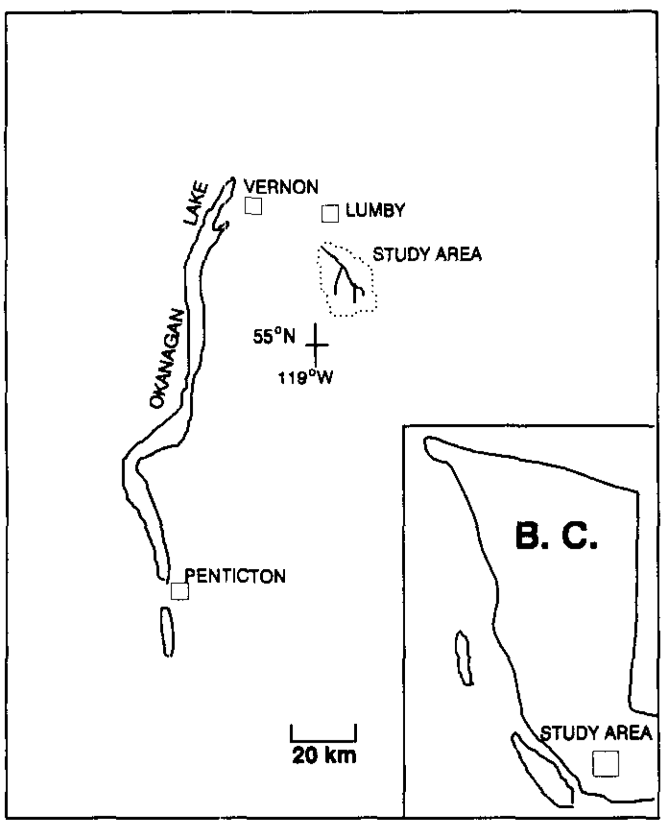

Figure 3-3-1. Location of study area.

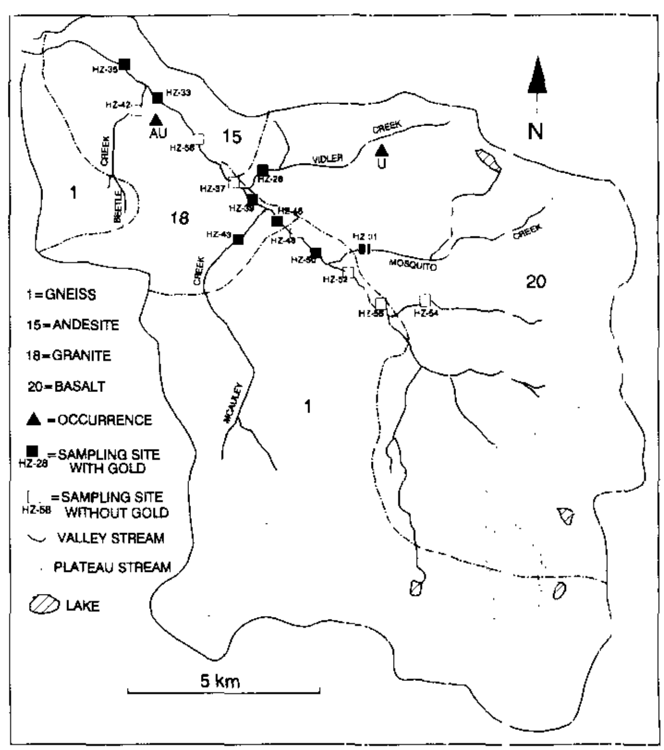

Figure 3-3-2. Catchment basin geology and sampling sites [geology simplified after Jones (1959)].

