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OLIVINE POTENTIAL IN THE TULAMEEN ULTRAMAFIC COMPLEX PRELIMINARY REPORT* (92H/10)

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INTRODUCTION

Olivine, the essential constituent mineral of the rock dunite, has long been known to occur in the core of the Tulameen ultramafic complex. A project initiated in August 1986 was designed to evaluate whether this dunite is a suitable source of olivine for industrial applications. At present olivine used in Canada as a foundry and blasting sand is imported from the United States. The objectives of the investigation are:

(1) To locate fresh unserpentinized olivine (loss-on-ignition less than 2 per cent) in selectively mineable and accessible bodies within the Tulameen complex.

(2) To test whether the dunite will meet commercial specifications for foundry sand in refractory applications.

Preliminary results indicate occurrences of unaltered olivine in weakly serpentinized zones.

TOPOGRAPHY AND ACCESS

The dunite core of the Tulameen complex is situated in rugged steep terrain between Grasshopper Mountain on the north and Olivine Mountain to the south (Figure 4-7-1, Plates 4-7-1 and 4-7-2). Outcrop is good, particularly at higher elevations; lower slopes are covered by heavy second growth forest.

The study area is approximately 12.5 kilometres west of the village of Tulameen and accessible by truck along the Tulameen River road.

REGIONAL SETTING AND STRUCTURE OF THE COMPLEX

The Tulameen complex is an Alaskan-type zoned intrusion, forming a southeasterly elongated ultramafic-gabbroic body surrounded by the Upper Triassic Nicola Group metasedimentary and metavolcanic rocks (Findlay, 1969). It is overlain by terrigenous sedimentary rocks and andesitic flows of the Eocene Princeton Group (Rublee, 1986). The complex is considered Middle Jurassic in age based on potassium-argon dates of 186 million years on biotite and 174 ± 4 million years on hornblende (Rublee, 1986). The principal ultramafic units are dunite, olivine clinopyroxenite and hornblende clinopyroxenite which are thought to result from fractional crystallization of an ultrabasic magma (Findlay, 1969).

LOCAL GEOLOGY

The dunite core forms an oval-shaped body, with an area of approximately 6 square kilometres, which underlies most of Grasshopper and Olivine Mountains (Findlay, 1969). The dunite is buff to yellowish brown in colour and weathers light to dark grey. It is fine to medium grained (<1 millimetre to 1-5 millimetres) and contains visible serpentine (up to 80 per cent), pods of chromite (up to 2 centimetres wide by 30 centimetres long), and magnetite.

A geological sketch of the area is shown in Figure 4-7-2.

Chemical analyses of six samples of olivine (Fo_{86}-Fo_{93}) collected by Findlay (1963) from the core are provided in Table 4-7-1. These results compare favourably to analyses of commercial olivines from seven deposits in North America and Europe.

TABLE 4-7-1. COMPARISON OF CHEMICAL ANALYSES OF SOME COMMERCIAL OLIVINES WITH SAMPLE FROM THE TULAMEEN DEPOSIT
(per cent)

	1	2	3	4	5	6	7	8
MgO	47.5	43–44	49.0	47.7	46.4	46.9	48.09	47.1–48.9
SiO_2	40.4	24–35	42.6	40.8	42.5	40.8	40.28	39.3–40.0
Fe_2O_3	9.0	7.6–7.7	6.0	7.5	8.0	9.4	9.13*	9.25*
Other oxides	2.5	0.7–0.8	1.8	1.9	2.4	3.2	1.51	0.84–3.46
LOI	0.8	?	0.6	2.0	0.5	0.6	?	0.92

1 — Ste. Anne des Monts, Quebec, Canada (Lefond, 1983).
2 — Leoben, Austria (Lefond, 1983).
3 — Aaheim, Norway (Lefond, 1983).
4 — Norddal, Norway (Lefond, 1983).
5 — Burnsville, North Carolina, U.S.A. (Lefond, 1983).
6 — Hamilton, Washington, U.S.A. (Lefond, 1983).
7 — Twin Sisters, Washington, U.S.A. (Olivine Corp., Company Report).
8 — Tulameen Ultramafic Complex, B.C., Canada (Findlay, 1969).

