PLATINOIDS IN THE TULAMEEN ULTRAMAFIC COMPLEX

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INTRODUCTION

The Tulameen Ultramafic Complex is approximately 22 kilometres west of Princeton, and 48 kilometres north of the Canada-United States border. The complex has a surface of about 57 square kilometres and is largely concordant with the regional northwest-southeast structural grain. It has been tentatively dated as Late Triassic (Findlay, 1969).

The Tulameen River area has been known to be a gold and platinum producer for more than one hundred years. Essentially all of the precious metal production has been from placers in the Tulameen River and its tributaries. No hard-rock mining of platinum has been attempted, mainly because information about the platinum distribution within the complex is lacking. The purpose of this project is to establish the distribution of the platinum group elements (PGE) and determine if they have any mineralogical associations. This research is being conducted as part of the requirements for an M.Sc. degree at the University of Alberta.

REGIONAL GEOLOGY

The Tulameen Complex intruded Late Triassic Nicola Group metavolcanic and metasedimentary rocks. The intrusion took place at the same time as major folding was in progress in the Nicola Group (Findlay, 1963). The Eagle granodiorite lies just west of the margin of the complex. This acidic intrusion is slightly younger than the Tulameen, and may contact the ultramafics at depth (Findlay, 1963).

The Tertiary Princeton Group, which consists of terrestrial coal-bearing sedimentary rocks, volcanic rocks, and basalt flows, unconformably overlies the eastern margin of the Complex (Findlay, 1963). In addition, glacial deposits cover much of the ultramafic, making outcrops scarce, especially in the southern half of the area.

GEOLOGY OF THE COMPLEX

As shown on Figure 1, the Tulameen Complex is oval with long axis trending northwest. It is imperfectly concentrically zoned. The general pattern of zonation, from core to margin is: dunite, (peridotite), olivine clinopyroxenite, hornblende clinopyroxenite, syenogabbro, and syenodiorite (Findlay, 1963, 1969). Because they are common along the southeastern coast of Alaska ultramafics with this type of zoning are

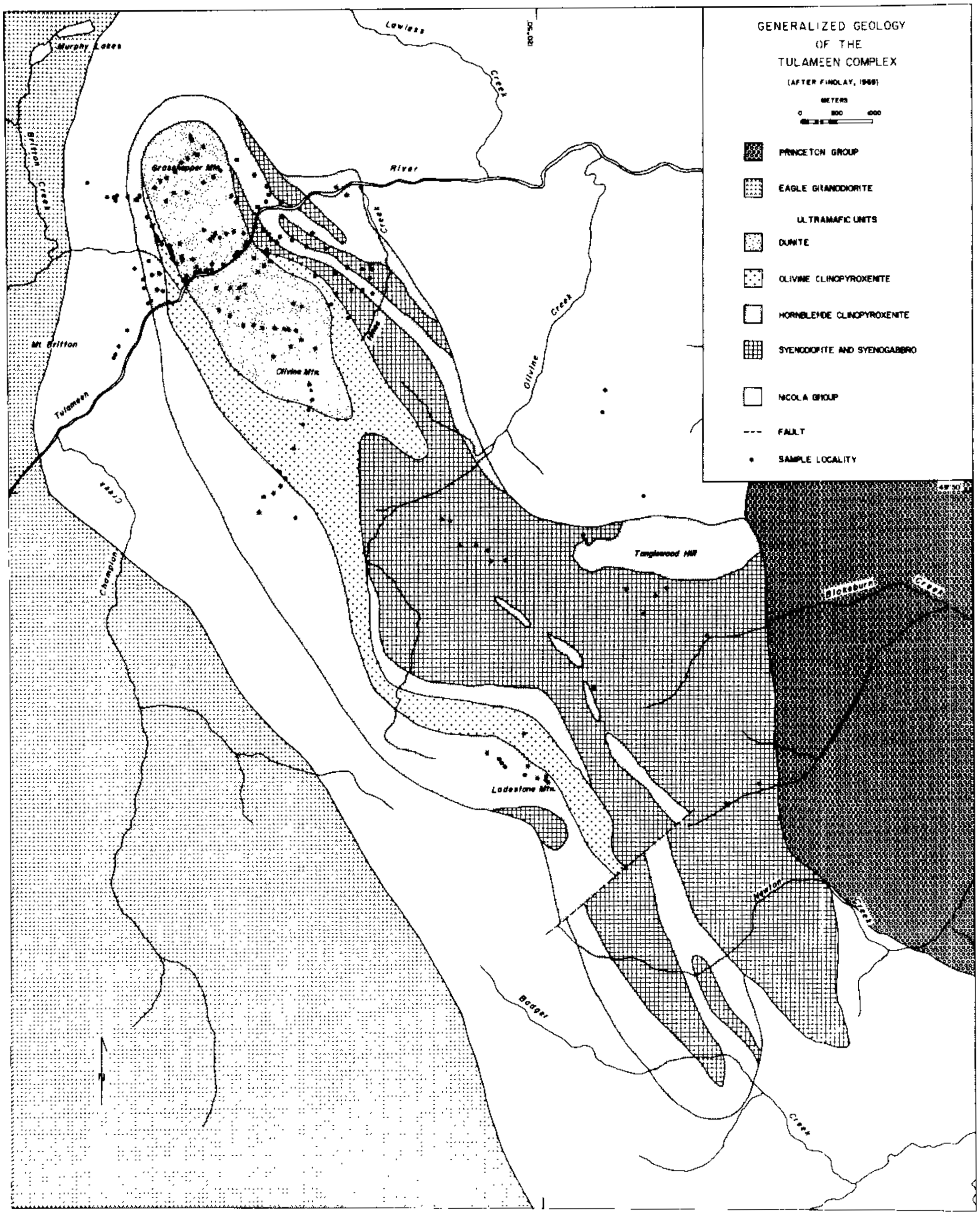

Figure 1. Generalized geology of the Tulameen Complex.

called Alaskan peridotites. The Alaskan peridotites are a special variety of alpine peridotites but they differ in zoning and chemistry. Both are found in geosynclinal orogenic zones (Wyllie, 1967). In addition to the zoning, Alaskan intrusions characteristically lack orthopyroxene and feldspars, and contain highly magnesian olivine, on the order of Fo_{75-93} (Wyllie, 1967). In the Tulameen Complex the bulk Fe ratio increases from core to margin, feldspars are only present in the gabbroic units, and no orthopyroxene has been found (Findlay, 1963).