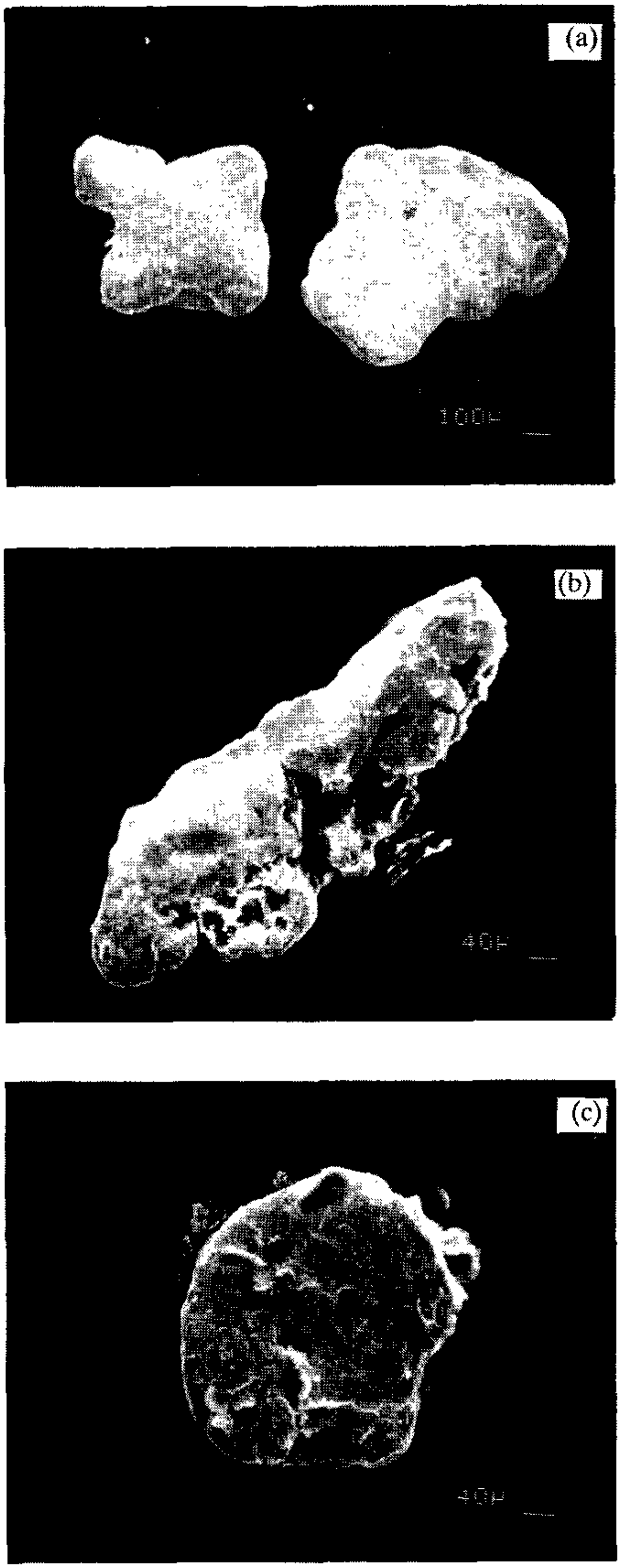

Plate 3-3-1. SEM photographs of (a) blocky shapes in HZ-35 with CSF 0.6 and 0.7, and roundness 0.3 and 0.6; (b) rod-like shape in HZ-46 with CSF 0.6, and roundness 0.4; and (c) spherical shape in HZ-50 with CSF 0.8, and roundness 0.6.

concentrate, was removed with a hand magnet. Gold particles were picked out of the nonmagnetic fraction under a binocular microscope.

The form and the size of the gold grains was investigated using the microscope and a Nanolab-7 scanning electron microscope. Grain size (d) was estimated as the geometric mean of the diameters of the intermediate and long axes [$d=(D_i*D_l)^{0.5}$, where D_i and D_l are the diameters of the intermediate and long axes, respectively. Particle shape is described using the Corey Shape Factor ($CSF=D_s/(D_i*D_l)^{0.5}$ where D_s is the smallest diameter]. The value of the Corey Shape Factor of flakes is from 0.1 to 0.3; the value of blocky grains from 0.5 to 0.7; and the value of near-spherical grains is 0.8 or larger. Grain roundness is a measure of the curvature of the corners and edges expressed as a ratio to the average curvature of the particle as a whole. It was estimated using Wadell's (1932) chart which has twelve sets of standard images with roundness values from 0.13 to 0.66: the roundness values of angular silhouettes varies from 0.13 to 0.35; subrounded ones from 0.35 to 0.60; and rounded ones from 0.60 to 0.66.

RESULTS AND DISCUSSION

Gold was found in Mosquito Creek (HZ-31) and at all but three sites on Harris Creek downstream from its confluence with Mosquito Creek (Table 3-3-1, Figure 3-3-2). Gold grains were also found in Vidler Creek (HZ-28) and McAuley Creek (HZ-43), but not in Beetle Creek or the headwaters of Harris Creek. There seems to be a slight increase in the abundance of gold grains downstream with the greatest number (3) at sites HZ-33 and HZ-35 on the main trunk.