* Total iron calculated as Fe_2O_3.
Sources: Findlay (1963); Lefond (1983); Olivine Corporation (1986).

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.
British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1.

SAMPLING PROGRAM

A sampling program by Findlay (1963) documented the intensity of serpentinization in the core of the Tulameen complex (Figure 4-7-1).

The 1986 program was designed to outline the least serpentinized part of the dunite core. In total 110 samples weighing 0.5 kilogram and three bulk samples (>100 kilograms) were collected.

RESULTS

(1) Nineteen of the 74 samples tested report a loss-on-ignition value of less than 2 per cent.

(2) Three zones with loss-on-ignition less than 2 per cent have been identified north of the Tulameen River on the southwest slope of Grasshopper Mountain (Figure 4-7-2). The northern zone, approximately 100 metres long by 75 metres wide, is open to the east. A second central zone is approximately 50 metres long by 40 metres wide and open to the west. The third, irregular zone, cut by the Tulameen River road, is approximately 100 metres long by 65 metres wide (maximum).

(3) Three isolated samples from north and south of the northern zone and west of the southern zone tested less than 2 per cent loss-of-ignition.

(4) All samples collected south of the Tulameen River on the north slope of Olivine Mountain have values greater than 2 per cent.

SUMMARY

The 1986 sampling and mapping program has outlined the presence of practically unserpentinized "fresh" dunite on the southwest slope of Grasshopper Mountain. Chemical analyses indicate it compares favourably with commercially produced olivine from around the world.

There is additional potential for reserves of relatively unaltered dunite, east of the sampled area on Grasshopper Mountain and on the north slope of Olivine Mountain in areas not yet sampled. Additional analytical tests on bulk samples are required to determine suitability for commercial applications of the olivine. These tests will determine specific gravity, hardness, melting point, and petrographic and chemical parameters.

ACKNOWLEDGMENTS

The author would like to acknowledge Z.D. Hora for suggesting the study. Field assistant David Hannay provided able and cheerful assistance in the field. The British Columbia Ministry of Energy, Mines and Petroleum Resources analytical laboratory carried out all loss-on-ignition tests. Figures were drafted by Bob Ryziuk.

REFERENCES

Findlay, D.C. (1963): Petrology of the Tulameen Ultramafic Complex, Yale District, B.C., Ph.D. Thesis, *Queen's University*, Kingston, Ontario.

——— (1969): Origin of the Tulameen Ultramafic-Gabbro Complex, Southern B.C., *Canadian Journal of Earth Sciences*, Volume 6, page 399.

Lefond, S.J. (1983): Industrial Minerals and Rocks, *Society of Mining Engineering*, Fifth Edition, Volume 2, pages 989-996.

Olivine Corporation: Physical Properties — Olivine, Unpublished Company Report, 1986.

Rublee, V.J. (1986): Occurrence and Distribution of Platinum-Group Elements in B.C., *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1986-7.

St. Louis, R.M. (1984): Geochemistry of the Platinum Group Elements, M.Sc. Thesis, *University of Calgary*, Edmonton, Alberta.