The dunite unit occurs at the northwest end of the complex and is also elongated to the northwest. It contains chromite in variable quantities, generally ranging from 2 to 20 volume per cent. Serpentine and magnetite are common. Serpentine generally constitutes less than 50 per cent of the rock and is commonly in zones of deformation and at contacts.

Peridotite is volumetrically insignificant and does not constitute a mappable unit. Olivine/serpentine and diopside comprise 45 to 90 per cent of the rock. The peridotite is generally located at the dunite-olivine clinopyroxenite contact, but also occurs within the olivine clinopyroxenite (Findlay, 1963).

Olivine clinopyroxenite partly envelopes the dunite unit on the south and extends southward as a single zone. It consists of 70 to 80 per cent diopside, 10 to 25 per cent olivine and serpentine, some magnetite, and local chromite.

Hornblende clinopyroxenite comprises the outer unit around most of the complex. It contains 30 to 75 per cent diopside, 5 to 70 per cent hornblende, 5 to 25 per cent magnetite, and accessory biotite.

Gabbroic rocks comprise a large mass along the eastern part of the complex. The syenogabbro generally contains 30 to 50 per cent diopside, 25 to 35 per cent plagioclase, 15 to 20 per cent K-feldspar, and minor biotite and magnetite. Syenodiorite contains 10 to 25 per cent diopside and hornblende, 35 to 55 per cent andesine plagioclase (An_{40}), 15 to 35 per cent K-feldspar, and accessory biotite, magnetite, and apatite (Findlay, 1963). These two units are typically saussuritized, and altered areas resemble one another in outcrop.

Contacts between gabbroic and ultramafic rocks are sharp. However, the ultramafic rocks grade into one another (Findlay, 1963). In general, contacts between ultramafic units are marked by xenoliths of one type in the other. Near contacts, hybrid mixtures of the two contacting units are common (Findlay, 1963).

The Tulameen Complex is geologically interesting for a number of reasons. It is one of the very few Alaskan peridotites found in Canada (one of the others being the Turnagain Complex, northern British Columbia). Also, it is unusual in that the Tulameen gabbroic rocks are potassic, whereas those of other Alaskan peridotites are tholeiitic. In addition, both ultramafic and gabbroic rocks of the Tulameen suite are undersaturated in silica (Findlay, 1969). Finally, platinum in Tulameen placers is part of a special class; it occurs as nuggets. Other placers of this type are found in the Ural Mountains and in Alaska.

PLATINUM GROUP ELEMENTS

Findlay (1963) performed some analyses for platinum and palladium in the Tulameen Complex. However, he did not analyse for the other platinoids, and did not develop a detailed picture of the PGE distribution. Raicevic and Cabri (1976), Cabri, Owens, and LaFlamme (1973), and Cabri and Hey (1974) examined PGE from Tulameen placers. They recognized one new PGE mineral (tulameenite) and helped establish some of the platinoid chemistry and mineralogy.

Alaskan peridotites are characterized by high Pt/(Pt+Os+Ir) ratios and high Pt/Pd ratios, relative to large layered ultramafic intrusions (Raicevic and Cabri, 1976). It should be noted that Pd is rare in the Tulameen material (Raicevic and Cabri, 1976; Findlay, 1963).

Overall, Findlay (1963) found the highest concentrations of Pt in dunite and peridotite. In rock samples, he found the highest Pt content to be 0.225 gram per short ton in dunite on Olivine Mountain. The background Pt content in the dunite is 0.08 to 0.09 gram per short ton (Findlay, 1963). Chromite segregations within the ultramafic rocks returned the highest value of 7.34 grams per short ton Pt. Findlay (1963) also found that Pt is enriched in the magnetic fraction of chromite samples relative to the non-magnetic fraction.

Although Findlay (1963) gives a brief sketch of the distribution of platinum within the Tulameen Complex, he has not systematically determined the overall PGE distribution or mineralogical/chemical associations for the PGE. The author hopes to establish both of these.

During the 1981 field season some 300 rock samples from the Complex were collected (Figure 2). Most weighed 4 or 5 kilograms. The samples represent all the major units of the complex, although the greatest sampling density was in the Olivine-Grasshopper Mountain area. The sampling distribution is largely a function of access and outcrop availability.

Analysis for all six PGE and gold will be carried out on the University of Alberta slowpoke reactor. A selective group separation scheme for radiochemical neutron activation, described by Nadkarni and Morrison (1977), will be used. This technique allows for precise precious metals determinations to less than 20 ppb levels of concentration. About 150 samples will be analysed in this manner.

Once the PGE concentration in the samples is known, reflected light and transmitted light microscopy will be used to determine mineralogical associations. Electron microprobe analysis will be used to supplement this work. These observations will be of interest not only with respect to the Tulameen Complex, but also to those seeking PGE in other Alaskan ultramafic complexes.

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