TABLE 3-3-1
SUMMARY OF DESCRIPTIVE CHARACTERISTICS OF VISIBLE GOLD FROM HARRIS CREEK

Sample number	Distance downstream (km)	Gold grains	Size (μm)	CSF	Roundness
Gold particles in the tributaries					
HZ-31	Mosquito Creek	2	348	0.3	0.2
			441	0.3	0.2
HZ-43	McAuley Creek	2	500	0.1	0.2
			292	0.5	0.5
HZ-28	Vidler Creek	1	297	0.3	0.5
Gold particles in the trunk stream					
HZ-50	1.0 km	1	353	0.8	0.6
HZ-46	2.4	2	430	0.6	0.4
			446	0.5	0.4
HZ-39	3.1	1	320	0.5	0.4
HZ-33	6.9	3	330	0.2	0.2
			393	0.7	0.3
			411	0.5	0.3
HZ-35	8.1	3	790	0.7	0.6
			669	0.6	0.3
			290	0.5	0.5

Note: $Size=(D_i*D_l)^{0.5}$, $CSF=D_s/(D_i*D_l)^{0.5}$ where D_s, D_i and D_l are the diameters of the short, intermediate and long axes, respectively.

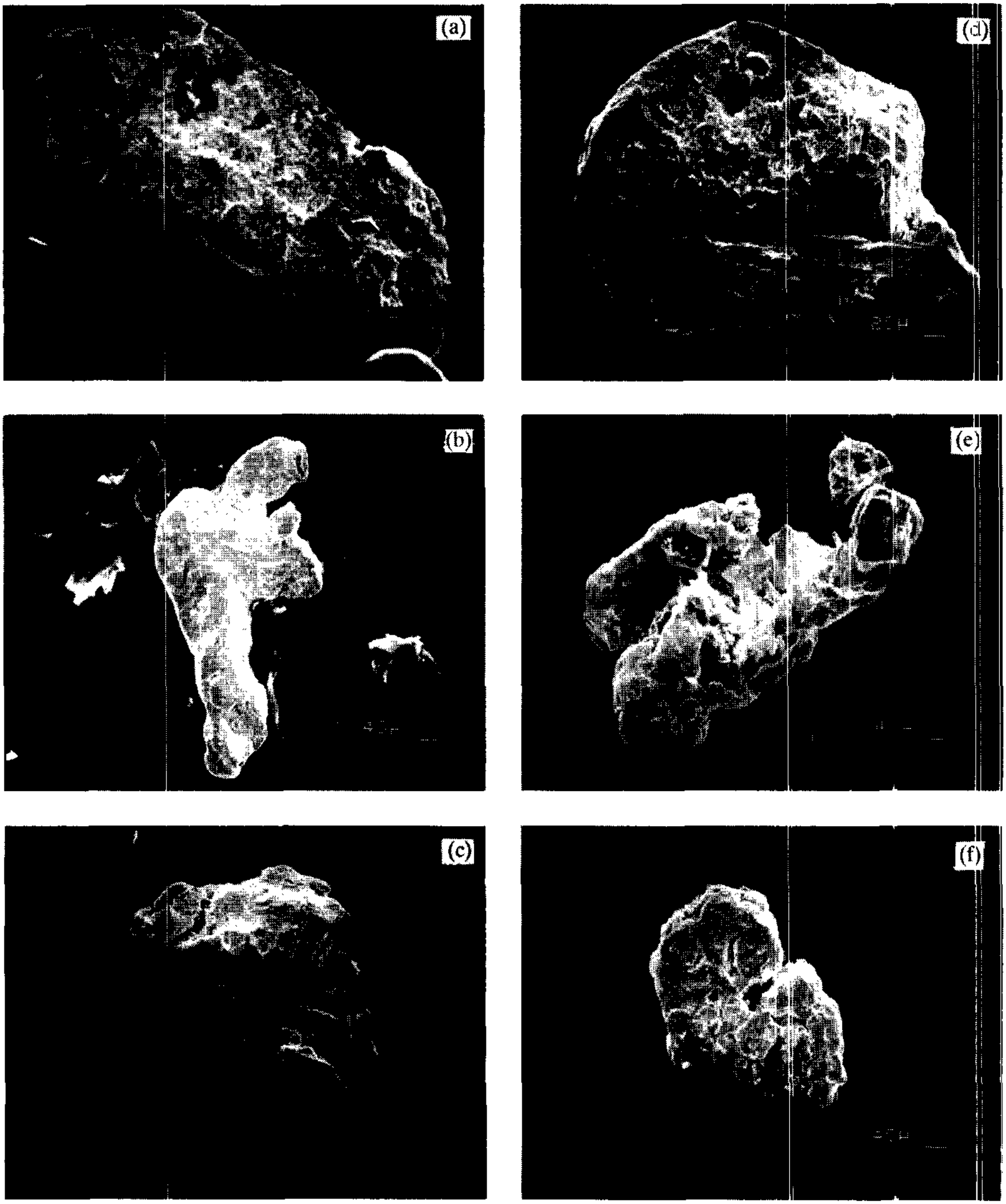

Plate 3-3-2. SEM photographs of (a) gold in HZ-43 with angular edges and blade shape, CSF 0.1, and roundness 0.2; (b) gold grain in HZ-31 with angular edges, smooth surface and flake shape, CSF 0.3, and roundness 0.2; (c) gold in HZ-33 with curled edges, CSF 0.5, and roundness 0.3; (d) gold in HZ-39 with striated surface, CSF 0.5, and roundness 0.4; (e) gold in HZ-46 with crumpled edges and porous surface, CSF 0.5, and roundness 0.4; and (f) gold in HZ-33 with scaly and porous surface, CSF 0.7, and roundness 0.3.

Size of the gold particles varies from 290 to 790 millimetres with both the maximum and minimum sizes being found in the downstream sample HZ-35. Based on their Corey Shape Factor, gold grains below the confluence with Mosquito Creek are blocky (Plate 3-3-1a) and rod-like (CSF 0.5 to 0.7; Plate 3-3-1b) or near-spherical (CSF 0.8; Plate 3-3-1c). Blades (Plate 3-3-2a) and flakes (Plate 3-3-2b) of gold (CSF 0.1-0.3) are more typical of the tributary streams. Roundness of the gold grains varies erratically, but those in Mosquito Creek (and perhaps McAuley Creek) appear to be less rounded than those from the trunk stream.

Dilabio (1990) proposed a nongenetic, descriptive classification of the shapes and surface textures of gold (Table 3-3-2). No pristine gold grains were found. However, gold particles in McAuley Creek and Mosquito Creek have blade and flake shapes with angular edges (Plate 3-3-2a, b) that approach pristine. Gold particles in the trunk stream having curled edges (Plate 3-3-2c) and moderately striated surfaces (Plate 3-3-2d) are classified as "modified"; and others having crumpled edges and porous surfaces (Plate 3-3-2e), and scaly, felty and porous surfaces (Plate 3-3-2f) are classified as "reshaped".