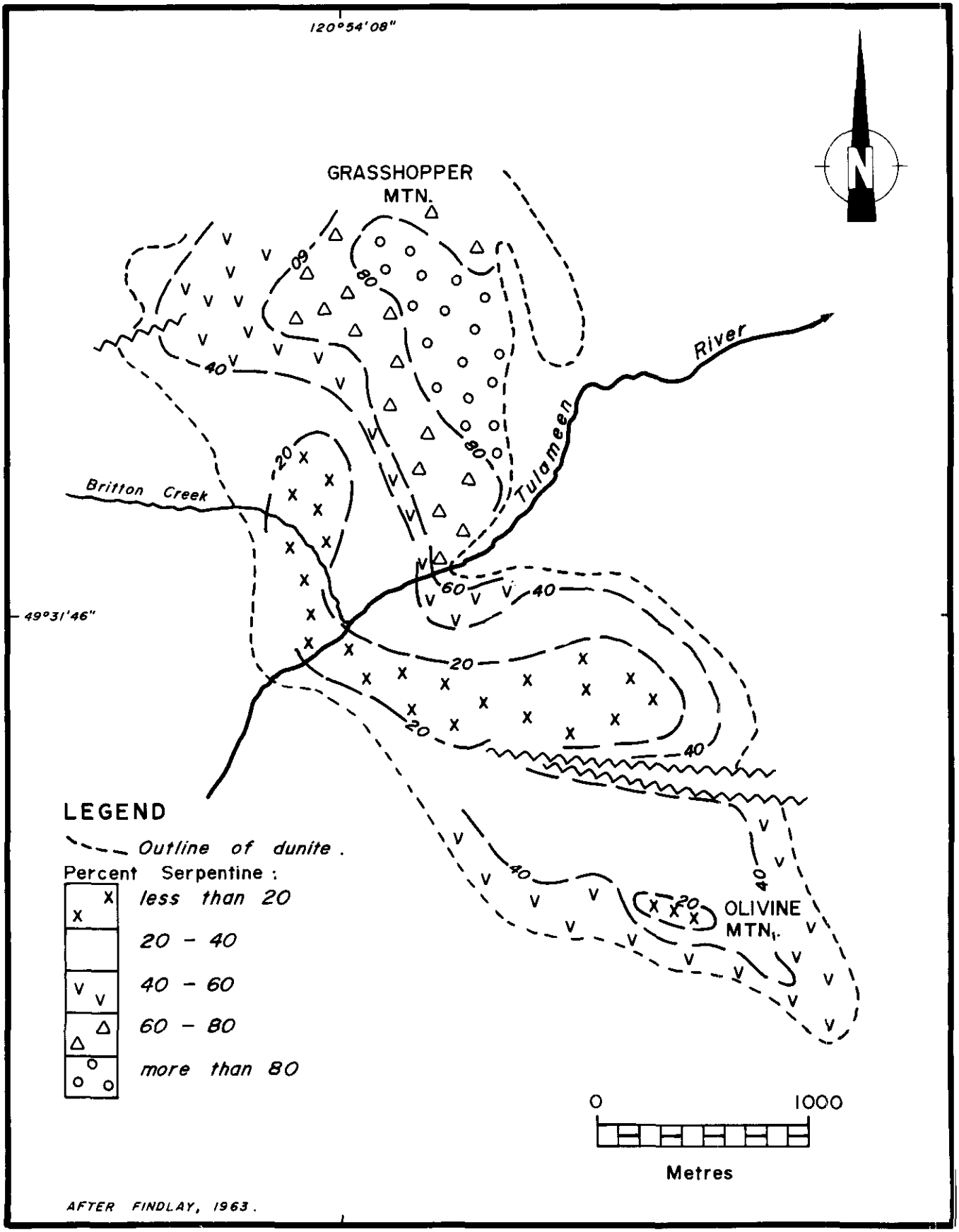

Figure 4-7-1. Serpentinized zones in the dunite core, Tulameen ultramafic complex.

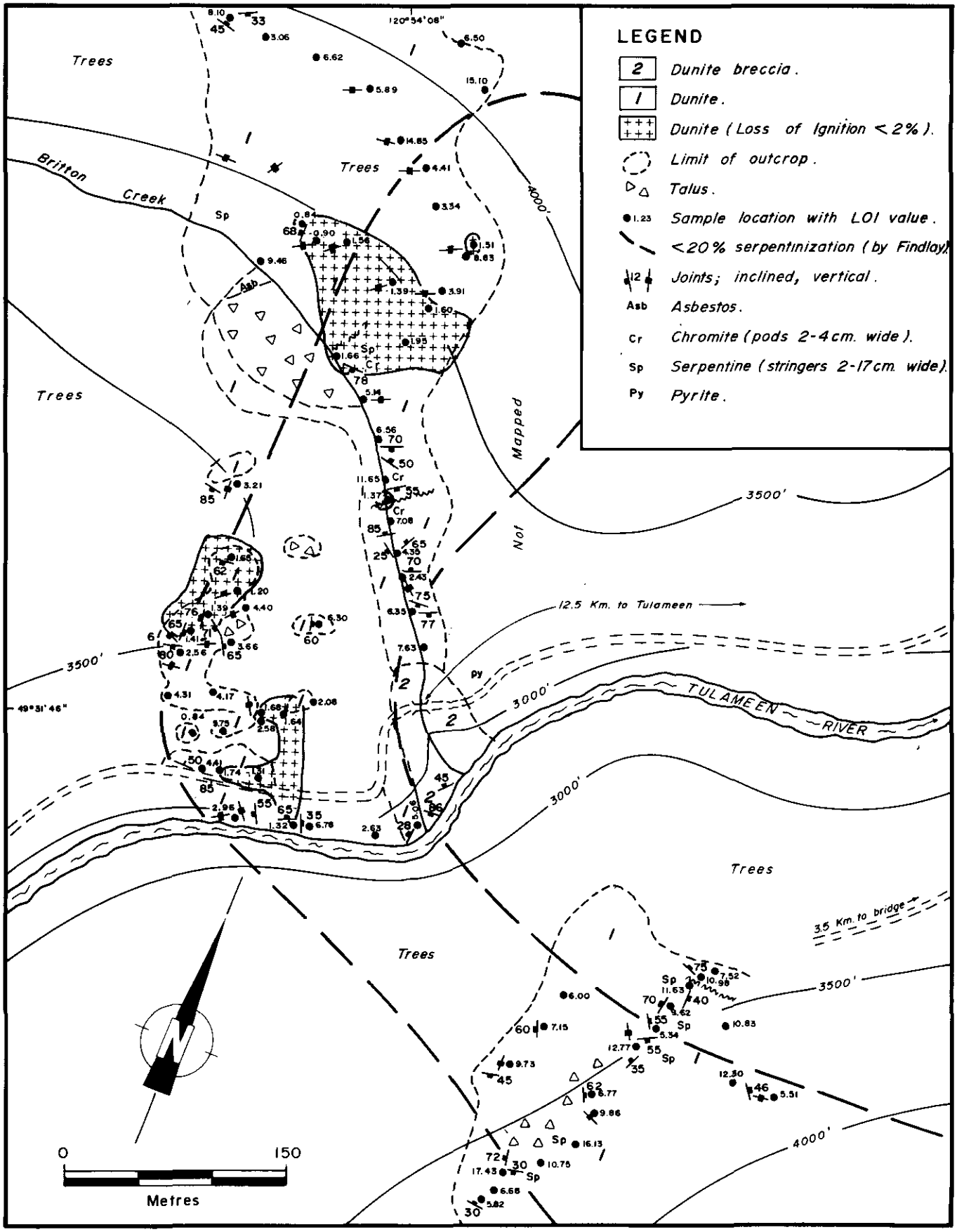

Figure 4-7-2. Geological sketch map of the study area and sample locations with reported loss-on-ignition values.