Although gold is widely distributed in the Harris Creek catchment basin, too few gold grains were found to make definitive statements about trends in their abundance and morphology. Nevertheless, it appears that abundance, size, sphericity, roundness, and degree of modification and reshaping may increase downstream. In contrast, grains in McAuley Creek and Mosquito Creek are more flake-like and pristine with lower roundness and CSF values.

The presence of gold in McAuley, Mosquito and Vidler creeks suggests that there may be several distinct bedrock sources of gold. Possibilities include: placer gold in uraniferous channel-gravels below Miocene plateau basalts in the Vidler Creek and Mosquito Creek catchment basins (Day, 1987); and a source in granodiorite and gneiss for the delicate gold grains found in McAuley Creek. The near-pristine character of these grains suggests proximity to their source. However, because of the complex glacial history of the Harris Creek catchment basin, it is also possible that the widespread distribution of gold results partly from its dispersion throughout the catchment basin as a result of glacial and glaciolacustrine processes.

The (slight) increase in abundance and size of gold grains downstream is consistent with the observation of Day and Fletcher (1989) that trapping of gold by bar-head cobble-gravels counteracts downstream anomaly dilution in Harris Creek. Field evidence and bedload transport theory both indicate that this process is most effective for coarse gold (Day and Fletcher, 1991).

TABLE 3-3-2
CLASSIFICATION OF SHAPES AND SURFACE TEXTURES OF GOLD GRAINS (AFTER DILABIO (1990)

Class	Shape	Surface texture
Pristine	—block —rod —wire —leaf —crystal —star —globule	—smooth surface —angular edges —grain moulds clearly visible —thin edges not curled —some striae
Modified	—all shapes damaged	—pristine shapes visible —leaf edges and wires bent —blunted and thickened edges —grain moulds preserved where protected. —moderately striated —felty texture where damaged
Reshaped	—folded rod wire, flake —rounded block —typical discoid placer flake —nugget	—pristine shapes destroyed —well-rounded grain outline —moderately striated —porous, scaly, felty or spongy

CONCLUSIONS

Preliminary studies of the distribution and morphology of gold in the Harris Creek catchment basin suggest that there may be several bedrock sources of gold. Alternatively, gold may have been widely dispersed by glacial processes. The downstream increase in abundance of coarse gold is consistent with earlier field observations and bedload transport theory.

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