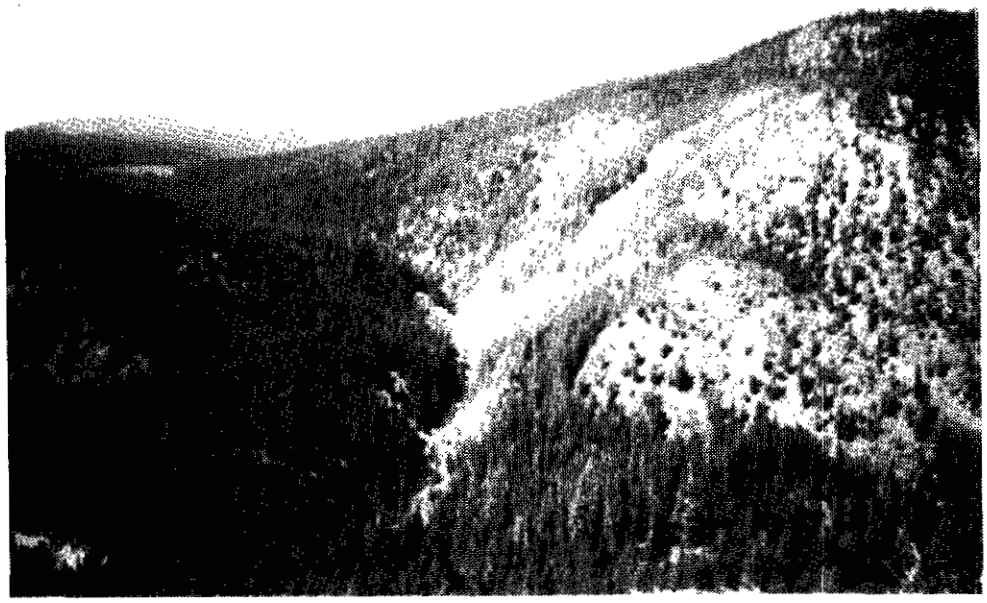

Plate 4-7-1. Looking north up Britton Creek (92H/10).

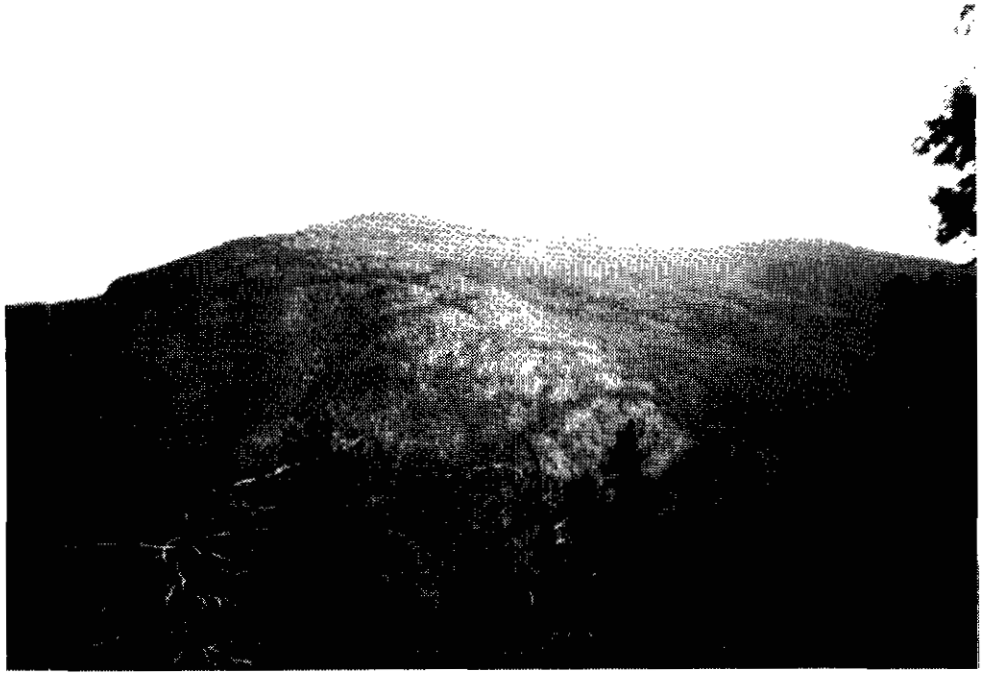

Plate 4-7-2. Olivine Mountain, looking south (92H/10).